Noise and Vibration Impacts Report

for the East San Fernando Valley Transit Corridor

July 2016

Metro

Prepared by the
U.S. Department of Transportation
Federal Transit Administration

and the Los Angeles County
Metropolitan Transportation Agency

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Acronyms and Abbreviations

2008 RCP	2008 Regional Comprehensive Plan
2012 RTP	2012–2035 Regional Transportation Plan/Sustainable Communities Strategy
AA	Alternatives Analysis
BRT	bus rapid transit
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CPA	Community Plan Area
dBA	A-weighted decibel
DEIR	Draft Environmental Impact Report
DEIS	Draft Environmental Impact Statement
FDL	Force Density Level
FTA	Federal Transit Administration
Growth Vision	2004 Compass Blueprint Growth Vision
HOV	high-occupancy vehicle
Hz	Hertz, frequency in cycles per second
I	Interstate
LADOT	Los Angeles Department of Transportation
L_{dn}	24-hour day-night sound level
L_{eq}	Equivalent sound level
L_{max}	Maximum sound level
LRT	light rail transit
LRV	light rail vehicle
LRTP	Long-Range Transportation Plan
LSTM	Line Source Transfer Mobility
Metro	Los Angeles County Metropolitan Transportation Authority
MPO	Metropolitan Planning Organization
MSF	maintenance and storage facility
NEPA	National Environmental Policy Act
RTP/SCS	Regional Transportation Plan/Sustainable Communities Strategy
SCAG	Southern California Association of Governments
SEL	Sound Exposure Level
SR	State Route
TPSS	Traction Power Sub-Station
TSM	Transportation System Management
U.S.C.	United States Code
VdB	vibration decibel with reference to 1 microinch/second

Chapter 1
Introduction

1.1 Study Background

What Is the East San Fernando Valley Transit Corridor?

The Federal Transit Administration (FTA) and Los Angeles County Metropolitan Transportation Authority (Metro) have initiated a Draft Environmental Impact Statement (DEIS)/Environmental Impact Report (DEIR) for the East San Fernando Valley Transit Corridor Project (project). The DEIS/DEIR is being prepared with the FTA as the Lead Agency under the National Environmental Policy Act (NEPA) and Metro as the Lead Agency under the California Environmental Quality Act (CEQA).

The DEIS/DEIR and related engineering are being undertaken by Metro, in close coordination with the Cities of Los Angeles and San Fernando. The DEIS/DEIR will be a combined document complying with the most recent state and federal environmental laws. The project's public/community outreach component is being undertaken as an integrated parallel effort to the DEIS/DEIR.

Prior to the initiation of the DEIS/DEIR, an Alternatives Analysis (AA) was received by the Metro Board in January 2013 to study the East San Fernando Valley Transit Corridor in order to define, screen, and recommend alternatives for future study.

This study enabled Metro, the City of Los Angeles, and the City of San Fernando to evaluate a range of new public transit service alternatives that can accommodate future population growth and transit demand, while being compatible with existing land uses and future development opportunities. The study considered the Sepulveda Pass Corridor, which is another Measure R project, and the proposed California High Speed Rail Project. Both of these projects may be directly served by a future transit project in the project study area. The Sepulveda Pass Corridor could eventually link the West Los Angeles area to the east San Fernando Valley and the California High Speed Rail Project via the project corridor. As part of the January 2013 Alternatives Analysis, most of Sepulveda Boulevard was eliminated as an alignment option, as well as the alignment extending to Lakeview Terrace. As a result of the Alternatives Analysis, modal recommendations were for Bus Rapid Transit (BRT) and Light Rail Transit (LRT).

As a result of the alternatives screening process and feedback received during the public scoping period, a curb-running BRT, median-running BRT, median-running low-floor LRT/tram, and a median-running LRT were identified as the four build alternatives, along with the Transportation Systems Management (TSM) and No-Build Alternatives, to be carried forward for analysis in this DEIS/DEIR.

1.1.1 Study Area

Where Is the Study Area Located?

The East San Fernando Valley Transit Corridor Project study area is located in the San Fernando Valley in the County of Los Angeles. Generally, the project study area extends from the City of San Fernando and the Sylmar/San Fernando Metrolink Station in the north to the Van Nuys Metro

Orange Line Station within the City of Los Angeles in the south. However, the project study area used for the environmental issue described in this report could vary from this general project study area, depending on the needs of the analysis. For the purposes of the analysis contained in this report, the project study area coincides with the general project study area.

The eastern San Fernando Valley includes the two major north-south arterial roadways of Sepulveda and Van Nuys Boulevards, spanning approximately 10 to 12 miles and the major north-west arterial roadway of San Fernando Road.

Several freeways traverse or border the eastern San Fernando Valley. These include the Ventura Freeway (US-101), the San Diego Freeway (Interstate [I] 405), the Golden State Freeway (I-5), the Ronald Reagan Freeway (State Route [SR] 118), and the Foothill Freeway (I-210). The Hollywood Freeway (SR-170) is located east of the project study area. In addition to Metro Local and Metro Rapid bus service, the Metro Orange Line (Orange Line) BRT service, the Metrolink Ventura Line commuter rail service, Amtrak inter-city rail service, and the Metrolink Antelope Valley Line commuter rail service are the major transit corridors that provide interregional trips in the project study area.

Land uses in the project study area include neighborhood and regional commercial land uses, as well as government and residential land uses. Specifically, land uses in the project study area include government services at the Van Nuys Civic Center, retail shopping along the project corridor, and medium- to high-density residential uses throughout the project study area. Notable land uses in the eastern San Fernando Valley include: The Village at Sherman Oaks, Panorama Mall, Whiteman Airport, Van Nuys Airport, Mission Community Hospital, Kaiser Permanente Hospital, Van Nuys Auto Row, and several schools, youth centers, and recreational centers.

1.1.2 Alternatives Considered

What Alternatives Are under Consideration?

The following six alternatives, including four build alternatives, a TSM Alternative, and the No-Build Alternative, are being evaluated as part of this study:

- No-Build Alternative
- TSM Alternative
- Build Alternative 1 – Curb-Running BRT Alternative
- Build Alternative 2 – Median-Running BRT Alternative
- Build Alternative 3 – Low-Floor LRT/Tram Alternative
- Build Alternative 4 – LRT Alternative

All build alternatives would operate over 9.2 miles, either in a dedicated bus lane or guideway (6.7 miles) and/or in mixed-flow traffic lanes (2.5 miles), from the Sylmar/San Fernando Metrolink station to the north to the Van Nuys Metro Orange Line station to the south, with the exception of Build Alternative 4 which includes a 2.5-mile segment within Metro-owned railroad right-of-way adjacent to San Fernando Road and Truman Street and a 2.5-mile underground segment beneath portions of Panorama City and Van Nuys.

1.1.2.1 No-Build Alternative

The No-Build Alternative represents projected conditions in 2040 without implementation of the project. No new transportation infrastructure would be built within the project study area, aside from projects that are currently under construction or funded for construction and operation by 2040.

These projects include highway and transit projects funded by Measure R and specified in the current constrained element of the Metro 2009 Long-Range Transportation Plan (LRTP) and the 2012 Southern California Association of Governments (SCAG) Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS). Existing infrastructure and future planned and funded projects assumed under the No-Build Alternative include:

- Existing Freeways – I-5, I-105, SR-118, and U.S. 101;
- Existing Transitway – Metro Orange Line;
- Existing Bus Service – Metro Rapid and Metro Local Shuttle;
- Los Angeles Department of Transportation Commuter Express, and DASH;
- Existing and Planned Bicycle Projects – Bicycle facilities on Van Nuys Boulevard and connecting east/west facilities; and
- Other Planned Projects – Various freeway and arterial roadway upgrades, expansions to the Metro Rapid bus system, upgrades to the Metrolink system and the proposed California High Speed Rail project.

This alternative establishes a baseline for comparison to other alternatives in terms of potential environmental effects, including adverse and beneficial environmental effects.

1.1.2.2 TSM Alternative

The TSM Alternative enhances the No-Build Alternative and emphasizes transportation systems upgrades, which may include relatively low-cost transit service improvements. It represents efficient and feasible improvements to transit service, such as increased bus frequencies and minor modifications to the roadway network. Additional TSM Alternative transit improvements that may be considered include, but are not limited to, traffic signalization improvements, bus stop amenities/improvements, and bus schedule restructuring (Figure 1-1).

