4.7 Noise and Vibration

This section summarizes the methodology and assumptions used to analyze potential effects from noise and vibration generated during construction and operation of the proposed build alternatives. Potential noise and vibration impacts of the proposed alternatives are evaluated in this section. Information in this section is based primarily on the Noise and Vibration Technical Memorandum prepared for the project contained in Appendix S of the Draft EIS/EIR and Appendix R-2, Updated Locally Preferred Alternative Noise and Vibration Analysis, of this Supplemental EA/Recirculated Draft EIR Sections.

This section has been updated since publication of the Draft EIS/EIR based on refinements to the Locally Preferred Alternative (LPA). A vertical line in the margin is used to show where revisions have occurred to this section since publication of the Draft EIS/EIR.

Based on comments received on the Draft EIS/EIR and input received from community meetings held after circulation of the Draft EIS/EIR, refinements were made to the LPA, which are described in further detail in Chapter 2 herein above. Additional noise and vibration studies were performed (Appendix R-2 of this Supplemental EA/Recirculated Draft EIR Sections) to analyze refinements of the alignment in areas near sensitive receptors, specifically the Walt Disney Concert Hall, the Roy and Edna Disney/CalArts Theater (REDCAT), office uses in the Japanese Village Plaza (JVP), the Hikari Lofts, and the Nakamura Tetsujiro Building. With implementation of mitigation, noise and vibration impacts associated with construction and operation of the LPA would be less than significant. Since designation of an LPA, mitigation measures have been refined for the LPA, which are listed in Section 4.7.5 herein below, based on input received during the Draft EIS/EIR public review period.

The analysis of potential noise and vibration impacts during construction and operation of the LPA is detailed herein below in Section 4.7.3.5.

4.7.1 Regulatory Framework

4.7.1.1 Federal Transit Administration

Noise Standards

The noise impact analysis for this project is based on criteria defined in the *FTA Transit Noise and Vibration Impact Assessment* (USDOT 2006). The standards are based on community reaction to noise and evaluate potential changes to existing noise using a sliding scale. If existing noise is already high, a potential project is more limited in the amount of noise it can create.

Table 4.7-1 and Figure 4.7-1 show the FTA noise criteria used to determine "moderate" and "severe" levels of impact. Under NEPA, a "severe" level of impact is considered an adverse impact. In Table 4.7-1, the first column shows existing noise exposure, and the remaining columns show additional noise exposure caused by a potential transit project which is used to determine the level of impact. The future noise exposure would be the combination of existing noise exposure and the additional noise exposure caused by the Regional Connector Transit Corridor project. As the existing noise exposure increases in a particular location, the amount of the allowable increase in the overall noise exposure caused by the project decreases.

Table 4.7-1. Noise Impact Criteria

Existing Noise Exposure Leq or Ldn[1]	Project Noise Exposure Impact Thresholds: Ldn or Leq[1] (all noise levels in dBA)			
	Category 1 or 2 Sites		Category 3 Sites	
	Moderate Impact	Severe Impact	Moderate Impact	Severe Impact
<43	Ambient +10	Ambient +15	Ambient +15	Ambient +20
43-44	52	58	57	63
45	52	58	57	63
46-47	53	59	58	64
48	53	59	58	64
49-50	54	59	59	64
51	54	60	59	65
52-53	55	60	60	65
54	55	61	60	66
55	56	61	61	66
56	56	62	61	67
57-58	57	62	62	67
59-60	58	63	63	68
61-62	59	64	64	69
63	60	65	65	70
64	61	65	66	70
65	61	66	66	71
66	62	67	67	72
67	63	67	68	72
68	63	68	68	73
69	64	69	69	74
70	65	69	70	74

Table 4.7-1. Noise Impact Criteria (continued)

Existing Noise Exposure Leq or Ldn[1]	Project Noise Exposure Impact Thresholds: Ldn or Leq[1] (all noise levels in dBA)			
	Category 1 or 2 Sites		Category 3 Sites	
	Moderate Impact	Severe Impact	Moderate Impact	Severe Impact
71	66	70	71	75
72-73	66	71	71	76
74	66	72	71	77
75	66	73	71	78
76-77	66	74	71	79
>77	66	75	71	80

Source: Transit Noise and Vibration Impact Assessment, FTA, May 2006
Note:
[1]Ldn (average day-night noise level) is used for land uses where nighttime sensitivity is a factor; daytime Leq (equivalent continuous noise level) is used for land uses involving only daytime activities.

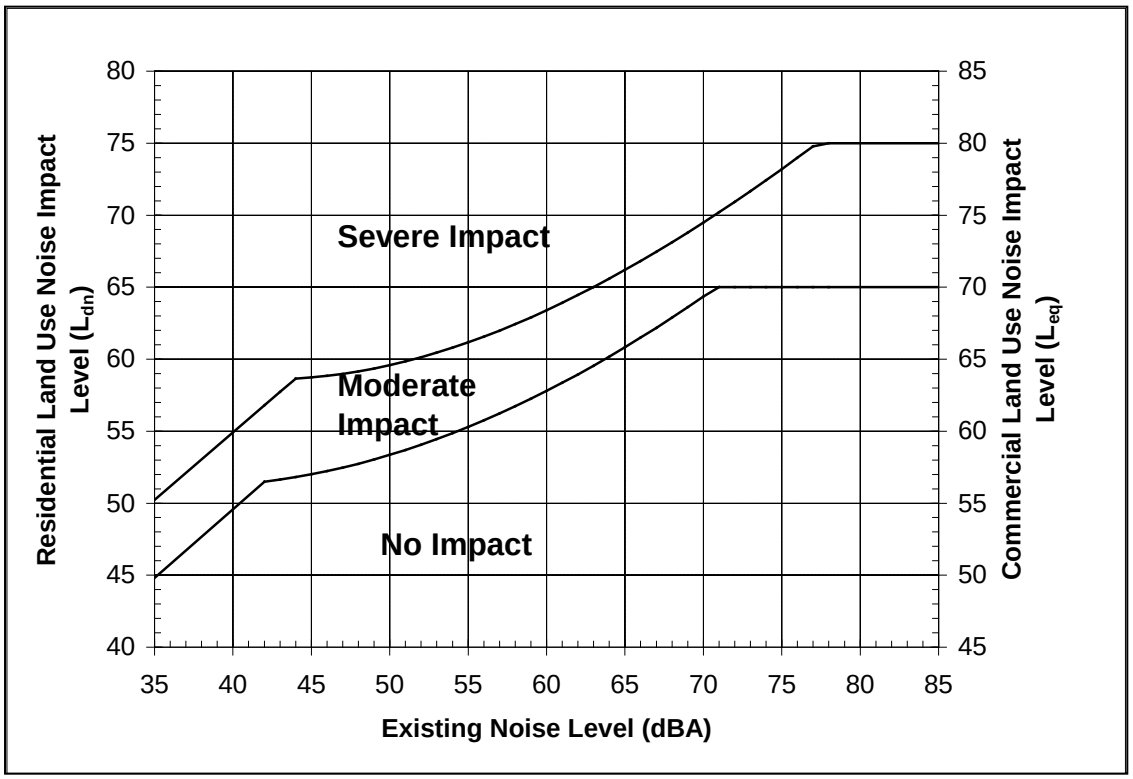

Figure 4.7-1. Noise Impact Criteria for Transit Projects

In an urban setting, a change of 1 decibel (dBA) or less is generally not detectable by the human ear while a change of 3 dBA will be noticeable to most people. A change of 5 dBA is readily perceived. A change of 10 dBA, up or down, is typically perceived as a doubling or halving of an urban noise level, respectively.

Some land use types are more sensitive to noise than others. For example, parks, churches, and residences are typically more noise-sensitive than industrial and commercial areas. The FTA noise impact criteria classify sensitive land uses into three categories:

- Category 1: Buildings or parks where low noise is an essential element of their purpose (e.g., amphitheaters and concert pavilions).
- Category 2: Buildings where people normally sleep, including residences, hospitals, and hotels where nighttime sensitivity is assumed to be of utmost importance.
- Category 3: Institutional land uses with primarily daytime uses that depend on low noise as an important part of operations (e.g., schools, libraries, churches, theaters, and places of study).

Vibration Standards

FTA has developed impact criteria for ground-borne vibration (GBV), which is expressed as a velocity level in units of VdB, and ground-borne noise (GBN) due to transit project construction and operation of transit vehicles (USDOT 2006). GBN is created when a vibration source such as a train pass-by causes vibration of floors and walls in nearby buildings resulting in a low frequency rumble sound within the building. Impacts of GBN are particularly important for underground transit operations because, depending on the soil type, tunnels more efficiently transmit vibration to the surrounding soil than surface track structures.

There appears to be a relationship between the number of perceived vibration events and the degree of annoyance caused by the vibration. It is intuitive to expect that more frequent vibration events, or events that last longer, will be more annoying to building occupants. FTA guidelines address vibration frequency by applying different levels of annoyance criteria based on the number of transit vibration events per day.

A different analysis is used for vibration from construction activities that could cause damage to sensitive buildings. When assessing the potential for building damage, GBV is usually expressed in terms of the peak particle velocity (PPV) in units of inches per second. As defined in Section 7.1.2 of the *FTA Transit Noise and Vibration Impact Assessment*, "The peak particle velocity (PPV) is defined as the maximum instantaneous positive or negative peak of the vibration signal. PPV is often used in monitoring of blasting vibration since it is related to the stresses that are experienced by buildings."

PPV is used for evaluating the potential for building damage, because it shows the peak of the vibration signal, which is what could cause stress to the structure of a building. Vibration sensitivity of a land use is described by using the root mean square (RMS) or the "smoothed" vibration amplitude. This is typically "the square root of the squared amplitude of the average of the squared amplitude of the signal. The average is typically calculated over a one-second period" (FTA May 2006).

In short, RMS (shown with the abbreviation "VdB") is used to evaluate human response to the vibration signals, and PPV is used to evaluate the potential for building damage.

The threshold of vibration perception for most humans is around 65 to 70 VdB. Levels in the 70 to 75 VdB range are often noticeable but acceptable. Levels greater than 80 VdB are often considered unacceptable.

Table 4.7-2 summarizes the FTA impact criteria for GBV and GBN. Some buildings, such as concert halls, television and recording studios, and theaters, can be very sensitive to vibration but are not included in the three listed categories. These types of buildings, noted in Table 4.7-3, usually warrant special attention during the environmental review and engineering/pre-construction phases of a project. Table 4.7-2 and Table 4.7-3 list impact criteria for transit operations. Following FTA guidance, some criteria in Table 4.7-2 may also be used to assess human annoyance caused by vibration from construction activities.

In addition to human annoyance from transit operations, FTA guidelines also address the potential for construction-activity-induced vibration to damage buildings. The potential for GBV to cause damage to a building varies by the type of materials and structural techniques used to construct each building. FTA vibration damage criteria for various structural categories are listed in Table 4.7-4.

FTA guidelines suggest minimum safe distances between construction equipment and buildings based on the types of construction equipment and the category of a building (see Table 4.7-4). Minimum safe distances between construction and nearby buildings are presented in Table 4.7-5. For example, the minimum safe distance between the most invasive method of construction (impact pile driving) and a Category IV building (the most vibration-sensitive type of building) would be at least 136 feet. Conversely, a small bulldozer could safely operate less than five feet from a Category I building (the least vibration-sensitive type of building).

GBN from at-grade or open excavation construction activities is rarely a concern because the air-borne noise from the activity would likely dominate the noise environment. While not generally likely, some GBN from underground construction activity such as tunneling could occasionally be audible. However, this GBN would be temporary and of short duration as the construction activity moves along the project alignment.

This project would not involve impact or sonic pile driving or large vibratory rollers. As a result, the minimum safe distance between construction activities and buildings would never exceed 37 feet for this project. Distances in Table 4.7-5 are approximations based on typical equipment and construction activities and the general classification of structures.

Table 4.7-2. FTA Ground-Borne Vibration (GBV) and Ground-Borne Noise (GBN) Impact Criteria for General Assessment

Land Use Category	GBV Impact Levels (VdB re: 1 Micro-inch/sec)			GBN Impact Levels (dB re: 20 micro-Pascals)		
	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]	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]	N/A[4]	N/A[4]	N/A[4]
Category 2: Residences and buildings where people normally sleep	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use	75 VdB	78 VdB	83 VdB	40 dBA[5]	43 dBA[5]	48 dBA[5]

Source: Transit Noise and Vibration Impact Assessment (USDOT 2006)
Notes:
[1] "Frequent Events" are defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
[2] "Occasional Events" are defined as between 30 and 70 vibration events of the same source per day. Most commuter rail lines produce at least this many events.
[3] "Infrequent Events" are 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. Buildings used for vibration-sensitive manufacturing or research will require detailed evaluation to define acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.
[5] Vibration-sensitive equipment is generally not sensitive to GBN.

