Regional Connector Transit Corridor
Draft Environmental Impact Statement/
Draft Environmental Impact Report

APPENDIX S

NOISE AND VIBRATION

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Regional Connector Transit Corridor
Noise and Vibration
Technical Memorandum

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Prepared for

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ACRONYMS

ALRT	At-grade Emphasis LRT Alternative
ANSI	American National Standards Institute
CEQA	California Environmental Quality Act
CPUC	California Public Utility Commission
dBA	Decibels
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
FULRT	Fully Underground LRT Alternative
GBV	Ground-borne Vibration
JANM	Japanese American National Museum
Ldn	Average day-night Noise Level
Leq	Land Uses Involving only Daytime Activities
LRT	Light Rail Transit
MF	Multi-Family Residence
MOCA	Museum of Contemporary Art
MPH	Miles Per Hour
NEPA	National Environmental Policy Act
PPV	Peak particle velocity
RMS	Root mean squared
RTP	Regional Transportation Plan
RTIP	Regional Transportation Improvement Program

RWQCB	Regional Water Quality Control Board
SF	Single Family Residence
TBM	Tunnel boring machine
TPSS	Traction power substations
TSM	Transportation Management System
ULRT	Underground LRT Alternative

1.0 SUMMARY

Noise and vibration impacts may be generated during both construction and operation of the Regional Connector Transit Corridor project. Noise and vibration effects are of concern in residential areas located in proximity to the project. Additionally, vibration impacts may pose a concern for historic properties located very close to construction or operation of the build alternatives. A special vibration analysis would be conducted on fragile and historic structures as is deemed necessary. It is a project goal to prevent damage to any historic structure.

The Regional Connector Transit Corridor project is extremely unlikely to create vibration levels high enough to cause even minor or cosmetic building damage. Vibration may be intrusive to building occupants or interfere with vibration-sensitive equipment; however, a recent Metro study indicates ground-borne vibration (GBV) from train operation would likely be imperceptible at ground elevation. In addition, ground-borne noise (GBN) may be slightly audible at sensitive uses located close to the tracks. This potential impact has also been evaluated.

The No Build Alternative is not expected to change existing noise levels in the project area because traffic in the area is already at or above road capacity and generates substantial noise. New sources of vibration would not be added; therefore, vibration impacts are not expected. The No Build Alternative involves no construction, so there are no noise or vibration impacts predicted for the No Build Alternative.

The Transportation System Management (TSM) Alternative is not expected to change existing noise levels in the project area since traffic is already at or above road capacity and generates substantial noise. Furthermore, buses already operate along the proposed new routes. The high existing ambient noise levels along proposed routes would mask the noise of additional buses associated with this alternative. New sources of vibration would not be added under this alternative so new vibration impacts are not expected. The TSM Alternative may involve minor construction like installation of new bus stop benches and signs. This construction would very short in duration (potentially less than one day) at each potential location and require no heavy equipment. Thus, there would be no negative noise or vibration impacts predicted for the TSM Alternative.

The At-Grade Emphasis LRT Alternative would result in three moderate noise impacts during operation at the following locations: the ground floor of the Kawada Hotel (Site C); the ground floor of the Higgins Building (Site I); and, the ground floor of the New Otani Hotel (Site D). Proposed mitigation measures would reduce noise levels on the ground floor of the Kawada Hotel and the Higgins Building but would not reduce noise to below a moderate impact level. Implementation of proposed mitigation measures would reduce noise levels to below moderate impact levels at the New Otani Hotel. Potential noise impacts associated with LRT vehicle pass-by would be below a "severe" level; and, therefore, no adverse impact would occur. All other potential noise impacts from operations would be less than significant. Potential adverse vibration impacts from operation are not anticipated for the At-Grade Emphasis Alternative. However, two GBN impacts were identified, which would be mitigated to a level of less than significant if this alternative were selected.

Operation of the Underground Emphasis LRT Alternative would result in moderate noise impacts at the Savoy Condominiums on Alameda and 1st Streets from special track work. Noise impacts associated with special track work would be below "severe" levels. Proposed mitigation measures would further reduce these potential impacts to a "no adverse impact" level. Adverse noise or vibration impacts from operation of the Underground Emphasis LRT Alternative are not anticipated.

The Fully Underground LRT Alternative - Little Tokyo Variations 1 and the Fully Underground LRT Alternative – Little Tokyo Variation 2 would result in no noise impacts. Adverse vibration impacts from operation of either of these alternatives would not be expected.

Compliance with Section 41.40(a) of the Los Angeles Municipal Code during construction of any of the proposed alternatives would ensure that potential noise and vibration effects do not result in an adverse impact. Sensitive and/or historic buildings within 21 feet of construction activities may be susceptible to vibration damage. Proposed mitigation measures could include conducting a survey of any buildings potentially susceptible to construction vibration. Implementation of proposed mitigation measures described in Section 6.0 would ensure that potential impacts to sensitive and/or historic buildings would be reduced to a less than significant level.

2.0 INTRODUCTION

This Technical Memorandum outlines potential noise and vibration, including ground-borne noise, impacts for the Regional Connector Transit Corridor project alternatives. Noise and vibration impacts may be generated during both construction and operation of the Regional Corridor Connector Transit Corridor project. Noise and vibration effects are of concern in residential areas located in proximity to the project. Additionally, vibration impacts may pose a concern for historic properties within the project area.

This memorandum outlines the methodology and assumptions used to analyze potential effects from noise and vibration generated during construction and operation of the proposed build alternatives. It then analyzes potential noise and vibration impacts associated with each of the alternatives. Potential mitigation measures are discussed to mitigate potential impacts.

3.0 METHODOLOGY FOR IMPACT EVALUATION

This section discusses regulatory standards relevant to noise and vibration impacts analysis and discusses the methodology used to evaluate impacts.

3.1 Standards of Significance

3.1.1 Noise Standards

The noise impact analysis for this project is based on criteria defined in the Federal Transit Administration (FTA) *Transit Noise and Vibration Impact Assessment* (U.S. Department of Transportation 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 3-1 and Figure 3-1 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 effect.

CEQA Guidelines Appendix G states that a significant adverse effect from noise may exist if the project would result in:

- Exposure of persons to or generation of noise levels exceeding standards established in the local general plan or noise ordinance, or applicable standards of other agencies
- A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project
- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project

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 threshold for significance.

In an urban setting, a change of 1 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)

As shown in Figure 3-1, the FTA criteria specify two levels of impact, severe and moderate. The level of severity affects potential mitigation requirements for the project.

Severe noise impact is considered an adverse effect as this term is used in NEPA and implementing regulations. Severe noise impacts represent the most compelling need for mitigation. Before mitigation measures are considered, alternative project locations/alignments must be evaluated to determine whether it is feasible to avoid creating severe impacts altogether.

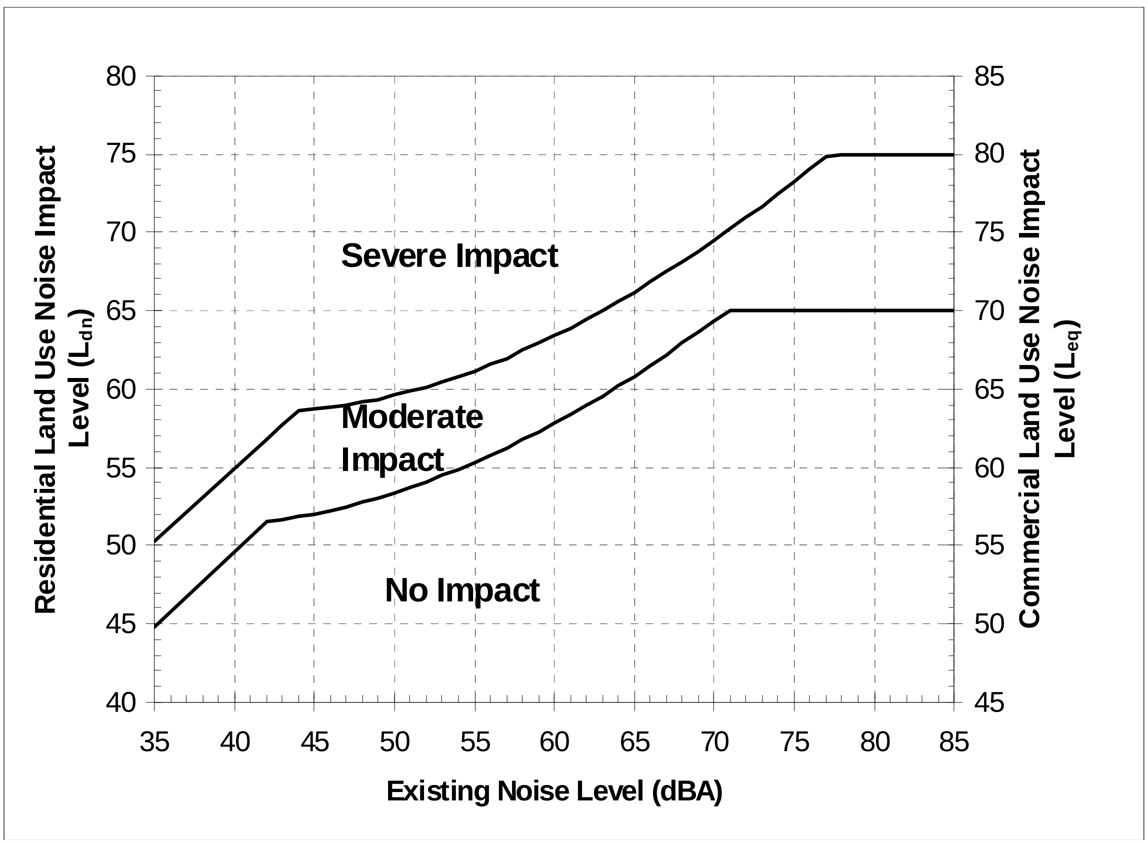

Figure 3-1. Noise Impact Criteria for Transit Projects

If it is not practical to avoid severe impacts by changing the location or design of the project, mitigation measures must be considered. Severe impacts have the greatest adverse effect on the community. Barring extenuating circumstances, there is a presumption by the FTA that mitigation measures would be incorporated into a project with a potential severe noise impact.

Moderate noise impacts also require consideration and adoption of mitigation measures when reasonable. When considering adoption of mitigation measures, factors to be considered include the predicted increase over existing noise levels, the type and number of noise-sensitive land uses affected, existing outdoor/indoor sound insulation, community views, special protection provided by law, and cost-effectiveness of mitigation measures.

Noise impact criteria for transit operations are summarized in Table 3-1. 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.

3.1.2 Vibration Standards

FTA has developed impact criteria for ground-borne vibration (GBV) and ground-borne noise (GBN) due to transit project construction and operation of transit vehicles (U.S. Department of Transportation 2006). Ground-borne noise 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. Such a rumble is noise radiated from the motion of room surfaces. In essence, the room surfaces act like a loudspeaker. Impacts of ground-borne noise are particularly important for underground transit operations. At-grade and above ground transit operations create airborne noise in greater amounts through other processes, so ground-borne noise is typically less of a specific concern for these type of operations.

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. There is currently no clear basis for defining an optimal trade-off between frequency and intensity of vibrations in minimizing annoyance. However, FTA guidelines do address vibration frequency by applying different levels of annoyance criteria based on number of transit vibration events per day.

Ground-borne vibration from transit vehicle operations should be characterized in terms of the root mean squared (RMS) vibration velocity amplitude. A one-second RMS time constant is assumed. The amplitude or strength of vibration is expressed as a velocity level in units of VdB.

Table 3-1. 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	Amb.+10	Amb.+15	Amb.+15	Amb.+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

Table 3-1. 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
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
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
Notes: [1] Ldn is used for land uses where nighttime sensitivity is a factor; Daytime Leq is used for land uses involving only daytime activities.

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. 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 3-2 summarizes the FTA impact criteria for GBV. 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 3-3, usually warrant special attention during the environmental review and engineering/pre-construction phases of a project. Table 3-2 and Table 3-3 list impact criteria for transit operations. Following FTA guidance, some criteria in Table 3-2 may also be used to assess human annoyance caused by vibration from construction activities.

Table 3-2. 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 (U.S. Department of Transportation 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 ground-borne noise.

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 3-4.

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 3-4). Minimum safe distances between construction and nearby buildings are presented in Table 3-5. For example, 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). Ground-borne noise (GBN) from at-grade or open excavation construction activities is rarely a concern because the airborne 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 moved along the project alignment.

Table 3-3. 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	Occasional or Infrequent Events[2, 3]	Frequent Events[1]	Occasional or Infrequent Events[2, 3]
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 (U.S. Department of Transportation 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 or Infrequent Events" is defined as fewer than 70 vibration events per day. This category includes most commuter rail systems .*
[3] *"Infrequent Events" are defined as fewer than 30 vibration events of the same source per day. .*
[2] *"Occasional Events" are defined as between 30 and 70 vibration events of the same kind per day. Most commuter rail lines have this many events.*
[3] *"If the building will rarely be occupied when the trains are operating, there is no need to consider impact.*

Table 3-4. 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.

This project will 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 3-5 are approximations based on typical equipment and construction activities and the general classification of structures.

Table 3-5. 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

3.2 Evaluation Methodology

3.2.1 Transit Operations Noise

Analysis of potential project-related noise levels for the build alternatives was based on FTA reference sound levels (U.S. Department of Transportation 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.

This noise impact analysis compared potential project-related noise levels from each alternative with existing noise levels. The change in cumulative noise levels under each alternative was analyzed under FTA criteria. Appropriate and reasonable mitigation measures are identified in Section 6.0.

Noise from light rail transit operations is generated from the following sources: the interaction of wheels on track, motive power, signaling and warning systems, platform announcements, and the operation of traction power substations (TPSS). Furthermore, steel wheels on rails generate three different types of noise: trackwork noise from wheel squeal on a tightly-curved track, noise from wheels on crossovers or turnouts, and noise from rolling of the wheel over continuous rail. For at-grade portions of build alternatives, this analysis also considered noise from train horns and warning bells near at-grade crossings and stations.

To assess potential noise impacts, long-term (24-hour) measurements of existing ambient noise were conducted near residences and other buildings where people normally sleep (Figure 4-1). Short-term (15-minute) noise measurements were also taken to determine existing noise levels near recreational, institutional, and commercial land uses with primarily daytime and evening non-sleep activities.