The TSM Alternative considers the existing bus network, enhanced operating hours, and increased bus frequencies for Metro Rapid Line 761 and Local Line 233. Under this alternative, the Metro Rapid Line 761 and Metro Local Line 233 bus routes would retain existing stop locations. This alternative would add 20 additional buses to the existing Metro Local 233 and Metro Rapid 761 bus routes. These buses would be similar to existing Metro 60-foot articulated buses, and each bus would have the capacity to serve up to 75 passengers (57 seats x 1.30 passenger loading standard). Buses would be equipped with transit signal priority equipment to allow for improved operations and on-time performance.

The existing Metro Division 15 maintenance and storage facility (MSF) located in Sun Valley would be able to accommodate the 20 additional buses with the implementation of the TSM Alternative. Operational changes would include reduced headway (elapsed time between buses) times for Metro Rapid Line 761 and Metro Local Line 233, as follows:

- Metro Rapid Line 761 would operate with headways reduced from 10 minutes to 8 minutes during peak hours (7 a.m. to 9 a.m. and 4 p.m. to 7 p.m. on weekdays) and from 17.5 minutes to 12 minutes during off-peak hours.
- Metro Local Line 233 would operate with headways reduced from 12 minutes to 8 minutes during peak hours and from 20 minutes to 16 minutes during off-peak hours.

Figure 1-1: TSM Alternative

Source: KOA and ICF International, 2014.

1.1.2.3 Build Alternative 1 – Curb-Running BRT Alternative

Under the Curb-Running BRT Alternative, the BRT guideway would incorporate 6.7 miles of existing curb lanes (i.e., lanes closest to the curb) along Van Nuys Boulevard between San Fernando Road and the Metro Orange Line. This alternative would be similar to the Metro Wilshire BRT project and would operate similarly. The lanes would be dedicated curb-running bus lanes for Metro Rapid Line 761 and Metro Local Line 233, and for other transit lines that operate on short segments of Van Nuys Boulevard. In addition, this alternative would incorporate 2.5 miles of mixed-flow lanes, where buses would operate in the curb lane along San Fernando Road and Truman Street between Van Nuys Boulevard and Hubbard Avenue for Metro Line 761. Metro Line 233 would continue north on Van Nuys Boulevard to Lakeview Terrace. These improvements would result in an improved Metro Rapid Line 761 (hereafter referred to as 761X) and an improved Metro Local Line 233 (hereafter referred to as 233X). The route of the Curb-Running BRT Alternative is illustrated in Figure 1-2.

From the Sylmar/San Fernando Metrolink station:

- Metro Rapid Line 761X would operate within roadway travel lanes on Truman Street and San Fernando Road.
- At Van Nuys Boulevard, Metro Rapid Line 761X would turn southwest and travel south within a curb-running dedicated bus lane along Van Nuys Boulevard.
- The alternative would continue to be curb running along Van Nuys Boulevard until reaching the Metro Orange Line Van Nuys station where Metro Rapid Line 761X service would be integrated into mixed-flow traffic.
- Metro Line 761X would then continue south to Westwood as under existing conditions, though it should be noted that in December 2014 the Metro Rapid Line 761 will be re-routed to travel from Van Nuys Boulevard to Ventura Boulevard, and then to Reseda Boulevard, while a new Metro Rapid Line 788 would travel from Van Nuys Boulevard through the Sepulveda Pass to Westwood as part of a Metro demonstration project.

Metro Local Line 233X would operate similar to how it currently operates between the intersections of Van Nuys and Glenoaks Boulevards to the north and Van Nuys and Ventura Boulevards to the south. However, Metro Local Line 233X would operate with improvements over existing service because it would utilize the BRT guideway where its route overlaps with the guideway along Van Nuys Boulevard.

Transit service would not be confined to only the dedicated curb lanes. Buses would still have the option to operate within the remaining mixed-flow lanes to bypass right-turning vehicles, a bicyclist, or another bus at a bus stop.

The Curb-Running BRT Alternative would operate in dedicated bus lanes, sharing the lanes with bicycles and right turning vehicles. However, on San Fernando Road and Truman Street, no dedicated bus lanes would be provided. The Curb-Running BRT Alternative would include 18 bus stops.

Figure 1-2: Build Alternative 1 – Curb-Running BRT Alternative

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Source: KOA and ICF International, 2014.

1.1.2.4 Build Alternative 2 – Median-Running BRT Alternative

The Median-Running BRT Alternative consists of approximately 6.7 miles of dedicated median-running bus lanes between San Fernando Road and the Metro Orange Line, and would have operational standards similar to the Metro Orange Line. The remaining 2.5 miles would operate in mixed-flow traffic between the Sylmar/San Fernando Metrolink Station and San Fernando Road/Van Nuys Boulevard. The Median-Running BRT Alternative is illustrated in Figure 1-3.

Similar to the Curb-Running BRT Alternative, the Median-Running BRT (Metro Rapid Line 761X) would operate as follows from the Sylmar/San Fernando Metrolink station:

- Metro Rapid Line 761X would operate within mixed-flow lanes on Truman Street and San Fernando Road.
- At Van Nuys Boulevard, the route would turn southwest and travel south within the median of Van Nuys Boulevard in a new dedicated guideway.
- Upon reaching the Van Nuys Metro Orange Line Station, the dedicated guideway would end and the Metro Rapid Line 761X service would then be integrated into mixed-flow traffic.
- The route would then continue south to Westwood, similar to the existing route. Similar to Build Alternative 1, it should be noted that in December 2014 the Metro Rapid Line 761 will be re-routed to travel from Van Nuys Boulevard to Ventura Boulevard, and then to Reseda Boulevard, while a new Metro Rapid Line 788 would travel from Van Nuys Boulevard through the Sepulveda Pass to Westwood as part of a Metro demonstration project.

Metro Local Line 233 would operate similar to existing conditions between the intersections of Van Nuys and Glenoaks Boulevards to the north and Van Nuys and Ventura Boulevards to the south. Metro Rapid bus stops that currently serve the 794 and 734 lines on the northern part of the alignment along Truman Street and San Fernando Road would be upgraded and have design enhancements that would be Americans with Disabilities Act (ADA) compliant. These stops would also serve the redirected 761X line:

1. Sylmar/San Fernando Metrolink Station
2. Hubbard Station
3. Maclay Station
4. Paxton Station
5. Van Nuys/San Fernando Station

Along the Van Nuys Boulevard segment, bus stop platforms would be constructed in the median. Seventeen new median bus stops would be included.

Figure 1-3: Build Alternative 2 – Median-Running BRT Alternative

Source: KOA and ICF International, 2014.

1.1.2.5 Build Alternative 3 – Low-Floor LRT/Tram Alternative

The Low-Floor LRT/Tram Alternative would operate along a 9.2-mile route from the Sylmar/San Fernando Metrolink station to the north, to the Van Nuys Metro Orange Line station to the south. The Low-Floor LRT/Tram Alternative would operate in a median dedicated guideway for approximately 6.7 miles along Van Nuys Boulevard between San Fernando Road and the Van Nuys Metro Orange Line station. The low-floor LRT/tram alternative would operate in mixed-flow traffic lanes on San Fernando Road between the intersection of San Fernando Road/Van Nuys Boulevard and just north of Wolfskill Street. Between Wolfskill Street and the Sylmar/San Fernando Metrolink station, the low-floor LRT/tram would operate in a median dedicated guideway. It would include 28 stations. The route of the Low-Floor LRT/Tram Alternative is illustrated in Figure 1-4.

The Low-Floor LRT/Tram Alternative would operate along the following route:

- From the Sylmar/San Fernando Metrolink station, the low-floor LRT/tram would operate within a median dedicated guideway on San Fernando Road.
- At Wolfskill Street, the low-floor LRT/tram would operate within mixed-flow travel lanes on San Fernando Road to Van Nuys Boulevard.
- At Van Nuys Boulevard, the low-floor LRT/tram would turn southwest and travel south within the median of Van Nuys Boulevard in a new dedicated guideway.
- The low-floor LRT/tram would continue to operate in the median along Van Nuys Boulevard until reaching its terminus at the Van Nuys Metro Orange Line Station.

