4.10.4 Transit Noise and Vibration

4.10.4.1 Introduction

This section addresses potential noise and vibration impacts associated with operation of transit systems proposed under certain SPAS alternatives, specifically, the elevated/dedicated busway system proposed under Alternatives 1, 2, and 8, and the Automated People Mover (APM) systems proposed under Alternatives 3 and 9.

Alternatives 4, 5, 6, and 7 do not include an elevated/dedicated busway and do not include an APM, and are therefore not addressed further in this section. It should be noted that the ground access improvements proposed under Alternatives 1 and 2, including the design and operational characteristics of the elevated/dedicated busway system, are identical between the two; therefore, those two alternatives are referenced henceforth in this section singularly as "Alternative 1-2."

4.10.4.2 General Characteristics of Transit Noise and Vibration

4.10.4.2.1 Transit Noise

Section 4.10.1.1.1, presented earlier, provides an overview of the basics of sound and the metrics used to measure and characterize sound, and describes typical noise levels associated with aircraft operations. That overview of sound basics and sound metrics also applies to transit noise, as addressed in this section, and the following describes typical noise levels associated with transit operations.

Figure 4.10.4-1 provides an overview of several different types of non-project specific noises from transit sources and, for comparison, non-transit sources, and what the typical sound level is in A-weighted decibels (dBA) for those sources. Traffic noise, defined as unwanted sound, is associated with highway/transit projects and is usually in the form of loud or persistent noises from cars, trucks, and buses. Traffic noise, as may occur along the busway proposed under Alternatives 1-2 and 8, is generated primarily from engines/transmissions, mufflers, wind shear, and tire contact with the roadway. APM noise, as may occur under Alternatives 3 and 9, is generated primarily from electric control systems and traction (electric) motors, gear systems, wind shear, and contact between wheels and the rails. While train horns and crossing notification systems can also be typical noise sources for APM/light rail systems, this is not considered to be a concern relative to Alternatives 3 and 9, since the proposed APM systems would be exclusive grade-separated alignments with no vehicle or pedestrian crossings along the routes.

4.10.4.2.2 Transit Vibration

Vibration consists of rapidly unpredictable motions. Ground-borne vibration is the perceptible movement of building floors, rattling windows and doors, shaking of items on shelves or walls, and rumbling sounds. The root mean square (RMS) amplitude of a motion over a one-second period is commonly used to predict human response to vibration. The motion due to ground-borne vibration is described in vibration velocity levels, measured in decibels referenced to 1 micro-inch per second and expressed as vibration decibels (VdB). Ground-borne vibration is not a common environmental problem unlike roadway noise or transit noise.

Vibration caused by trains is the result of wheels rolling on the rails. This energy is then transmitted through the track support system into the transit structure, through the ground, to the foundations of nearby buildings, and finally throughout the remainder of the building structure. The level of vibration received at the building is a function of the type of trains, their speeds, track system, structure, support and condition, distance from the tracks, geological conditions, and the receiving structure. Ground-borne vibration does not typically annoy people who are outdoors. Typical outdoor sources of perceptible ground-borne vibration are construction equipment, steel-wheeled trains, and traffic on rough roads.

4.10.4.3 Methodology

The transit noise and vibration analysis methodology is based on procedures presented in the Federal Transit Administration's (FTA's) *Transit Noise and Vibration Impact Assessment Manual*[615] and is described below.

4.10.4.3.1 Transit Noise

FTA Land Use Categories Related to Transit Noise Impacts

Under FTA's guidelines, land use types used in determining the level and types of transit noise impacts are grouped into three categories (1, 2, and 3), as shown below. These categories were developed to help determine what dBA levels of transit noise would disturb people during various activities and at various locations.

- **Land Use Category 1:** Land where quiet is an essential element of the intended purpose. This includes outdoor amphitheaters and historic landmarks with substantial outdoor use.
- **Land Use Category 2:** Residences, hotels, hospitals, and other uses where nighttime sensitivity to noise is important.
- **Land Use Category 3:** Institutional land uses with primarily daytime and evening use. This includes medical offices, schools, libraries, and churches.

Of the three FTA land use categories, only Land Use Category 2 is relevant to the SPAS transit noise analysis. Land use types included in Land Use Categories 1 and 3 do not occur within the scope of this analysis along the proposed busway or APM routes; however, within Land Use Category 2 land use types, there are nine hotels located along Century Boulevard and 98th Street in the vicinity of transit route alignments under Alternatives 1-2, 3, 8, and 9.

Transit Noise Screening Analysis

An initial step in the transit noise evaluation process is to conduct screening analyses to determine whether noise-sensitive uses would be affected by the SPAS alternatives. Based on the noise screening procedure and specifications set forth in Section 4 of the *Transit Noise and Vibration Impact Assessment Manual*, the screening analyses take into account noise impact criteria, land use categories, and the type of project to be constructed. The screening procedure provides an impact distance that is far enough out to include all locations potentially affected by transit noise. Specifically, the screening distance is the estimated distance from the centerline of a transit route to the point at which noise associated with a particular transit system type would be approximately 50 dBA, which is below the sound levels that would impact noise-sensitive uses. Based on FTA's guidelines, the screening distances for a transit system are 350 feet (unobstructed) and 175 feet (intervening buildings) for light rail transit and 200 feet (unobstructed) and 100 feet (intervening buildings) for bus rapid transit on exclusive roadway. Appendix J3, *Transit Noise and Vibration*, contains several figures delineating the areas that fall within the boundaries of the screening distances of the proposed busway and APM routes. In the noise screening analysis conducted for the relevant alternatives (Alternatives 1-2, 3, 8, and 9), it was determined that receptors considered to be noise-sensitive in the FTA guidelines, specifically hotels, are located within the applicable screening distances from the proposed transit routes, hence, a more detailed analysis is warranted for these locations pursuant to the FTA guidelines. **Figure 4.10.4-2** shows the locations of the hotel receptors.