If significant, adverse noise impacts were found to be likely under a project alternative, mitigation measures were identified and evaluated for feasibility and reasonableness. Proposed mitigation measures are intended to reduce potential noise impacts to below a significant level.

3.2.2 Transit Operations Vibrations

Vibration impacts from light rail transit operations are generated by motions and actions at the wheel/rail interface. The smoothness of these motions and actions is influenced by wheel and rail roughness, transit vehicle suspension, train speed, track construction (including types of fixation and ballast) the location of switches and crossovers, and the geologic strata (layers of rock and soil) underlying the track and found between the track and sensitive buildings.

Vibration from passing trains has a small potential to traverse geologic strata and negatively impact near-by sensitive buildings. However, the principal concern with light rail transit 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 ground-borne noise 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 (U.S. Department of Transportation 2006). Standard transfer mobility functions used to determine the ground attenuation of vibration were based on FTA reference data (U.S. Department of Transportation 2006). The conversion from vibration level to ground-borne noise level was accomplished by selecting one of three conversion factors in the FTA manual depending on the frequency content (spectrum) of the vibration generated by the transit vehicles, whether the system is at-grade or a subway, and the local soil characteristics. The spectrum used for the GBN impact analyses was measured from the transit vehicles operating on the Metro Gold Line, which the Regional Connector would join. The spectrum is provided in Appendix 9.2 (ATS Consultants). The spectrum indicates a definite low frequency bias, and selection of the 'low frequency" conversion factor of -50 dB would be reasonable. However, to provide a very conservative analysis, the "typical" conversion factor of -35 dB was used to calculate the GBN level. Note that the vibration levels in the Appendix 9.2 reflect a train traveling 50 miles-per-hour whereas the Regional Connector trains would be travelling at a maximum of 35 miles-per-hour 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 a building's specific reaction to ground-borne vibration. Predicted GBV and GBN levels were compared to FTA criteria to determine potential impacts.

If significant or adverse vibration or ground-borne noise levels were found to be likely for a project alternative, mitigation measures were identified and evaluated for feasibility and reasonableness. Mitigation measures would reduce potential adverse impacts to below a significant or adverse level.

3.2.3 Construction Noise and Vibration

The construction noise and vibration analysis used the description of construction methods described in the Construction Technical Memorandum. The analysis considered both daytime and nighttime construction activities using the procedures presented in Chapter 12 of the FTA guidance manual (U.S. Department of Transportation 2006).

4.0 AFFECTED ENVIRONMENT

4.1 Area of Potential Effect

When considering build alternatives with at-grade segments, this analysis follows the FTA guidelines that specify the size of an area where potential noise effects from a new project should be screened (U.S. Department of Transportation 2006). The relevant area for rail rapid transit systems with at-grade facilities is 350 feet from at-grade tracks where there are buildings between the source and the receiver and 700 feet from tracks in unobstructed areas. For rail rapid transit stations, the distances are 100 feet with an obstruction between the receiver and noise source and 200 feet with no obstruction, respectively. For parking facilities the distances are 75 feet and 125 feet, respectively, and for yards and shops the distances are 650 feet and 1000 feet, respectively (U.S. Department of Transportation 2006).

For underground subway systems, screening distances are much smaller. When considering underground portions of the build alternatives, this study assessed the potential for vibration and ground-borne noise impacts at vibration-sensitive uses within 150-200 feet (vertical, diagonal, or horizontal as appropriate) of proposed track alignments. Thus, the Disney Concert Hall was only analyzed for vibration effects because all of the alternatives are below grade in the vicinity of the Disney Hall (site DH) and there is no potential for airborne noise impact.

4.2 Existing Conditions

Figure 4-1 shows FTA land use categories within the project area. Table 4-1 lists noise sensitive uses within the screening distance for the build alternatives. This analysis identified noise-sensitive land uses at twelve locations along the proposed alternative alignments and near proposed station locations (Figure 4-1). Noise levels were measured at nine locations to establish the existing noise environment for the overall project alignments. The measurements included seven 24 hour and three short-term, 10 minute measurements. All noise measurements were conducted consistent American National Standards Institute (ANSI) procedures for community noise measurements.

The project area of potential effect for noise lies within the urban core of the City of Los Angeles. Existing noise levels are typical of an urban environment. The average day-night noise level (Ldn) ranges from 69 to 74 dBA. Figure 4-1 and Table 4-1 show existing noise levels by location. Noise levels and noise sensitive land uses are described by street segment along the proposed alignments. Noise monitoring notes are provided in Appendix 9.1.

Noise levels were measured at four locations along Flower Street, Sites 1, 2, A and B shown on Figure 4-1.

A 24-hour measurement was conducted at Site A on the pool deck of the Westin Bonaventure. The pool deck sits four floors above Flower Street and is the closest open area to hotel rooms.

An Ldn of 71 dBA and a peak-hour Leq of 68 dBA was measured at 6:00 a.m. Noise levels are dominated by traffic noise from Flower and 5th Streets.

Table 4-1. Noise Sensitive Land Use within Screen Distance

Name	Location	Build Alternative within Screen Distance
Park at Central Library	200 N Main Street	ALRT, ULRT, FULRT
Bonaventure Hotel	404 South Figueroa Street	ALRT, ULRT, FULRT
World Trade Center Tennis Courts	333 South Figueroa Street	ALRT, ULRT, FULRT
Open Space Bank of America Building Plaza	333 Hope Street	ALRT, ULRT, FULRT
Bunker Hill Towers	234 South Figueroa Street	ALRT, ULRT, FULRT
Kawada Hotel	200 South Hill Street	ALRT, ULRT, FULRT
Higgins Building	108 South West 2nd Street	ALRT, ULRT, FULRT
Saint Vibiana	206 South Main Street	ALRT, ULRT, FULRT
Los Angeles Library Little Tokyo Branch	203 South Los Angeles Street	ALRT, ULRT, FULRT
New Otani Hotel	120 South Los Angeles Street	ALRT, ULRT, FULRT
Temple Street Jail	150 North Los Angeles Street	ALRT
Hikari Lofts	375 East 2nd Street	ALRT
Japanese American National Museum (JANM)	369 East 1st Street	ULRT, FULRT
Savoy – Alameda Street	100 South Almeda Street	ULRT, FULRT
Los Angeles Hompa Hongwanji Temple	815 E 1st Street	FULRT
Los Angeles Metropolitan Detention Center	535 North Alameda Street	FULRT

Notes: ALRT = At-Grade Emphasis LRT Alternative; ULRT = Underground Emphasis LRT Alternative; FULRT = Fully Underground LRT Alternatives – including both Little Tokyo Variation 1 and Little Tokyo Variation 2.

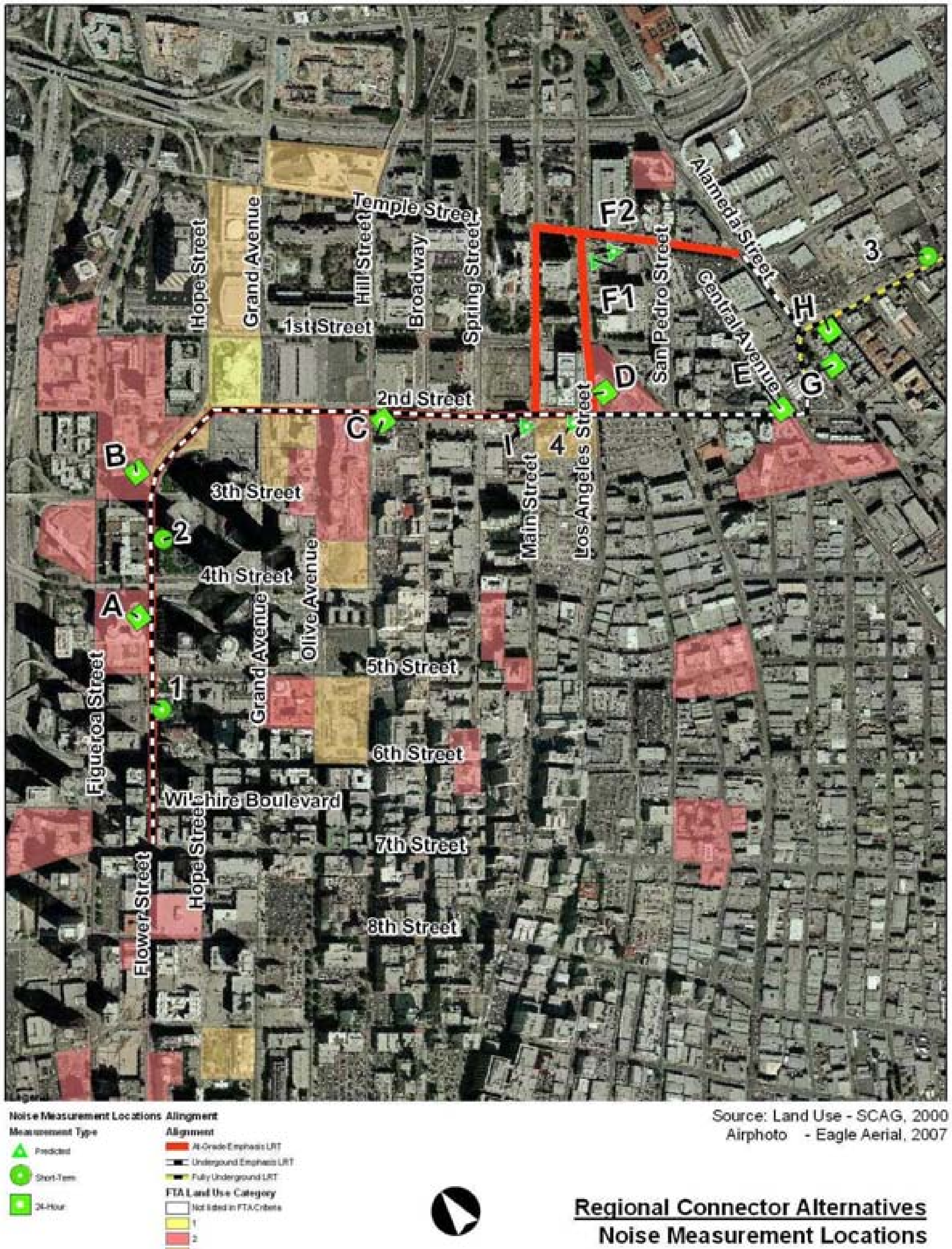

Figure 4-1. Noise Measurement Locations (Site #)

A 24-hour measurement was obtained at Site B 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 are dominated by traffic noise from Flower and 3rd Streets.

A short-term (10-minute) measurement was conducted at Site 1 from 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. This analysis estimates a peak-hour Leq of 68 dBA at this location. This was estimated by comparing the short-term measurement to the 24-hour measurement obtained at the Westin Bonaventure. Noise levels are dominated by traffic noise from Flower and 5th Streets.

A short-term measurement was conducted at Site 2 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 located on the north side of Flower Street. A one-hour Leq of 61 was measured at 1:15 p.m. The peak hour Leq at Site B is estimated at 63 dBA. Noise levels are dominated by traffic noise from Flower Street.

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 4-1.

A 24-hour measurement was conducted at Site C 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 are dominated by traffic noise from 2nd and Hill Streets.

A 24-hour measurement was conducted at Site E 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 are dominated by traffic noise from 2nd and Alameda Streets and Central Avenue.

Site I is located at the Higgins Building at the northwest corner of 2nd and Main Streets. This building houses residential lofts. Existing noise levels could not be accurately measured due to construction at Saint Vibiana and on Main Street. Noise levels for Site I were estimated based on the measurements at Sites C and D.

Site 4 lies on 2nd Street between Main and Los Angeles Streets. This site 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.

Category 1, 2 or 3 (i.e., potentially sensitive) land uses do not exist on Main Street, so no measurements were conducted there.

On Los Angeles Street, one sensitive land use was observed at Site D. A 24-hour measurement was conducted at Site D on 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. The garden terrace on the 4th floor was not used as a measurement location because other noise sources (e.g., waterfalls, piped in music) masked street noise. Noise levels are dominated by traffic noise from Los Angeles Street.

On Temple Street, sensitive land uses exist at Sites F and F1 where the Metropolitan Detention Center is located. Due to construction on Temple Street, and actives at the jail, representative existing noise levels could not be measured. Noise levels for Sites F and F1 were estimated based on measurements at Sites D and H.

One noise measurement was conducted on Alameda Street at Site G. A 24-hour measurement was conducted at ground level to approximate noise in certain units of the Savoy Condominiums 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.

Two noise measurements were conducted on 1st Street, represented by Sites H and 3. A 24-hour measurement was conducted at Site H 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 a peak hour Leq of 72 dBA were measured at 7:00 p.m.

A short-term measurement was conducted at ground level at Site 3, 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.

5.0 IMPACTS

Potential noise and vibration impacts from transit operations and construction are analyzed and compared to the existing conditions as described in Section 4.0. 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.

The analysis of construction effects is based on Section 3 of the Construction Staging Plan from the *Traffic Handling and Construction Staging Report* (CDM 2009). Potential construction noise and vibration under the build alternatives could result in a non-permanent impact on sensitive receivers. Construction noise and vibration is generally not considered a significant impact since it is temporary and occurs mainly in the daytime. However, some receivers that are currently adversely impacted by traffic noise could also be adversely impacted by project construction noise. Some receivers could periodically perceive low levels of vibration and ground-borne noise during construction.

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).

5.1 No Build Alternative

5.1.1 Transit Operations Noise

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. If congestion increased, traffic speeds would decline, and noise levels increases would be correspondingly low. In sum, no significant noise impacts are anticipated for the No Build Alternative.

5.1.2. Transit Operations Vibration

Under the No Build Alternative, there would not be any new sources of vibration proposed by this project and there would be no increase in vibration levels over existing sources of vibration. No adverse vibration impacts would be anticipated from operation of the No Build Alternative.

5.1.3 Construction Noise and Vibration

There would be no major construction activities under the No Build Alternative; therefore, no construction noise and vibration impacts would be anticipated.