Based on Metro's *Operations Plan for the East San Fernando Valley Transit Corridor Project,* the Low-Floor LRT/Tram Alternative would assume a similar travel speed as the Median-Running BRT Alternative, with speed improvements of 18 percent during peak hours/peak direction and 15 percent during off-peak hours.

The Low-Floor LRT/Tram Alternative would operate using low-floor articulated vehicles that would be electrically powered by overhead wires. This alternative would include supporting facilities, such as an overhead contact system (OCS), traction power substations (TPSS), signaling, and a maintenance and storage facility (MSF).

Because the Low-Floor LRT/Tram Alternative would fulfill the current functions of the existing Metro Rapid Line 761 and Metro Local Line 233, these bus routes would be modified to maintain service only to areas outside of the project corridor. Thus, Metro Rapid Line 761 (referred to as 761S with reduced service) would operate only between the Metro Orange Line and Westwood, and Metro Local Line 233 (referred to as 233S with reduced service) would operate only between San Fernando Road and Glenoaks Boulevard. It should be noted that in December 2014 the Metro Rapid Line 761 will be re-routed to travel from Van Nuys Boulevard to Ventura Boulevard, and then to Reseda Boulevard, while a new Metro Rapid Line 788 would travel from Van Nuys Boulevard through the Sepulveda Pass to Westwood as part of a Metro demonstration project.

Stations for the Low-Floor LRT/Tram Alternative would be constructed at various intervals along the entire route. There are portions of the route where stations are closer together and other portions where they are located further apart. Twenty-eight stations are proposed with the Low-Floor LRT/Tram Alternative. The 28 proposed low-floor LRT/tram stations would be ADA compliant.

Figure 1-4: Build Alternative 3 – Low-Floor LRT/Tram Alternative

Source: KOA and ICF International, 2014.

1.1.2.6 Build Alternative 4 – LRT Alternative

Similar to the Low-Floor LRT/Tram Alternative, the LRT would be powered by overhead electrical wires (Figure 1-5). Under Build Alternative 4, the LRT would travel in a dedicated guideway from the Sylmar/San Fernando Metrolink station along San Fernando Road south to Van Nuys Boulevard, from San Fernando Road to the Van Nuys Metro Orange Line Station, over a distance of approximately 9.2 miles. The LRT Alternative includes a segment in exclusive right-of-way through the Antelope Valley Metrolink railroad corridor, a segment with semi-exclusive right-of-way in the middle of Van Nuys Boulevard, and an underground segment beneath Van Nuys Boulevard from just north of Parthenia Street to Hart Street.

The LRT Alternative would be similar to other street-running LRT lines that currently operate in the Los Angeles area, such as the Metro Blue Line, Metro Gold Line, and Metro Exposition Line. The LRT would travel along the median for most of the route, with a subway of approximately 2.5 miles in length between Vanowen Street and Nordhoff Street. On the surface-running segment, the LRT Alternative would operate at prevailing traffic speeds and would be controlled by standard traffic signals.

Stations would be constructed at approximately 1-mile intervals along the entire route. There would be 14 stations, three of which would be underground near Sherman Way, the Van Nuys Metrolink station, and Roscoe Boulevard. Entry to the three underground stations would be provided from an entry plaza and portal. The entry portals would provide access to stairs, escalators, and elevators leading to an underground LRT station mezzanine level, which, in turn, would be connected via additional stairs, escalators, and elevators to the underground LRT station platforms

Similar to the Low-Floor LRT/Tram Alternative, the LRT Alternative would require a number of additional elements to support vehicle operations, including an OCS, TPSS, communications and signaling buildings, and an MSF.

Figure 1-5: Build Alternative 4 – LRT Alternative

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Source: KOA and ICF International, 2014.

Chapter 2
Regulatory Framework/Methodology

2.1 Regulatory Framework

2.1.1 Federal Regulations

2.1.1.1 Operational Noise

Federal noise impact thresholds for LRT and BRT operations are defined in the FTA Guidance Manual (U.S. Department of Transportation). The FTA criteria apply to transit projects seeking federal funds. The general assessment procedures and criteria are well suited to compare noise impacts among different transit modes and project alternatives. Therefore, the FTA noise criteria are applied to the BRT, LRT, TSM, and no-build options for the project.

The FTA criteria are based on the best available research on community response to noise. The research shows that characterizing the overall noise environment using measures of noise "exposure" provides the best correlation with human annoyance. Measures of noise exposure are used to characterize noise levels over a period of time.

The FTA provides different thresholds for different land uses. Table 2-1 lists the three FTA land use categories and the applicable noise metric for each category.

Table 2-1: FTA Land Use Categories and Noise Metrics

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

[1] L_{eq} for the noisiest hour of transit related activity during hours of noise sensitivity.

Source: FTA, 2006

For Category 2 land uses (residential areas where people sleep), noise exposure is characterized using L_{dn}. In calculating L_{dn}, noise created during the nighttime hours is more heavily weighted than daytime noise to reflect residents' greater sensitivity during those hours. For Category 1 and Category 3 land uses (areas with primarily daytime use), noise exposure is characterized using the peak hour L_{eq}, which is a time-averaged sound level over the noisiest hour of transit related activity.

The FTA noise impact threshold is a sliding scale based on existing noise exposure and land use of the sensitive receivers. Noise exposure characterizes noise levels over a period of time. The basic concept of the FTA impact thresholds is that more project noise exposure is allowed in areas where existing noise exposure is higher. However, in areas where existing noise exposure is higher the allowable increase above the existing noise exposure decreases. For example, in an area with an existing noise level of 55 dBA, the allowable increase in noise level is 3 dBA, which will result in a total future noise level of 58 dBA. For an area with an existing noise level of 60 dBA, the allowable increase in noise level is only 2 dBA, which will result in a total future noise level of 62 dBA.

The criteria are shown graphically in Table 2-1 for the three land use categories, along with an example of how the criteria are applied. The two graphs on the left show the Category 1 and 3 thresholds (for nonresidential land uses) where Leq is used as the noise metric. The top right graph shows Category 2 thresholds (residential land uses) where Ldn is used as the noise metric.

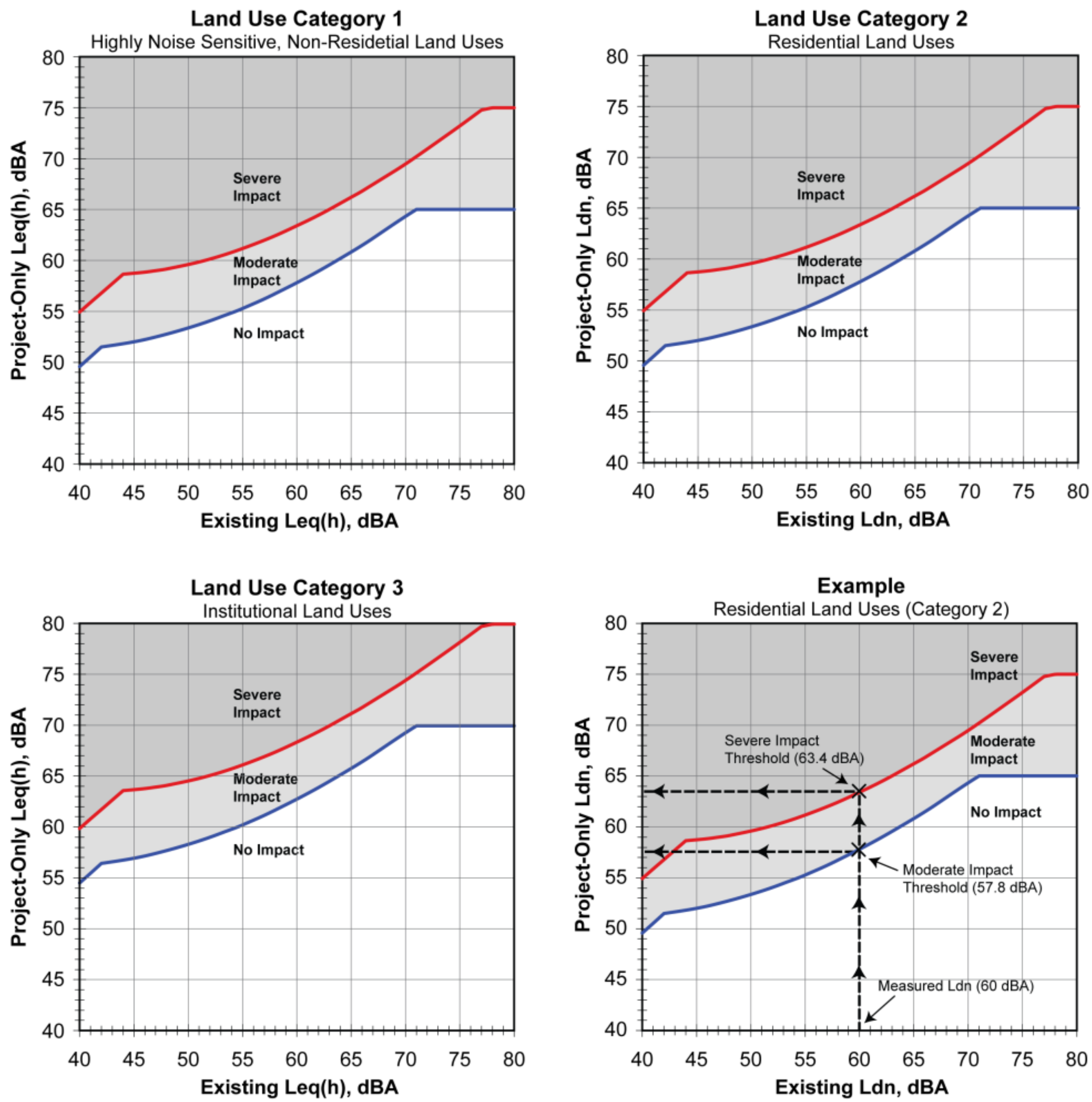
The curves in Table 2-1 are defined in terms of the project-only noise (on the vertical axes) and the existing noise (on the horizontal axes). The project-only noise is the noise introduced into the environment by the project; it is not the future noise level with the project. The project-only noise does not include noise from existing noise sources in the area that won't change as a result of the project such as automobile traffic and airplanes.