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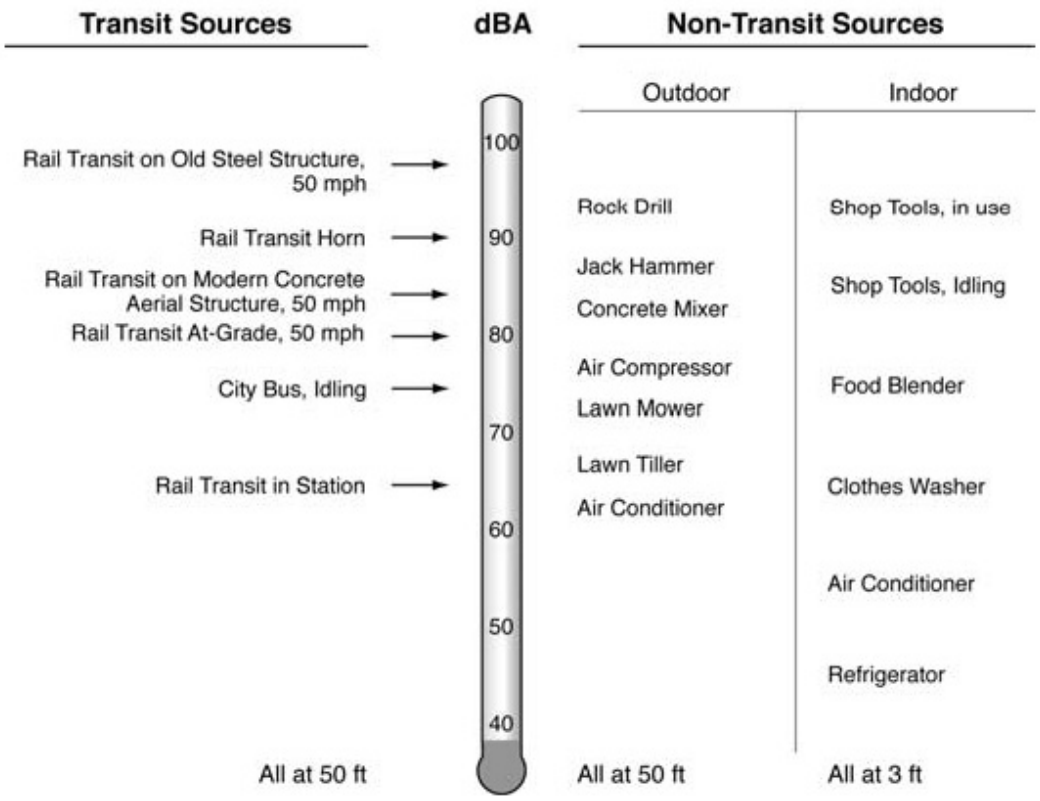
615 U.S. Department of Transportation, Federal Transit Administration, Transit Noise and Vibration Impact Assessment Manual, FTA-VA-90-1003-06, May 2006.



Source: Transit Noise and Vibration Impact Assessment, May 2006.
Prepared by: CDM Smith, 2012.

LAX Specific Plan Amendment Study Draft EIR	**Types of Noise Sources and Levels**	Figure **4.10.4-1**

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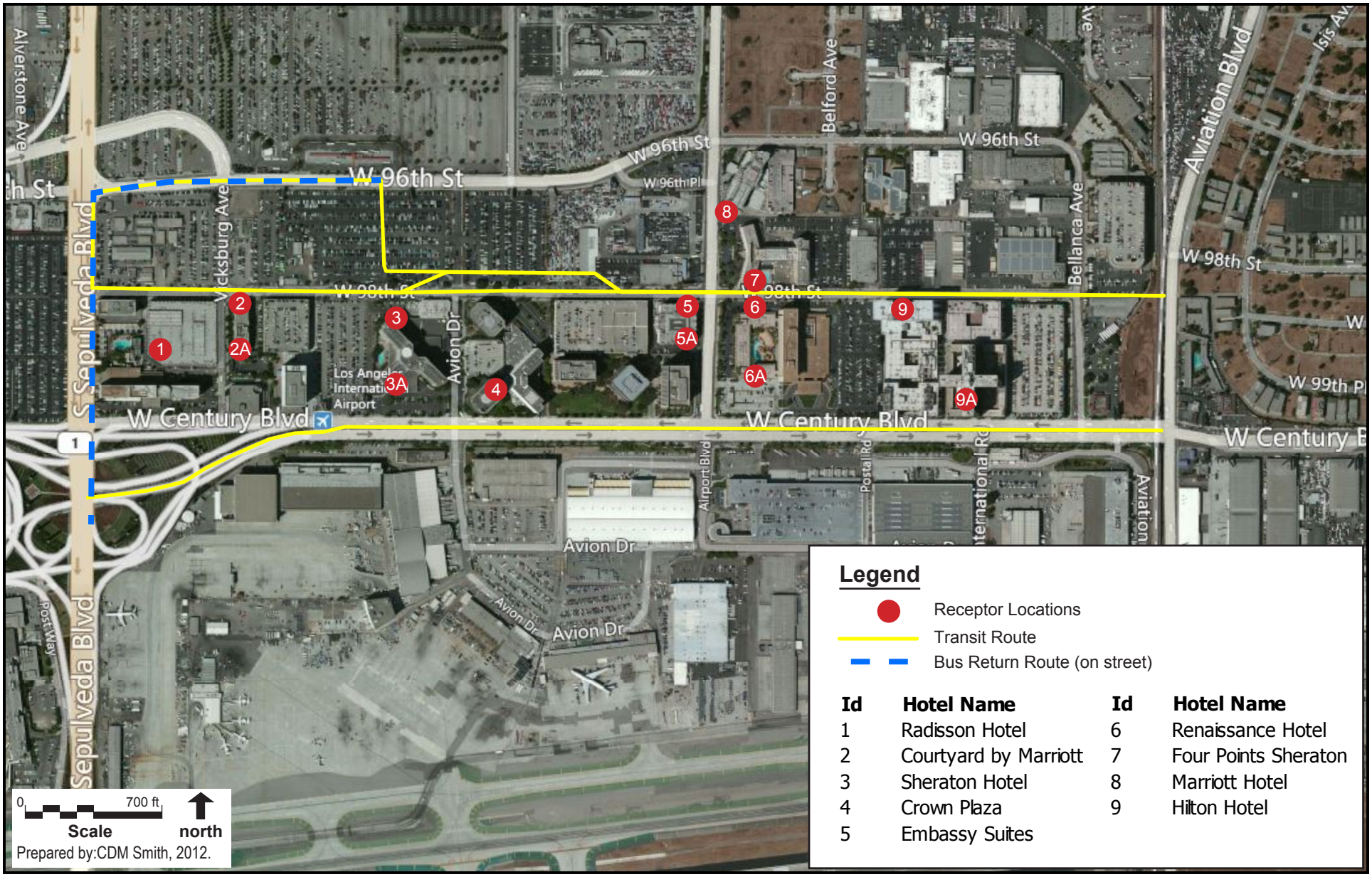