5.2 Transportation System Management (TSM) Alternative

5.2.1 Transit Operations Noise

The TSM Alternative would have no significant noise impacts. This alternative would add bus routes along Alameda, Temple, 2nd, 3rd, 5th, 7th, Flower, Figueroa, and Olive Streets and Grand Avenue. Intersections would be modified to shorten bus commutes. Bus service frequency would increase from 10-minute to 5-minute headways during peak periods and from 20-minute to 10-minute headways during off-peak periods.

Existing environmental noise levels along the proposed bus routes are 69 to 74 dBA Ldn. The FTA's General Transit Noise Assessment provides a reference sound exposure level of 84 dBA for a bus pass-by at 50 feet at 50 mph. Based on this estimate, noise levels resulting from the proposed doubling of bus traffic are predicted to be 47 to 61 dBA Ldn. Existing noise levels are substantially higher and would mask the noise of additional buses. Under FTA criteria, the potential increase in noise from this alternative would result in no significant noise impacts.

5.2.2 Transit Operation Vibrations

Under the TSM Alternative, there are no new sources of vibration proposed. Operation of additional buses along the proposed route would not result in a noticeable increase in vibration levels over levels generated by existing buses. As a result, no adverse vibration impacts are anticipated from operation of the TSM Alternative.

5.2.3. Construction Noise and Vibration

There would be no major construction activities under the TSM Alternative; therefore, no construction noise and vibration impacts would be anticipated.

5.3 At-Grade Emphasis Light Rail Transit (LRT) Alternative

5.3.1 Transit Operations Noise

Operation of the At-Grade Emphasis LRT Alternative could generate six potential sources of noise impacts: pass-by from LRT vehicles, warning signals for at-grade crossings, areas of special trackwork, grade separations, ventilation shafts, and traction power substations (TPSS). Table 5-1 illustrates potential noise impacts under this alternative.

5.3.1.1 Pass-by Impacts From LRT Vehicles

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.

This 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 (Table 5-1).

5.3.1.2 Impacts From At-Grade Crossing 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. The California Public Utility Commission (CPUC) must approve this plan; still, no noise impacts from at-grade warning signals are expected to result under this alternative.

5.3.1.3 Impacts From Special Trackwork

The At-Grade Emphasis LRT Alternative would require special trackwork for turnouts and crossovers. Turnouts, also known as switches, allow trains to move from one track to another. Train movement from the mainline to maintenance and storage yards would utilize turnouts. Crossovers allow trains to move between parallel tracks. They allow a single train to run alternately in both directions. The junction between the Regional Connector and the Gold Line would also include switches.

Noise from switches or crossovers comes from a small gap in the central part of the switch known as a frog. When crossing this gap, train noise levels could increase 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 to connect to the Metro Gold Line tracks.

Noise-sensitive land uses do not exist near areas of special trackwork. The closest noise-sensitive land use to special trackwork is the Geffen Contemporary at the Museum of Contemporary Art (MOCA), which is located at the intersection of Alameda and Temple Streets approximately 200 feet south of the proposed alignment. Noise impacts from special trackwork are not predicted at the Geffen Contemporary at MOCA.

5.3.1.4 Impacts From Grade Separation of Alameda and 1st Street

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

5.3.1.5 Impacts From Ventilation Shafts

Under this alternative, both normal and emergency ventilation would be supplied to underground segments of the alignment by fans. Potential noise associated with ventilation systems would include pass-by noise from trains transmitted through vent shafts to the street, normal fan operation, and testing of emergency ventilation fans.

Vent shafts and emergency ventilation fans would be designed in accordance with Metro system-wide design criteria noise guidelines for residential areas. These guidelines suggest a ceiling of 60 dBA for train pass-by noise and 50 dBA for fan noise at a distance of 50 feet or to the nearest residential building, whichever is closer. The predicted noise level associated with the proposed ventilation shafts would be 50 dBA at 50 feet or the nearest residential building. Under this alternative, noise levels associated with ventilation would be far lower than current ambient noise levels at Flower and 2nd Streets.

Noise associated with vent shafts would not exceed FTA noise impact criteria, and no significant, adverse noise impact would occur.

5.3.1.6 Impacts From Traction Power Substation (TPSS)

As part of the At-Grade Emphasis LRT Alternative, TPSSs would be installed at the proposed 2nd/Hope Street station and in the Los Angeles Times' parking structure at 2nd and Spring Streets. Each TPSS would be designed in accordance with the Metro system-wide design criteria noise guideline of 50 dBA at 50 feet or the nearest residential building, whichever is closer. The operating noise level for the TPSS would be substantially lower than existing ambient noise levels and LRT pass-by noise. Noise generated by TPSS would not exceed FTA noise impact criteria, and no, significant, adverse noise impact would occur.

Table 5-1. At-Grade Emphasis LRT 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)	Predicted Existing + Project Ldn[2] (dBA)/ Peak Hour Leq (dBA)	Number of Noise Impacts					
							Moderate			Severe		
							SF[3]	MF[3]	Non- Residential	SF	MF	Non- Residential
1	Park at Central Library	Flower Street – Wilshire to 5th	3	68	Proposed Underground	**68**	0	0	0	0	0	0
A	Bonaventure Hotel	Flower Street – 5th to 3rd	2	71	63	**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	**64**	0	0	0	0	0	0
B	Bunker Hill Towers	Flower Street – 3rd to 2nd Street	2	74	60	**74**	0	0	0	0	0	0
B1	Bunker Hill Towers – Top Floor	Flower Street – 3rd to 2nd Street	2	71	54	**71**	0	0	0	0	0	0
C	Kawada Hotel	2nd Street – Hill to Los Angeles	2	75	69	**76**	0	1	0	0	0	0
C1	Kawada Hotel – Top Floor	2nd Street – Hill to Los Angeles	2	70	61	**70**	0	0	0	0	0	0
I	Higgins Building	2nd Street – Hill to Los Angeles	2	75	69	**76**	0	1	0	0	0	0
4	Saint Vibiana Little Tokyo Library	2nd Street – Hill to Los Angeles	3	69	61	**70**	0	0	0	0	0	0
D	New Otani Hotel	Los Angeles Street – 2nd to 1st	2	73	67	**74**	0	1	0	0	0	0
D1	New Otani Hotel 3rd Floor Garden	Los Angeles Street – 2nd to 1st	3	70	61	**70**	0	0	0	0	0	0
F1	Temple Street Jail	Los Angeles Street –1st to Temple	2	71	65	**72**	0	0	0	0	0	0
F2	Temple Street Jail	Temple Street –Los Angeles to Alameda	2	67	61	**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] *SF = Single family residential; MF = Multi-family residential*

5.3.2 Transit Operations Vibration

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

5.3.2.1 Pass-by Impacts From LRT Vehicles

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, no adverse vibration impacts are predicted, but ground-borne noise impact at Site C and Site D is predicted from LRT vehicle pass-bys under this alternative (U.S. Department of Transportation 2006) (See Table 5-2).

Table 5-2. At-Grade Emphasis LRT Predicted Vibration and GBN Levels and Operational 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: [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 is for frequent events. [3] Based on more conservative "typical" vibration spectra.

5.3.2.2 Impacts from Special Trackwork

The At-Grade Emphasis LRT Alternative would require special trackwork at two locations as described in Section 5.3.1.3. The areas of special trackwork are not located near any vibration-sensitive land uses. The closest vibration-sensitive land use to the special trackwork is the Geffen Contemporary at the MOCA, which is located at the intersection of Alameda and Temple Streets, approximately 200 feet south of the proposed alignment. Thus, adverse vibration impacts from special trackwork are not predicted under this alternative.

5.3.3 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 5-3.

The *Regional Connector Transit Corridor Description of Construction* states that "Pre-auguring would likely be necessary for installation of the soldier piles, to eliminate impact pile driving which would cause vibration and noise." In pre-auguring, holes for piles would be drilled before they are cast in place. As a result, pile drivers and hoe rams would not be used during construction of this alternative, and no adverse construction vibration impacts related to impact-type equipment are anticipated.

5.3.3.1 Construction Noise

To insure noise impacts are minimized during construction, all construction activities shall conform to the provisions in Section 41.40(a) of the City of 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.

The contractor would also be responsible for complying with the applicable local ordinance 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. The Los Angeles Municipal Code section 41.40(a) does not set acceptable noise level limits for either daytime or nighttime construction activities. If a noise variance is required, the noise variance will set the acceptable noise level limits.

Typical types of mitigation measures and Best Management Practices the contractor can use to meet the acceptable limits 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.

Table 5-3. Construction Activity and Equipment Typical Noise Levels in dBA at 50 feet from Source for the At-Grade Emphasis LRT Alternative

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

Table 5-3. Construction Activity and Equipment Typical Noise Levels in dBA at 50 feet from Source for the At-Grade Emphasis LRT Alternative						
Activity	Duration (months)	Construction Equipment				
		Concrete Truck	Dozer	Excavator	Crane	Drill Rig
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

5.3.3.2 Construction Vibration

GBV can cause damage to buildings depending on the building type (i.e., building materials and structural techniques) (see Table 3-4). This analysis calculates a "minimum safe distance" (with respect to vibration level) between construction equipment and buildings under various scenarios (See Table 3-5). Using the minimum safe distance for Category IV buildings of 0.12 inch/sec Peak Particle Velocity (PPV) to identify potential impacts, will insure that the potential "worst case" is identified, even for very sensitive or historic buildings. Minimum safe working distances will account for the most sensitive buildings under the strongest potential vibration impact scenarios.

For the At-Grade Emphasis Alternative, pre-auguring of soldier piles at cut and cover sections would eliminate the need for impact pile driving. Equipment such as large bulldozers and drill rigs would be the main construction vibration sources. For the surface trackwork sections on 2nd, Main, Los Angeles, and Temple Streets, drill rigs for installation of the poles to hold catenary wires would be the largest source of vibration. Large bulldozers and drill rigs would operate intermittently during construction and would not be used every day. Track construction could begin simultaneously at several locations in the project area and would be brought to completion at approximately the same time. Construction activities would not dwell in one location for the entire duration of construction.

A survey of structures within 21 feet of potential vibration-producing construction activities would be conducted. The survey would assess the building categories and the potential for GBV to cause damage. The survey would also help to establish baseline, pre-construction conditions for historic or other sensitive buildings. During preliminary and final design of the project, subsurface (geotechnical) investigations would be undertaken to evaluate soil, groundwater, seismic, and environmental conditions along the alignment.

During construction of this alternative, building protection measures would be applied. Measures could include underpinning, soil grouting, or other forms of ground improvement, and use of lower vibration equipment or construction techniques. Additionally, a geotechnical and vibration monitoring program would be used to protect identified historic and sensitive structures.

Mitigation measures identified in Section 6.3 would reduce construction-related vibration impacts to historic and sensitive buildings, located within 21 feet of the anticipated vibration-producing construction activity, to a less than significant level.

Large bulldozer and drill rigs, the main construction vibration sources, could exceed levels specified in FTA annoyance criteria for sensitive receptors (See Table 3-2). However, perceptible vibration from construction equipment would be short-term and intermittent. Therefore, perceptible vibration from these pieces of construction equipment is considered an "infrequent event," 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. Short-term vibration levels during construction could exceed the annoyance impact limits for infrequent events if specific construction activities were within 20 feet of a Category 2 land use and within 16 feet of a Category 3 land use. However, taking into account a 10 dBA reduction in vibration for coupling to building foundation loss (Table 10-1, FTA, 2006), occupants would not be subject to vibration annoyance impacts. It should be noted, 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 ground-borne noise) associated with large bulldozer and drill rigs would be less than significant. Implementation of mitigation measures identified in Section 6.1.3 would further reduce impacts below the level of less than significant.

5.4 Underground Emphasis LRT Alternative

5.4.1 Transit Operations Noise

The Underground Emphasis LRT Alternative would involve the same six potential sources of noise impacts during operations as the At-Grade Emphasis LRT Alternative. These include pass-by noise from LRT vehicles, warning signals near at-grade crossings, special trackwork, grade separations, ventilation shafts, and TPSSs. Table 5-4 illustrates potential noise impacts under this alternative.

5.4.1.1 Pass-by Impacts From LRT Vehicles

Noise modeling for the Underground 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. The analysis assumed a speed of 30 MPH for all segments of the Underground Emphasis LRT alternative.

The Underground Emphasis LRT Alternative would run in a tunnel from the 7th Street/Metro Center Station to a portal between Central Avenue and Alameda Street. Thus, the only areas with potential noise impacts 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. Based on FTA criteria, no noise impacts are predicted from LRT vehicle pass-bys (See Table 5-4).

5.4.1.2 Impacts From At-Grade Crossing Warning Signals

Warning signals near at-grade rail crossings include bells and train horns and could generate noise impacts, which could increase impacts caused by LRT pass-bys. 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 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.

5.4.1.3 Impacts from Special Trackwork

The Underground Emphasis LRT Alternative would require special trackwork for crossovers or switches. Like the At-Grade Emphasis LRT Alternative, trains in the Underground Emphasis LRT Alternative would produce noise as they cross switches. Potential noise levels would increase up to six dBA in the vicinity of a switch.

This alternative would have four areas of special trackwork, including an underground crossover north of the proposed Flower/5th/4th Street Station; a set of switches between the proposed underground stations at Flower/5th/4th and 2nd/Hope Street to allow for a pocket track; an underground crossover near the proposed station on 2nd Street (the exact location would depend on which option is chosen); and the at-grade junction near Alameda and 1st Street to connect to the Gold Line tracks. 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 (see Table 5-5).

5.4.1.4 Impacts from Grade Separation of Alameda and 1st Street

Under this alternative, traffic on Alameda Street would be grade separated from the LRT tracks. The traffic capacity of Alameda, Temple, and 1st Streets would remain the same. Therefore, traffic noise levels along Alameda Street from 2nd to 1st Streets would not be expected to increase compared to the No Build Alternative.

5.4.1.5 Impacts from Ventilation Shafts

Under this alternative, both normal and emergency ventilation would be supplied to underground segments of the alignment by fans. Potential noise associated with ventilation systems would include pass-by noise from trains transmitted through vent shafts to the street, normal fan operation, and testing of the emergency ventilation fans.