The FTA defines two levels of impact: Moderate and Severe. The lower curve in Table 2-1 (shown in blue) defines the threshold for a Moderate Impact, and the upper curve (shown in red) defines the threshold for Severe Impact. FTA guidance is to consider mitigation if the predicted increase in noise exposure exceeds the moderate threshold. If the predicted increase exceeds the severe threshold, FTA guidance is to include noise mitigation in the project unless there are compelling reasons why mitigation is not feasible. Consideration of mitigation for moderate impacts should include factors such as cost, number of sensitive receivers affected, community views, the amount that the predicted levels exceed the impact threshold, and the sensitivity of the affected receivers. The criteria are shown in tabular form in Table 2-2.

2.1.1.2 Construction Noise

No standardized federal criteria have been developed for assessing construction noise impact from a transit project. While the FTA Guidance Manual does not provide standardized criteria, it does provide guidelines for reasonable criteria for assessment if there are no state or local criteria applicable to the project. As a general guide for determining criteria, the manual states: "Project construction noise criteria should take into account the existing noise environment, the absolute noise levels during construction activities, the duration of the construction, and the adjacent land use."

Figure 2-1: FTA Noise Impact Criteria



Source: ATS Consulting, 2012

Table 2-2: FTA Noise Impact Criteria

Existing Noise Exposure[1] Leq(h) or Ldn (dBA)	Project Noise Exposure,[1] Leq(h) or Ldn(dBA)					
	Category 1 or 2 Sites			Category 3 Sites		
	No Impact	Moderate Impact	Severe Impact	No Impact	Moderate Impact	Severe Impact
<43	<Ambient+10	Ambient+ 10 to 15	>Ambient+15	<Ambient+15	Ambient+ 15 to 20	>Ambient+20
43	<52	52-58	>58	<57	57-63	>63
44	<52	52-58	>58	<57	57-63	>63
45	<52	52-58	>58	<57	57-63	>63
46	<53	53-59	>59	<58	58-64	>64
47	<53	53-59	>59	<58	58-64	>64
48	<53	53-59	>59	<58	58-64	>64
49	<54	54-59	>59	<59	59-64	>64
50	<54	54-59	>59	<59	59-64	>64
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63	<60	60-65	>65	<65	65-70	>70
64	<61	61-65	>65	<66	66-70	>70
65	<61	61-66	>66	<66	66-71	>71
66	<62	62-67	>67	<67	67-72	>72
67	<63	63-67	>67	<68	68-72	>72
68	<63	63-68	>68	<68	68-73	>73
69	<64	64-69	>69	<69	69-74	>74
70	<65	65-69	>69	<70	70-74	>74
71	<66	66-70	>70	<71	71-75	>75
72	<66	66-71	>71	<71	71-76	>76
73	<66	66-71	>71	<71	71-76	>76
74	<66	66-72	>72	<71	71-77	>77
75	<66	66-73	>73	<71	71-78	>78
76	<66	66-74	>74	<71	71-79	>79
77	<66	66-74	>74	<71	71-79	>79
>77	<66	66-75	>75	<71	71-80	>80

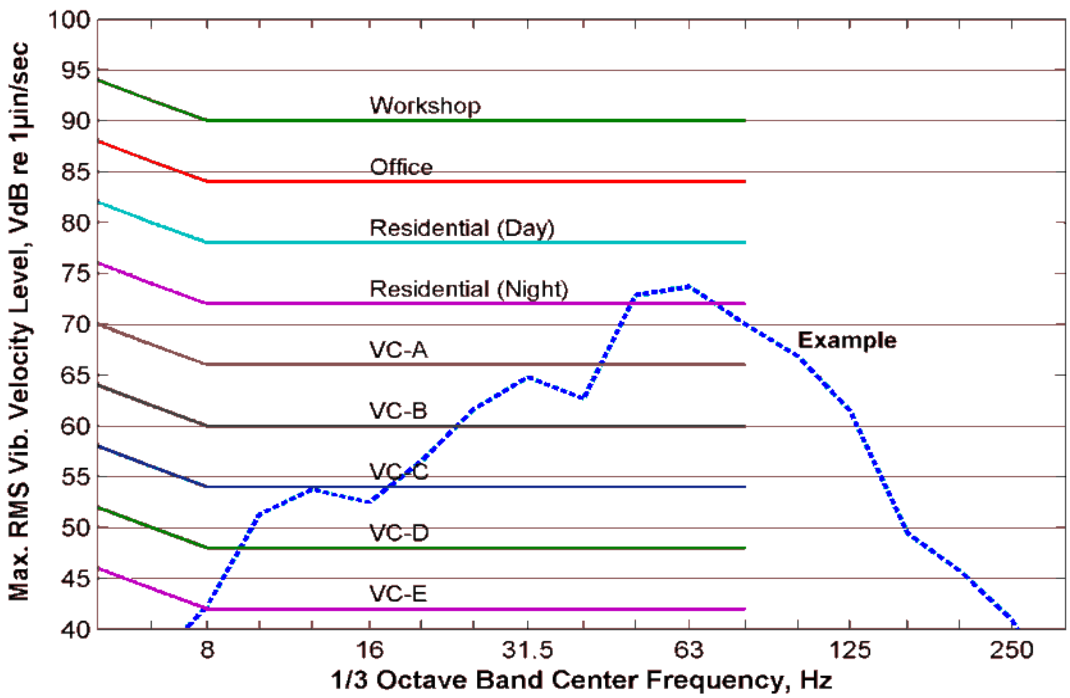
Notes: Values in this table are from the Table 3-1 in the FTA Manual and may be rounded differently than the impact thresholds applied in the analysis. The impact thresholds applied in the analysis are based on the equations in Appendix B of the FTA Manual.
[1]Ldn is used for land uses where nighttime sensitive is a factor, Leq during the hour of maximum transit noise exposure is used for land use involving only daytime activities.
Source: FTA, 2006

2.1.1.3 Operational Vibration

The FTA vibration impact criteria are based on the maximum indoor vibration level as a light-rail vehicle passes. There are no impact criteria for outdoor spaces such as parks because they are not considered vibration sensitive by the FTA.