Table 4.7-3. FTA Ground-Borne Vibration (GBV) and Ground-Borne Noise (GBN) Impact Criteria for Special Buildings

Type of Building or Room	GBV Impact Levels (VdB re: 1 micro inch/sec)		GBN Impact Levels (dB re: 20 micro Pascals)	
	Frequent Events[1]	Occasional or Infrequent Events[2]	Frequent Events[1]	Occasional or Infrequent Events[2]
Concert Halls	65 VdB	65 VdB	25 dBA	25 dBA
Television Studios	65 VdB	65 VdB	25 dBA	25 dBA
Recording Studios	65 VdB	65 VdB	25 dBA	25 dBA
Auditoriums	72 VdB	80 VdB	30 dBA	38 dBA
Theaters	72 VdB	80 VdB	35 dBA	43 dBA

Source: Transit Noise and Vibration Impact Assessment (USDOT 2006)
Notes:
[1] "Frequent Events" are defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
[2] "Occasional Events" are defined as between 30 and 70 vibration events of the same source per day. Most commuter rail lines have this many events.

Table 4.7-4. FTA Construction Vibration Damage Criteria

Building Category and Description	PPV (in/sec)
I. Reinforced-concrete, steel, or timber (no plaster)	0.5
II. Engineered concrete and masonry (no plaster)	0.3
III. Non-engineered timber and masonry buildings	0.2
IV. Buildings extremely susceptible to vibration damage	0.12

Source: Federal Transit Administration's Transit Noise and Vibration Impact Assessment Manual, May 2006. FTA-VA-90-1003-06. Table 12-3.

Table 4.7-5. Calculated "Minimum Safe Distances" from Construction Equipment to Reduce Potential for GBV Damage (ft)

Equipment		Building Categories and (FTA Guideline Damage Thresholds)			
		Cat I (0.5 PPV) Inch/sec	Cat II (0.3 PPV) Inch/sec	Cat III (0.2 PPV) Inch/sec	Cat IV (0.12 PPV) Inch/sec
Pile Driver (Impact)	Upper Range	53	74	97	136
	Typical	30	42	55	77
Pile Driver (Sonic)	Upper Range	33	46	60	84
	Typical	13	18	23	32
Large Vibratory Roller		15	20	26	37
Hoe Ram		8	12	15	21
Large Bulldozer		8	12	15	21
Caisson drilling		8	12	15	21

4.7.1.2 California Environmental Quality Act (CEQA)

Neither CEQA nor the City of Los Angeles provides quantitative thresholds for a substantial noise impact or a significant adverse vibration impact. This analysis applies FTA criteria to determine the thresholds for significance. More information regarding these regulations and criteria is available in Appendix S, Noise and Vibration Technical Memorandum, of the Draft EIS/EIR and Appendix R-2, Updated Locally Preferred Alternative Noise and Vibration Analysis, of this Supplemental EA/Recirculated Draft EIR Sections.

4.7.2 Affected Environment

An assessment of existing noise conditions along the Regional Connector Transit Corridor alternatives alignments was conducted to establish a baseline by which alternatives could be evaluated. Figure 4.7-2 shows noise monitoring locations and FTA land use categories within the project area. Table 4.7-6 lists noise-sensitive land uses within the screening distance for the build alternatives.

Noise levels were measured at 11 locations to establish the existing noise environment. The measurements included seven 24-hour and four short-term measurements. Existing noise levels are typical of an urban environment. The average day-night noise level (Ldn) ranges from 69 to 74 dBA. Most of the noise came directly from nearby or distant sources where there was no intervening terrain or buildings, some noise came from sources not in direct view that were partially shielded by a building, and some measured noise was reflected off one or more structures. Noise levels were also estimated at four locations using nearby noise measurements.

Noise levels were measured at four locations along Flower Street, Sites 1, 2, A, and B shown on Figure 4.7-2.

- Site 1: A short-term (10-minute) measurement was conducted at the park area outside of the Los Angeles Library on Flower Street. A one-hour Leq of 67 was measured at 2:00 p.m. and a peak-hour Leq of 68 dBA was estimated at this location based on the 24-hour measurement obtained at the Westin Bonaventure. Noise levels at this location are dominated by traffic noise from Flower and 5th Streets.

- Site 2: A short-term measurement was conducted in the Bank of America Building Plaza. The plaza is located five floors above Flower Street at the same level as the tennis courts of the World Trade Center, which is located on the north side of Flower Street. A one-hour Leq of 61 was measured at 1:15 p.m. and a peak-hour Leq at Site B is estimated at 63 dBA. Noise levels at this location are dominated by traffic noise from Flower Street.

- Site A: A 24-hour measurement was conducted on the pool deck of the fourth floor of the Westin Bonaventure. An Ldn of 71 dBA and a peak-hour Leq of 68 dBA was measured at 6:00 a.m.

- Site B: A 24-hour measurement was obtained outside the ground-floor condominiums of the Bunker Hill Towers at Flower and 3rd Streets. An Ldn of 74 dBA and a peak-hour Leq of 72 dBA were measured at 8:00 a.m. Noise levels at this location are dominated by traffic noise from Flower and 3rd Streets.

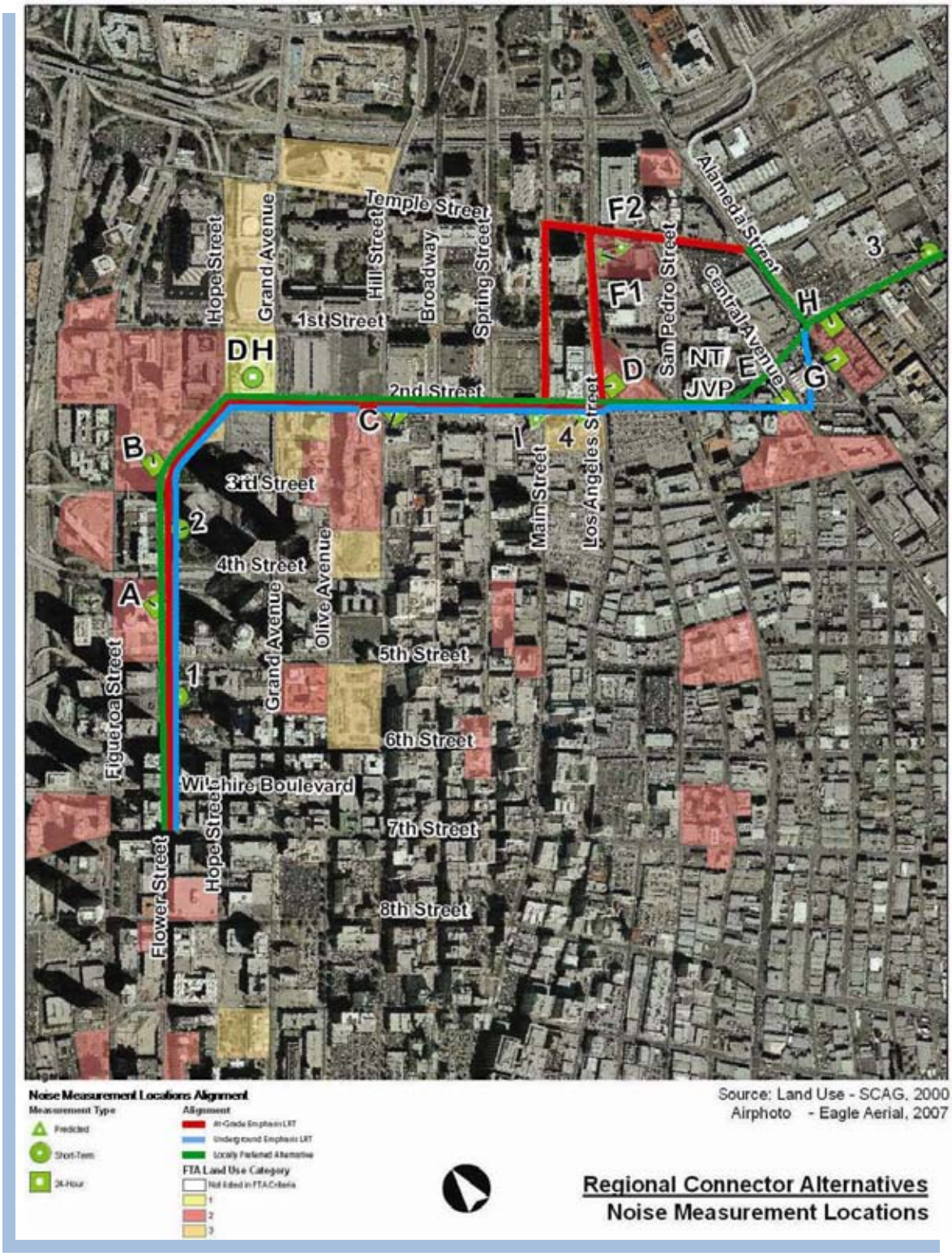

Figure 4.7-2. Noise Measurement Locations (Site #) and Noise-Sensitive Land Uses

Table 4.7-6. Noise-Sensitive Land Uses within Screening Distance

Name	Location	Build Alternative within Screening Distance	Land Use Category
Park at Central Library	200 North Main Street	ALRT, ULRT, LPA	3
Bonaventure Hotel	404 South Figueroa Street	ALRT, ULRT, LPA	2
World Trade Center Tennis Courts	333 South Figueroa Street	ALRT, ULRT, LPA	3
Open Space Bank of America Building Plaza	333 Hope Street	ALRT, ULRT, LPA	3
Bunker Hill Towers	234 South Figueroa Street 800 West 1st Street	ALRT, ULRT, LPA	2
Promenade Residences	121 South Hope Street	ALRT, ULRT, LPA	2
The Colburn School	200 South Grand Avenue	ALRT, ULRT, LPA	3
Kawada Hotel	200 South Hill Street	ALRT, ULRT, LPA	2
Higgins Building	108 South West 2nd Street	ALRT, ULRT, LPA	2
Saint Vibiana	206 South Main Street	ALRT, ULRT, LPA	3
Los Angeles Library Little Tokyo Branch	203 South Los Angeles Street	ALRT, ULRT, LPA	3
New Otani Hotel	120 South Los Angeles Street	ALRT, ULRT, LPA	2
Temple Street Jail	150 North Los Angeles Street	ALRT	2
Hikari Lofts	375 East 2nd Street	ALRT, LPA	2
JANM	369 East 1st Street	ULRT, LPA	3
Savoy – Alameda Street	100 South Alameda Street	ULRT, LPA	2
Los Angeles Hompa Hongwanji Temple	815 East 1st Street	LPA	3
Federal Metropolitan Detention Center	535 North Alameda Street	LPA	2

Notes:
ALRT = At-Grade Emphasis LRT Alternative; ULRT = Underground Emphasis LRT Alternative; LPA = Locally Preferred Alternative.
** The Walt Disney Concert Hall was analyzed for vibration effects, including GBV and GBN for the LPA, only because all of the alternatives are below-grade in the vicinity of the Concert Hall (Site DH), which would attenuate noise resulting in no potential for air-borne noise impact.*

Noise measurements were obtained at two locations along 2nd Street, Sites C and E, and existing conditions were estimated at Site I, as shown on Figure 4.7-2.

- Ambient noise exterior to the Walt Disney Concert Hall (Concert Hall, Site DH) was not measured because the alternatives are underground near the Walt Disney Concert Hall. Interior, short-term ambient noise was measured at the Walt Disney Concert Hall. A Leq of 24 to 28 dBA was measured inside the Walt Disney Concert Hall. In addition, interior noise monitoring was conducted at the REDCAT, which is located adjacent to the Walt Disney Concert Hall at the northeast corner of 2nd and Hope Streets. A Leq of 26 dBA was measured inside the REDCAT. The Walt Disney Concert Hall and REDCAT were included in the modeling of potential vibration impacts (including GBN).

- Site C: A 24-hour measurement was conducted on the roof of the Kawada Hotel at the intersection of 2nd and Hill Streets. An Ldn of 70 dBA and a peak hour Leq of 70 dBA were measured at 4:00 p.m. Noise levels at this location are dominated by traffic noise from 2nd and Hill Streets.

- Site E: A 24-hour measurement was conducted on the roof of the Hikari Loft Apartments at the intersection of 2nd Street and Central Avenue. A 24-hour Ldn of 69 dBA and a peak hour Leq of 71 dBA were measured at 7:00 p.m. Noise levels at this location are dominated by traffic noise from 2nd and Alameda Streets and Central Avenue.