Vent shafts and emergency ventilation fans would be designed in accordance with Metro system-wide design criteria noise guidelines for residential areas. These guidelines suggest a ceiling of 60 dBA for train pass-by noise and 50 dBA for fan noise at a distance of 50 feet or to the nearest residential building, whichever is closer. Noise levels associated with ventilation would be far lower than current ambient noise levels in areas above underground segments. Noise associated with vent shafts would not exceed FTA noise impact criteria, and no significant, adverse noise impact would occur.

5.4.1.6 Impacts from Traction Power Substations (TPSS)

As part of the Underground Emphasis LRT Alternative, TPSSs would be installed underground near the proposed Flower/5th/4th Street station and the proposed 2nd Street station. Even though each TPSS would be located underground, they would be designed in accordance with the Metro System-wide design criteria noise guideline of 50 dBA at 50 feet or the nearest residential building, whichever is closer. Noise generated by TPSSs would not exceed the FTA noise impact criteria, and no significant, adverse noise impact would occur.

5.4.2. Transit Operations 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.

5.4.2.1 Pass-by Impacts From LRT Vehicles

Vibration modeling for the Underground Emphasis LRT Alternative used the same assumptions about train traffic as the noise impact analysis. Based on FTA criteria, no adverse vibration impacts are predicted from LRT vehicle pass-bys (Table 5-6).

5.4.2.2 Impacts from Special Trackwork

The Underground Emphasis LRT Alternative would require special trackwork in four locations as described in Section 5.4.1.3.

The switches on Alameda and 1st Streets are near the Savoy Condominiums (Site H) 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-by. The resulting predicted vibration level would be 68 VdB, which remains under the FTA threshold of 72 VdB. The GBN levels would be 33 dBA, which is below the FTA criterion of 35 VdB. Thus, no adverse vibration or ground-borne noise impacts from special trackwork are predicted for the Underground Emphasis LRT Alternative.

Table 5-4. Underground Emphasis LRT 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
E	Hikari Lofts	Portal to Little Tokyo Station	2	74	57	74	0	0	0	0	0	0
E1	Top Floor of Hikari Lofts	Portal to Little Tokyo Station	2	68	51	68	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

Table 5-5. Underground Emphasis LRT Alternative Predicted Noise Levels with Special Trackwork and Operational Impacts

Site #	FTA Land Use Category 1	Existing Ldn2 (dBA)/Peak Hour Leq (dBA)	Predicted Project Ldn2 (dBA)/Peak Hour Leq (dBA)	Noise Impact	Predicted Project+ 6 dBA for Special Trackwork Ldn2 (dBA)/Peak Hour Leq (dBA)	Predicted Existing + Project and Special Trackwork L_{dn}2 (dBA)/Peak Hour L_{eq} (dBA)	Noise Impact
E	2	74	57	No Impact	63	74	No Impact
E1	2	68	51	No Impact	57	68	No Impact
G	2	73	60	No Impact	66	74	Moderate Impact
H	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.

Table 5-6. Underground Emphasis LRT Alternative Predicted Vibration and GBV 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

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 is for frequent events. [3] Based on more conservative "typical" vibration spectra.[4] with special track work.

5.4.3 Construction Noise and Vibration

Considering 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 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 a launch site near either 2nd Street and Central Avenue or the proposed 2nd/Hope Street station. These eight activities have the most potential for noise and vibration impacts due to the duration and their proximity to sensitive land uses.

5.4.3.1 Construction Noise

Construction activities, relevant construction equipment, and related noise levels for this alternative are shown in Table 5-7.

To insure noise impacts are minimized during construction, all construction activities shall conform to the provisions in Section 41.40(a) of the City of 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.

The contractor would also be responsible for complying with the applicable local ordinance 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. The Los Angeles Municipal Code section 41.40(a) does not set acceptable noise level limits for either daytime or nighttime construction activities. If a noise variance is required, the noise variance will set the acceptable noise level limits.

Typical types of mitigation measures and Best Management Practices the contractor can use to meet the acceptable limits 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.

Table 5-7. Construction Activity and Equipment Typical Noise Levels at 50 feet for the Underground Emphasis LRT Alternative

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 St 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)	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 Launch 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

5.3.3.2 Construction Vibration

GBV can cause damage to buildings depending on the building type (i.e., building materials and structural techniques) (see Table 3-4). This analysis calculates a “minimum safe distance” (with respect to vibration level) between construction equipment and buildings under various scenarios (see Table 3-5). Minimum safe working distances would account for the most sensitive buildings under the strongest potential vibration impact scenarios.

Potential noise from TBM operations at the launch site, where bored material is hauled out, treated and removed, is listed in Table 5-7. Noise levels for the TBM are not listed for the alignment sections between the TBM launch and recovery sites. The TBM produces little to no noise that reaches surface land uses when it is operating underground. Additionally, the TBM is slow moving and causes very little vibration and related ground-borne noise to the surrounding area.

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 at the same 33 foot distance 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.

For the Underground Emphasis LRT Alternative, pre-auguring of soldier piles at cut and cover sections would eliminate the need for impact pile driving. As a result, pile drivers and hoe rams would not be used during construction of this alternative. Equipment such as large bulldozers and drill rigs would be the main construction vibration sources. Large bulldozers and drill rigs would operate intermittently during construction and would not be used every day. Track construction could begin simultaneously at several locations in the project area and would be brought to completion at approximately the same time. Construction activities would not dwell in one location for the entire duration of construction.

A survey of structures within 21 feet of potential vibration-producing construction activity locations would be conducted. The survey would assess the building categories and the potential for GBV to cause damage. The survey would also help to establish baseline, pre-construction conditions for historic or other sensitive buildings. During preliminary and final design of the project, subsurface (geotechnical) investigations would be undertaken to evaluate soil, groundwater, seismic, and environmental conditions along the alignment.

During construction of this alternative, building protection measures would be applied. Measures could include underpinning, soil grouting, or other forms of ground improvement, and use of lower vibration equipment or construction techniques. Additionally, a geotechnical and vibration monitoring program would be used to protect identified historic and sensitive structures. Mitigation measures identified in Section 6.4 would reduce construction-related vibration impacts to historic and sensitive buildings, located within 21 feet of the anticipated vibration-producing construction activity, to a less than significant level.

Large bulldozer and drill rigs, the main construction vibration sources, could exceed levels specified in FTA annoyance criteria for sensitive receptors (See Table 3-2). However, perceptible vibration from construction equipment would be short-term and intermittent. Therefore, perceptible vibration from these pieces of construction equipment is 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. Short-term vibration levels during construction could exceed the annoyance impact limits for infrequent events if specific construction activities were within 20 feet of a Category 2 land use and within 16 feet of a Category 3 land use. However, taking into account a 10 dBA reduction in vibration for coupling to building foundation loss (Table 10-1, FTA, 2006), sensitive receivers would not be subject to vibration annoyance impacts. It should be noted, 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 ground-borne noise) associated with large bulldozer and drill rigs would be less than significant. Implementation of mitigation measures identified in Section 6.1.3 would further reduce impacts below the level of less than significant.

5.5 Fully Underground LRT Alternative – Little Tokyo Variation 1 and Little Tokyo Variation 2

5.5.1 Transit Operations Noise

The Fully Underground LRT Alternative – Little Tokyo Variation 1 and the Fully Underground LRT Alternative – Little Tokyo Variation 2 are expected to have identical noise impacts and are analyzed together. These alternatives would have the same six potential sources of noise impacts during operations as the Underground Emphasis LRT Alternative. These include pass-by noise from LRT vehicles, warning signals near at-grade crossings, areas of special trackwork, grade separation, ventilation shafts, and TPSSs. Table 5-8 illustrates potential noise impacts of these alternatives.

5.5.1.1 Pass-by Impacts From LRT Vehicles

Noise modeling for the Fully Underground LRT alternatives 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. The model assumed a speed of 30 MPH for all segments of the Fully Underground LRT Alternative - Little Tokyo Variations 1 and 2.

Both of the Fully Underground LRT Alternatives would run in an underground tunnel from the 7th Street/Metro Center Station to a portal between Rose and Garey Streets, north of Temple Street, just east of Alameda Street. The Fully Underground LRT Alternative – Little Tokyo Variation 1 would also exit to the east through a portal on 1st Street east of Alameda Street. The Fully Underground LRT Alternative - Little Tokyo Variation 2 would also exit through two portals located between Alameda and Vignes Streets on 1st Street. Thus, the only area under these alternatives with potential noise impacts would be the Los Angeles Hompa Hongwanji Temple at the intersection of 1st and Vignes Streets. LRT vehicle pass-bys would not result in significant, adverse noise impacts under these alternatives (see Table 5-8).

5.5.1.2 Impacts from At-Grade Crossing Warning Signals

Warning signals near at-grade rail crossings include bells and train horns and could generate noise impacts and increase potential impacts caused by LRT pass-bys.

Under the Fully Underground LRT Alternative – Little Tokyo Variation 1 and the Fully Underground LRT Alternative – Little Tokyo Variation 2, LRT vehicles would run underground. They rise out of portals east of Alameda Street to connect to existing at-grade tracks of the Gold Line. These alternatives would not add any additional warning signals and would not create noise impacts from at-grade warning signals.

5.5.1.3 Impacts from Special Trackwork

Like other build alternatives, the Fully Underground LRT Alternative – Little Tokyo Variations 1 and 2 would require special trackwork for crossovers and junctions. Trains under these alternatives would produce noise as they cross switches. Noise levels would increase up to 6 dBA in the vicinity of a switch.

Three areas of special trackwork would exist under these alternatives: an underground crossover just north of the proposed station at Flower/5th/4th, an underground crossover near 2nd Street and Broadway, and the underground junction that allows trains to connect to the Gold Line tracks. The exact configuration of the underground junction would depend on which variation of the Fully Underground LRT Alternative were to be constructed. In addition, both alternatives would include switches at the connection to the Gold Line tracks over US 101 north of Temple and just east of Alameda.

The Fully Underground LRT Alternative – Little Tokyo Variation 1 would also include switches on 1st Street between Hewitt and Garey Streets during construction. These switches might be used for operation. These switches would be located within 70 feet of the Los Angeles Hompa Hongwanji Temple but the noise analysis predicts that there would not be an adverse noise impact at this receptor (see Table 5-9).

The Fully Underground LRT Alternative – Little Tokyo Variation 2 would also include switches located between Garey and Vignes Streets. The switches would also be located within 70 feet of the Los Angeles Hompa Hongwanji Temple but would only be used during construction.

The switches for Fully Underground LRT Alternative – Little Tokyo Variation 2 are not predicted to cause an adverse noise impact at the Temple (See Table 5-10).

5.5.1.4 Impacts from Ventilation Shafts

Under both the Fully Underground LRT Alternative – Little Tokyo Variation 1 and the Fully Underground LRT Alternative –Little Tokyo Variation 2, both normal and emergency ventilation would be supplied to underground segments of the alignment by fans. Potential noise associated with ventilation systems would include pass-by noise from trains transmitted through vent shafts to the street, normal fan operation, and testing of the emergency ventilation fans.

Vents and emergency ventilation fans would be designed in accordance with Metro system-wide design criteria noise guidelines for residential areas. These guidelines suggest a ceiling of 60 dBA for train pass-by noise and 50 dBA for fan noise at a distance of 50 feet or to the nearest residential building, whichever is closer. Under the Fully Underground LRT alternatives, noise levels associated with ventilation would be lower than current ambient noise levels in areas above underground segments of the alignment. Noise associated with vent shafts would not exceed FTA noise impact criteria, and no significant, adverse noise impact would occur.

5.5.1.5 Impacts from Traction Power Substations (TPSS)

As part of Fully Underground LRT Alternative – Little Tokyo Variations 1 and 2, TPSSs would be installed underground at the proposed Flower/5th/4th Street station and the proposed 2nd Street/Broadway station. Each TPSS would be designed in accordance with the Metro system-wide design criteria noise guideline of 50 dBA at 50 feet or the nearest residential building, whichever is closer. The operating noise level for the TPSSs would be substantially lower than existing ambient noise levels and LRT pass-by noise. Noise generated by TPSSs would not exceed the FTA noise impact criteria, and no, significant, adverse noise impact would occur.

Table 5-8. Fully Underground LRT Alternative - Little Tokyo Variations 1 and 2 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 5-9. Fully Underground LRT Alternative – Little Tokyo Variation 1 Predicted Noise Levels with Special Trackwork and Operational Impacts							
Site #	FTA Land Use Category 1	Existing Ldn2 (dBA)/Peak Hour Leq (dBA)	Predicted Project Ldn2 (dBA)/Peak Hour Leq (dBA)	Noise Impact	Predicted Project+ 6 dBA for Special Trackwork Ldn2 (dBA)/Peak Hour Leq (dBA)	Predicted Existing + Project and Special Trackwork Ldn2 (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.

Table 5-10. Fully Underground LRT Alternatives – Little Tokyo Variation 2 Predicted Noise Levels with Special Trackwork and Operational Impacts							
Site #	FTA Land Use Category 1	Existing Ldn2 (dBA)/ Peak Hour Leq (dBA)	Predicted Project Ldn2 (dBA)/ Peak Hour Leq (dBA)	Noise Impact	Predicted Project+ 6 dBA for Special Trackwork Ldn2 (dBA)/Peak Hour Leq (dBA)	Predicted Existing + Project and Special Trackwork Ldn2 (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.

5.5.2. Transit Operations Vibration

The Fully Underground LRT Alternative - Little Tokyo Variation 1 and the Fully Underground LRT Alternative – Little Tokyo Variation 2 would have similar potential vibration (including ground-borne noise) impacts and the results of the analysis are reported together. These alternatives would involve two potential sources of vibration impacts during operations: pass-by vibration from LRT vehicles and areas of special trackwork.

5.5.2.1 Pass-by Impacts From LRT Vehicles

Vibration modeling for Fully Underground LRT Alternative - Little Tokyo Variations 1 and 2 used the same assumptions about train traffic as the noise impact analysis. Based on FTA criteria, no vibration (including ground-borne noise) impacts are predicted from LRT vehicle pass-bys under these alternatives (see Table 5-11).

5.5.2.2 Impacts from Special Trackwork

Fully Underground LRT Alternative - Little Tokyo Variations 1 and 2 would require special trackwork as described in Section 5.5.1.3.