The FTA Guidance Manual provides two sets of criteria: one based on the overall vibration velocity level for use in a General Vibration Impact Assessment and one based on the maximum vibration velocity level in any 1/3 octave band for use with a Detailed Vibration Assessment. A 1/3 octave band is a range of frequencies and each 1/3 octave band is referred to by the center frequency in that band. Predicting vibration on a 1/3 octave band basis allows vibration mitigation to be designed for the frequency range in which it will be most effective. This study uses the Detailed Vibration Assessment criteria. The thresholds for use with the Detailed Vibration Assessments are shown in Figure 2-2. The predicted vibration levels for each 1/3 octave band spectra are compared to the curves shown in Figure 2-2 to determine whether there is impact and the frequency range over which vibration mitigation is required. The VC-A through VC-E curves are used to specify acceptable vibration limits for sensitive equipment such as electron microscopes. Impact occurs when the predicted vibration velocity in any 1/3 octave band exceeds the applicable curve.

Figure 2-2: FTA Vibration Criteria for Detailed Assessment



Source: ATS Consulting, 2012

The “Residential (Night)” curve is applied to residential land uses in this study. When this curve is used, impact occurs when the predicted vibration velocity (shown on the vertical axis) exceeds 72 VdB in at least one 1/3 octave band (shown on the horizontal axis) between 8 and 80 Hz. The use of the criteria is illustrated by the example vibration levels (the dashed blue line) shown in Figure 2-2. The maximum example level exceeds the “Residential (Night)” curve in the 50 and 63 Hz 1/3 octave bands. For this example, impact would be predicted for residential land uses, and vibration mitigation would be evaluated.

The FTA vibration thresholds do not specifically account for existing vibration because it is rare that even substantial volumes of vehicular traffic, including trucks and buses, generate perceptible ground vibration unless there are irregularities in the roadway surface, such as potholes or wide expansion joints. For the same reason, the FTA Guidance Manual does not require an evaluation of vibration from BRT operations.

2.1.1.4 Construction Vibration

The primary concern regarding construction vibration is potential damage to structures. The thresholds for potential damage are much higher than the thresholds for evaluating potential annoyance presented in the previous section. The FTA Guidance Manual provides limits for construction vibration that "should be viewed as criteria that should be used during the environmental impact assessment phase to identify problem locations that must be addressed during final design." Those limits are presented in Table 2-3, below. The limits are presented both in terms of PPV (in/sec) and RMS vibration velocity (VdB).

Table 2-3: Construction Vibration Damage Criteria

Building Category	PPV (in/sec)	Approximate Lv (VdB)[1]
I. Reinforced-concrete, steel or timber (no plaster)	0.5	102
II. Engineered concrete and masonry (no plaster)	0.3	98
III. Non-engineered timber and masonry buildings	0.2	94
IV. Buildings extremely susceptible to vibration damage	0.12	90

[1] RMS velocity in decibel (VdB) ref 1 micro-inch/second
Source: FTA Guidance Manual, 2006

2.1.2 State Regulations

2.1.2.1 Operational Noise

The State of California has published *Guidelines for the Preparation and Content of the Noise Element for the General Plan*. These state guidelines are meant to provide sufficient information concerning community noise environment so that noise may be effectively considered in the land use planning process. In contrast with the FTA criteria and guidelines, the state noise guidelines were not developed to apply specifically to transit projects.

The criteria provided in the state guidelines are presented in Table 2-4 for reference. In general, the state guidelines recommend that residences and other noise sensitive land uses locate in areas where noise levels do not exceed CNEL 70 dBA.

Table 2-4: State Land Use Compatibility Guidelines for Noise

Land Use	Normally Acceptable	Conditionally Acceptable	Normally Unacceptable	Clearly Unacceptable
	CNEL, dBA			
Single-Family, Duplex, Mobile Homes	50–60	55–70	70–75	Above 70
Multi-Family Homes	50–65	60–70	70–75	Above 70
Schools, Libraries, Churches, Hospitals, Nursing Homes	50–70	60–70	70–80	Above 80
Transient Lodging-Motels, Hotels	50–65	60–70	70–80	Above 80
Auditoriums, Concert Halls, Amphitheaters	—	50–70	—	Above 65
Sports Arena, Outdoor Spectator Sports	—	50–75	—	Above 70
Playgrounds, Neighborhood Parks	50–70	—	67–75	Above 72
Golf Courses, Riding Stables, Water Recreation, Cemeteries	50–75	—	70–80	Above 80
Office Buildings, Business and Professional Commercial	50–70	67–77	Above 75	—
Industrial, Manufacturing, Utilities, Agriculture	50–75	70–80	Above 75	—

Notes:

Normally Acceptable: Specified land use is satisfactory based upon the assumption that any buildings involved are of normal conventional construction without any special noise insulation requirements.

Conditionally Acceptable: New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.

Normally Unacceptable: New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.

Clearly Unacceptable: New construction or development should generally not be undertaken.

Source: California Department of Health Services, 2003

2.1.2.2 Construction Noise

The state of California does not have limits for construction noise. The state of California Health and Safety code Division 28 is the Noise Control Act, which addresses state regulations for noise. Chapter 6 of the Noise Control Act states: "It is the purpose of this chapter to encourage the enactment and enforcement of local ordinances in those areas which are most properly the responsibility of local government." Therefore, the construction noise limits set forth in the applicable local noise ordinances are used to assess potential for construction noise impact.

2.1.2.3 Operational Vibration

The state of California does not have limits for vibration from transit systems.

2.1.2.4 Construction Vibration

The state of California does not have limits for construction vibration.

2.1.3 Local Regulations

2.1.3.1 Operational Noise

City of Los Angeles

The City of Los Angeles has prepared the *L.A. CEQA Thresholds Guide*, which specifies noise criteria for railroad and vehicular noise sources. The guide states "a project would normally have a significant impact with regard to exterior noise levels resulting from project operations if the project causes noise measured at the property line of a noise sensitive receptor to increase by 3 dBA in CNEL to or within the 'normally unacceptable' or 'clearly unacceptable' category; or any 5 dBA or greater noise increase." Table 2-5, below, based on the California Department of Health Services guidelines presented in Section 2.1.2.1, presents the "normally unacceptable" and "clearly unacceptable" thresholds for different land uses.

The impact threshold in the *L.A. CEQA Thresholds Guide* is specified in terms of the CNEL noise metric, while the FTA guidance manual noise impact threshold is specified in terms of the Ldn noise metric. However, the *L.A. CEQA Thresholds Guide* does state: "the Ldn measurement is slightly less sensitive than CNEL, but it results in very similar noise ratings for most community settings, usually differing by less than 1 dBA." Based on the relationship between CNEL and Ldn, it can be interpreted that the project will result in significant noise impact at residential and institutional land uses if:

- The existing Ldn is 67 dBA or greater at residential and institutional land uses and the project will cause noise in Ldn at the noise sensitive receiver to increase by 3 decibels or more.
- The project would cause noise in Ldn at any noise sensitive receiver to increase by 5 decibels or more.

The *L.A. CEQA Thresholds Guide* impact thresholds apply to the property line of the noise sensitive receiver; however, the FTA noise impact thresholds apply to the facade of the building. The front yards of sensitive receivers along Van Nuys Boulevard in the project area are rarely used except as an entryway. Due to infrequent outdoor use at the property line at the majority of sensitive receivers in the project area, in this analysis the *L.A. CEQA Thresholds Guide* impact thresholds are also applied to the facade of the building.

Table 2-5: State Land Use Compatibility Guidelines for Noise

Land Use	Normally Acceptable	Conditionally Acceptable	Normally Unacceptable	Clearly Unacceptable
	CNEL, dBA			
Single-Family, Duplex, Mobile Homes	50–60	55–70	70–75	Above 70
Multi-Family Homes	50–65	60–70	70–75	Above 70
Schools, Libraries, Churches, Hospitals, Nursing Homes	50–70	60–70	70–80	Above 80
Playgrounds, Neighborhood Parks	50–70	—	67–75	Above 72

Notes:

Normally Acceptable: Specified land use is satisfactory based upon the assumption that any buildings involved are of normal conventional construction without any special noise insulation requirements.

Conditionally Acceptable: New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.

Normally Unacceptable: New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.

Clearly Unacceptable: New construction or development should generally not be undertaken.

Source: L.A. CEQA Thresholds Guide, 2006

City of San Fernando

The City of San Fernando has adopted a noise control ordinance as part of its municipal code. However, the ordinance exempts trains operated in conformity with and regulated by any federal or state agency. The code also exempts any activity to the extent regulation thereof has been preempted by state or federal law. Therefore, the FTA operational noise thresholds should be applied for the project to comply with the City of San Fernando noise ordinance.