LAX Specific Plan Amendment Study Draft EIR	**Transit Noise and Vibration Sensitive Receptor Sites**	Figure **4.10.4-2**

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General Transit Noise Assessment

In light of the screening analysis results, a general noise assessment was prepared to further assess the potential noise impacts from transit operations associated with Alternatives 1-2, 3, 8, and 9. It should be noted that a more detailed noise assessment is typically prepared in conjunction with the detailed design and engineering of a proposed transit system, such as the busway or APM associated with Alternatives 1-2, 3, 8, and 9; however, a general noise assessment such as that completed for this SPAS EIR is suitable and appropriate at a program level of planning and evaluation.

Using information from a Geographic Information System (GIS) land use database and the FTA noise calculation methodology, Community Noise Equivalent Level (CNEL)[616] noise levels were calculated at all noise-sensitive receptor locations along the bus route under Alternatives 1-2 and 8, and the APM routes under Alternatives 3 and 9. Calculation worksheets and assumptions are provided in Appendix J3, *Transit Noise and Vibration*.

Existing baseline (2010) ambient noise levels for the nine receptor sites along the project corridor are based on ambient exterior noise levels around LAX reported in the LAX California State Airport Noise Standards Quarterly Report for 4th Quarter 2010 (i.e., September through December 2010), as further described below in Section 4.10.4.4. Future noise exposure for Alternatives 1-2, 3, 8, and 9 was determined in accordance with analysis procedures defined in FTA's *Transit Noise and Vibration Impact Assessment Manual*.

Per FTA guidance, transit noise impacts are based on comparing existing outdoor noises levels with future noise levels of proposed transit operations. The transit noise analysis herein includes the consideration of absolute noise levels and the increase over baseline (4th Quarter 2010, as described below) levels in order to determine the severity of the impact caused by the project. Noise impact criteria were established for each receptor based on the threshold of significance described in Section 4.10.4.5 below.

4.10.4.3.2 Transit Vibration

FTA Land Use Categories Related to Transit Vibration Impacts

Similar to the transit noise analysis approach described above, FTA guidelines take into account specific land use types in determining the level and types of transit vibration impacts and are grouped into three categories (1, 2, and 3) described below. These categories were developed to help determine what VdB levels of vibration would disturb people during various activities and at various locations.

- **Land Use Category 1:** High Vibration Sensitivity - Included in Category 1 are buildings where vibration would interfere with operations within the building, including levels that may be well below those associated with human annoyance. Typical Category 1 land uses include vibration-sensitive research and manufacturing facilities, hospitals, and university research operations. Category 1 also includes special land uses, such as concert halls, television and recording studios, and theaters, which can be very sensitive to vibration and ground-borne noise. The FTA has developed special vibration levels for these land uses.
- **Land Use Category 2:** Residential - This category includes all residential land uses and any building where people sleep, such as hotels and hospitals.
- **Land Use Category 3:** Institutional - This category includes schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment, but still have the potential for activity interference.

616 Although the FTA transit noise calculation model estimates total daily (24-hour) noise levels in terms of $L_{Day\text{-}Night}$ (L_{dn}), that noise metric is considered to be comparable to that of CNEL, the main difference being that L_{dn} divides the 24-hour day into two time periods, while CNEL divides it into three time periods.

With respect to human annoyance, FTA provides criteria for various land use categories, taking into consideration the frequency of vibration events, as indicated in **Table 4.10.4-1**.

Table 4.10.4-1

FTA Vibration Impact Criteria-Typical Human Annoyance Levels

Land Use Category	Ground-Borne Vibration Impact (VdB re 1 micro-inch/sec)		
	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]
Category 1: Buildings where vibration would interfere with interior operations.	65 VdB[4]	65 VdB[4]	65 VdB[4]
Category 2: Residences and buildings where people normally sleep (such as hotels and hospitals).	72 VdB	75 VdB	80 VdB
Category 3: Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB

1 "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.