- Site I: Noise levels for Site I, the Higgins Building at the northwest corner of 2nd and Main Streets, were estimated based on the measurements at Sites C and D. Existing noise levels could not be accurately measured due to construction at Saint Vibiana and on Main Street.

Noise measurements were obtained at four locations along 1st, Los Angeles, and Alameda Streets (Sites D, G, H, and 3), and existing conditions were estimated at Sites 4, F1, and F2, as shown on Figure 4.7-2.

- Site 4: This site, which lies on 2nd Street between Main and Los Angeles Streets, includes Saint Vibiana and the Los Angeles Library, Little Tokyo Branch. Existing noise levels could not be accurately measured due to construction at Saint Vibiana and on Main Street. Peak hour noise levels were estimated based on the measurements at Site D on the southeast corner of 2nd and Los Angeles Streets.

- No Category 1, 2 or 3 land uses are located on Main Street; thus, measurements were not recorded there.

- Site D: A 24-hour measurement was conducted at the ground level of the New Otani Hotel midway between 2nd and 1st Streets. This location most approximated noise levels in the tower that houses guest rooms. An Ldn of 73 dBA and a peak hour Leq of 73 dBA were measured at 7:00 a.m. and 6:00 p.m., respectively. Noise levels are dominated by traffic noise from Los Angeles Street.

- Sites F1 and F2: On Temple Street, noise-sensitive land uses exist where the Temple Street Jail is located. Due to construction on Temple Street, and activities at the jail, representative existing noise levels could not be measured. Noise levels for Sites F1 and F2 were estimated based on measurements at Sites D, which is a nearby noise measurement, and H, which is an equivalent noise measurement.

- Site G: A 24-hour measurement was conducted at ground level to approximate noise in certain units of the Savoy Condominium where traffic noise levels are dominated by street traffic on Alameda Street. An Ldn of 73 dBA and a peak hour Leq of 75 dBA were measured at 7:00 p.m.

- Site H: A 24-hour measurement was conducted at ground level to approximate noise in certain condo units in the Savoy Condominium building where noise levels are dominated by the traffic on 1st Street and train noise from Metro Gold Line operations. An Ldn of 72 dBA and a peak hour Leq of 72 dBA were measured at 7:00 p.m.

- Site 3: A short-term measurement was conducted at ground level on East 1st Street, between Garey and Vignes Streets. This location approximates existing noise effects on the meeting room and meditation area of the Los Angeles Hompa Hongwanji Temple. Ambient noise levels at Site 3 are dominated by traffic on 1st Street and train noise from the Metro Gold Line operations. A one-hour (non-peak) Leq of 66 was measured at 2:00 p.m. At the time of this measurement, lane closures were in effect along 1st Street. This resulted in a lower ambient Leq than would have been expected if all lanes were open. Based on the long-term measurement at Site H, the peak hour Leq at Site 3 was calculated at 70 dBA.

For more information regarding existing noise levels within the project area, please refer to Appendix S, Noise and Vibration Technical Memorandum, of the Draft EIS/EIR and Appendix R-2, Updated Locally Preferred Alternative Noise and Vibration Analysis, of this Supplemental EA/Recirculated Draft EIR Sections.

4.7.3 Environmental Impacts/Environmental Consequences

The following sections summarize the evaluation of potential noise and vibration impacts for each alternative. Table 4.7-7 summarizes the results of the analysis.

Impact conclusions for all of the alternatives are based on the thresholds identified herein above in Section 4.7.1. Potential noise and vibration impacts from transit operations and construction are analyzed and compared to the existing conditions as described in Section 4.7.2 herein above.

The analysis of construction effects is based on Chapter 3 of the Construction Staging Plan from the Traffic Handling and Construction Staging Report (CDM 2009). Each of the build alternatives would utilize different construction methods, so each alternative would potentially generate different levels of construction noise and vibration. The Traffic Handling and Construction Staging Report estimates a four- to five-year construction period with surface street disruption of approximately 24 to 48 months for all build alternatives (CDM 2009). This analysis considered both daytime and nighttime construction activities using the procedures presented in Chapter 12 of the FTA guidance manual (USDOT 2006).

Table 4.7-7. Summary of Potential Noise and Vibration Impacts

Alternative	Construction Impacts		Operational Impacts		Mitigation Required
	Noise	Vibration	Noise	Vibration	
No Build	None	None	None	None	None
TSM	None	None	None	None	None
At-Grade Emphasis LRT	None	Adverse effect (mitigated)	Significant/Adverse effect (mitigated)	None	Mitigation proposed
Underground Emphasis LRT	None	Adverse effect (mitigated)	None	None	Mitigation proposed
LPA	Significant/Adverse effect GBN (mitigated)	Significant/Adverse effect (mitigated)	Significant/Adverse effect GBN (mitigated)	None	Mitigation proposed

Analysis of potential project-related noise levels for the build alternatives was based on FTA reference sound levels (USDOT 2006) and sound level data from current Metro Blue and Gold Line operations. This analysis used the project assumptions about how the project would be operated (speed, headways, and schedule) in estimating ridership, fare revenue, and other impacts. Operation noise and vibration sources could include the movement of vehicles along each alignment (pass-by), noise from warning signals, locations of special trackwork, ventilation related noise, and operation of traction power substations (TPSS).

Vibration impacts from light rail transit (LRT) operations are generated by motions and actions at the wheel/rail interface. Vibration from passing trains has a small potential to traverse geologic strata and negatively impact near-by sensitive buildings. However, the principal concern with LRT vibration is potential annoyance to building occupants. It is extremely unlikely that GBV from transit operations would cause any damage to buildings.

The potential for vibration and GBN impacts resulting from the build alternatives was determined using the vibration assessment information and procedures contained in Chapters 7, 8, and 10 of the FTA's guidance manual for a general vibration assessment (USDOT 2006). Ground attenuation of vibration was based on FTA reference data (USDOT 2006). The conversion from vibration level to GBN level was based on the conversion factors in the FTA manual and measurements taken from the transit vehicles operating on the Metro Gold Line that the Regional Connector will join. To provide a very conservative analysis, the "typical" conversion factor of -35 dB was used to calculate the GBN level. A train traveling 50 miles per hour (MPH) was used to estimate vibration levels whereas the Regional Connector trains would be traveling at 35 MPH maximum and would generate lower vibration levels.

All estimates of GBV from the potential project alignments were projected to the foundations of the nearest building. The vibration estimates do not include adjustments for calculations of a building's specific reaction to GBV. Predicted GBV and GBN levels were compared to FTA criteria to determine potential impacts.

4.7.3.1 No Build Alternative

Automobile traffic would be the only likely source of increased noise levels under the No Build Alternative. However, traffic in the project area is already at or above road capacity, so increases in automobile traffic volumes are not expected to change existing 24-hour (Ldn) noise levels. New sources of vibration would not be proposed by this alternative and major construction activities would not occur under the No Build Alternative. Therefore, significant noise or vibration impacts are not anticipated under the No Build Alternative.

4.7.3.1.1 NEPA Finding

The No Build Alternative would have no effect on existing noise and vibration levels.

4.7.3.1.2 CEQA Determination

The No Build Alternative would have no impact on existing noise and vibration levels.

4.7.3.2 TSM Alternative

Major construction activities would not occur under the TSM Alternative; therefore, construction noise or vibration impacts would not occur under the TSM Alternative. This alternative would add bus routes along Alameda, Temple, 2nd, 3rd, 5th, 7th, Flower, Figueroa, and Olive Streets and Grand Avenue. Existing noise levels along proposed bus routes are substantially higher and would mask the noise of additional buses. Additionally, it takes a doubling of traffic to result in a 3 dBA (noticeable noise increase to the human ear) increase in noise (USDOT 2006). The number of buses that would be added under the TSM Alternative would not result in a doubling of traffic along the roadways listed above and, therefore, would not result in a noticeable increase in roadway noise. Operation of additional buses along the proposed route would not result in a noticeable increase in vibration levels. Under FTA criteria, the potential increase in noise and vibration from this alternative would not result in a significant noise impact.

4.7.3.2.1 NEPA Finding

The TSM Alternative would not have adverse noise and vibration impacts associated with either construction or operation.

4.7.3.2.2 CEQA Determination

The TSM Alternative would not have significant noise and vibration impacts associated with either construction or operation.

4.7.3.3 At-Grade Emphasis LRT Alternative

4.7.3.3.1 Construction Noise and Vibration

Under the At-Grade Emphasis LRT Alternative, the following construction activities would have the most potential for noise and vibration impacts: cut and cover construction of a tunnel on Flower Street; cut and cover construction of the proposed Flower/6th/5th Street station; cut and

cover construction of the proposed 2nd/Hope Street station; and re-grading of Alameda Street near the junction at Alameda and Temple Streets. These four activities have the most potential for noise impacts because of their duration and their proximity to noise-sensitive land uses.

Construction activities, relevant construction equipment, and related noise levels for this alternative are shown in Table 4.7-8.

Table 4.7-8. At-Grade Emphasis LRT Alternative Construction Activity and Equipment Typical Noise Levels at 50 feet

Activity	Duration (months)	Construction Equipment				
		Concrete Truck	Dozer	Excavator	Crane	Drill Rig
Pre-Construction	4-6	NA	NA	NA	NA	90
Site Preparation	6-12	77	85	82	NA	NA
Flower Street Cut and Cover Tunnel	24-48	77	85	82	81	90
Flower/6th/5th Cut and Cover Station	24-48	77	85	82	81	90
Portal on Flower south of 3rd	12-18	77	85	82	81	90
Portal northeast of Flower and 3rd	TBD	77	85	82	81	90
2nd/Hope Street Cut and Cover Station	24-28	77	85	82	81	90
New Portal into 2nd Street Tunnel	TBD	77	85	82	81	90
Surface Trackwork	12-18	77	85	82	81	NA
Main and Los Angeles At-Grade Stations	12-18	77	85	82	81	90
Temple and Alameda Junction	24-36	77	85	82	81	90
Operating Systems Installation	TBD	TBD	TBD	TBD	TBD	TBD

Construction would be consistent with the goals of Section 41.40(a) of the Los Angeles Municipal Code. The contractor would also be responsible for consistency with the goals of the applicable local ordinances as it applies to all equipment on the job or related to the job, including but not limited to trucks, transit mixers or transient equipment that may or may not be owned by the contractor.

In addition, the construction contractor would use Best Management Practices (BMPs) to reduce construction-related noise levels. Typical types of BMPs the contractor can use, which are included in Section 4.7.4 of the Draft EIS/EIR, to be consistent with the goals of the applicable local ordinances include, but are not limited to, the following:

- Placement of temporary noise barriers around the construction site;
- Placement of localized barriers around specific items of equipment or smaller areas;
- Use of alternative back-up alarms/warning procedures;
- Higher performance mufflers on equipment used during nighttime hours; and
- Portable noise sheds for smaller, noisy, equipment, such as air compressors, dewatering pumps, and generators.

Consistency with the goals of the applicable local ordinances and implementation of BMPs would ensure that noise and vibration levels associated with construction of the At-Grade Emphasis LRT Alternative would not result in a significant adverse impact.

However, sensitive or historic buildings, such as the Barker Brothers and the Los Angeles Times Mirror Building, in the vicinity of construction activities may be susceptible to vibration damage. Construction of the project would not involve impact or sonic pile driving (pre-auguring would be used for installation of the soldier piles instead) or large vibratory rollers. Therefore, equipment such as large bulldozers and drill rigs would be the main source of construction vibration that could have the potential to cause vibration damage. Based on the FTA's minimum safe distances identified for Category IV buildings of 0.12 inch/sec PPV in Table 4.7-5, the minimum safe distance between construction activities (involving large bulldozers and drill rigs) and buildings would be 21 feet according to FTA guidelines for minimum safe distances. Therefore, sensitive or historic buildings within 21 feet of construction may be susceptible to vibration damage. Refer to Section 4.12.1, Historic Resources - Built Environment, herein below, for a list of historic resources that are near construction activities associated with the At-Grade Emphasis LRT Alternative and may be susceptible to vibration damage.

As part of mitigation for the At-Grade Emphasis LRT Alternative, a survey of structures within 21 feet of the anticipated vibration-producing construction activity would be conducted to assess the building category and the potential for GBV to cause damage. During construction, use of building protection measures such as underpinning, soil grouting, or other forms of ground improvement, use of lower vibration equipment and/or construction techniques, combined with a geotechnical and vibration monitoring program would be used to protect identified historic and sensitive structures. With implementation of these mitigation measures, identified in Section 4.7.4 of the Draft EIS/EIR, construction-related vibration impacts to historic and sensitive buildings located within 21 feet of the anticipated vibration-producing construction activity would be reduced to less than significant.