2.1.3.2 Construction Noise

City of Los Angeles

The City of Los Angeles construction noise regulations are addressed in the City of Los Angeles Municipal Code Chapter IV Section 41.40 and the *LA CEQA Thresholds Guide*. The construction noise regulations included in the municipal code are:

- No person shall, between the hours of 9:00 p.m. and 7 a.m. of the following day, perform any construction or repair work of any kind ... [which] entails the use of ... equipment which makes loud noises.
- The provisions do not apply to construction work done in any district zoned for manufacturing or industrial land uses.

The municipal code does not specify noise limits for construction. Construction noise limits are specified in the *L.A. CEQA Thresholds Guide*. Based on the guide, there would be a significant impact on noise levels from construction if:

- Construction activities lasting more than one day would exceed existing ambient exterior noise levels by 10 dBA or more at a noise sensitive use;
- Construction activities lasting more than 10 days in a three month period would exceed existing ambient exterior noise levels by 5 dBA or more at a noise sensitive use; or
- Construction activities would exceed the ambient noise level by 5 dBA at a noise sensitive use between the hours of 9:00 p.m. and 7:00 a.m. Monday through Friday, before 8:00 a.m. or after 6:00 p.m. on Saturday, or at any time on Sunday.

City of San Fernando

The City of San Fernando addresses construction noise in their municipal code in Section 34-31: "Noise sources associated with construction, repair, remodeling or grading of any real property are allowed up to 70 dB measured at the property line, provided such activities do not take place between the hours of 6:00 p.m. and 7:00 a.m. on weekdays and 6:00 p.m. and 8 a.m. on Saturdays, or at any time on Sundays or on federal holidays."

The project may file an application with the City for a variance from the noise code. The variance should include reasons why immediate compliance cannot be achieved. Additional information on obtaining a noise variance is outlined in the City of San Fernando Municipal Code Section 34-34.

2.1.3.3 Operational Vibration

There are no local regulations from the City of Los Angeles or City of San Fernando that address operational vibration.

2.1.3.4 Construction Vibration

There are no local regulations from the City of Los Angeles and the City of San Fernando that address construction vibration.

2.2 Methodology

2.2.1 Noise Impact Assessment Methodology

The noise impact assessment methodology follows the Detailed Noise Assessment guidelines outlined in the FTA Guidance Manual (U.S. Department of Transportation, Federal Transportation Agency). The basic approach of the Detailed Noise Assessment used to identify noise impacts is:

1. **Identify sensitive receivers**. Noise-sensitive land uses along the corridor are identified first using aerial photography followed by field visits to confirm land uses and the presence of any features, such as intervening structures, that may provide acoustic shielding. Sensitive receivers were grouped into clusters based on their location relative to the proposed tracks and their land use. An inventory of the sensitive receiver clusters is provided in Appendix B.

2. **Determine existing conditions**. Existing noise levels are measured throughout the project corridor. FTA noise impact thresholds are a function of the measured existing noise levels. The results of the existing conditions measurements are presented in Chapter 3.
3. **Apply prediction models**. The noise prediction models in the FTA Guidance Manual use standard formulas to characterize noise from light-rail vehicles (LRV) and BRT vehicles. Measurements of noise at existing light rail and bus rapid transit systems are also incorporated into the predictions model. The prediction model takes into account the forecasted future number of LRT or BRT operations per day, the distribution of these operations throughout the day (early morning, daytime, and nighttime), the distance of sensitive receivers from the guideway, operations speeds, and the presence of walls, berms, or structures that provide acoustic shielding for the receivers. The predictions of noise from LRT operations include the additional noise from the use of the bells to alert passengers and patrons in stations that an LRV is approaching. Details on the noise prediction models are included in Appendix D.
4. **Evaluate receivers for predicted impact**. The prediction models are used to estimate future noise for each cluster of sensitive receivers. Predictions for each cluster are compared to the applicable FTA impact thresholds and CEQA thresholds to identify potential noise impacts. The FTA impact thresholds are determined based on the existing noise levels at each cluster. The impact assessment is presented in Chapter 4.
5. **Evaluate mitigation options**. Mitigation options are evaluated for all locations where the predicted noise levels exceed the applicable threshold. Mitigation recommendations are presented in Chapter 5.

2.2.2 Vibration Impact Assessment Methodology

The approach for the vibration assessment is similar to the approach for the noise assessment. The primary differences are:

- The propagation of vibration through the ground must be based on measurements while the propagation of noise through air can be based on standard attenuation formulas.
- Existing vibration is usually not a consideration when assessing vibration impacts because it is relatively rare for people to be exposed to perceptible groundborne vibration unless they are near a construction site or near roadways with large potholes and heavy vehicles. However, existing vibration levels are taken into consideration when assessing Category 1 land uses, such as research labs or recording studios with equipment that is sensitive to groundborne vibration; and for sensitive receivers located near existing rail operations.
- Outdoor spaces are not considered sensitive to groundborne vibration. In contrast, outdoor spaces where quiet is important for their intended function are considered noise sensitive (e.g., spaces intended for meditation or study associated with cemeteries, monuments, or historical spaces).
- Vibration assessment is applicable only for FTA based evaluation of LRT operations. A vibration assessment is not required for evaluation of BRT operations.

The basic steps used to identify potential vibration impacts are:

1. Identify sensitive receivers. Vibration sensitive receivers are identified in the same manner as noise sensitive receivers: first using aerial photography, followed by field visits to confirm land uses. However, the vibration sensitive receivers may not be identical to the noise sensitive receivers because outdoor open spaces such as parks may be considered to be noise sensitive but

are not vibration sensitive. Also, special land uses such as recording studios and concert halls are often considered more sensitive to groundborne vibration than to airborne noise. An inventory of the sensitive receiver clusters is provided in Appendix D.

2. Determine existing conditions at Category 1 land uses or at sensitive receivers near an existing rail line. The results of the existing conditions measurements are presented in Chapter 3.
3. Develop prediction models. The vibration prediction model is based on the detailed vibration assessment methodology presented in the FTA Guidance Manual. The model incorporates measurements of vibration propagation conditions throughout the project corridor and vibration measurements of existing LRT transit systems. The model also takes into account the proposed LRV speed, the proposed track type, and the distance from the sensitive receivers to the proposed location of the LRT tracks. Details on the vibration prediction models are included in Appendix F.
4. Evaluate receivers for predicted impact. The prediction models are used to predict vibration levels from LRT operations at the identified sensitive receivers. The predictions are compared to the applicable FTA detailed vibration impact thresholds to identify potential vibration impacts. The impact assessment is presented in Chapter 4.
5. Evaluate mitigation options. Mitigation options are evaluated for all locations where the predicted vibration levels exceed the FTA detailed assessment impact thresholds. Mitigation recommendations are presented in Chapter 5.

The FTA detailed vibration prediction model mentioned in step 3 is an empirical method based on measurements of the vibration propagation characteristics of the soil in the project corridor and measurements of the vibration characteristics of a similar light-rail vehicle. The vibration propagation test is used to determine the line source transfer mobility (LSTM). The LSTM quantifies how easily vibration travels through the soil. The vibration characteristics of the light-rail or tram vehicle are quantified by the force density level (FDL). The basic relationship used for the vibration predictions is:

$$Lv = LSTM + FDL + \text{Safety Factor}$$

where:

Lv = Train vibration velocity measured at ground surface,

LSTM = Line source transfer mobility characterizing how easily vibration travels through the soil,

FDL = Force density level that characterizes the vibration forces generated by the train and track,

Safety Factor = Safety factor of +5 dB included in the predictions to ensure predicted groundborne vibration levels are not underestimated.

The LSTM was measured at ten sites throughout the project corridor. The FDL was measured on the Metro Gold Line north of the Chinatown station. Detailed measurement results for the LSTM and FDL are presented in Appendix D and Appendix F.

2.3 Significance Thresholds

2.3.1 Federal

2.3.1.1 Operational Noise

The FTA has established specific operational noise criteria for transit projects in the FTA Guidance Manual. The FTA Guidance Manual presents both moderate and severe noise impact thresholds. These criteria are summarized in Section 2.1.1.1. The severe noise impact criteria are used as the federal operational noise significance thresholds for the project; however, noise mitigation is considered for any locations where moderate noise impact is identified.