2 "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations.

3 "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.

4 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 the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.

Source: Federal Transit Administration, 2006.

Rapid transit or light rail systems typically generate vibration levels of 70 VdB or more near their tracks. On the other hand, buses and trucks rarely create vibration that exceeds 70 VdB unless there are bumps in the road.[617]

Transit Vibration Screening Analysis

The vibration analysis methodology is based on procedures presented in the 2006 FTA *Transit Noise and Vibration Impact Assessment Manual*. Based on those procedures, a Screening Vibration Assessment was first performed to determine if any vibration-sensitive land uses exist within FTA's fixed, default vibration screening distance of 150 feet. Results of the screening assessment confirmed the presence of vibration-sensitive land uses (i.e., hotels along Century Boulevard and 98th Street) within FTA's screening distances along transit route alignments under Alternatives 1-2, 3, 8, and 9 (see Figures 7 and 8 in Appendix J3, *Transit Noise and Vibration*). As such, a General Vibration Assessment was then performed to determine impacts to FTA Category 2 noise-sensitive land uses located along Century Boulevard and 98th Street.

General Transit Vibration Assessment

As delineated in the FTA *Transit Noise and Vibration Impact Assessment Manual*, the basic approach for the General Vibration Assessment is to define a curve, or set of curves, that predicts the overall ground-surface vibration as a function of distance from the source, apply adjustments to those vibration curves to

617 U.S. Department of Transportation, Federal Transit Administration, Transit Noise and Vibration Impact Assessment Manual, FTA-VA-90-1003-06, May 2006, p. 7-6.

account for site- or system-specific factors such as speed and system design, and estimate the vibration levels for uses located along the transit corridor. **Figure 4.10.4-3** presents the generalized ground surface vibration curves set forth in the FTA Manual. In estimating the transit vibration levels associated with the SPAS alternatives, the vibration curve for Rubber-Tired Vehicles was used for the dedicated busway system proposed under Alternatives 1-2 and 8, and the vibration curve for Rapid Transit or Light Rail Vehicles was used for the APM systems proposed under Alternatives 3 and 9. Based on adjustment factors presented in the FTA Manual, each base curve was reduced by 10 dB to account for the design of both the proposed busway system and the APM systems to operate on an elevated structure. Speed adjustments were also made, with 2.5 dB being added to the base curve for Rubber-Tired Vehicles to increase the default speed of 30 miles per hour (mph) to 40 mph, and 0.8 dB was added to the base curve for Rapid Transit or Light Rail Vehicles to increase the default speed of 50 mph to 55 mph. These adjustments for system design and operating speeds are reflected in the adjusted curves shown in **Figure 4.10.4-3**.

4.10.4.4 Existing Conditions

4.10.4.4.1 Ambient Noise

As described in Section 4.10.4.3 above, there are nine FTA Category 2 noise-sensitive land uses located along Century Boulevard and 98th Street in the vicinity of transit route alignments under Alternatives 1-2, 3, 8, and 9. All of the nine land uses, or receptors, are hotels. **Table 4.10.4-2** indicates the receptor identification number, hotel name, and baseline exterior ambient noise level at each receptor. **Figure 4.10.4-2** shows the locations of the receptors.

For those receptors where the hotel complex extends along a north-south axis, with hotel facilities located in proximity to both 98th Street and Century Boulevard, such sites were assigned a second receptor location to account for the geographic scope of Alternative 3, which includes a secondary APM path along Century Boulevard, as described in the impacts discussion in Section 4.10.4.7 below. For each such hotel receptor site, including Receptors 2, 3, 5, 6, and 9, the receptor location nearest to Century Boulevard includes the letter "A" in the identification number. For example, at the Courtyard by Marriot site, the receptor location closest to 98th Street is "Receptor 2" while the receptor location nearest to Century Boulevard is "Receptor 2A." Due to the proximity of the two sites to one another, ambient noise levels were assumed to be comparable for each pair.

Table 4.10.4-2

Baseline Ambient Noise Levels at Hotel Receptor Sites

Receptor ID #	Receptor (Hotel) Name	Baseline Ambient Outdoor Noise Level (CNEL)
1	Radisson Hotel	68 dBA
2/2A	Courtyard by Marriott	67 dBA
3/3A	Sheraton Hotel	69 dBA
4	Crown Plaza Hotel	68 dBA
5/5A	Embassy Suites	68 dBA
6/6A	Renaissance Hotel	67 dBA
7	Four Points Sheraton	67 dBA
8	Marriott Hotel	69 dBA
9/9A	Hilton Hotel	70 dBA

Source: CDM Smith, 2012.

The baseline ambient noise level at each receptor location was estimated based on the LAX California State Airport Noise Standards Quarterly Report for 4th Quarter 2010 (i.e., September through December

2010).[618] In evaluating significance of noise impacts associated with a proposed transit project, the FTA noise assessment guidelines and criteria take into account the existing ambient noise levels of the potentially affected uses. With the receptors being in close proximity to the airport runway flight paths, aircraft noise is the predominant noise influence in the area and the additional contribution from local roadway traffic is considered to be relatively minor.

4.10.4.4.2 Ground-borne Vibration

There are no notable existing sources of ground-borne vibration in proximity to the hotels along Century Boulevard and 98th Street. Although vehicle traffic on the subject streets includes trucks and buses, such activity does not typically generate notable levels of ground-borne vibration, as indicated above in Section 4.10.4.3.2.