FTA's general vibration assessment guideline suggests special trackwork will increase vibration levels for LRT vehicle pass-by by 10 db. Because of the depth of the track at underground locations this would not result in an adverse impact to sensitive receptors. At the switches 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. The GBN levels would be 33 dBA, which is below the FTA criterion of 35 VdB. Thus, no adverse vibration or ground-borne noise impacts from special trackwork are predicted for these alternatives.

Table 5-11. Fully Underground LRT Alternative – Little Tokyo Variations 1 and 2 Predicted Vibration Levels (VdB) and Ground-Borne Noise Levels (dBA) 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[4]	23/33[4]	No Impact
3	3	75	40	58/68[4]	23/33[4]	No Impact
DH	Special Building	65	25	53	18	No Impact

Source: Parsons Brinckerhoff, Inc., 2009
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 is for frequent events. [3] Based on more conservative "typical" vibration spectra, [4] with special track work.

5.5.3 Construction Noise and Vibration

Construction-related noise and vibration impacts would be nearly identical under the Fully Underground LRT Alternative – Little Tokyo Variation 1 and the Fully Underground LRT Alternative – Little Tokyo Variation 2, and the results of the analysis are presented together.

Under these alternatives, 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 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 the proposed 2nd Street /Broadway station; construction of the proposed 2nd Street/Central Avenue station; and, TBM tunneling beneath 2nd Street and the launch site near either 1st and Alameda Streets or the proposed 2nd/Hope Street station. These eight activities have the most potential for noise and vibration impacts due to their duration and their proximity to noise sensitive land uses.

5.5.3.1 Construction Noise

Table 5-12 lists the construction activities, and the construction equipment expected to be used during each construction activity, and the related noise levels anticipated for the Fully Underground LRT Alternative - Little Tokyo Variations 1 and 2.

To insure noise impacts are minimized during construction, all construction activities shall conform to the provisions in Section 41.40(a) of the City of 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.

The contractor would also be responsible for complying with the applicable local ordinance 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. The Los Angeles Municipal Code section 41.40(a) does not set acceptable noise level limits for either daytime or nighttime construction activities. If a noise variance is required, the noise variance will set the acceptable noise level limits.

Typical types of mitigation measures and Best Management Practices the contractor can use to meet the acceptable limits 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.

Table 5-12. Fully Underground LRT Alternative - Little Tokyo Variations 1 and 2 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 St 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)	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 Launch 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

5.5.3.2 Construction Vibration

GBV can cause damage to buildings depending on the building type (i.e., building materials and structural techniques) (see Table 3-4). This analysis calculates a "minimum safe distance" (with respect to vibration level) between construction equipment and buildings under various scenarios (see Table 3-5). Minimum safe working distances would account for the most sensitive buildings under the strongest potential vibration impact scenarios.

Potential noise from TBM operations at the launch site, where bored material would be hauled out, treated and removed, is listed in Table 5-12. Noise levels for the TBM are not listed for the alignment sections between the TBM launch and recovery sites. When it is operating underground, the TBM produces little to no noise that reaches surface land uses. Additionally, the TBM is slow moving and causes very little vibration to the surrounding area.

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 at the same 33 feet distance 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.

For the Fully Underground LRT Alternative – Little Tokyo Variations 1 and 2, pre-auguring of soldier piles at cut and cover sections would eliminate the need for impact pile driving. As a result, pile drivers and hoe rams would not be used during construction of this alternative. Equipment such as large bulldozers and drill rigs would be the main construction vibration sources. Large bulldozers and drill rigs would operate intermittently during construction and would not be used every day. Track construction could begin simultaneously at several locations in the project area and would be brought to completion at approximately the same time. Construction activities would not dwell in one location for the entire duration of construction.

A survey of structures within 21 feet of potential vibration-producing construction activity locations would be conducted. The survey would assess the building categories and the potential for GBV to cause damage. The survey would also help to establish baseline, pre-construction conditions for historic or other sensitive buildings. During preliminary and final design of the project, subsurface (geotechnical) investigations would be undertaken to evaluate soil, groundwater, seismic, and environmental conditions along the alignment.

During construction of this alternative, building protection measures would be applied. Measures could include underpinning, soil grouting, or other forms of ground improvement, and use of lower vibration equipment or construction techniques. Additionally, a geotechnical and vibration monitoring program would be used to protect identified historic and sensitive structures.

Mitigation measures identified in Section 6.5 would reduce construction-related vibration impacts to historic and sensitive buildings, located within 21 feet of the anticipated vibration-producing construction activity, to a less than significant level.

Large bulldozer and drill rigs, the main construction vibration sources, could exceed levels specified in FTA annoyance criteria for sensitive receivers (see Table 3-2). However, perceptible vibration from construction equipment would be short-term and intermittent. Therefore, perceptible vibration from these pieces of construction equipment is 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. Short-term vibration levels during construction could exceed the annoyance impact limits for infrequent events if specific construction activities were within 20 feet of Category 2 land uses or within 16 feet of Category 3 land uses. However, taking into account a 10 dBA reduction in vibration for coupling to building foundation loss (Table 10-1, FTA, 2006), sensitive receivers would not be subject to vibration annoyance impacts. It should be noted, 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 associated with large bulldozer and drill rigs would be less than significant. Implementation of mitigation measures identified in Section 6.1.3 would further reduce impacts below the level of less than significant.

6.0 MITIGATION MEASURES

The following mitigation measures could be implemented to avoid or minimize potentially impacts identified in Section 5.0.

6.1 No Build Alternative

Noise and vibration impacts are not anticipated for the No Build Alternative; therefore, no mitigation is proposed.

6.2 Transportation Management (TSM) Alternative

Noise and vibration impacts are not anticipated for the TSM Alternative; therefore, no mitigation is proposed.

6.3 At-Grade Emphasis LRT Alternative

LRT vehicle pass-bys associated with operation of the At-Grade Emphasis LRT Alternative would result in moderate noise impacts at the following locations: Site C, the ground floor of the Kawada Hotel; Site I, ground floor of the Higgins Building; and Site D, the ground floor of the New Otani Hotel (see Figure 4-1).

The alignment under this alternative would run in the middle of the street with traffic, so sound walls could not be used to reduce noise levels. However, wheel skirts could be included on LRT vehicles to reduce wayside noise levels by at least 2 dBA. Wheel skirts would reduce noise levels to below a moderate impact at the New Otani Hotel. Wheel skirts would improve noise levels, but not reduce them to below a moderate impact, at the ground floor of the Kawada Hotel and the Higgins Building.

No vibration impacts from operations are anticipated for the At-Grade Emphasis LRT Alternative; therefore, no mitigation is proposed.

Ground-borne noise impacts are predicted at sites C and D. The ground-borne noise levels are both predicted to be 35 dBA, equal to the impact criterion level. These predicted levels do not reflect any adjustment of the vibration levels to account for expected attenuation from the building's foundation coupling loss. Use of High-Resilience rail fasteners in these two area would reduce the ground-borne noise levels to below the 35 dBA criterion. If the At-Grade Emphasis is chosen as the preferred alternative, a more detailed study of the geologic conditions should be done to confirm the ground-borne noise levels.

If a noise variance from Section 41.40(a) of the Los Angeles Municipal Code is required, the variance will specify acceptable noise level limits. The contractor could use the following measures to meet relevant construction-related noise limits:

- Place 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
- Portable noise sheds for smaller, noisy, equipment, such as air compressors, dewatering pumps, and generators

During the construction phase of this alternative, sensitive or historic buildings within 21 feet of construction may be susceptible to vibration damage. A survey of structures within 21 feet of anticipated vibration-producing construction activity would be conducted. The survey would classify buildings by category of sensitivity and note the potential for GBV to cause damage to buildings.

The survey would be used to establish baseline, pre-construction conditions for historic or other sensitive buildings. If the survey of relevant structures finds buildings susceptible to vibration damage, a monitoring plan would be developed. This plan would ensure that construction-induced vibration would not damage historic buildings.

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, maintain distances greater than those provided in Table 5-2 to avoid potential construction-related vibration damage.
- When feasible, use construction equipment or less vibration intensive techniques near vibration sensitive locations.
- When feasible, route heavily laden vehicles away from vibration-sensitive locations.
- Operate earthmoving equipment as far as possible from vibration-sensitive locations by site layout considerations.
- Sequence construction activities that produce vibration such as demolition, excavation, earthmoving, and ground impacting so that the vibration sources do not operate simultaneously.
- When feasible, avoid nighttime construction activities that produce noticeable vibration.

- Use as small an impact device (i.e. hoe ram, pile driver) as possible to accomplish necessary tasks.
- When feasible, select non-impact demolition and construction methods such as saw or torch cutting and removal for off-site demolition, and use chemical splitting, or hydraulic jack splitting, instead of high impact methods.
- Use building protection measures such as underpinning, soil grouting, or other forms of ground improvement.
- Avoid using pavement breakers and vibratory rollers and packers near sensitive uses.

6.4 Underground Emphasis LRT Alternative

Under this alternative, a moderate noise impact from operation was predicted at the Savoy Condominiums on Alameda and 1st Streets. The noise impact would be due to track switches near the intersection of 1st and Alameda Streets. However, a spring-rail or movable frog switch could be used at this location to reduce potential noise by covering the gap in the central part of the switch. Using this measure would reduce switch noise to a FTA criteria level of no impact.

No vibration or ground-borne noise impacts from operations are anticipated for the Underground Emphasis LRT Alternative; therefore, no mitigation is proposed.

If a noise variance from Section 41.40(a) of the Los Angeles Municipal Code is required, the variance will specify acceptable noise level limits. The contractor could use the following measures to meet relevant construction-related noise limits:

- 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
- Portable noise sheds for smaller, noisy, equipment, such as air compressors, dewatering pumps, and generators

During the construction phase of this alternative, sensitive or historic buildings within 21 feet of construction may be susceptible to vibration damage. A survey of structures within 21 feet of anticipated vibration-producing construction activity would be conducted. The survey would classify buildings by category of sensitivity and note the potential for GBV to cause damage to buildings.

The survey would be used to establish baseline, pre-construction conditions for historic or other sensitive buildings. If the survey of relevant structures finds buildings susceptible to vibration damage, a monitoring plan would be developed. This plan would ensure that construction-induced vibration would not damage historic buildings.

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, maintain distances greater than those provided in Table 5-2 to avoid potential construction-related vibration damage.
- When feasible, use construction equipment or less vibration intensive techniques near vibration sensitive locations.
- Use as small an impact device (i.e. hoe ram, pile driver) as possible to accomplish necessary tasks.
- When feasible, route heavily laden vehicles away from vibration-sensitive locations.
- Operate earthmoving equipment as far as possible from vibration-sensitive locations by site layout considerations.
- Sequence construction activities that produce vibration such as demolition, excavation, earthmoving, and ground impacting so that the vibration sources do not operate simultaneously.
- When feasible, avoid nighttime construction activities that produce noticeable vibration.
- When feasible, select non-impact demolition and construction methods such as saw or torch cutting and removal for off-site demolition, and use chemical splitting, or hydraulic jack splitting, instead of high impact methods.
- Use building protection measures such as underpinning, soil grouting, or other forms of ground improvement.
- Avoid using pavement breakers and vibratory rollers and packers near sensitive uses.

Table 6-1. At-Grade Emphasis LRT Predicted Noise Levels and Impacts with Wheel Skirts

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)	Predicted Existing + Project Ldn[2] (dBA)/Peak Hour Leq (dBA)	Number of Noise Impacts					
							Moderate			Severe		
							SF	MF	Non- Residential	SF	MF	Non- Residential
1	Park at Central Library	Flower Street – Wilshire to 5th	3	68	Proposed Underground	68	0	0	0	0	0	0
A	Bonaventure Hotel	Flower Street – 5th to 3rd	2	71	61	71	0	0	0	0	0	0
2	Park Area 4th floor deck of Bank of America Building	Flower Street – 5th to 3rd	3	63	52	63	0	0	0	0	0	0
B	Bunker Hill Towers	Flower Street – 3rd to 2nd Street	2	74	58	74	0	0	0	0	0	0
B1	Bunker Hill Towers – Top Floor	Flower Street – 3rd to 2nd Street	2	71	52	71	0	0	0	0	0	0
C	Kawada Hotel	2nd Street – Hill to Los Angeles	2	75	67	75	0	1	0	0	0	0
C1	Kawada Hotel – Top Floor	2nd Street – Hill to Los Angeles	2	70	59	70	0	0	0	0	0	0
I	Higgins Building	2nd Street – Hill to Los Angeles	2	75	67	76	0	1	0	0	0	0
4	Saint Vibiana Little Tokyo Library	2nd Street – Hill to Los Angeles	3	69	59	69	0	0	0	0	0	0
D	New Otani Hotel	Los Angeles Street – 2nd to 1st	2	73	65	74	0	0	0	0	0	0
D1	New Otani Hotel 3rd Floor Garden	Los Angeles Street – 2nd to 1st	3	70	59	70	0	0	0	0	0	0
F1	Temple Street Jail	Los Angeles Street –1st to Temple	2	71	63	71	0	0	0	0	0	0
F2	Temple Street Jail	Temple Street –Los Angeles to Alameda	2	67	59	67	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.

6.5 Fully Underground LRT Alternative – Little Tokyo Variations 1 and 2

Under these alternatives, no noise or vibration or ground-borne noise impacts from project operations would require mitigation measures.

If a noise variance is required from Section 41.40(a) of the Los Angeles Municipal Code, the variance will specify acceptable noise level limits. As with other build alternatives, the contractor could use the following measures to meet relevant construction-related noise limits:

- 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
- Portable noise sheds for smaller, noisy, equipment, such as air compressors, dewatering pumps, and generators

During the construction phase of this alternative, sensitive or historic buildings within 21 feet of construction may be susceptible to vibration damage. A survey of structures within 21 feet of anticipated vibration-producing construction activity would be conducted. The survey would classify buildings by category of sensitivity and note the potential for GBV to cause damage to buildings.

The survey would be used to establish baseline, pre-construction conditions for historic or other sensitive buildings. If the survey of relevant structures finds buildings susceptible to vibration damage, a monitoring plan would be developed. This plan would ensure that construction-induced vibration would not damage historic buildings.

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, maintain distances greater than those provided in Table 5-2 to avoid potential construction-related vibration damage.
- When feasible, use construction equipment or less vibration intensive techniques near vibration sensitive locations.