2.3.1.2 Construction Noise

The FTA has not established standardized construction noise criteria for transit projects and instead defers to state and local guidelines. Therefore, there are no federal significance thresholds for construction noise that are applicable to the project and the state and local significance thresholds for construction noise will be used to assess potential for impact.

2.3.1.3 Operational Vibration

The FTA has established specific operational vibration criteria for transit projects in the FTA Guidance Manual. The FTA Guidance Manual presents both general and detailed vibration criteria. The detailed vibration criteria are summarized in Section 2.1.1.5 and are used as the federal operational vibration significance thresholds for the project.

2.3.1.4 Construction Vibration

The FTA Guidance Manual includes recommended impact thresholds for construction vibration to be used during the environmental impact assessment. These criteria are summarized in Section 2.1.1.4, and are used as the federal construction vibration significance thresholds for the project.

2.3.2 State and Local

The state provides guidelines for acceptable noise levels; however, there are no specific thresholds that are directly applicable to transit projects. Therefore, the thresholds set forth for noise in the *L.A. CEQA Thresholds Guide* are used as the state and local operational noise significance thresholds for the project. These criteria are summarized in Section 2.1.3.

2.3.2.1 Operational Noise

The thresholds set forth in the *L.A. CEQA Thresholds Guide* will be used to evaluate the following questions set forth in the checklist provided in Appendix G of the state *CEQA Statute and Guidelines:*

- Would the project expose people to or generate noise levels in excess of standards established in the local general plan or noise ordinance or in the applicable standards of other agencies?
- Would the project result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?

- For a project located within an airport land use plan or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport, would the project expose people residing or working in the project study area to excessive noise levels?
- For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project study area to excessive noise levels?

2.3.2.2 Construction Noise

The thresholds set forth for construction noise in the *L.A. CEQA Thresholds Guide* and the City of San Fernando municipal code are used as the state and local construction noise significance thresholds for the project. These criteria are summarized in Section 2.1.3.2. These thresholds will be used to evaluate the following question from the checklist provided in Appendix G of the state *CEQA Statute and Guidelines*:

- Would the project result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?

2.3.2.3 Operational Vibration

There are no applicable state and local operational vibration criteria. Therefore, there are no state and local operational vibration significance thresholds that are applicable to the project and the federal operational vibration significance thresholds will be used to assess potential for impact. Specifically, the federal operational vibration significance thresholds will be used to evaluate the following question from the checklist provided in Appendix G of the state *CEQA Statute and Guidelines*:

- Would the project expose people to or generate excessive groundborne vibration or groundborne noise levels?

2.3.2.4 Construction Vibration

There are no applicable state and local construction vibration criteria. Therefore, there are no state and local construction vibration significance thresholds that are applicable to the project and the federal construction vibration significance thresholds will be used as the significance thresholds.

Chapter 3
Affected Environment/Existing Conditions

3.1 Existing Noise Levels

A noise measurement program was carried out to document the existing noise levels at sensitive receivers throughout the project corridor. The test procedures followed the detailed noise analysis procedure described in the FTA Guidance Manual. The primary noise source throughout the project corridor is traffic on Van Nuys Boulevard. The existing noise measurements also capture all other environmental noises, including emergency sirens, airplanes, dogs barking, and pedestrians.

The measurement sites were selected to represent a range of existing noise conditions throughout the project corridor. Short-term (1-hour) noise measurements were conducted at locations with primarily daytime use, such as schools and churches. Long-term (24-hour) noise measurements were conducted at residential land uses where people sleep and are sensitive to nighttime noise.

At each site, the measurement microphone was positioned to characterize the exposure of the site to the dominant noise sources in the area. For example, microphones at most sites were located at approximately the same distance from Van Nuys Boulevard as the noise sensitive building. The microphones were also positioned to avoid acoustic shielding by walls, fences, or other obstructions and acoustic reflections from hard surfaces.

3.1.1 Short-Term Noise Measurement Results

Existing ambient noise levels at noise sensitive sites with primarily daytime use, such as schools and churches, were characterized through 13 one-hour measurements. The results of the noise measurements are summarized in Table 3-1. The 1-hour L_{eq} at the 13 sites ranged from 62 to 71 dBA. The primary noise source at all short-term measurement sites was traffic noise from the nearest roadway. Sites located closest to Van Nuys Boulevard have the highest existing noise levels.

Table 3-1: Summary of Short-Term Noise Measurement Results

Site Label	Measurement Location	Distance to Nearest Major Roadway	Start of Measurement		L_{eq} (1-hr) (dBA)
			Date	Time	
ST-1	San Fernando Middle School 130 N Brand Boulevard	30 ft	3/14/13	11:19	62
ST-2	Pacoima Branch Library 13605 Van Nuys Boulevard	30 ft	1/20/12	14:53	71
ST-3	Mary Immaculate School 10390 Remick Avenue	390 ft	1/20/12	14:46	65
ST-4	Arleta High School 14200 Van Nuys Boulevard	45 ft	1/19/12	15:21	70
ST-5	Imam Bukhari Masjid 8741 Van Nuys Boulevard	45 ft	1/19/12	14:02	69

Site Label	Measurement Location	Distance to Nearest Major Roadway	Start of Measurement		L_{eq} (1-hr) (dBA)
			Date	Time	
ST 6	Western Beauty Institute 8612 Van Nuys Boulevard	30 ft	1/25/12	13:57	71
ST 7	Panorama High School 8015 Van Nuys Boulevard	40 ft	1/19/12	12:41	71
ST 8	UEI College 7335 Van Nuys Boulevard	70 ft	1/18/12	13:55	65
ST 9	ICDC College 14434 Sherman Way	150 ft	1/18/12	14:10	62
ST 10	CHAMPS Charter High School 6952 Van Nuys Boulevard	50 ft	1/24/12	11:19	69
ST 11	Preferred College of Nursing 6551 Van Nuys Boulevard	20 ft	1/20/12	12:19	70
ST 12	Los Angeles ORT College 14159 Sylvan Street	195 ft	1/24/12	14:13	62

Source: ATS Consulting, 2013

3.1.2 Long-Term Noise Measurement Results

Existing ambient noise levels at residential land uses or other locations where people are sensitive to nighttime noise (such as hotels and hospitals) were documented through nine 24-hour measurements. The noise measurement results are summarized in Table 3-2. The noise levels at residential land uses are presented in terms of the Day-Night Sound Level (Ldn). Ldn is the energy average noise level of 24-hours, with noise during the nighttime hours (10 p.m. to 7 a.m.) weighted more heavily.

Three of the long-term (LT) measurement locations were on Van Nuys Boulevard where the dominant noise source is traffic on Van Nuys Boulevard. These locations are referred to as first-row receivers because there are no buildings or other intervening structures that block noise from traffic on Van Nuys Boulevard. The long-term measurement sites at first row receivers are LT- 4, LT- 5, and LT -6. The 24-hour L_{dn} noise levels at the first row receivers ranged from 69 dBA to 72 dBA.

Four of the long-term measurement locations were located one block back from Van Nuys Boulevard at second-row receivers. These residences are acoustically shielded from the traffic noise by commercial buildings. The dominant noise source at these receivers was noise from local traffic on peripheral streets and some reduced noise from Van Nuys and Ventura Boulevards. The long-term measurement sites at second row receivers are LT-3, LT-7, LT-8, and LT-9. The 24-hr L_{dn} noise levels at the second row receivers ranged from 54 to 62 dBA.

Table 3-2: Summary of Long-Term Noise Measurement Results

Site Label	Measurement Location	Distance[1]	Start of Measurement		L_{dn} (dBA)
			Date	Time	
LT-1	12171 San Fernando Rd	365 ft (this is to NT)[3]	3/05/13	16:00	68
LT-2	101 Park Avenue	145 ft (this is to NT)[3]	3/05/13	16:00	76
LT-3	13642 Pinney Street	255 ft[2]	1/25/12	15:00	62
LT-4	1396 Bartee Street	45 ft	1/19/12	16:00	72
LT-5	9301 Van Nuys Boulevard	50 ft	1/19/12	14:00	69
LT-6	8924 Van Nuys Boulevard	35 ft	3/04/13	13:00	73
LT-7	8801 Tilden Avenue	290 ft[2]	2/28/13	15:00	54
LT-8	7467 Sylmar Avenue	285 ft[2]	1/26/12	16:00	58
LT-9	5322 Circle Drive	175 ft[2]	1/18/12	11:00	62

[1] Distance to closest lane of traffic on Van Nuys Boulevard, Sepulveda Boulevard, or Ventura Boulevard.
[2] The measurement location is a second-row receiver. There is an intervening row of buildings between the measurement location and the project.
[3] Distance to the existing Metrolink/freight tracks. The dominant noise source in this area is horn noise from Metrolink and freight trains.
Source: ATS Consulting, 2013.