4.10.4.5 Thresholds of Significance

A significant transit noise impact would occur if the direct and indirect changes in the environment caused by the particular SPAS alternative would result in the following future condition:

- Transit operations, associated with either the elevated/dedicated busway or the APM proposed by a SPAS alternative causes the ambient noise level measured at the affected noise-sensitive uses to increase by 3 dBA or more in CNEL.

The above threshold is derived from the L.A. CEQA Thresholds Guide relative to railroad noise associated with a proposed project.

A significant transit vibration impact would occur if the direct and indirect changes in the environment caused by the particular SPAS alternative would result in the following future condition:

- Vibration or ground-borne noise levels exceed the FTA recommended maximum acceptable level threshold of 72 VdB for residences and buildings where people normally sleep, including hotels.

The above threshold is derived from the 2006 FTA *Transit Noise and Vibration Impact Assessment Manual*.

4.10.4.6 Applicable LAX Master Plan Commitments and Mitigation Measures

As part of the LAX Master Plan, LAWA adopted one commitment and seven mitigation measures pertaining to noise (denoted with "N") in the Alternative D Mitigation Monitoring and Reporting Program (MMRP). Of these commitment and mitigation measures, one mitigation measure is specific to transit noise impacts.

- **MM-N-11. Automated People Mover (APM) Noise Assessment and Control Plan.**

  In conjunction with detailed design and engineering of the proposed APM systems, a noise control plan shall be prepared specifying noise attenuation measures to reduce APM noise levels at the two significantly impacted hotels to acceptable levels (i.e., less than 67 dBA CNEL for the Courtyard by Marriott and the Four Points Sheraton). Potential options for such noise control/reduction include, but are not limited to, the following:

  - Measures that Mitigate Noise at the Source
    - Stringent vehicle and equipment noise specifications
    - Operational restrictions

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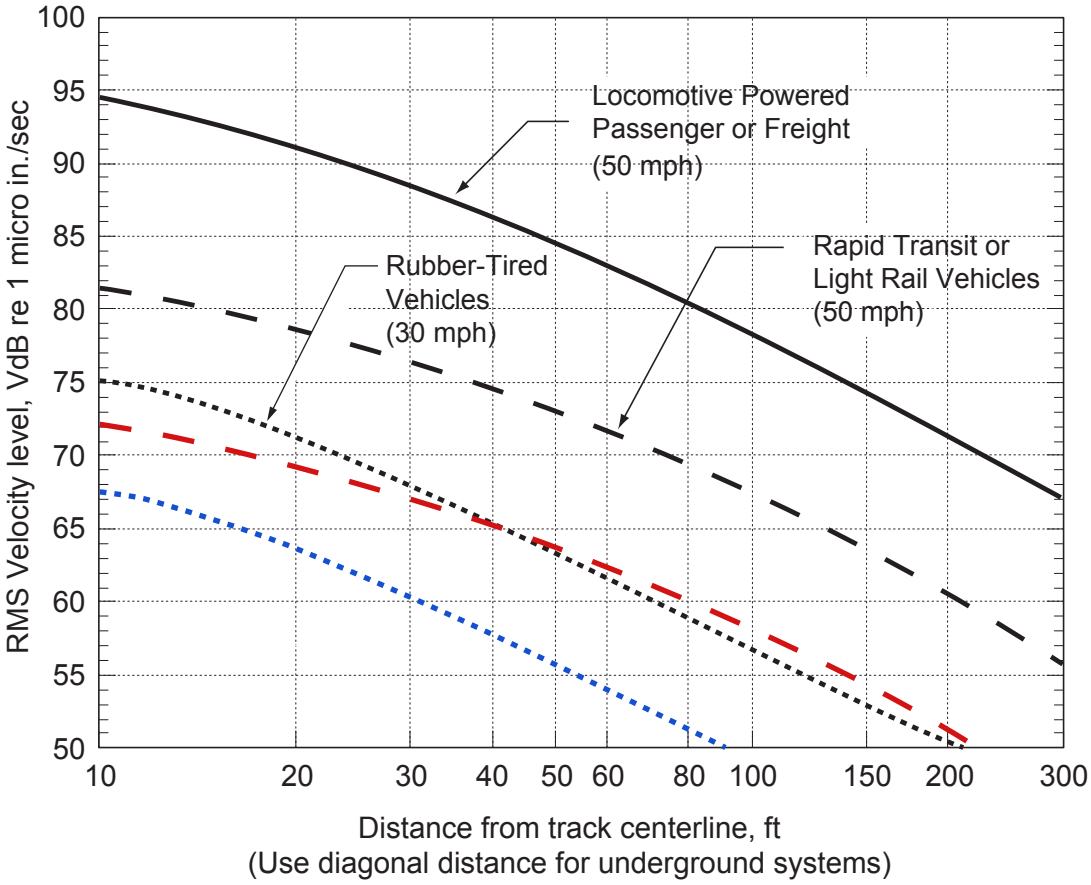
618 City of Los Angeles, Los Angeles World Airports, California State Airport Noise Standards Quarterly Report, Fourth Quarter 2010, Available: http://lawa.org/uploadedFiles/LAX/pdf/lax4q10%20noise%20contour%20map.pdf, accessed April 17, 2012.



Legend

Adjusted Curves *

- Rapid Transit or Light Rail Vehicle
- Rubber-Tired Vehicle

* Adjusted for speed and elevated system.

Prepared by: CDM Smith, 2012.