Large bulldozers and drill rigs, the main sources of construction vibration, could exceed levels specified in FTA annoyance criteria for sensitive receptors (See Table 4.7-2). However,

perceptible vibration from construction equipment would be short-term and intermittent and, therefore, considered an "infrequent event" (occurring less than 30 times a day) as defined by FTA. Sensitive receptors located along the alignment are considered Category 2 and Category 3 land uses under the FTA annoyance criteria. Taking into account a 10 dBA reduction in vibration for coupling to building foundation loss (Table 10-1, FTA 2006), occupants would not be subjected to vibration annoyance impacts. It should be noted that large bulldozers and drill rigs would operate intermittently and would not be used every day of construction. In addition, construction of the alignment would not dwell in one location for the entire duration of construction. Therefore, vibration impacts (including GBN) associated with large bulldozers and drill rigs would be less than significant.

4.7.3.3.2 Transit Operation Noise

Operation of the At-Grade Emphasis LRT Alternative could generate six potential sources of noise impacts: pass-bys from LRT vehicles, warning signals for at-grade crossings, areas of special trackwork, grade separation, ventilation shafts, and TPSS.

Pass-by Impacts:

Noise modeling for the At-Grade Emphasis LRT Alternative assumes a three-car train with 2.5-minute headways during peak hours (6:00 a.m. to 9:00 a.m. and 3:00 p.m. to 7:00 p.m.) and 5-minute headways during off peak hours (5:00 a.m. to 6:00 a.m., 9:00 a.m. to 3:00 p.m., and 7:00 p.m. to 1:00 a.m.). There would be no regularly planned service between 1:00 a.m. and 5:00 a.m. However, Metro may run trains later during special events like New Years Eve. The model assumes trains will travel at 35 MPH along Flower and Temple Streets and 25 MPH along 2nd, Main, and Los Angeles Streets.

As shown in Table 4.7-9, the analysis predicts three potential "moderate" level noise impacts from LRT vehicle pass-bys under this alternative. Two impacts would occur on 2nd Street on the ground floor of the Kawada Hotel and the Higgins Building. One impact would occur on Los Angeles Street on the ground floor of the New Otani Hotel. These noise impacts are below "severe" level of change and, therefore, are not considered adverse impacts.

Warning Signals:

Warning signals near at-grade rail crossings that include bells and train horns could generate noise impacts and increase potential impacts caused by LRT pass-bys. The At-Grade Emphasis LRT Alternative would make LRT trains run with existing traffic signals. Warning signals would not be regularly used by LRT trains. No noise impacts from at-grade warning signals are expected to result under this alternative.

Table 4.7-9. At-Grade Emphasis LRT Alternative Predicted Noise Levels and Operational Impacts

Site #	Receptor Description	At-Grade LRT Segment	FTA Land Use[1]	Existing Ldn[2] (dBA)/ Peak Hour Leq (dBA)	Predicted Project Ldn[2] (dBA)/Peak Hour Leq (dBA)	Noise Impact Criteria for Predicted Project Noise Moderate/Severe[3]	Predicted Existing + Project Ldn[2] (dBA)/Peak Hour Leq (dBA)	Number of Noise Impacts	
								Moderate	Severe
								SF[4]/MF[4]/Non-Residential	SF/MF/Non-Residential
1	Park at Central Library	Flower Street – Wilshire to 5th	3	68	Proposed Underground	68/73	68	0/0/0	0/0/0
A	Bonaventure Hotel	Flower Street – 5th to 3rd	2	71	63	66/71	72	0/0/0	0/0/0
2	Park Area 4th floor deck of Bank of America Building	Flower Street – 5th to 3rd	3	63	54	65/70	64	0/0/0	0/0/0
B1	Bunker Hill Towers – Top Floor	Flower Street – 3rd to 2nd Street	2	71	54	66/70	71	0/0/0	0/0/0
B2	Bunker Hill Towers[5]	Flower Street – 3rd to 2nd Street	2	74	60	66/72	74	0/0/0	0/0/0
C1	Kawada Hotel – Top Floor	2nd Street – Hill to Los Angeles	2	70	61	65/69	70	0/0/0	0/0/0
C2	Kawada Hotel[5]	2nd Street – Hill to Los Angeles	2	75	69	66/73	76	0/1 MF/0	0/0/0
I	Higgins Building	2nd Street – Hill to Los Angeles	2	75	69	66/73	76	0/1 MF/0	0/0/0

Table 4.7-9. At-Grade Emphasis LRT Predicted Noise Levels and Operational Impacts (continued)

Site #	Receptor Description	At-Grade LRT Segment	FTA Land Use[1]	Existing Ldn[2] (dBA)/ Peak Hour Leq (dBA)	Predicted Project Ldn[2] (dBA)/Peak Hour Leq (dBA)	Noise Impact Criteria for Predicted Project Noise Moderate/Severe[3]	Predicted Existing + Project Ldn[2] (dBA)/Peak Hour Leq (dBA)	Number of Noise Impacts	
								Moderate	Severe
								SF[4]/MF[4]/Non-Residential	SF/MF/Non-Residential
4	Saint Vibiana Little Tokyo Library	2nd Street – Hill to Los Angeles	3	69	61	69/74	70	0/0/0	0/0/0
D1	New Otani Hotel	Los Angeles Street – 2nd to 1st	2	73	67	66/71	74	0/1 MF/0	0/0/0
D2	New Otani Hotel 3rd Floor Garden[5]	Los Angeles Street – 2nd to 1st	2	70	61	65/70	70	0/0/0	0/0/0
F1	Temple Street Jail	Los Angeles Street –1st to Temple	2	71	65	66/70	72	0/0/0	0/0/0
F2	Temple Street Jail	Temple Street – Los Angeles to Alameda	2	67	61	63/67	68	0/0/0	0/0/0

Source: Parsons Brinckerhoff, 2009
Notes:
[1] *Land use category descriptors are as follows: FTA Category 1 = buildings or parks where low noise levels are an essential element of their purpose; FTA Category 2 = residences and other buildings where people sleep, such as hotels, apartments and hospitals; and FTA Category 3 = institutional land uses with primarily daytime and evening use, including schools, libraries and churches.*
[2] *Ldn is used for land uses with nighttime sensitivity to noise and for residential areas where FTA rather than FHWA noise procedures are applicable. Peak-hour Leq is used for commercial, industrial, and other land uses that do not have nighttime noise sensitivity.*
[3] *Moderate and severe noise impact criteria are based on Table 4.7-1 and are the thresholds for noise generated by the project. The noise impact criteria correspond to the FTA land use category identified in Table 4.7-9.*
[4] *SF = Single family residential; MF = Multi-family residential*
[5] *Existing noise levels were estimated for Sites B2, C2, and D2. Estimates were based on noise measurements taken at Sites B1, C1, and D1.*

Special Trackwork:

The At-Grade Emphasis LRT Alternative would require special trackwork for turnouts, which allow trains to move from one track to another, and crossovers, which allow trains to move between parallel tracks. Noise from switches or crossovers comes from a small gap in the central part of the switch, which could increase noise levels up to 6 dBA locally.

The At-Grade Emphasis LRT Alternative would have two areas of special trackwork: an at-grade crossover on 2nd Street near Broadway and an at-grade junction near Temple Street and Alameda Street to connect to the Metro Gold Line tracks. Noise-sensitive land uses do not exist near areas of special trackwork. Noise impacts from special trackwork are not predicted.

Grade Separation:

Under this alternative, a vehicular underpass would be constructed at Alameda and 1st Streets to provide a grade separation between trains and vehicles. Traffic on Alameda, Temple and 1st Streets would not increase and, therefore, traffic noise levels along Alameda Street from 2nd to 1st Streets are not expected to increase as a result of this alternative.

Ventilation Shafts and TPSS:

Ventilation shafts and TPSS would be designed in accordance with Metro system-wide design criteria noise guideline of 50 dBA at 50 feet or the nearest residential building, whichever is closer. Under this alternative, noise levels associated with ventilation and TPSS would be far lower than current ambient noise levels and would not exceed FTA noise impact criteria. No significant, adverse noise impact would occur.

4.7.3.3.3 Transit Operation Vibration

The At-Grade Emphasis LRT Alternative would have two potential sources of vibration impacts during operations: transit vehicle pass-bys and special trackwork.

Vibration modeling for the At-Grade Emphasis LRT Alternative uses the same assumptions about train traffic as the noise impact analysis. Based on FTA's generalized ground surface vibration curves, adverse vibration impacts are not predicted from LRT vehicle pass-bys under this alternative (USDOT 2006). However, GBN impacts at Site C and Site D are predicted to occur from LRT vehicle pass-bys under this alternative, as presented in Table 4.7-10. These predicted levels do not reflect any adjustment of the vibration levels to account for expected attenuation from the building's foundation coupling loss. With implementation of mitigation, GBN impacts would be reduced to less than significant.

As indicated above, the areas of special trackwork are not located near any vibration-sensitive land uses. Thus, adverse vibration impacts from special trackwork are not predicted under this alternative and vibration impacts would be less than significant.

Table 4.7-10. At-Grade Emphasis LRT Alternative Predicted Ground-Borne Noise and Vibration Levels and Impacts

Site #	FTA Land Use Category[1]	FTA Vibration Level Criteria (VdB)	FTA GBN Level Criteria (dBA)[2]	Predicted Project Vibration Levels (VdB)	Predicted Project GBN Levels (dBA)[3]	Vibration and GBN Impact
1	3	75	40	67	32	No Impact
A	2	72	35	64	29	No Impact
2	3	75	40	64	29	No Impact
B	2	72	35	58	23	No Impact
C	2	72	35	70	35	GBN Impact
I	2	72	35	62	27	No Impact
4	3	75	40	60	25	No Impact
D	2	72	35	70	35	GBN Impact
F1	2	72	35	59	24	No Impact
F2	2	72	35	53	18	No Impact
DH	Special Buildings	65	25	57	22	No Impact

Source: Parsons Brinckerhoff, Inc., 2009
Notes:
DH = Walt Disney Concert Hall
[1] Land use category descriptors: FTA Category 1 = buildings or parks where quiet is an essential element of their purpose; FTA Category 2 = residences and other buildings where people sleep, such as hotels, apartments and hospitals; FTA Category 3 = institutional land uses with primarily daytime and evening use, including schools, libraries and churches.
[2] Impact criteria are for frequent events.
[3] Based on more conservative "typical" vibration spectra.

4.7.3.3.4 NEPA Finding

Construction of the At-Grade Emphasis LRT Alternative would not have adverse effects from vibration on sensitive receptors. However, sensitive or historic buildings within 21 feet of construction may be susceptible to vibration damage. Implementation of proposed mitigation measures would reduce adverse effects to sensitive or historic buildings within 21 feet of construction to not substantially adverse. All other potential noise and vibration effects associated with construction would not be substantially adverse. Mitigation measures, which would mitigate damage to sensitive or historic buildings within 21 feet of construction, would

also further reduce potential noise and vibration effects from construction to not substantially adverse.

Noise effects in the entire project area associated with LRT vehicle pass-bys would be below "severe" impact level. Thus, the At-Grade Emphasis LRT Alternative would not have adverse noise effects related to LRT vehicle pass-bys. "Moderate" noise impacts from LRT vehicle pass-bys would not result in a substantial permanent increase in ambient noise levels and potential effects would not be adverse. GBN effects associated with LRT vehicle pass-bys during project operation would occur at Sites C and D but would not be adverse with implementation of mitigation. All other noise and vibration effects from operations would not be adverse.

4.7.3.3.5 CEQA Determination

Potential noise and vibration impacts associated with construction would be less than significant. Mitigation measures would further reduce potential noise and vibration impacts from construction below less than significant levels.

"Moderate" noise impacts would occur in the entire project area associated with LRT vehicle pass-bys, but noise impacts would be below "severe" impact level. "Moderate" noise impacts from LRT vehicle pass-bys associated with the At-Grade Emphasis Alternative would not result in a substantial permanent increase in ambient noise levels and potential impacts would not be significant. GBN impacts associated with LRT vehicle pass-bys during project operation would occur at Sites C and D but would be reduced below the significance threshold with implementation of mitigation. All other noise and vibration impacts from operations would be less than significant.