- Use as small an impact device (i.e. hoe ram, pile driver) as possible to accomplish necessary tasks.
- When feasible, route heavily laden vehicles away from vibration-sensitive locations.
- Operate earthmoving equipment as far as possible from vibration-sensitive locations by site layout considerations.
- Sequence construction activities that produce vibration such as demolition, excavation, earthmoving, and ground impacting so that the vibration sources do not operate simultaneously.
- When feasible, avoid nighttime construction activities that produce noticeable vibration.
- When feasible, select non-impact demolition and construction methods such as saw or torch cutting and removal for off-site demolition, and use chemical splitting, or hydraulic jack splitting, instead of high impact methods.
- Use building protection measures such as underpinning, soil grouting, or other forms of ground improvement.
- Avoid using pavement breakers and vibratory rollers and packers near sensitive receptors.

7.0 CONCLUSIONS

7.1 No Build Alternative

Adverse noise and vibration impacts are not anticipated for the No Build Alternative.

7.2 Transportation System Management (TSM) Alternative

Adverse noise and vibration impacts are not anticipated for the TSM Alternative.

7.3 At-Grade Emphasis LRT Alternative

7.3.1 NEPA Findings

Noise impacts in the entire project area associated with LRT vehicle pass-by would be below severe impact levels. Thus, no significant adverse noise impacts would result. Significant adverse vibration impacts from operations are not anticipated for the At-Grade Emphasis Alternative.

LRT vehicle pass-bys associated with operation of the At-Grade Emphasis LRT Alternative would result in moderate noise impacts at three locations and ground-borne noise impacts at two locations. Implementation of mitigation measures would reduce potential noise levels to below a moderate impact at one location. Mitigation measures would improve noise levels at two other locations. Implementation of vibration mitigation measures would reduce potential ground-borne noise levels to no impact. At all locations, potential impacts would be less than the “severe” impact threshold, therefore, there would be no significant adverse impacts from transit operations.

Construction of this alternative would comply with Section 41.40(a) of the Los Angeles Municipal Code. Thus, noise and vibration levels associated with construction of this alternative would not result in a significant adverse impact. Sensitive or historic buildings within 21 feet of construction may be susceptible to vibration damage. Mitigation measures would ensure a less than significant adverse impact to these sensitive land uses.

7.3.2 CEQA Determinations

Three moderate noise impacts from LRT vehicle pass-bys are predicted for the At-Grade Emphasis LRT Alternative. However, moderate noise impacts at these locations would not result in a substantial permanent increase in ambient noise levels. Coupled with mitigation measures, noise impacts would be less than significant. All other noise and vibration impacts from operations would be less than significant.

Mitigation measures would reduce potential noise and vibration impacts from construction to less than significant levels in the entire project area.

7.4 Underground Emphasis LRT Alternative

7.4.1 NEPA Findings

Under this alternative, moderate noise impacts from operations are predicted at one location. Since these impacts would fall below the "severe" impact level, no significant adverse effect would result under NEPA. Significant adverse noise or vibration and ground-borne noise impacts from operation of the Underground Emphasis LRT Alternative are not anticipated.

Construction of this alternative would comply with Section 41.40(a) of the Los Angeles Municipal Code. Thus, noise and vibration levels associated with construction of this alternative would not result in a significant adverse impact. Sensitive or historic buildings within 21 feet of the construction may be susceptible to vibration damage. Mitigation measures would ensure a less than significant adverse impact to these sensitive land uses.

7.4.2 CEQA Determinations

Moderate noise impacts are predicted at one location. Under CEQA, such impacts are not considered significant. All other noise and vibration impacts from operation of the Underground Emphasis LRT Alternative would be less than significant.

Mitigation measures would reduce potential noise and vibration impacts from construction to less than significant levels in the entire project area.

7.5 Fully Underground LRT Alternative – Little Tokyo Variations 1 & 2

7.5.1 NEPA Findings

Significant adverse noise or vibration and ground-borne noise impacts from operation of the Fully Underground LRT Alternative - Little Tokyo Variations 1 or 2 are not anticipated.

Construction of the Fully Underground LRT Alternative – Little Tokyo Variation 1 or Little Tokyo Variation 2, would comply with Section 41.40(a) of the Los Angeles Municipal Code. Thus, noise and vibration levels associated with construction of this alternative would not result in a significant adverse impact. Sensitive or historic buildings within 21 feet of the construction may be susceptible to vibration damage. Mitigation measures would ensure a less than significant adverse impact to these sensitive land uses. All other noise and vibration impacts associated with construction would be less than significant.

7.5.2 CEQA Determinations

Potential noise and vibration impacts from operation of the Fully Underground LRT Alternative - Little Tokyo Variation 1 or Little Tokyo Variation 2 would be less than significant.

Mitigation measures would reduce potential noise and vibration impacts from construction to less than significant levels in the entire project area.

8.0 REFERENCES

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Greene, R. 1998. Tanner Creek Stream Diversion Project, Phase 2-- BES Project #5500 Baseline Vibration Study for City of Portland, OR.

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New, B.M. 1990. Ground Vibration Caused by Construction Works. Tunneling and Underground Space Technology, Vol-5, No. 3, pp 179-190.

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9.0 APPENDICES

9.1 Field Measurement Data Sheets

FIELD MEASUREMENT DATA SHEET

PB 100 YEARS

Project Name: REGIONAL CONNECTOR Job #

SITE IDENTIFICATION: 1 OBSERVER(s): KEVIN K
START DATE & TIME: 4-30-09 2:00 END DATE & TIME: 4-30-09 - 2:10
ADDRESS: CENTRAL LIBRARY

GPS coordinates:

ID

TEMP: 79 °F HUMIDITY: 30 % R.H. WIND: CALM LIGHT MODERATE VARIABLE
WINDSPEED: 0 MPH DIR: N NE E SE S SW W NW STEADY GUSTY 0 MPH
SKY: CLEAR SUNNY DARK PARTLY CLOUDY OVRCST FOG DRIZZLE RAIN Other:

Weather

INSTRUMENT: B+K 2238 TYPE: 1 2 SERIAL #: 2160297
CALIBRATOR: B+K SERIAL #: ~~3415~~ 1351953
CALIBRATION CHECK: PRE-TEST 94 dBA SPL POST-TEST 94 dBA SPL WINDSCREEN Y

SETTINGS: A-WEIGHTED SLOW FAST FRONTAL RANDOM ANSI OTHER:

Rec #	Start Time	End Time							
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			L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	
			L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	
			L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	

COMMENTS:

Acoustic Measurements

PRIMARY NOISE(S): TRAFFIC AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER
ROADWAY TYPE: FLOWER STREET

COUNT DURATION: ____-MINUTE

	NB / EB / SB / WB	SPEED (mph) NB EB / SB WB	#2 COUNT: NB / EB / SB / WB	SPEED (mph) NB EB / SB WB
AUTOS:	/	/	/	/
MED. TRUCKS:	/	/	/	/
HVY TRUCKS:	/	/	/	/
BUSES:	/	/	/	/
MOTORCYCLES:	/	/	/	/

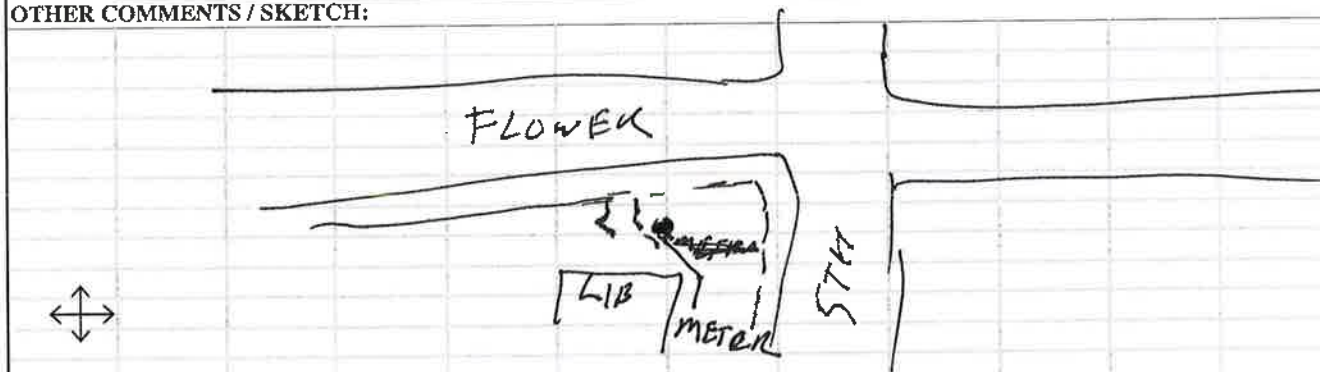
SPEED ESTIMATED BY: RADAR / DRIVING / OBSERVER

OTHER NOISE SOURCES: distant AIRCRAFT overhead / RUSTLING LEAVES / distant BARKING DOGS / BIRDS
distant CHILDREN PLAYING / distant TRAFFIC / distant LANDSCAPING / distant TRAINS

OTHER:

Source Info and Traffic Counts

TERRAIN: HARD SOFT MIXED FLAT OTHER:
PHOTOS:
OTHER COMMENTS / SKETCH:



Description / Sketch

measform.xls

505 S. Main Street, Suite 900, Orange, CA 92868, 714-835-6886

FIELD MEASUREMENT DATA SHEET

Project Name: REGIONAL CONNECTOR Job #

SITE IDENTIFICATION: A OBSERVER(s): KEVIN KELLER
START DATE & TIME: 4-29-09 10:00 END DATE & TIME: 4-30-09 - 10:00
ADDRESS: BONVENTURA HOTEL - POOL DECK

GPS coordinates:

ID

TEMP: ° F HUMIDITY: % R.H. WIND: CALM LIGHT MODERATE VARIABLE
WINDSPEED: MPH DIR: N NE E SE S SW W NW STEADY GUSTY MPH
SKY: CLEAR SUNNY DARK PARTLY CLOUDY OVRCST FOG DRIZZLE RAIN Other:

Weather

INSTRUMENT: LD-705 TYPE: 1 2 SERIAL #: 41098
CALIBRATOR: LD CAL 150 SERIAL #: 0337
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Rec #	Start Time / End Time							
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	/	L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	
	/	L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	
	/	L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	

COMMENTS:

Acoustic Measurements

PRIMARY NOISE(S): TRAFFIC AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER
ROADWAY TYPE: FLOWER STREET

COUNT DURATION: -MINUTE

	NB / EB / SB / WB	SPEED (mph) NB EB / SB WB	#2 COUNT: NB / EB / SB / WB	SPEED (mph) NB EB / SB WB
AUTOS:	/	/	/	/
MED. TRUCKS:	/	/	/	/
HVY TRUCKS:	/	/	/	/
BUSES:	/	/	/	/
MOTORCYCLES:	/	/	/	/

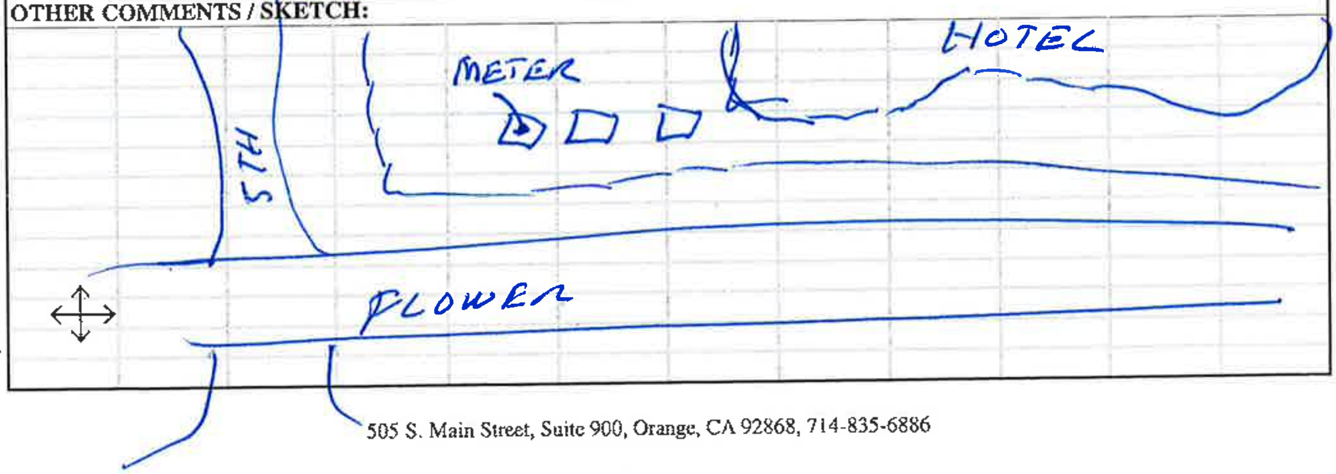
SPEED ESTIMATED BY: RADAR / DRIVING / OBSERVER

OTHER NOISE SOURCES: distant AIRCRAFT overhead / RUSTLING LEAVES / distant BARKING DOGS / BIRDS
distant CHILDREN PLAYING / distant TRAFFIC / distant LANDSCAPING / distant TRAINS

OTHER:

Source Info and Traffic Counts

TERRAIN: HARD SOFT MIXED FLAT OTHER:
PHOTOS:
OTHER COMMENTS / SKETCH:



Description / Sketch

measform.xls

FIELD MEASUREMENT DATA SHEET

Project Name: REGIONAL CONNECTOR Job #

ID

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START DATE & TIME: 4-29-09 1100 END DATE & TIME: 4-29-09 1130
ADDRESS: BOFA TOWER

GPS coordinates:

Weather

TEMP: 72 °F HUMIDITY: 20 % R.H. WIND: CALM LIGHT MODERATE VARIABLE
WINDSPEED: MPH DIR: N NE E SE S SW W NW STEADY GUSTY MPH
SKY: CLEAR SUNNY DARK PARTLY CLOUDY OVRCST FOG DRIZZLE RAIN Other:

Acoustic Measurements

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Rec #	Start Time / End Time	L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	
	11:15 / 11:30	61.3	72.5	58.2	~~67~~ 59.5	60.5	62.0	
	/							
	/							
	/							

COMMENTS:

Source Info and Traffic Counts

PRIMARY NOISE(S): TRAFFIC AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER
ROADWAY TYPE: FLOWER STREET
COUNT DURATION: -MINUTE

	NB / EB / SB / WB	SPEED (mph) NB EB / SB WB	#2 COUNT: NB / EB / SB / WB	SPEED (mph) NB EB / SB WB
AUTOS:	/	/	/	/
MED. TRUCKS:	/	/	/	/
HVY TRUCKS:	/	/	/	/
BUSES:	/	/	/	/
MOTORCYCLES:	/	/	/	/

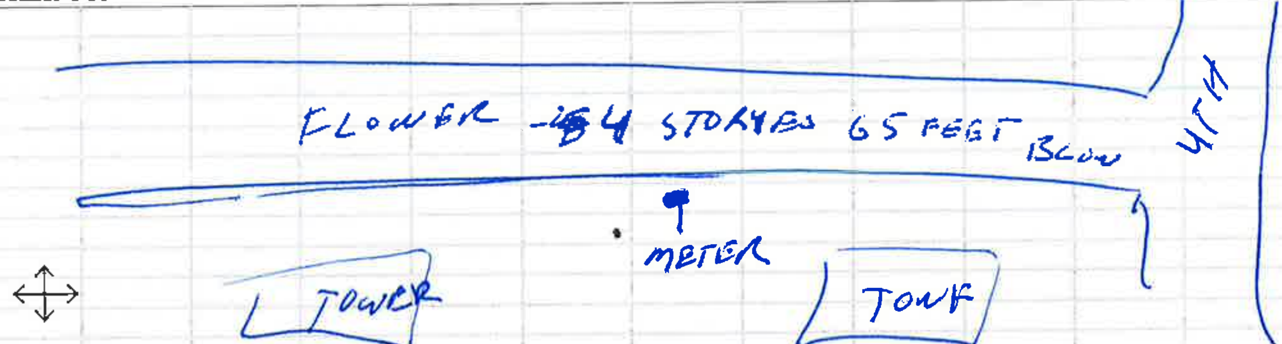
SPEED ESTIMATED BY: RADAR / DRIVING / OBSERVER

OTHER NOISE SOURCES: distant AIRCRAFT overhead / RUSTLING LEAVES / distant BARKING DOGS / BIRDS
distant CHILDREN PLAYING / distant TRAFFIC / distant LANDSCAPING / distant TRAINS

OTHER:

Description / Sketch

TERRAIN: HARD SOFT MIXED FLAT OTHER:
PHOTOS:
OTHER COMMENTS / SKETCH:



measform.xls

FIELD MEASUREMENT DATA SHEET

PB 100 YEARS

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ID

SITE IDENTIFICATION: B OBSERVER(s): KEVIN K
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ADDRESS: BUNKER HILL TOWERS - GROUND FLOOR

GPS coordinates:

Weather

TEMP: ______ °F HUMIDITY: ______ % R.H. WIND: CALM LIGHT MODERATE VARIABLE
WINDSPEED: ______ MPH DIR: N NE E SE S SW W NW STEADY GUSTY ____ MPH
SKY: CLEAR SUNNY DARK PARTLY CLOUDY OVRCST FOG DRIZZLE RAIN Other: ______

Acoustic Measurements

INSTRUMENT: LD 706 TYPE: 1 2 SERIAL #: 17390
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SETTINGS: A-WEIGHTED SLOW FAST FRONTAL RANDOM ANSI OTHER: 24-HOUR

Rec #	Start Time	End Time							
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			L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	
			L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	
			L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	

COMMENTS:

Source Info and Traffic Counts

PRIMARY NOISE(S): TRAFFIC AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER
ROADWAY TYPE: FLOWER - 93RD STREET
COUNT DURATION: ____ -MINUTE

	NB / EB / SB / WB	SPEED (mph) NB EB / SB WB	#2 COUNT: NB / EB / SB / WB	SPEED (mph) NB EB / SB WB
AUTOS:	/	/	/	/
MED. TRUCKS:	/	/	/	/
HVY TRUCKS:	/	/	/	/
BUSES:	/	/	/	/
MOTORCYCLES:	/	/	/	/

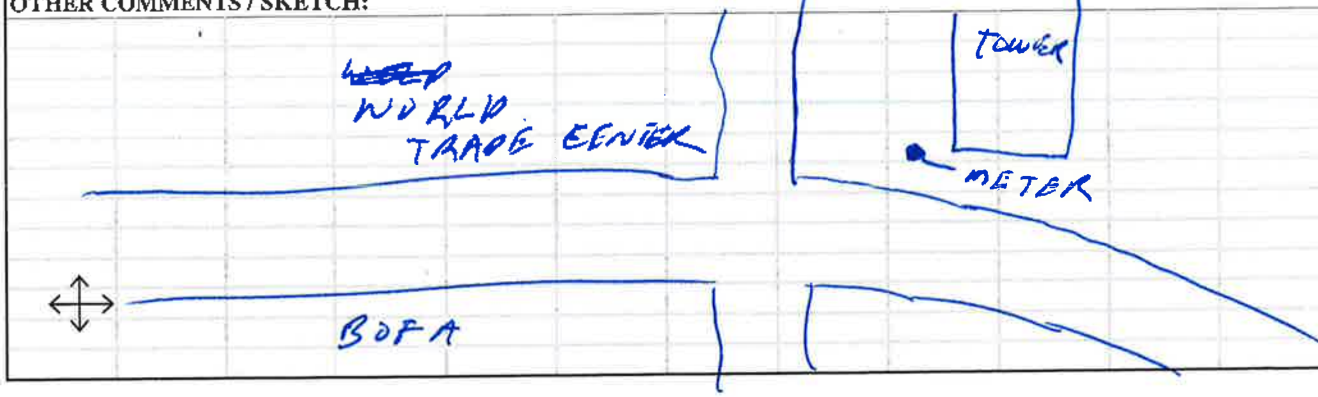
SPEED ESTIMATED BY: RADAR / DRIVING / OBSERVER

OTHER NOISE SOURCES: distant AIRCRAFT overhead / RUSTLING LEAVES / distant BARKING DOGS / BIRDS
distant CHILDREN PLAYING / distant TRAFFIC / distant LANDSCAPING / distant TRAINS

OTHER:

Description / Sketch

TERRAIN: HARD SOFT MIXED FLAT OTHER:
PHOTOS:
OTHER COMMENTS / SKETCH:



measform.xls

505 S. Main Street, Suite 900, Orange, CA 92868, 714-835-6886

FIELD MEASUREMENT DATA SHEET

Project Name: REGIONAL CONNECTOR Job #

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ADDRESS: KAWADA HOTEL - 4TH FLOOR
GPS coordinates:

ID

TEMP: ____ °F HUMIDITY: ____ % R.H. WIND: CALM LIGHT MODERATE VARIABLE
WINDSPEED: ____ MPH DIR: N NE E SE S SW W NW STEADY GUSTY ____ MPH
SKY: CLEAR SUNNY DARK PARTLY CLOUDY OVRCST FOG DRIZZLE RAIN Other: ____

Weather

INSTRUMENT: LD 712 TYPE: 1 2 SERIAL #: 0343
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SETTINGS: A-WEIGHTED SLOW FAST FRONTAL RANDOM ANSI OTHER: 24-HOUR

Rec #	~~Start Time / End Time~~ — 24 HOUR							
	11:00 / 11:00	: L_{eq}	, L_{max}	, L_{min}	, L_{90}	, L_{50}	, L_{10}	,
	/	: L_{eq}	, L_{max}	, L_{min}	, L_{90}	, L_{50}	, L_{10}	,
	/	: L_{eq}	, L_{max}	, L_{min}	, L_{90}	, L_{50}	, L_{10}	,
	/	: L_{eq}	, L_{max}	, L_{min}	, L_{90}	, L_{50}	, L_{10}	,

COMMENTS:

Acoustic Measurements

PRIMARY NOISE(S): TRAFFIC AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER
ROADWAY TYPE: 2ND STREET - HILL

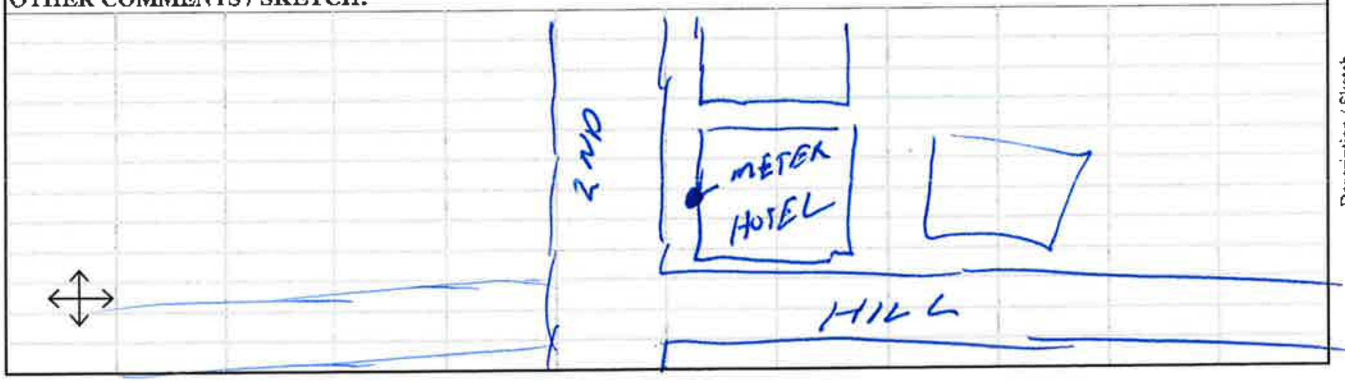
COUNT DURATION: ____-MINUTE	NB / EB / SB / WB	SPEED (mph) NB EB / SB WB	#2 COUNT: NB / EB / SB / WB	SPEED (mph) NB EB / SB WB
AUTOS:	/	/	/	/
MED. TRUCKS:	/	/	/	/
HVY TRUCKS:	/	/	/	/
BUSES:	/	/	/	/
MOTORCYCLES:	/	/	/	/

SPEED ESTIMATED BY: RADAR / DRIVING / OBSERVER

OTHER NOISE SOURCES: distant AIRCRAFT overhead / RUSTLING LEAVES / distant BARKING DOGS / BIRDS
distant CHILDREN PLAYING / distant TRAFFIC / distant LANDSCAPING / distant TRAINS
OTHER:

Source Info and Traffic Counts

TERRAIN: HARD SOFT MIXED FLAT OTHER:
PHOTOS:
OTHER COMMENTS / SKETCH:



Description / Sketch

measform3.xls

505 S. Main Street, Suite 900, Orange, CA 92868, 714-835-6886

FIELD MEASUREMENT DATA SHEET

Project Name: REGIONAL CONN Job #

SITE IDENTIFICATION: O OBSERVER(s): KEVIN K
START DATE & TIME: 4-29-09 11:20 END DATE & TIME: 4-30-09 - 11:40
ADDRESS: 154070 GRAND HOTEL

GPS coordinates:

ID

TEMP:_____°F HUMIDITY:_____% R.H. WIND: CALM LIGHT MODERATE VARIABLE
WINDSPEED:_____MPH DIR: N NE E SE S SW W NW STEADY GUSTY_____MPH
SKY: CLEAR SUNNY DARK PARTLY CLOUDY OVRCST FOG DRIZZLE RAIN Other: _____

Weather

INSTRUMENT: LD 720 TYPE: 1 2 SERIAL #: 0514
CALIBRATOR: LD CAL 150 SERIAL #: D337
CALIBRATION CHECK: PRE-TEST 114.0 dBA SPL POST-TEST 113.4 dBA SPL WINDSCREEN 4"
SETTINGS: A-WEIGHTED SLOW FAST FRONTAL RANDOM ANSI OTHER:_____

24-HOUR

Rec #	Start Time / End Time							
	11:30 / 11:30	L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	
	/	L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	
	/	L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	
	/	L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	

COMMENTS:

Acoustic Measurements

PRIMARY NOISE(S): TRAFFIC AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER
ROADWAY TYPE: LOS ANGELES STREET

COUNT DURATION:_____-MINUTE	NB / EB / SB / WB	SPEED (mph) NB EB / SB WB	#2 COUNT: NB / EB / SB / WB	SPEED (mph) NB EB / SB WB
AUTOS:	/	/	/	/
MED. TRUCKS:	/	/	/	/
HVY TRUCKS:	/	/	/	/
BUSES:	/	/	/	/
MOTORCYCLES:	/	/	/	/

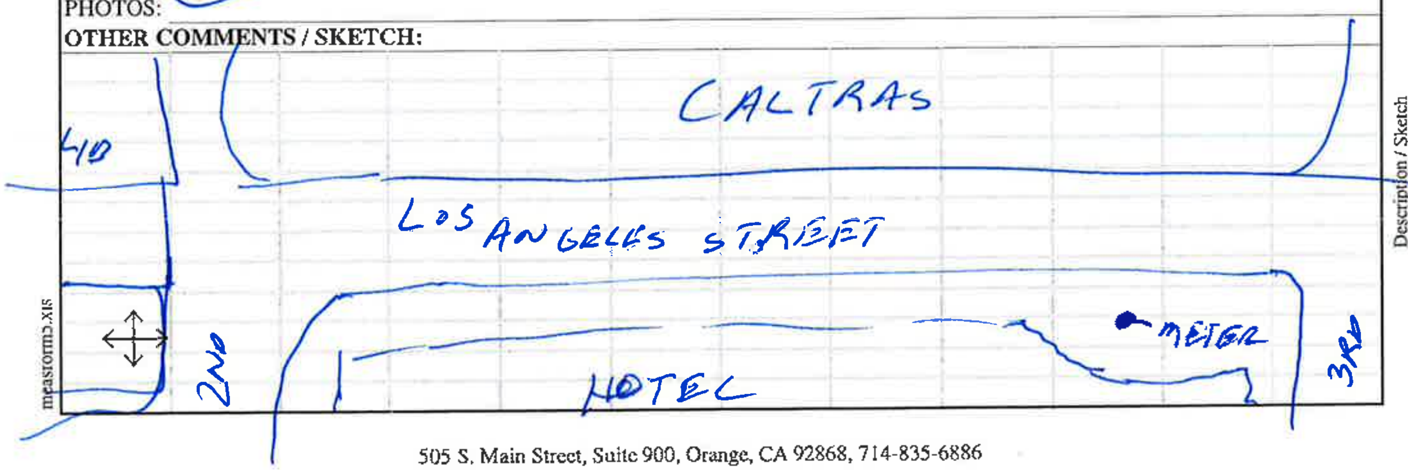
SPEED ESTIMATED BY: RADAR / DRIVING / OBSERVER