LAX Specific Plan Amendment Study Draft EIR	**Generalized Ground Surface Vibration Curves**	Figure **4.10.4-3**

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  - Vehicle skirts (i.e., steel/fiberglass panels that extend down to enclose wheel and undercarriage noise)
  - Undercar sound absorption
  - Limited turning radii
- Measures that Mitigate Noise Along the Source-to-Receptor Propagation Path
  - Sound barriers close to vehicles
  - Sound barriers at Right-of-Way line
  - Alteration of horizontal and vertical alignments (i.e., altering the height or path of the APM alignment to reduce the exposure of noise sensitive receptors)
  - Acquisition of buffer zones
  - Resilient support on aerial guideway
- Measures that Mitigate Noise at the Receptor
  - Construction of sound barriers within affected properties
  - Building noise insulation or insulation upgrades

4.10.4.7 Impacts Analysis

4.10.4.7.1 Transit Noise

Table 4.10.4-3 presents the estimated project-related transit noise levels at each receptor location for the relevant SPAS alternatives (Alternatives 1-2, 3, 8, and 9). The calculation assumptions and worksheets for the estimated noise levels shown in **Table 4.10.4-3** are presented in Appendix J3, *Transit Noise and Vibration*. The following describes the impacts particular to Alternatives 1-2, 3, 8, and 9.

Table 4.10.4-3

Ambient Noise Levels With Addition of Transit Noise Associated with Alternatives 1-2, 3, 8, and 9

Receptor	Baseline Ambient Noise Level (CNEL)	Transit Noise Levels: Ambient Noise Level With Addition of Transit Noise (CNEL)				
		Alt. 1-2	Alt. 3		Alt. 8	Alt. 9
		Busway	APM 1	APM 2	Busway	APM
Receptor 1 - Radisson Hotel	68 dBA	68 dBA	68 dBA	68 dBA	68 dBA	68 dBA
Receptor 2 - Courtyard by Marriott[1]	67 dBA	69 dBA	**73 dBA**	NA	**70 dBA**	68 dBA
Receptor 2A - Courtyard by Marriott[2]	67 dBA	NA	NA	67 dBA	NA	NA
Receptor 3 - Sheraton Hotel[1]	69 dBA	69 dBA	70 dBA	NA	69 dBA	69 dBA
Receptor 3A - Sheraton Hotel[2]	69 dBA	NA	NA	70 dBA	NA	NA
Receptor 4 - Crown Plaza Hotel	68 dBA	68 dBA	68 dBA	**71 dBA**	68 dBA	68 dBA
Receptor 5 - Embassy Suites[1]	68 dBA	70 dBA	**73 dBA**	NA	70 dBA	69 dBA
Receptor 5A - Embassy Suites[2]	68 dBA	NA	NA	68 dBA	NA	NA
Receptor 6 - Renaissance Hotel[1]	67 dBA	69 dBA	**72 dBA**	NA	69 dBA	68 dBA
Receptor 6A - Renaissance Hotel[2]	67 dBA	NA	NA	68 dBA	NA	NA
Receptor 7 - Four Points Sheraton	67 dBA	**70 dBA**	**74 dBA**	67 dBA	**71 dBA**	68 dBA
Receptor 8 - Marriott Hotel	69 dBA	69 dBA	69 dBA	69 dBA	69 dBA	69 dBA
Receptor 9 - Hilton Hotel[1]	70 dBA	**73 dBA**	**78 dBA**	NA	**74 dBA**	72 dBA
Receptor 9A - Hilton Hotel[2]	70 dBA	NA	NA	**78 dBA**	NA	NA

Notes:

NA = Not applicable
Noise levels shown in bold text indicate an increase of 3 dBA or more.
LAX Master Plan Mitigation Measure MM-N-11 was not quantitatively accounted for in Table 4.10.4-3.

[1] Receptor location nearest to 98th Street - see Figure 4.10.4-2.
[2] Receptor location nearest to Century Boulevard - see Figure 4.10.4-2.

Source: CDM Smith, 2012.

Alternative 1-2

Under Alternative 1-2, a grade-separated busway would be constructed between Manchester Square and the Central Terminal Area (CTA), primarily using the 98th Street corridor. During daytime hours, the busway system would operate at an estimated 35 mph with an estimated 54 trips per hour. During nighttime hours, the busway system would operate at 40 mph with an average of 20 trips per hour.

With the additional noise from the busway operations proposed under Alternative 1-2, Receptors 7 and 9, the Four Points Sheraton and the Hilton Hotel, would experience an increase in ambient noise levels of 3 dBA CNEL. As such, Alternative 1-2 would result in a significant transit noise impact at Receptors 7 and 9.

Alternative 3

Under Alternative 3, two APM systems are proposed: one, referred to as "APM 1," would extend along 98th Street between the CTA and the Consolidated Rental Car Facility (CONRAC), turning south along Aviation Boulevard to connect with the Intermodal Transportation Center (ITC); the other, referred to as "APM 2," would extend along Century Boulevard between the CTA and the Ground Transportation Center (GTC). The FTA Category land uses in proximity to these two routes are the hotels identified above in **Table 4.10.4-3**. The APM 1 route alignment extends along 98th Street and the APM 2 route extends along Century Boulevard. Both APM systems would be fully automated (driverless).

At the present conceptual level of planning, the exact nature and design of the APM system is not known. For general analysis purposes, it is assumed that the APM system would either utilize rubber-tire vehicles operating along a fixed guideway or steel-wheel vehicles operating along welded track with resiliently supported ties. In comparing those two system types, as could be developed for Alternative 3, the steel-wheel system would typically operate with cars that are larger and less in number at faster speeds than the rubber-tire system (i.e., four cars at 55 mph compared to 6 cars at 45 mph). From a noise perspective, the two systems would generate comparable noise levels, as can be seen in the transit noise calculation worksheets in Appendix J3, *Transit Noise and Vibration*. As such, the noise levels presented for Alternative 3 in **Table 4.10.4-3** are applicable to both design types.