4.7.3.4 Underground Emphasis LRT Alternative

4.7.3.4.1 Construction Noise and Vibration

For the Underground Emphasis LRT Alternative, the following construction activities would have the most potential for noise and vibration impacts: cut and cover construction of a tunnel on Flower Street; cut and cover construction of the proposed Flower/5th/4th Street station; cut and cover construction of the approach to the proposed 2nd/Hope Street station and the station itself; construction of either of the proposed 2nd Street station alternatives (Los Angeles Street or Broadway Options); grade separation at the junction of 1st and Alameda Streets; and tunnel boring machine (TBM) tunneling beneath 2nd Street with an insertion site near either 2nd Street and Central Avenue or the proposed 2nd/Hope Street station. These seven activities have the most potential for noise and vibration impacts due to the duration and their proximity to sensitive land uses.

Construction activities, relevant construction equipment, and related noise levels for this alternative are shown in Table 4.7-11.

Table 4.7-11. Underground Emphasis LRT Alternative Construction Activity and Equipment Typical Noise Levels at 50 feet

Activity	Duration (months)	Construction Equipment				
		Concrete Truck	Dozer	Excavator	Crane	Drill Rig
Pre-Construction	4-6	NA	NA	NA	NA	90
Site Preparation	12-18	77	85	82	NA	NA
Flower Street Cut and Cover Tunnel	24-48	77	85	82	81	90
Flower/5th/4th Street Cut and Cover Station	24-48	77	85	82	81	90
Cut and Cover Approach to 2nd/Hope Street Station	24-48	77	85	82	81	90
2nd/Hope Street Station (SEM)[1]	24-48	77	85	82	81	NA
2nd/Hope Street Station (Cut and Cover)	24-48	77	85	82	81	90
2nd Street TBM Tunnel	24-48	77	85	82	81	NA
2nd Street Cut and Cover Station (Broadway Option)	24-48	77	85	82	81	NA
2nd Street Cut and Cover Station (Los Angeles Street Option)	24-48	77	85	82	81	90
Portal	12-24	77	85	82	81	90
TBM Insertion Site	2-4	77	85	82	81	90
1st and Alameda Junction	24-36	77	85	82	81	NA
Operating Systems Installation	TBD	TBD	TBD	TBD	TBD	TBD

Note:
[1]SEM = sequential excavation method.

Potential noise from TBM operations at the insertion site, where bored material would be hauled out, treated and removed, is listed in Table 4.7-11. Noise levels for the TBM are not listed for the segments of the alignment between the TBM insertion and recovery sites. When it is operating underground, the TBM produces little to no noise that reaches surface land uses.

Construction would be consistent with the goals of Section 41.40(a) of the Los Angeles Municipal Code. The contractor would also be responsible for consistency with the goals of the applicable local ordinances as it applies to all equipment on the job or related to the job, including but not limited to trucks, transit mixers, or transient equipment that may or may not be owned by the contractor.

Consistency with the goals of the applicable local ordinances and implementation of BMPs, listed in Section 4.7.3.3.1 herein above, would ensure that noise and vibration levels associated with construction of the Underground Emphasis LRT Alternative would not result in a significant adverse impact.

However, sensitive or historic buildings, such as the Roosevelt Building and The California Club, in the vicinity of construction may be susceptible to vibration damage. The Underground Emphasis LRT Alternative would involve the same vibration producing construction equipment as the At-Grade Emphasis LRT Alternative. Therefore, the minimum safe distance of 21 feet between construction activities (involving large bulldozers and drill rigs) and buildings would also apply. Refer to FTA guidelines in Table 4.7-5 for minimum safe distances between large bulldozers and drill rigs and buildings under various scenarios. As a result, sensitive or historic buildings within 21 feet of construction may be susceptible to vibration damage. Refer to Section 4.12.1, Historic Resources - Built Environment, herein below, for a list of historic resources that are near construction activities associated with the Underground Emphasis LRT Alternative and may be susceptible to vibration damage.

Vibration produced by a TBM during tunneling activities is not anticipated to result in vibration damage. According to one study, peak particle vibration velocities from tunnel construction (in soft ground) lie in the range from 0.0024 to 0.0394 inches per second PPV at a distance of 33 feet from the vibration source (Verspohl 1995). Another study measured vibration velocities in the range of 0.0157 to 0.0551 inches per second also at a distance of 33 feet from the source (New 1990). These PPV vibrations may also be expressed as RMS vibration velocity levels ranging from 56 to 83 VdB. Given this range of potential vibration impacts, and the distance below-grade that tunnel boring would occur, vibration produced by a TBM would be well below the FTA threshold for Category IV buildings of 0.12 inches per second PPV and no vibration damage associated with operation of the TBM would occur.

As part of mitigation for the Underground Emphasis LRT Alternative, a survey of structures within 21 feet of the anticipated vibration-producing construction activity would be conducted to assess the building category and the potential for GBV to cause damage. During construction, use of building protection measures such as underpinning, soil grouting, or other forms of ground improvement, use of lower vibration equipment and/or construction techniques, combined with a geotechnical and vibration monitoring program would be used to protect identified historic and sensitive structures. With implementation of these mitigation measures, identified in Section 4.7.4 of the Draft EIS/EIR, construction-related vibration impacts to historic and sensitive buildings located within 21 feet of the anticipated vibration-producing construction activity would be reduced to a less than significant level.

The Underground Emphasis LRT Alternative would involve the same vibration producing construction equipment as the At-Grade Emphasis LRT Alternative, large bulldozers and drill rigs, and would, therefore, have similar vibration annoyance impacts on sensitive receptors (Table 4.7-2). Taking into account a 10 dBA reduction in vibration for coupling to building foundation loss (Table 10-1, FTA 2006), occupants would not be subjected to vibration annoyance impacts. It should be noted that large bulldozers and drill rigs would operate intermittently and would not be used every day of construction. In addition, construction of the alignment would not dwell in one location for the entire duration of construction. Therefore, vibration impacts (including GBN) associated with large bulldozers and drill rigs would be less than significant.

4.7.3.4.2 Transit Operation Noise

The Underground Emphasis LRT Alternative would involve six potential sources of noise impacts during operations. These include pass-by noise from LRT vehicles, warning signals near at-grade crossings, special trackwork, grade separations, ventilation shafts, and TPSS.

Pass-by Impacts:

Assumptions for the Underground Emphasis LRT Alternative noise modeling are the same as the At-Grade Emphasis LRT Alternative, except the analysis assumed a speed of 30 MPH for all segments instead of 35 MPH for the At-Grade Emphasis LRT Alternative. Given the underground design of this alternative, the only land uses with potential noise impacts from LRT vehicle pass-bys are the Hikari Lofts at the intersection of 2nd Street and Central Avenue and the Savoy Condominiums on Alameda Street, between 2nd and 1st streets. Given the existing ambient noise levels adjacent to the sensitive receptors (69 to 73 dBA Ldn), noise generated from LRT vehicle pass-bys would not result in an increase in ambient noise levels (Table 4.7-12). Based on FTA criteria, no noise impacts are predicted from LRT vehicle pass-bys.

Warning Signals:

Under this alternative, LRT vehicles would run underground except crossing Alameda and 1st Streets. The LRT vehicles would run with existing traffic signals on 1st Street and would be separated from traffic on Alameda Street. Therefore, pending California Public Utilities Commission (CPUC) approval, the project would not include the use of warning signals or gates and would not create noise impacts from at-grade warning signals.

Special Trackwork:

This alternative would have one area of special trackwork that is above-grade, the at-grade junction near Alameda and 1st Streets to connect to the Metro Gold Line tracks. Potential noise levels would increase up to 6 dBA in the vicinity of a switch. The junction near Alameda and 1st Streets are near the Savoy Condominiums and would be predicted to cause a "moderate" noise impact at the condominiums, as shown in Table 4.7-13.

Grade Separation:

Under this alternative, a vehicular underpass would be constructed at Alameda and 1st Streets to provide a grade separation between trains and vehicles. Traffic on Alameda, Temple and 1st Streets would not increase and, therefore, traffic noise levels along Alameda Street from 2nd to 1st Streets are not expected to increase as a result of this alternative.

Ventilation Shafts and TPSS:

Ventilation shafts and TPSS would be designed in accordance with Metro system-wide design criteria noise guideline of 50 dBA at 50 feet or the nearest residential building, whichever is closer. Under this alternative, noise levels associated with ventilation and TPSS would be far lower than current ambient noise levels and would not exceed FTA noise impact criteria. No significant, adverse noise impact would occur.

4.7.3.4.3 Transit Operation Vibration

The Underground Emphasis LRT Alternative has the same two potential sources of vibration impacts during operations as the At-Grade Emphasis LRT Alternative: pass-by vibration from LRT vehicles and areas of special trackwork.

Based on vibration modeling and FTA criteria, adverse vibration impacts are not predicted from LRT vehicle pass-bys, as presented in Table 4.7-14. The Underground Emphasis LRT Alternative would require one at-grade special trackwork on Alameda and 1st Streets, near the Savoy Condominiums and the Japanese American National Museum (JANM). Based on FTA's general vibration assessment guidelines, special trackwork for this alternative would add 10 db to the vibration level for LRT vehicle pass-bys. As a result, special trackwork for this alternative would generate vibration levels of 68 VdB, which remains under the FTA threshold of 72 VdB. Thus, adverse vibration impacts are not predicted for the Underground Emphasis LRT Alternative.

As shown in Table 4.7-14, this alternative would generate GBN levels up to 33 dBA, which is below the FTA criterion of 35 dBA. Thus, no adverse vibration or GBN impacts from special trackwork are predicted for the Underground Emphasis LRT Alternative.

4.7.3.4.4 NEPA Finding

Construction of the Underground Emphasis LRT Alternative would not have adverse effects from vibration on sensitive receptors. However, sensitive or historic buildings within 21 feet of construction may be susceptible to vibration damage. Implementation of proposed mitigation measures would reduce adverse effects to sensitive or historic buildings within 21 feet of construction to not substantially adverse. All other noise and vibration effects from construction would not be substantially adverse. Proposed mitigation measures, which would mitigate damage to sensitive or historic buildings within 21 feet of construction, would also further reduce potential noise and vibration effects from construction to not be substantially adverse.

Noise effects associated with operation of the Underground Emphasis LRT Alternative would be below "severe" impact levels and an adverse effect would not result under NEPA. Adverse noise or vibration effects from operation of the Underground Emphasis LRT Alternative are not anticipated. All other noise and vibration effects associated with operation would not be adverse.

Table 4.7-12. Underground Emphasis LRT Alternative Predicted Noise Levels and Operational Impacts

Site #	Receptor Description	Underground LRT Segment	FTA Land Use[1]	Existing Ldn[2] (dBA)/Peak Hour Leq (dBA)	Predicted Project Ldn[2] (dBA)/Peak Hour Leq (dBA)	Predicted Existing + Project Ldn[2] (dBA)/Peak Hour Leq (dBA)	Number of Noise Impact					
							Moderate			Severe		
							SF[3]	MF[3]	Non-Residential	SF	MF	Non-Residential
E1	Top Floor of Hikari Lofts	Portal to Little Tokyo Station	2	69	51	69	0	0	0	0	0	0
E2	Hikari Lofts[4]	Portal to Little Tokyo Station	2	74	57	74	0	0	0	0	0	0
G	Savoy – Alameda Street	Portal to Little Tokyo Station	2	73	60	73	0	0	0	0	0	0
H	Savoy – 1st Street	Portal to Little Tokyo Station	2	72	60	72	0	0	0	0	0	0

Source: Parsons Brinckerhoff, 2009
Notes:
[1] Land use category descriptors: FTA Category 1 = buildings or parks where low noise levels are an essential element of their purpose; FTA Category 2 = residences and other buildings where people sleep, such as hotels, apartments and hospitals; FTA Category 3 = institutional land uses with primarily daytime and evening use, including schools, libraries and churches.
[2] Ldn is used for land uses with nighttime sensitivity to noise and for residential areas where FTA rather than FHWA noise procedures are applicable. Peak-hour Leq is used for commercial, industrial, and other land uses that do not have nighttime noise sensitivity.
[3] SF = Single family residential; MF = Multi-family residential
[4] Existing noise level was estimated for Site E2. Estimate was based on noise measurements taken at Site E1.