OTHER NOISE SOURCES: distant AIRCRAFT overhead / RUSTLING LEAVES / distant BARKING DOGS / BIRDS
distant CHILDREN PLAYING / distant TRAFFIC / distant LANDSCAPING / distant TRAINS

OTHER:

Source Info and Traffic Counts

TERRAIN: HARD SOFT MIXED FLAT OTHER:
PHOTOS:
OTHER COMMENTS / SKETCH:



Description / Sketch

measform3.xls

FIELD MEASUREMENT DATA SHEET

Project Name: REGIONAL CONNECTOR Job #

SITE IDENTIFICATION: E OBSERVER(s): KEVIN K
START DATE & TIME: 4-29-09 - 1:00 END DATE & TIME: 4-30-09 - 1:00
ADDRESS: HIKARI LOFTS - ROOF 4TH FLOOR

GPS coordinates:

ID

TEMP: °F HUMIDITY: % R.H. WIND: CALM LIGHT MODERATE VARIABLE
WINDSPEED: MPH DIR: N NE E SE S SW W NW STEADY GUSTY MPH
SKY: CLEAR SUNNY DARK PARTLY CLOUDY OVRCST FOG DRIZZLE RAIN Other:

Weather

INSTRUMENT: LD 720 TYPE: 1 2 SERIAL #: 0460
CALIBRATOR: LD CAL150 SERIAL #: 0337
CALIBRATION CHECK: PRE-TEST 114.0 dBA SPL POST-TEST 114.1 dBA SPL WINDSCREEN 4
SETTINGS: A-WEIGHTED SLOW FAST FRONTAL RANDOM ANSI OTHER: 24-HOUR

Rec # Start Time / End Time 24-HOUR

/ 1:00 / 1:00 : ~~L_{eq}, L_{max}, L_{min}, L_{90}, L_{50}, L_{10},~~
/ / : L_{eq}, L_{max}, L_{min}, L_{90}, L_{50}, L_{10},
/ / : L_{eq}, L_{max}, L_{min}, L_{90}, L_{50}, L_{10},
/ / : L_{eq}, L_{max}, L_{min}, L_{90}, L_{50}, L_{10},

COMMENTS:

Acoustic Measurements

PRIMARY NOISE(S): TRAFFIC AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER
ROADWAY TYPE: 2ND AND CENTRAL

COUNT DURATION: -MINUTE	NB / EB / SB / WB	SPEED (mph) NB EB / SB WB	#2 COUNT: NB / EB / SB / WB	SPEED (mph) NB EB / SB WB
AUTOS:	/	/	/	/
MED. TRUCKS:	/	/	/	/
HVY TRUCKS:	/	/	/	/
BUSES:	/	/	/	/
MOTORCYCLES:	/	/	/	/

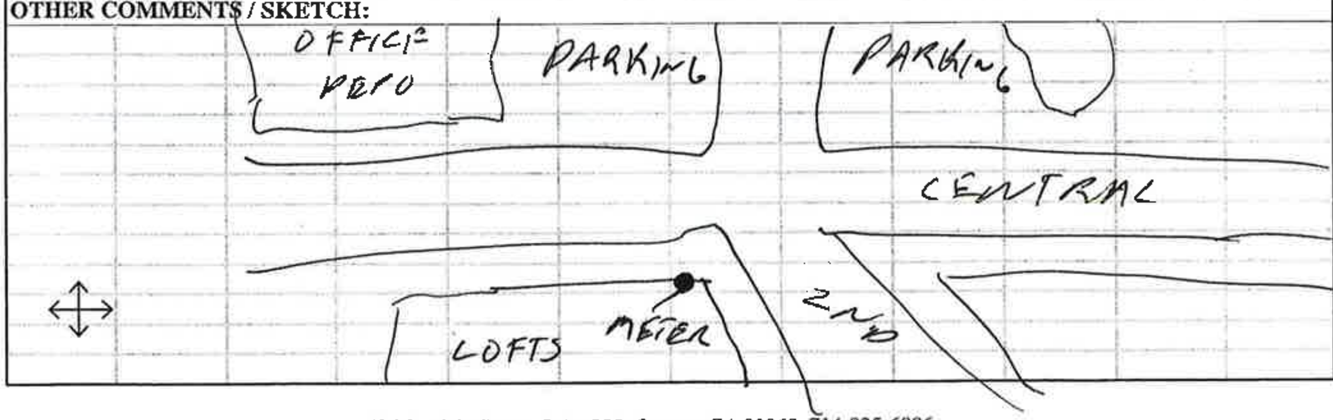
SPEED ESTIMATED BY: RADAR / DRIVING / OBSERVER

OTHER NOISE SOURCES: distant AIRCRAFT overhead / RUSTLING LEAVES / distant BARKING DOGS / BIRDS
distant CHILDREN PLAYING / distant TRAFFIC / distant LANDSCAPING / distant TRAINS

OTHER:

Source Info and Traffic Counts

TERRAIN: HARD SOFT MIXED FLAT OTHER:
PHOTOS:
OTHER COMMENTS / SKETCH:



Description / Sketch

measform.xls

505 S. Main Street, Suite 900, Orange, CA 92868, 714-835-6886

FIELD MEASUREMENT DATA SHEET

Project Name: REGIONAL CONNETOR Job #

SITE IDENTIFICATION: H OBSERVER(s): KEVIN KELLER
START DATE & TIME: 4-29-09 - 11:40 END DATE & TIME: 4-30-09 - 12:00
ADDRESS: SAVOY APTS - GROUND FLOOR

GPS coordinates:

ID

TEMP:_____ °F HUMIDITY:_____% R.H. WIND: CALM LIGHT MODERATE VARIABLE
WINDSPEED:__________MPH DIR: N NE E SE S SW W NW STEADY GUSTY____MPH
SKY: CLEAR SUNNY DARK PARTLY CLOUDY OVRCST FOG DRIZZLE RAIN Other: __________

Weather

INSTRUMENT: LD 712 TYPE: 1 2 SERIAL #: 0218
CALIBRATOR: LD CAL 150 SERIAL #: 0337
CALIBRATION CHECK: PRE-TEST 114.0 dBA SPL POST-TEST 113.9 dBA SPL WINDSCREEN Y
SETTINGS: A-WEIGHTED SLOW / FAST FRONTAL RANDOM ANSI OTHER: 24-HOUR

Rec #	Start Time / End Time							
1	12:00 / 12:00 :	~~L_{eq}~~	~~L_{max}~~	~~L_{min}~~	~~L_{90}~~	~~L_{50}~~	~~L_{10}~~	24-HOUR
/	/ :	L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	
/	/ :	L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	
/	/ :	L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	

COMMENTS:

Acoustic Measurements

PRIMARY NOISE(S): TRAFFIC AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER
ROADWAY TYPE: ALAMEAD STREET / 1ST

COUNT DURATION:_____-MINUTE SPEED (mph) #2 COUNT: SPEED (mph)

	NB / EB / SB / WB	NB EB / SB WB	NB / EB / SB / WB	NB EB / SB WB
AUTOS:	/	/	/	/
MED. TRUCKS:	/	/	/	/
HVY TRUCKS:	/	/	/	/
BUSES:	/	/	/	/
MOTORCYCLES:	/	/	/	/

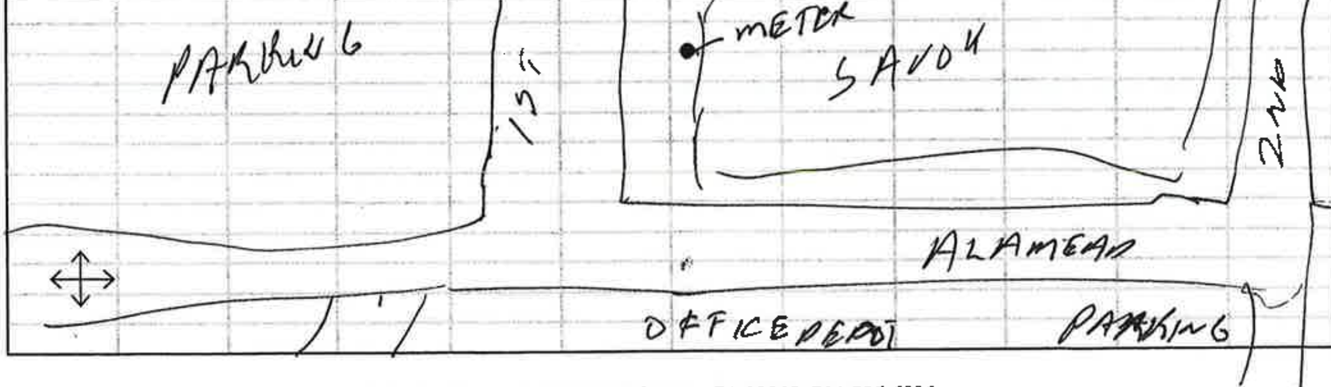
SPEED ESTIMATED BY: RADAR / DRIVING / OBSERVER

OTHER NOISE SOURCES: distant AIRCRAFT overhead / RUSTLING LEAVES / distant BARKING DOGS / BIRDS
distant CHILDREN PLAYING / distant TRAFFIC / distant LANDSCAPING / distant TRAINS

OTHER:

Source Info and Traffic Counts

TERRAIN: HARD SOFT MIXED FLAT OTHER:
PHOTOS:
OTHER COMMENTS / SKETCH:



Description / Sketch

measrorm3.xls

FIELD MEASUREMENT DATA SHEET

Project Name: R C Job #

SITE IDENTIFICATION: BUWISI TRIP 3 OBSERVER(s): KEVIN KELLER
START DATE & TIME: 1-5-00 1:41 END DATE & TIME:
ADDRESS: 1ST STREET

GPS coordinates:

TEMP: 84 °F HUMIDITY: 70 % R.H. WIND: CALM LIGHT MODERATE VARIABLE
WINDSPEED: 0 MPH DIR: N NE E SE S SW W NW STEADY GUSTY 0 MPH
SKY: CLEAR SUNNY DARK PARTLY CLOUDY OVRCST FOG DRIZZLE RAIN Other:

INSTRUMENT: B+K 2238 TYPE: 1 2 SERIAL #: 2160241
CALIBRATOR: B+K 4236 SERIAL #: ~~345~~ 1351753
CALIBRATION CHECK: PRE-TEST 94 dBA SPL POST-TEST 94 dBA SPL WINDSCREEN Y
SETTINGS: A-WEIGHTED SLOW FAST FRONTAL RANDOM ANSI OTHER:

Rec #	Start Time / End Time	L_{eq}	L_{max}	L_{min}	L_{90}	L_{50}	L_{10}	
1	1:42 / 1:52	63.5	79.9	49.3	53.8	58	65.0	
2	2:01 / 2:11	62.0	77.0	49.5	52.5	57.5	63.5	
3	2:13 / 2:23	62.4	80.1	50.1	51.0	57.5	68.0	
	/							

COMMENTS: REC 1 TWO GOOD PASS
REC 2 TWO GOOD PASS
REC 3 TWO GOOD PASS

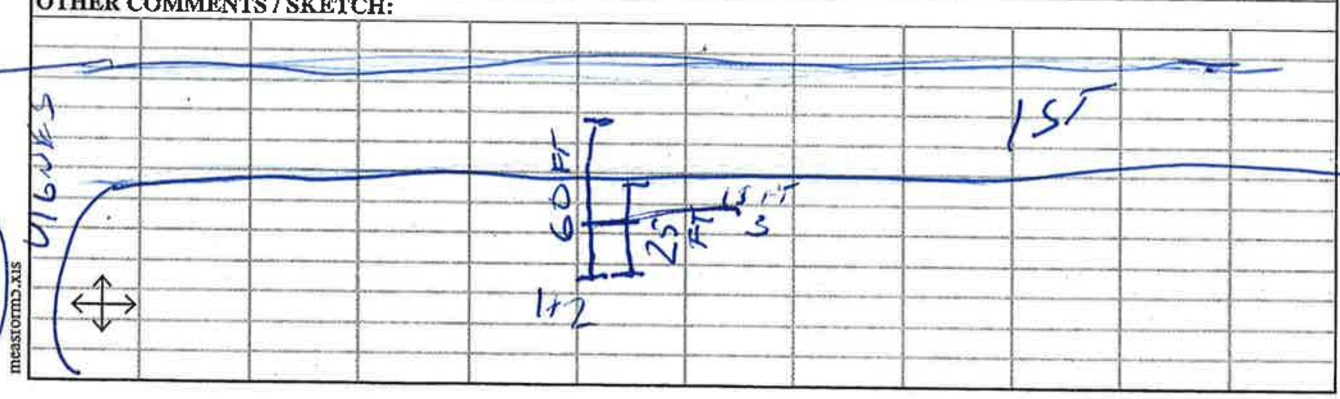
PRIMARY NOISE(S): TRAFFIC AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER
ROADWAY TYPE: 1ST AVE
COUNT DURATION: ____-MINUTE

	NB / EB / SB / WB	SPEED (mph) NB EB / SB WB	#2 COUNT: NB / EB / SB / WB	SPEED (mph) NB EB / SB WB
AUTOS:	/	/	/	/
MED. TRUCKS:	/	/	/	/
HVY TRUCKS:	/	/	/	/
BUSES:	/	/	/	/
MOTORCYCLES:	/	/	/	/

SPEED ESTIMATED BY: RADAR / DRIVING / OBSERVER

OTHER NOISE SOURCES: distant AIRCRAFT overhead / RUSTLING LEAVES / distant BARKING DOGS / BIRDS
distant CHILDREN PLAYING / distant TRAFFIC / distant LANDSCAPING / distant TRAINS
OTHER:

TERRAIN: HARD SOFT MIXED FLAT OTHER:
PHOTOS:
OTHER COMMENTS / SKETCH:



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9.2 Gold Line Transit Vehicles Force Density Spectrum