With the additional noise from the APM 1 operations proposed under Alternative 3, ambient noise levels at Receptors 2, 5, 6, 7, and 9 (Courtyard by Marriott, Embassy Suites, Renaissance Hotel, Four Points Sheraton, and Hilton Hotel) would experience an increase in ambient noise levels of 3 dBA CNEL or more. With the additional noise from the APM 2 operations proposed under Alternative 3, ambient noise levels at Receptors 4 and 9A (Crown Plaza Hotel and Hilton Hotel) would experience an increase in ambient noise levels of 3 dBA CNEL or more. However, for both APM routes, implementation of LAX Master Plan Mitigation Measure MM-N-11, Automated People Mover (APM) Noise Assessment and Control Plan, described in Section 4.10.4.6 above, requires the preparation of a noise control plan to incorporate appropriate noise attenuation measures into the detailed design and engineering plans for the APM systems in order to achieve acceptable (i.e., less than significant) noise levels at affected receptor locations. With implementation of this existing measure, the transit noise impacts associated with Alternative 3 would be less than significant.

Alternative 8

Under Alternative 8, a grade-separated busway would be constructed between the CONRAC/public parking in Manchester Square and the CTA, primarily using the 98th Street corridor. As with Alternative 1-2, during daytime hours, the busway system would operate at an estimated 35 mph with an estimated 128 trips per hour. During nighttime hours, the busway system would operate at 40 mph with an average of 20 trips per hour.

With the additional noise from the busway operations proposed under Alternative 8, Receptors 2, 7, and 9 (Courtyard by Marriott, Four Points Sheraton, and Hilton Hotel) would experience an increase of 3 dBA CNEL or more. As such, Alternative 8 would result in a significant transit noise impact at Receptors 2, 7, and 9. It should be noted that, although Alternative 8 proposes the same elevated/dedicated busway system as that of Alternative 1-2, described above, the average daily transit noise levels and associated impacts of Alternative 8 would be comparatively greater due to a greater number of hourly operations during the daytime hours (i.e., 128 trips per hour versus 54), which is mostly attributable to the CONRAC proposed under Alternative 8.

Alternative 9

Under Alternative 9, an elevated APM would be constructed between Manchester Square and the CTA, primarily using the 98th Street corridor. The APM would be fully automated (driverless). The pinched-loop system would operate with a round trip time of approximately 19 minutes. The system would operate 24 hours a day. Similar to Alternative 3 above, the nature and design of the APM system for Alternative 9, relative to rubber-tire or steel-wheel, are unknown at this time. For analysis purposes, it is assumed that the system would be steel-wheel, recognizing that the noise characteristics of a rubber-tire system would be generally similar, as discussed above for Alternative 3.

The additional noise from the APM operations proposed under Alternative 9 would result in an increase in ambient noise levels of approximately 2 dBA CNEL or less at all of the receptor locations. As such, Alternative 9 would not result in significant transit noise impacts. It should be noted that, although the APM route along 98th Street for Alternative 9 is the same as the same segment of APM 1 under Alternative 3, the APM noise levels along 98th Street for Alternative 9 would be substantially lower than those of Alternative 3 because the former has far fewer hourly trips and shorter trains than the latter.

Under Alternative 3, all passenger traffic to and from the CTA, except for FlyAways, would utilize the APM system, whereas under Alternative 9, the CTA would remain open to various modes of traffic and only a limited portion of the passenger traffic would utilize the APM.

4.10.4.7.2 Transit Vibration

Alternative 1-2

Based on the adjusted vibration level curve for Rubber-Tired Vehicles described above in Section 4.10.4.3.2, the highest ground-borne vibration level associated with the elevated/dedicated busway would be approximately 67.5 VdB at a distance of 10 feet from the busway centerline. Notwithstanding that the hotel nearest to the proposed busway route along 98th Street would be more than three times that distance away from the busway (i.e., Receptor 9 - the Hilton Hotel at 35+ feet from the busway centerline), the maximum vibration level of 67.5 VdB is below the threshold of significance of 72 VdB. Therefore, transit-related ground-borne vibration under Alternative 1-2 would be less than significant.

Alternative 3

Based on the adjusted vibration level curve for Rapid Transit or Light Rail Vehicles described above in Section 4.10.4.3.2, the highest ground-borne vibration level associated with the APM system under Alternative 3 would be 72.3 VdB at a distance of 10 feet from the APM centerline. The hotel nearest to the APM route along 98th Street would be approximately 35+ feet from the APM centerline (Receptor 9 - the Hilton Hotel) and the hotel nearest to the APM route proposed along Century Boulevard would be approximately 65+ feet from the APM centerline (Receptor 9A - the Hilton Hotel). As such, the estimated ground-borne vibration levels at the nearest hotel areas would be approximately 67 VdB along 98th Street and 60 VdB along Century Boulevard, both of which are less than the threshold of significance of 72 VdB. Therefore, transit-related ground-borne vibration under Alternative 3 would be less than significant.

Alternative 8

Based on the adjusted vibration level curve for Rubber-Tired Vehicles described above in Section 4.10.4.3.2, the highest ground-borne vibration level associated with the elevated/dedicated busway would be approximately 67.5 VdB at a distance of 10 feet from the busway centerline. Notwithstanding that the hotel nearest to the proposed busway would be more than three times that distance away from the busway (i.e., Receptor 9 - the Hilton Hotel at 35+ feet from the busway centerline), the maximum vibration level of 67.5 VdB is below the threshold of significance of 72 VdB. Therefore, transit-related ground-borne vibration under Alternative 8 would be less than significant.