Table 4.7-13. Underground Emphasis LRT Alternative Predicted Noise Levels with Special Trackwork

Site #	Receptor Description	FTA Land Use Category[1]	Existing Ldn[2] (dBA)/Peak Hour Leq (dBA)	Predicted Project Ldn[2] (dBA)/Peak Hour Leq (dBA)	Noise Impact	Predicted Project + 6 dBA for Special Trackwork Ldn[2] (dBA)/Peak Hour Leq (dBA)	Predicted Existing + Project and Special Trackwork Ldn[2] (dBA)/Peak Hour Leq (dBA)	Noise Impact
E1	Top Floor of Hikari Lofts	2	68	51	No Impact	57	68	No Impact
E2	Hikari Lofts[3]	2	74	57	No Impact	63	74	No Impact
G	Savoy – Alameda Street	2	73	60	No Impact	66	74	Moderate Impact
H	Savoy – 1st Street	2	72	60	No Impact	66	73	Moderate Impact

Source: Parsons Brinckerhoff, Inc., 2009
Notes:
[1] Land use category descriptors: FTA Category 1 = buildings or parks where low noise levels are an essential element of their purpose; FTA Category 2 = residences and other buildings where people sleep, such as hotels, apartments and hospitals; FTA Category 3 = institutional land uses with primarily daytime and evening use, including schools, libraries and churches.
[2] Ldn is used for land uses with nighttime sensitivity to noise and for residential areas where FTA rather than FHWA noise procedures are applicable. Peak-hour Leq is used for commercial, industrial, and other land uses that do not have nighttime noise sensitivity.
[3] Existing noise level was estimated for Site E2. Estimate was based on noise measurements taken at Site E1.

Table 4.7-14. Underground Emphasis LRT Alternative
Predicted Ground-Borne Noise
and Vibration Levels and Impacts

Site #	FTA Land Use Category[1]	FTA Vibration Level Criteria (VdB)	FTA GBN Level Criteria (dBA)[2]	Predicted Project Vibration Levels (VdB)	Predicted Project GBN Levels (dBA)[3]	Vibration and GBN Impact
1	3	75	40	65	30	No Impact
A	2	72	35	64	29	No Impact
2	3	75	40	61	26	No Impact
B	2	72	35	58	23	No Impact
C	2	72	35	63	28	No Impact
I	2	72	35	67	32	No Impact
4	3	75	40	67	32	No Impact
D	2	72	35	67	32	No Impact
E	2	72	35	62	27	No Impact
G	2	72	35	58	23	No Impact
H	2	72	35	58/68	23/33	No Impact
DH	Special Buildings	65	25	53	18	No Impact

Source: Parsons Brinckerhoff, Inc., 2009
DH = Walt Disney Concert Hall
Notes:
[1] Land use category descriptors: FTA Category 1 = buildings or parks where quiet is an essential element of their purpose; FTA Category 2 = residences and other buildings where people sleep, such as hotels, apartments and hospitals; FTA Category 3 = institutional land uses with primarily daytime and evening use, including schools, libraries and churches.
[2] Impact criteria are for frequent events.
[3] Based on more conservative "typical" vibration spectra.

4.7.3.4.5 CEQA Determination

Potential noise and vibration impacts associated with construction would be less than significant. Mitigation measures would further reduce potential noise and vibration impacts from construction below less than significant levels.

Noise impacts associated with operation of the Underground Emphasis LRT Alternative would be below "severe" impact levels and would not result in a substantial permanent increase in ambient noise levels. Therefore, noise impacts associated with operation of the Underground Emphasis LRT Alternative would be less than significant. All other noise and vibration impacts associated with operation would not be significant.

4.7.3.5 Locally Preferred Alternative

4.7.3.5.1 Construction Noise and Vibration

For the LPA, the following construction activities would have the most potential for construction-related noise and vibration impacts: cut and cover construction of a tunnel at Flower Street; cut and cover construction of the approach to the proposed 2nd/Hope Street station and cut and cover or sequential excavation method (SEM) construction of the station itself; construction of the proposed 2nd Street/Broadway station; construction of the proposed 1st Street/Central Avenue station; and TBM tunneling beneath 2nd Street and the insertion site northeast of the 1st and Alameda Streets intersection. These seven activities have the most potential for noise and vibration impacts due to their duration and their proximity to noise-sensitive land uses identified in Table 4.7-6.

Table 4.7-15 lists the construction activities, and the construction equipment expected to be used during each construction activity, and the related noise levels anticipated for the LPA.

Potential noise from TBM operations at the insertion site, where bored material would be hauled out, treated and removed, is listed in Table 4.7-15. Noise levels for the TBM are not listed for the segments of the alignment between the TBM insertion and recovery sites because it would be operating underground.

Construction would be consistent with the goals of Section 41.40(a) of the Los Angeles Municipal Code. The code states that engaging in construction, repair, or excavation work, with any construction device, or job-site delivery of construction materials without a Police Commission-issued Variance or Permit would constitute a violation:

- Between the hours of 9:00 p.m. and 7:00 a.m.
- In any residential zone, or within 500 feet of land so occupied, before 8:00 a.m. or after 6:00 p.m. on any Saturday, or at any time on any Sunday.
- In a manner as to disturb the peace and quiet of neighboring residents or any reasonable person of normal sensitiveness residing in the area.

Table 4.7-15. Locally Preferred Alternative
Construction Activity and Equipment Typical Noise Levels at 50 feet

Activity	Duration (months)	Construction Equipment				
		Concrete Truck	Dozer	Excavator	Crane	Drill Rig
Pre-Construction	4-6	NA	NA	NA	NA	90
Site Preparation	12-18	77	85	82	NA	NA
Flower Street Cut and Cover Tunnel	24-48	77	85	82	81	90
Cut and Cover Approach to 2nd/Hope Street Station	24-48	77	85	82	81	90
2nd/Hope Street Station (SEM)[1]	24-48	77	85	82	81	NA
2nd/Hope Street Station (Cut and Cover)	24-48	77	85	82	81	90
2nd Street TBM Tunnel	24-48	77	85	82	81	NA
2nd Street Cut and Cover Station (Broadway Option)	24-48	77	85	82	81	NA
1st/Central Avenue Station	24-48	77	85	82	81	90
Portal	12-24	77	85	82	81	90
TBM Insertion Site	2-4	77	85	82	81	90
1st and Alameda Junction	24-36	77	85	82	81	NA
Operating Systems Installation	TBD	TBD	TBD	TBD	TBD	TBD

Note:
All noise levels are expressed in dBA.
[1] SEM = sequential excavation method.

The contractor would also be responsible for consistency with the goals of the applicable local ordinances as it applies to all equipment on the job or related to the job, including but not limited to trucks, transit mixers or transient equipment that may or may not be owned by the contractor.

In addition, the construction contractor would use BMPs to reduce construction-related noise levels. Typical types of BMPs the contractor can use to be consistent with the goals of the applicable local ordinances include, but are not limited to, the following:

- Placement of temporary noise barriers around the construction site;
- Placement of localized barriers around specific items of equipment or smaller areas;
- Use of alternative back-up alarms/warning procedures;
- Higher performance mufflers on equipment used during nighttime hours; and
- Portable noise sheds for smaller, noisy, equipment, such as air compressors, dewatering pumps, and generators.

Consistency with the goals of the applicable local ordinances and implementation of BMPs, listed above, would ensure that noise and vibration levels associated with construction of the LPA would not result in a significant adverse impact.

However, sensitive or historic buildings, such as the Roosevelt Building and the California Club, in the vicinity of construction may be susceptible to vibration damage. Construction of the project would not involve impact or sonic pile driving (pre-auguring would be used for installation of the soldier piles instead) or large vibratory rollers. In addition, vibration produced by a TBM during tunneling activities is not anticipated to result in vibration damage. According to one study, peak particle vibration velocities from tunnel construction (in soft ground) lie in the range from 0.0024 to 0.0394 inches per second PPV at a distance of 33 feet from the vibration source (Verspohl 1995). Another study measured vibration velocities in the range of 0.0157 to 0.0551 inches per second also at a distance of 33 feet from the source (New 1990). These PPV vibrations may also be expressed as RMS vibration velocity levels ranging from 56 to 83 VdB. Given this range of potential vibration impacts, and the distance below-grade that tunnel boring would occur, vibration produced by a TBM would be well below the FTA threshold for Category IV buildings of 0.12 inches per second PPV and no vibration damage associated with operation of the TBM would occur.

Therefore, equipment such as large bulldozers and drill rigs would be the main source of construction vibration that could have the potential to cause vibration damage. Based on the FTA's minimum safe distances identified for Category IV buildings of 0.12 inch/sec PPV in Table 4.7-5, the minimum safe distance between construction activities (involving large bulldozers and drill rigs) and buildings would be 21 feet. Refer to FTA guidelines in Table 4.7-5 for minimum safe distances between large bulldozers and drill rigs and buildings under various scenarios. As a result, sensitive or historic buildings within 21 feet of construction may be susceptible to vibration damage. Refer to Section 4.12.1, Historic Resources - Built Environment, herein below, for a list of historic resources that are near construction activities associated with the LPA and may be susceptible to vibration damage.

A survey of structures within 21 feet of the anticipated vibration-producing construction activity would be conducted to assess the building category and the potential for GBV to cause damage.

During construction, use of building protection measures such as underpinning, soil grouting, or other forms of ground improvement, use of lower vibration equipment and/or construction techniques, combined with a geotechnical and vibration monitoring program would be used to protect identified historic and sensitive structures. With implementation of mitigation measures identified in Section 4.7.5.1 herein below, construction-related vibration impacts to historic and sensitive buildings located within 21 feet of the anticipated vibration-producing construction activity would be reduced to a less than significant level.

The FTA provides short-term GBV and GBN impact criteria for project operation, which may also be used to assess human annoyance caused by vibration from construction activities. These criteria, identified in Section 4.7.1 herein above, were used for evaluating the LPA's potential GBV and GBN impacts during construction. Large bulldozers and drill rigs, the main at-grade sources of construction vibration, could exceed levels specified in FTA annoyance criteria for sensitive receptors (See Table 4.7-2). However, perceptible vibration from construction equipment would be short-term and intermittent and, therefore, considered an "infrequent event" (occurring less than 30 times a day) as defined by FTA. Sensitive receptors located along the alignment are considered Category 2 and Category 3 land uses under the FTA annoyance criteria. Taking into account a 10 dBA reduction in vibration for coupling to building foundation loss (Table 10-1, FTA 2006), occupants would not be subjected to vibration annoyance impacts. It should be noted that large bulldozers and drill rigs would operate intermittently and would not be used every day of construction. In addition, construction of the alignment would not dwell in one location for the entire duration of construction. Therefore, vibration impacts (including GBN) associated with large bulldozers and drill rigs would be less than significant.

Additional noise and vibration studies (contained in Appendix R-2 of this Supplemental EA/Recirculated Draft EIR Sections) were performed for refinements to the alignment associated with the LPA. Due to refinements to the LPA, the TBM and delivery trains used in the tunnel during construction could exceed levels specified in FTA annoyance criteria (See Tables 4.7-2 and 4.7-3) for the following sensitive receptors: the Walt Disney Concert Hall; the REDCAT; office uses in the JVP; the Hikari Lofts; and the Nakamura Tetsujiro Building.

The Walt Disney Concert Hall is located at the northwest corner of 2nd Street and Grand Avenue and the REDCAT is located adjacent to the Walt Disney Concert Hall at the northeast corner of 2nd and Hope Streets. The Walt Disney Concert Hall houses a variety of uses that range from Category 1 to Category 3 land uses. Taking into account building isolation and losses through the parking structure, the temporary and short-term GBV would range from approximately 53 VdB experienced at the most sensitive areas (Category 1) to 68 VdB experienced at the less sensitive areas (Category 2 and 3). These levels would not exceed the FTA GBV criteria of 65 VdB for Category 1 uses and 78 to 80 VdB for Category 2 and 3 land uses. The temporary and short-term GBN potentially generated from the TBM at the Walt Disney Concert Hall would range from approximately 18 to 48 dBA, respectively, which would exceed the FTA GBN criteria of 25 to 35 dBA for the Walt Disney Concert Hall. The temporary and short-term GBV and GBN potentially generated from the TBM at the REDCAT would be approximately 53 VdB and up to 33 dBA, respectively. These levels would not exceed the FTA criteria of 80 VdB and 43 dBA for the REDCAT. It should be noted that operation of the TBM would be temporary and it would not

operate for the entire duration of construction. The TBM would be underground in the vicinity of the Walt Disney Concert Hall and the REDCAT for approximately ten days assuming 35 feet per day.

GBN and GBV would also be generated by delivery trains in the tunnel during construction. Delivery trains could be used in the tunnel during construction as a method to move soil from the tunnel to the surface. It is estimated that the vibration generated by the delivery trains would be approximately 0 to 5dB greater than that generated by the LRT vehicles. Thus, at the Walt Disney Concert Hall, this would result in GBV of 50 VdB experienced at the most sensitive areas (Category 1) to 65 VdB experienced at the less sensitive areas (Category 2 and 3). These levels would not exceed the FTA GBV criteria of 65 VdB for Category 1 uses and 78 to 80 VdB for Category 2 and 3 land uses. GBN experienced at the Walt Disney Concert Hall would be 28 to 42 dBA at the most sensitive and less noise-sensitive land uses, respectively. Based on the FTA criteria for the Walt Disney Concert Hall indicated above, the delivery trains would potentially cause a short-term GBN impact at the Walt Disney Concert Hall. It is anticipated that the delivery trains would generate GBV of 44 VdB and GBN of approximately 26 dBA at the REDCAT, and impacts would be less than significant.

Overall during construction, operation of the TBM and delivery trains would result in a potentially significant GBN impact to the Walt Disney Concert Hall. Operation of the TBM and delivery train would not result in a significant GBV or GBN impact to the REDCAT. With implementation of mitigation identified in Section 4.7.5.1 herein below, GBN generated by the TBM and delivery train would not impact the sensitive activity occurring at the Walt Disney Concert Hall.

From the 2nd/Hope Street station, the tracks would continue east underneath 2nd Street to just west of Central Avenue, at approximately the pedestrian signal to the JVP, where the alignment would then veer northeast under privately held property, the JVP office land uses and the Nakamura Tetsujiro Building, and Central Avenue to a proposed Little Tokyo/Arts District underground station (1st/Central Avenue station). The Hikari Lofts, which is considered a Category 2 land use, is located at the northwest corner of 2nd Street and Central Avenue, adjacent to the JVP. As the alignment veers northeast, it would travel underground adjacent to the Hikari Lofts. These land uses are considered Category 2 and Category 3 land uses under the FTA annoyance criteria. As indicated in Table 4.7-2, the FTA annoyance criteria for Category 2 land uses ranges from 80 VdB to 72 VdB for GBV and 43 dBA to 35 dBA for GBN depending on the frequency of the event. The FTA annoyance criteria for Category 3 land uses (the JVP and Nakamura Tetsujiro Building) ranges from 83 VdB to 75 VdB for GBV and 48 dBA to 40 dBA for GBN depending on the frequency of the event.

At a distance of 25 feet, the TBM would potentially generate a GBV level of 86 VdB. The corresponding GBN could be approximately 51 dBA. The JVP offices and the Hikari Lofts would potentially be exposed to these levels of GBV and GBN from TBM activities. The Nakamura Tetsujiro Building would potentially experience GBV and GBN levels of 84 VdB and 49 dBA. Even though this maximum vibration and noise from TBM operations would be occasional or infrequent, the TBM activities would potentially exceed the annoyance criteria listed above for occasional or frequent events at the Hikari Lofts, JVP offices, and the Nakamura Tetsujiro

Building. With implementation of mitigation identified in Section 4.7.5.1 herein below, GBV and GBN potential impacts to these receptors would be reduced to less than significant.

Delivery trains would be used in the tunnel during construction, which could generate infrequent events of GBV and GBN. The Hikari Lofts, JVP offices, and the Nakamura Tetsujiro Building would experience GBV of approximately 64 VdB and GBN up to 42 dBA. These levels would be less than the infrequent events criteria for Category 2 and 3 land uses and thus no impact would occur from delivery trains.

4.7.3.5.2 Transit Operation Noise

The LPA would have five potential sources of noise impacts during operations. These include pass-by noise from LRT vehicles, warning signals near at-grade crossings, areas of special trackwork, ventilation shafts, and TPSS.

Pass-by Impacts:

Noise modeling for the LPA assumes a three-car train with 2.5-minute headways during peak hours (6:00 a.m. to 9:00 a.m. and 3:00 p.m. to 7:00 p.m.) and 5-minute headways during off peak hours (5:00 a.m. to 6:00 a.m., 9:00 a.m. to 3:00 p.m., and 7:00 p.m. to 1:00 a.m.). There would be no regularly planned service between 1:00 a.m. and 5:00 a.m. However, Metro may run trains later during special events like New Years Eve. The model assumes trains will travel at 35 MPH along Flower and Temple Streets and 25 MPH along 2nd, Main, and Los Angeles Streets.

The only land use under the LPA with potential pass-by noise impacts would be the Los Angeles Hompa Hongwanji Temple at the intersection of 1st and Vignes Streets. As shown in Table 4.7-16, LRT vehicle pass-bys would not result in significant, adverse noise impacts under this alternative.

Warning Signals:

The LPA would not add any additional warning signals and, therefore, would not create noise impacts from at-grade warning signals.

Special Trackwork:

The LPA would require special trackwork for turnouts, which allow trains to move from one track to another, and crossovers, which allow trains to move between parallel tracks. Noise from switches or crossovers comes from a small gap in the central part of the switch, which could increase noise levels up to 6 dBA locally.

The LPA would include an above-grade switch along 1st Street near the Los Angeles Hompa Hongwanji Temple, which would be needed during construction for the temporary tracks. The switch would be located along 1st Street, between Hewitt and Garey Streets, at a distance of 70 feet of the Los Angeles Hompa Hongwanji Temple to avoid impacts. The noise analysis predicted that there would not be an adverse noise impact to the Temple (see Table 4.7-17). All other special track work would be below-grade or within portal structures and would not result in noise impacts to sensitive receptors.

Ventilation Shafts and TPSS:

Ventilation shafts and TPSS would be designed in accordance with Metro system-wide design criteria noise guideline of 50 dBA at 50 feet or the nearest residential building, whichever is closer. Under the LPA, noise levels associated with ventilation and TPSS would be far lower than current ambient noise levels and would not exceed FTA noise impact criteria. No significant, adverse noise impacts would occur.

Roadway and Lane Reconfigurations:

Roadway and lane reconfigurations would be needed around the 2nd/Hope Street station. The roadways surrounding the 2nd/Hope Street station would be reconfigured, but not in a way that would increase traffic (e.g., increase number of land or vehicle trips) and, therefore, would not result in noise or vibration impacts. In addition, the roadway and lane reconfigurations would not result in the relocation of a noise source closer to a sensitive receptor.

4.7.3.5.3 Transit Operation Vibration

The LPA would have two potential sources of vibration impacts during operations: pass-by vibration from LRT vehicles and areas of special trackwork.

Vibration modeling for the LPA uses the same assumptions about train traffic as the noise impact analysis. Based on FTA's generalized ground surface vibration curves, vibration impacts (including GBN) are not predicted from LRT vehicle pass-bys under the LPA, as presented in Table 4.7-18 (USDOT 2006). The LPA would include an above-grade switch along 1st Street near the Los Angeles Hompa Hongwanji Temple. Based on FTA's general vibration assessment guidelines, special trackwork for this alternative would add 10 db to the vibration level for LRT vehicle pass-bys. At the switch along 1st Street, the predicted vehicle pass-by vibration level at Sites H and 3 would be 68 VdB, which is still below the FTA criterion of 72 VdB. Thus, no adverse GBV impacts would occur for the LPA.

Additional noise and vibration studies were performed for refinements to the LPA alignment (contained in Appendix R-2 of this Supplemental EA/Recirculated Draft EIR Sections). Due to the refinements to the LPA, operation of the LPA could result in GBN impacts at the following sensitive receptors: the Walt Disney Concert Hall; office uses in the JVP; the Hikari Lofts; and the Nakamura Tetsujiro Building. As shown in Table 4.7-18, one LRT vehicle pass-by associated with the LPA, which is considered a frequent event under FTA criteria, would potentially generate GBN up to 37 dBA at the Walt Disney Concert Hall and 47 dBA at the Hikari Lofts, office uses in the JVP, and the Nakamura Tetsujiro Building. These GBN levels would potentially exceed the following FTA annoyance criterion for frequent events: 25 dBA for the Walt Disney Concert Hall, 35 dBA for the Hikari Lofts, and 40 dBA for the office uses in the JVP and the Nakamura Tetsujiro Building. Thus, potentially significant GBN impacts from LRT vehicle pass-bys are predicted at these sensitive receptors.

Table 4.7-16. Locally Preferred Alternative Predicted Noise Levels and Operational Impacts

Site #	Receptor Description	Underground LRT Segment	FTA Land Use[1]	Existing Ldn[2] (dBA)/Peak Hour Leq (dBA)	Predicted Project Ldn[2] (dBA)/Peak Hour Leq (dBA)	Predicted Existing + Project Ldn[2] (dBA)/Peak Hour Leq (dBA)	Number of Noise Impact					
							Moderate			Severe		
							SF	MF	Non-Residential	SF	MF	Non-Residential
3	Los Angeles Hompa Hongwanji Temple	Portal to Gold Line	3	70	60	70	0	0	0	0	0	0

Source: Parsons Brinckerhoff, 2009
Notes:
[1] Land use category descriptors: FTA Category 1 = buildings or parks where low noise levels are an essential element of their purpose; FTA Category 2 = residences and other buildings where people sleep, such as hotels, apartments and hospitals; FTA Category 3 = institutional land uses with primarily daytime and evening use, including schools, libraries and churches.
[2] Ldn is used for land uses with nighttime sensitivity to noise and for residential areas where FTA rather than FHWA noise procedures are applicable. Peak-hour Leq is used for commercial, industrial, and other land uses that do not have nighttime noise sensitivity.

Table 4.7-17. Locally Preferred Alternative Predicted Noise Levels with Special Trackwork

Site #	FTA Land Use Category[1]	Existing Ldn[2] (dBA)/Peak Hour Leq (dBA)	Predicted Project Ldn[2] (dBA)/Peak Hour Leq (dBA)	Noise Impact	Predicted Project + 6 dBA for Special Trackwork Ldn[2] (dBA)/Peak Hour Leq (dBA)	Predicted Existing + Project and Special Trackwork Ldn[2] (dBA)/Peak Hour Leq (dBA)	Noise Impact
3	3	70	60	No Impact	66	71	No Impact

Source: Parsons Brinckerhoff, Inc., 2009
Notes:
[1] Land use category descriptors: FTA Category 1 = buildings or parks where low noise levels are an essential element of their purpose; FTA Category 2 = residences and other buildings where people sleep, such as hotels, apartments and hospitals; FTA Category 3 = institutional land uses with primarily daytime and evening use, including schools, libraries and churches.
[2] Ldn is used for land uses with nighttime sensitivity to noise and for residential areas where FTA rather than FHWA noise procedures are applicable. Peak-hour Leq is used for commercial, industrial, and other land uses that do not have nighttime noise sensitivity.

Table 4.7-18. Locally Preferred Alternative Predicted Ground-Borne Noise and Vibration Levels and Impacts

Site #	FTA Land Use Category[1]	FTA Vibration Level Criteria (VdB)	FTA GBN Level Criteria (dBA)[2]	Predicted Project Vibration Levels (VdB)	Predicted Project GBN Levels (dBA)[3]	Vibration and GBN Impact
1	3	75	40	65	30	No Impact
A	2	72	35	64	29	No Impact
2	3	75	40	61	26	No Impact
B	2	72	35	58	23	No Impact
C	2	72	35	63	28	No Impact
I	2	72	35	67	32	No Impact
4	3	75	40	67	32	No Impact
D	2	72	35	67	32	No Impact
E	2	72	35	64-69	40-47	GBN Impact
G	2	72	35	58	23	No Impact
H	2	72	35	58/68	23/33	No Impact
3	3	75	40	58/68	23/33	No Impact
DH	Special Building	65	25	55-64	37	GBN Impact
JVP	3	75	40	53-69	24-47	GBN Impact
NT	3	75	40	64-69	40-47	GBN Impact

Source: Parsons Brinckerhoff, Inc., 2009; Wilson Ihrig & Associates 2011.
Notes:
DH = Walt Disney Concert Hall, JVP = Japanese Village Plaza office land uses, NT = Nakamura Tetsujiro Building.
#/# = LRT pass-by/LRT pass-by with special track work.
[1] Land use category descriptors: FTA Category 1 = buildings or parks where quiet is an essential element of their purpose; FTA Category 2 = residences and other buildings where people sleep, such as hotels, apartments and hospitals; FTA Category 3 = institutional land uses with primarily daytime and evening use, including schools, libraries and churches.
[2] Impact criteria are for frequent events.
[3] Based on more conservative "typical" vibration spectra.

Under a two LRT vehicle pass-by scenario, which would be considered an occasional/infrequent event under FTA criteria, the LPA would potentially generate GBN between 26 and 40 dBA at the Walt Disney Concert Hall, and 50 dBA at the Hikari Lofts, office uses in the JVP, and the Nakamura Tetsujiro Building. These GBN levels would potentially exceed the following FTA annoyance criterion for occasional/infrequent events: 25 dBA for sensitive uses and 38 to 43 dBA for less sensitive uses for the Walt Disney Concert Hall, 38 dBA for the Hikari Lofts, and 43 dBA for the office uses in the JVP and the Nakamura Tetsujiro Building. Thus, potentially significant GBN impacts from two LRT vehicle pass-bys are predicted at these sensitive receptors. It should be noted that a two LRT vehicle pass-by would be infrequent.