Alternative 9

Based on the adjusted vibration level curve for Rapid Transit or Light Rail Vehicles described above in Section 4.10.4.3.2, the highest ground-borne vibration level associated with the APM system under Alternative 9 would be 72.3 VdB at a distance of 10 feet from the APM centerline. The hotel nearest to the APM route along 98th Street would be approximately 35+ feet from the APM centerline (Receptor 9 - the Hilton Hotel). As such, the estimated ground-borne vibration levels at the nearest hotel area would be approximately 67 VdB, which is less than the threshold of significance of 72 VdB. Therefore, transit-related ground-borne vibration under Alternative 3 would be less than significant.

4.10.4.7.3 Summary of Impacts

Transit Noise

Alternatives 1, 2, and 8 would result in significant transit noise impacts at noise-sensitive receptors (hotels) associated with the elevated/dedicated busway system proposed under these alternatives. Although Alternative 8 proposes the same elevated/dedicated busway system as that of Alternatives 1 and 2, the average daily transit noise levels and associated impacts of Alternative 8 would be

comparatively greater due to greater number of hourly operations during the daytime hours (i.e., 128 trips per hour versus 54), which is mostly attributable to the CONRAC proposed under Alternative 8. Alternatives 1 and 2 would result in a significant transit noise impact at two hotels (Four Points Sheraton and Hilton Hotel), while Alternative 8 would result in a significant transit noise impact at three hotels (Courtyard by Marriott, Four Points Sheraton, and Hilton Hotel).

Alternative 3 would result in potential increases of 3 dBA CNEL or more at six hotels (Courtyard by Marriott, Embassy Suites, Renaissance Hotel, Four Points Sheraton, Hilton Hotel, and Crown Plaza Hotel) from operation of the two APM systems proposed under this alternative. However, with implementation of mitigation already required under the LAX Master Plan, transit noise impacts under Alternative 3 would be less than significant.

Although the APM operations proposed under Alternative 9 would result in an increase in ambient noise levels at noise-sensitive receptors (hotels), such increases would be less than significant.

Alternatives 4, 5, 6, and 7 do not propose an elevated/dedicated busway system or APM system; as such, these alternatives would not result in any transit-related noise impacts.

Transit Vibration

Transit-related ground-borne vibration would be less than significant for all the modeled alternatives - Alternatives 1, 2, 3, 8, and 9.

Alternatives 4, 5, 6, and 7 do not propose an elevated/dedicated busway system or APM system; as such, these alternatives would not result in any transit vibration impacts.

4.10.4.8 Mitigation Measures

Transit noise impacts associated with Alternatives 4, 5, 6, 7, and 9 would be less than significant; therefore, no mitigation is required.

Implementation of LAX Master Plan Mitigation Measure MM-N-11, Automated People Mover (APM) Noise Assessment and Control Plan, would ensure that the transit noise impacts associated with the APM systems proposed under Alternative 3 would be less than significant. Therefore, no mitigation measures specific to SPAS are required for Alternative 3.

To address the significant transit noise impacts associated with the proposed elevated/dedicated busway associated with Alternatives 1, 2, and 8, the following mitigation measure specific to SPAS is proposed:

- **MM-N (SPAS)-1. Elevated/Dedicated Busway Noise Assessment and Control Plan (Alternatives 1, 2, and 8).**

  In conjunction with detailed design and engineering of the proposed elevated/dedicated busway system, a noise control plan shall be prepared that requires the implementation of noise attenuation measures to reduce busway operations noise at nearby hotel receptors to acceptable levels (i.e., less than 70 dBA CNEL for the Four Points Sheraton and less than 73 dBA for the Hilton Hotel under Alternatives 1, 2 and 8, and less than 70 dBA CNEL for the Courtyard by Marriott under Alternative 8).

  Options for such noise control/reduction measures include, but are not limited to, the following:

  - Measures that Mitigate Noise at the Source
    - Using state-of-the-art buses as low-floor Bus Rapid Transit (BRT) vehicles, reduces project noise levels as much as 7 dBA lower than the default FTA bus passby levels
    - Using hybrid buses since noise levels for the new hybrids is roughly half of that from a standard bus
    - Stringent vehicle and equipment noise specifications
    - Operational restrictions

- Vehicle skirts (i.e., steel/fiberglass panels that extend down to enclose wheel and undercarriage noise)
- Undercar sound absorption
- Wheel dampeners
- Frequent operational maintenance

- Measures that Mitigate Noise Along the Source-to-Receptor Propagation Path
  - Alteration of horizontal and vertical alignments (i.e., altering the height or path of the elevated busway alignment to reduce the exposure of noise-sensitive receptors)
  - Sound barriers close to busway or APM line
  - Sound barriers at right-of-way line
  - Acquisition of buffer zones
  - Resilient (i.e., hard plastic or other elastic material able to absorb energy) support on aerial guideway
- Measures that Mitigate Noise at the Receptor
  - Construction of sound barriers within affected properties
  - Building noise insulation or insulation upgrades
  - Installing windows with a minimum Sound Transmission Class (STC) rating of 39 on any windows exposed to the noise source
  - Installing solid-core wood doors and well-gasketed storm doors for exterior doors

4.10.4.9 Level of Significance After Mitigation

Implementation of SPAS Mitigation Measure MM-N (SPAS)-1, Elevated/Dedicated Busway Noise Assessment and Control Plan, would reduce noise impacts associated with the elevated/dedicated busway system under Alternatives 1, 2, and 8 to a level that is less than significant.