However with implementation of mitigation identified in Section 4.7.5.2 herein below, GBN impacts from one and two LRT vehicle pass-bys to the Walt Disney Concert Hall, the Hikari Lofts, office uses in the JVP, and the Nakamura Tetsujiro Building would be reduced to less than significant.

As shown in Table 4.7-18, the greatest GBN levels generated by LRT vehicle pass-bys and special trackwork would be 33 dBA at all other sensitive receptors, which is below the FTA criterion of 35 dBA. Thus, adverse vibration or GBN impacts from LRT vehicle pass-bys and special trackwork are not predicted at all other sensitive receptors.

4.7.3.5.4 NEPA Finding

During construction of the LPA, potential noise effects would not be adverse. Sensitive or historic buildings within 21 feet of construction may be susceptible to vibration damage. Implementation of mitigation measures identified in Section 4.7.5.1 herein below would reduce potentially adverse vibration effects under NEPA to sensitive or historic buildings within 21 feet of construction to not substantially adverse. During construction, GBV and GBN generated by the TBM would result in potentially adverse effect to office uses in the JVP; the Hikari Lofts, and the Nakamura Tetsujiro Building. GBN generated by the TBM and the delivery trains would result in a potentially adverse GBN noise effect to the Walt Disney Concert Hall. With implementation of mitigation identified in Section 4.7.5.1 herein below, potential GBV and GBN effects during construction would not be substantially adverse under NEPA at the locations identified above. All other noise and vibration effects associated with construction of the LPA would not be adverse. With implementation of mitigation measures identified in Section 4.7.5.1 herein below, construction of the LPA would not contribute to potentially adverse cumulative noise or vibration effects.

GBN generated by LRT vehicle pass-bys associated with operation of the LPA would result in potentially adverse effects at the Walt Disney Concert Hall, Hikari Lofts, office uses in the JVP, and the Nakamura Tetsujiro Building. With implementation of mitigation identified in Section 4.7.5.2 herein below, potential GBN effects to the Walt Disney Concert Hall, the Hikari Lofts, office uses in the JVP, and the Nakamura Tetsujiro Building would not be adverse. All other noise and vibration effects associated with operation of the LPA would not be adverse. With implementation of mitigation measures identified in Section 4.7.5.2 herein below, operation of the LPA would not contribute to potentially adverse cumulative noise or vibration effects.

4.7.3.5.5 CEQA Determination

During construction of the LPA, potential noise impacts would not be significant. During construction, GBV and GBN generated by the TBM would result in potentially significant impacts to office uses in the JVP; the Hikari Lofts, and the Nakamura Tetsujiro Building. GBN generated by the TBM and the delivery trains would result in a potentially significant GBN noise impact to the Walt Disney Concert Hall. With implementation of mitigation identified in Section 4.7.5.1 herein below, potential GBV and GBN impacts during construction would be less than significant under CEQA at the locations identified above. All other noise and vibration impacts associated with construction of the LPA would not be significant. With implementation of mitigation measures identified in Section 4.7.5.1 herein below, construction of the LPA would not contribute to potentially significant cumulative noise or vibration impacts.

GBN generated by LRT vehicle pass-bys associated with operation of the LPA would result in potentially significant impacts at the Walt Disney Concert Hall, Hikari Lofts, office uses in the JVP, and the Nakamura Tetsujiro Building. With implementation of mitigation identified in Section 4.7.5.2 herein below, potential GBN impacts to the Walt Disney Concert Hall, the Hikari Lofts, office uses in the JVP, and the Nakamura Tetsujiro Building would be reduced to less than significant. All other noise and vibration impacts associated with operation of the LPA would be less than significant. With implementation of mitigation measures identified in Section 4.7.5.2 herein below, operation of the LPA would not contribute to potentially significant cumulative noise or vibration impacts.

4.7.4 Candidate Mitigation Measures from the Draft EIS/EIR

Given that the No Build Alternative and the TSM Alternative would not result in any noise or vibration impacts, implementation of mitigation is not required for these alternatives. The Draft EIS/EIR included proposed candidate mitigation measures for all of the build alternatives. No changes have been made to the candidate mitigation measure sections since publication of the Draft EIS/EIR. Refer to Section 4.7.4 of the Draft EIS/EIR for a list of candidate mitigation measures for all of the build alternatives. Proposed final mitigation measures for the LPA are shown herein below in Section 4.7.5.

4.7.5 Proposed Final Mitigation Measures for the Locally Preferred Alternative

The mitigation measures in this section are proposed to be carried forward as final mitigation measures for the LPA in the Final EIS/EIR and Mitigation Monitoring and Reporting Program (MMRP).

4.7.5.1 Proposed Final Construction Mitigation Measures for the Locally Preferred Alternative

During the construction phase of the LPA, sensitive or historic buildings within 21 feet of construction may be susceptible to vibration damage. The following mitigation measures shall be implemented:

- A survey of historic properties and/or historical resources within 21 feet of vibration producing construction activity shall be conducted to assess the building category and the potential for GBV to cause damage. The survey shall also be used to establish baseline, pre-construction conditions for historic properties and historical resources. During preliminary engineering and final design of the project, subsurface (geotechnical) investigations shall be undertaken to evaluate soil, groundwater, seismic, and environmental conditions along the alignment. The analysis shall assist in the development of appropriate support mechanisms for cut and cover construction areas and any sequential excavation method (mining) construction areas. The subsurface investigation shall also identify areas that could experience differential settlement as a result of using a TBM in close proximity to historic properties and/or historical resources. An architectural historian or historical architect who meets the Secretary of Interior's Professional Qualification Standards shall provide input and review of design contract documents prior to implementation of the mitigation measures.

- The mitigation measure above shall also apply to sensitive, non-historic structures located within 21 feet of vibration producing construction activity. However, design contract documents shall not require input or review by an architectural historian or historical architect under this mitigation measure.

- A vibration monitoring plan shall be developed during Final Design to ensure appropriate measures are taken to avoid any damage to sensitive or historic buildings due to construction-induced vibration. This shall include pre-construction surveys of buildings to establish a baseline for measuring potential construction-induced damage where needed. Any damage caused by Metro's construction activities shall be repaired.

Mitigation measures would further reduce annoyance to sensitive receptors caused by GBV. All or a combination of the following measures may be used to mitigate adverse noise and vibration impacts:

- When feasible, distances greater than those provided in EIS/EIR Table 4.7-5 shall be maintained to avoid potential construction-related vibration impacts.

- When feasible, less vibration-intensive construction equipment or techniques shall be used near vibration-sensitive locations.

- When feasible, heavily laden vehicles shall be routed away from vibration-sensitive locations.

- Earthmoving equipment shall be operated as far as possible from vibration-sensitive locations.

- Construction activities that produce vibration, such as demolition, excavation, earthmoving, and ground impacting shall be sequenced so that the vibration sources do not operate simultaneously.

- When feasible, nighttime construction activities that produce noticeable vibration shall be avoided.

- Devices with the least impact shall be used to accomplish necessary tasks.
- When feasible, non-impact demolition and construction methods, such as saw or torch cutting and removal for off-site demolition, chemical splitting, and hydraulic jack splitting, shall be used instead of high impact methods.
- Building protection measures such as underpinning, soil grouting, or other forms of ground improvement shall be used where needed to prevent deterioration of building condition due to construction.
- Use of pavement breakers, vibratory rollers, and packers near sensitive uses shall be avoided when feasible.

If a noise complaint is filed during project construction, noise monitoring shall be conducted in the vicinity of the area in question. If monitored noise levels exceed FTA construction noise criteria, the contractor shall use all or a combination of the following measures to reduce construction noise levels below FTA construction noise criteria:

- Temporary noise barriers around the construction sites and localized barriers around specific items of equipment or smaller areas shall be provided as needed.
- Alternative back-up alarms/warning procedures shall be used where feasible as needed.
- Higher performance mufflers shall be used on equipment used during nighttime hours where feasible as needed.
- Portable noise sheds for smaller, noisy equipment, such as air compressors, dewatering pumps, and generators shall be provided where feasible as needed.

In addition to the construction mitigation measures listed above, the following mitigation measures would also reduce the potential annoyance to the Walt Disney Concert Hall, caused by GBN associated with construction of the LPA. The following measures shall be used to mitigate adverse GBN impacts:

- Construction of the LPA, in the vicinity of the Walt Disney Concert Hall, shall be done in accordance with the Memorandum of Agreement (MOA) between FTA and the State Historic Preservation Officer (SHPO), which includes stipulations that outline the specific requirements for consultation and decision-making between the lead federal agency and consulting parties, specify the level of Historic American Building Survey/Historic American Engineering Record (HABS/HAER) recordation, and outline specific requirements for pre- and post-construction surveys, geotechnical investigations, building protection measures, and TBM specifications.

Tunnel Boring Machine

- Maintenance and Operation: The construction contractor shall minimize vibration from jacking or pressing operations (if applicable, the action could be smoothed out to avoid a sharp push), and maintain machinery in good working order.

- Coordination and Notification: There would be times when the Main Auditorium is vacant or not used for a noise-sensitive activity, thereby eliminating any noise impact from TBM. Similarly, there would be times at the Los Angeles Philharmonic Association (LAPA) Conference Room (and offices) when activities are not particularly noise-sensitive. Metro shall coordinate closely with the Walt Disney Concert Hall to ensure that the noise-generating parts of TBM operations shall be conducted to avoid noise-sensitive periods.

Delivery Train

- Speed: Delivery train speed shall be limited to 5 MPH in the vicinity of the Walt Disney Concert Hall, which would reduce the GBN to the lower range, or 5 dBA from the maximum range.

- Resilient Mat: A resilient system to support and fasten the delivery train tracks shall be used during construction, which would reduce GBN levels by at least 4 dBA.

  - Such as system shall include a) resilient mat under the tracks and b) a resilient grommet or bushing under the heads of any track fasteners (assuming some kind of anchor or bolt system). The hardness of the resilient mat shall in the 40 to 50 durometer range, and be about one to two inches thick, depending on how heavily loaded the cars would be. The contractor shall select the mat thickness so that the rail doesn't bottom out during a car pass-by.

- Conveyor: The tunnel train shall be replaced with a conveyor system to transport materials in the tunnel.

- Coordination and Notification: There would be times when the Main Auditorium and Choral Hall are vacant or not used for noise-sensitive activities, thereby eliminating any noise impact from the delivery train. Metro shall coordinate closely with the Walt Disney Concert Hall to ensure that the delivery train pass-bys would be conducted to avoid noise-sensitive periods.

In addition to the general construction mitigation measures listed above, the following mitigation measures would also reduce the potential annoyance to the Hikari Lofts, office uses in the JVP, and the Nakamura Tetsujiro Building caused by GBV and/or GBN associated with construction of the LPA. The following measures shall be used to mitigate adverse GBV and GBN impacts:

- Metro shall provide advance notice and coordinate with the affected property owners regarding schedules for tunneling and other activities prior to the commencement of those activities.

- Metro shall provide advanced notification and coordination by doing the following.

  - Metro shall establish a Construction Community Relation Program to inform and coordinate construction activities including notification to all occupants at the Hikari Lofts, the interior designer office at the JVP, and the Nakamura Tetsujiro Building about the schedule of tunneling activities at least one month prior to the start of the activities.

  - Metro shall monitor GBN and GBV levels in the in the building adjacent to TBM activity during its operation in that area.

  - During the few days the TBM will be operating in this area, should GBN or GBV measurements exceed FTA annoyance criteria for short-term impacts during construction, Metro shall offer to temporarily relocate affected residents.

4.7.5.2 Proposed Final Operational Mitigation Measures for the Locally Preferred Alternative

The following mitigation measures would reduce potential GBN impacts at the Walt Disney Concert Hall, Hikari Lofts, office uses in the JVP, and the Nakamura Tetsujiro Building due to LRT vehicle pass-bys associated with the LPA.

- In the vicinity of the Walt Disney Concert Hall, Metro shall implement resiliently supported fasteners, isolated slab track, or other appropriate measures as needed to eliminate impacts and to reduce GBN below FTA annoyance criteria.

- In the vicinity of the Hikari Lofts and Nakamura Tetsujiro Building, Metro shall conduct engineering studies during Preliminary Engineering to verify initial estimates of GBN and shall implement high compliance resilient fasteners, floating slab trackbed, or other appropriate measures as needed to eliminate impacts and to reduce GBN below FTA annoyance criteria.

- In the vicinity of the offices at JVP, Metro shall conduct engineering studies during Preliminary Engineering to verify initial estimates of GBN and shall implement high compliance resilient fasteners or other appropriate measures as needed to eliminate impacts and reduce GBN below FTA annoyance criteria.