Two of the long-term measurement locations were located along the section of the project that runs parallel to San Fernando Road. In this area one of the main noise sources is noise from the existing Metrolink and freight rail line, particularly horn noise. The 24-hr L_{dn} noise levels at these two measurement locations (LT-1 and LT-2) are 68 and 76 dBA, respectively.

3.2 Existing Vibration Levels

The primary existing vibration source in the project study area is vehicular traffic on Van Nuys Boulevard. Vehicular traffic does not generally cause perceptible vibration, and when it does, the source can usually be traced to bumps in the roadway surface such as potholes or wide expansion joints. Because the existing environmental vibration is often too low to be noticed by humans, the FTA Guidance Manual recommends only a limited survey of existing vibration conditions. Situations where measurements of the existing vibration conditions are valuable include existing rail lines in the project study area and sensitive buildings where vibration may interfere with operations within the building (Category 1 land uses such as recording studios or laboratories with sensitive equipment).

There are two existing rail lines within the project study area: one between Keswick Street and Arminta Street and a second running along the east side of San Fernando Road (in the Metrolink ROW). Union Pacific Railroad freight trains, Metrolink commuter trains, and Amtrak trains operate on both existing rail lines. There are no vibration sensitive receivers within 250 feet of the rail line between Keswick Street and Arminta Street. Residential receivers and San Fernando Middle School are located near the Metrolink ROW along San Fernando Road.

An existing vibration measurement was performed at the San Fernando Middle School Auditorium. For the measurement, an accelerometer was placed outside on the sidewalk near the Auditorium about 550 feet from the existing Metrolink tracks. The measurement duration was approximately one hour. During the measurement, one Metrolink train and one freight train passed by. The vibration levels of the train events are shown in Table 3-3.

Existing vibration measurements were not performed at the residential receivers near the San Fernando Metrolink ROW because of the infrequent train traffic in the corridor. The FTA vibration impact thresholds do not take into account existing vibration levels when the existing train traffic is relatively infrequent compared to the project.

Table 3-3: Existing Vibration at the San Fernando Middle School Auditorium

Event	Vibration Level (VdB)[1]
Background (L_{eq})	47
Metrolink train	61
Freight train	54

[1] The background vibration level is the L_{eq} over the entire measurement period. The vibration level the trains is the maximum 1-second RMS (root mean square) vibration level (L_{max}).
Source: ATS Consulting, 2014

Chapter 4
Environmental Consequences/ Environmental Impacts

4.1 No-Build Alternative

4.1.1 Noise

There is no predicted change in noise levels for the No Build Alternative; therefore, the noise levels for the No Build Alternative do not exceed the FTA Impact thresholds and no noise impact is predicted.

4.1.2 Vibration

The vibration levels for the No Build Alternative are expected to remain the same as under existing conditions; therefore, the vibration levels for the No Build Alternative do not exceed the FTA impact thresholds and no vibration impact is predicted.

4.2 TSM Alternative

4.2.1 Noise

The TSM Alternative would add 20 additional buses to the existing Metro Local 233 and Metro Rapid 761 bus routes. Under the TSM Alternative, operational changes would include reduced headway times as follows:

- Metro Rapid Line 761 would operate with headways reduced from 10 minutes to 8 minutes during peak hours (7 a.m. to 9 a.m. and 4 p.m. to 7 p.m. on weekdays) and from 17.5 minutes to 12 minutes during off-peak hours.
- Metro Local Line 233 would operate with headways reduced from 12 minutes to 8 minutes during peak hours and from 20 minutes to 16 minutes during off-peak hours.

The proposed increase in bus volume would result in a 1.5 decibel increase in bus noise (L_{eq}). However, bus noise is only one part of the existing noise environment. A 1.5 decibel increase in bus noise would result in a less than one decibel increase in overall noise levels, because the overall noise levels are dominated by the automobile traffic noise.

The TSM Alternative may also include minor enhancements to the roadway network; however, those changes would probably have a negligible effect on future noise levels.

The changes in noise levels as a result of the TSM Alternative would not exceed the FTA severe or moderate noise impact thresholds or the CEQA significance threshold at any sensitive receivers. Therefore, there is no adverse noise impact using the federal impact threshold, and a less-than-significant impact using the state/local significance threshold.

4.2.2 Vibration

It is unusual for rubber-tired vehicles such as buses on smooth roadways to cause perceptible vibration. The FTA guidance manual advises that no vibration impact is likely and no analysis is needed for rubber-tired vehicles operating on smooth roadway. Therefore, vibration from additional bus volumes or minor changes to the roadway network that would be part of the TSM Alternative would have no adverse effect under the FTA guidance.

There are no applicable state and local operational vibration criteria. Therefore, the FTA impact thresholds are also adopted as the state and local significance thresholds. Under FTA guidance, the TSM alternative would have no significant vibration impact and would not expose people to or generate excessive groundborne vibration or groundborne noise.

4.3 Build Alternative 1 – Curb-Running BRT Alternative

4.3.1 Noise

Changes in noise levels as a result of Build Alternative 1 would be from an increase in bus traffic. The additional bus traffic would operate in the curb-side lane, close to sensitive receivers. The predicted noise levels for Build Alternative 1 assumes all new bus traffic would operate in the curb-side lane. The bus noise predictions are based on reference level measurements of the Metro Orange Line buses. Additional information on the bus noise prediction model is included in Appendix C.

Table 4-1 presents the noise impact assessment using the FTA and CEQA impact thresholds for Category 2, residential, receivers. Table 4-2 presents the same information for Category 3, institutional, receivers. The tables present predicted levels for clusters of sensitive receiver identified in the project area. The locations of the clusters of sensitive receivers are shown in Appendix B.

The FTA severe noise impact threshold is used as the federal significance threshold for operational noise impacts. Severe noise impact is not predicted at any clusters of sensitive receivers. Therefore, there is no adverse noise effect for Build Alternative 1.

Moderate noise impacts are predicted at three clusters of Category 2 sensitive receivers located closest to Van Nuys Boulevard. According to FTA guidance, mitigation measures should be implemented for severe noise impacts unless there are compelling reasons why mitigation is not feasible. For moderate noise impacts, noise mitigation should be considered and adopted when it is considered reasonable. The FTA guidance manual recommends taking into account the number of affected sites, the increase over existing noise levels, and the cost of the mitigation among other factors when determining if mitigation for moderate impacts is reasonable. Mitigation measures are suggested for moderate impacts in Section 5.1.1.1; however, final decisions on the implementation of mitigation measures for moderate impacts should weigh project specific factors related to reasonableness.

The local significance thresholds for operational noise impacts are based on the *L.A. CEQA Thresholds Guide*. A significant impact is identified if the predicted future noise level is 5 decibels greater than the existing noise level at any sensitive receiver, or if there is a 3 decibel increase at any sensitive receiver where the predicted future noise level is at least 70 dBA. The predicted future is the decibel sum of the existing noise level and the predicted project noise level. The predicted future noise level does not exceed the local significance threshold at any sensitive receivers. Therefore, there is less-than significant noise impact for Build Alternative 1.

Table 4-1: Predicted Noise Levels for Build Alternative 1, Category 2 (Residential) Receivers

			FTA Impact Assessment				CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Ldn in dBA)	Predicted Project Noise (Ldn in dBA)	FTA Moderate Impact Threshold, Project Noise (Ldn in dBA)	FTA Severe Impact Threshold, Project Noise (Ldn in dBA)	FTA Level of Impact before Mitigation[2]	Predicted Future Noise Level (Ldn in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before Mitigation[3]
NB-01	MFR	54	45	55	61	--	55	1	5	--
NB-02	MFR	54	45	55	61	--	55	1	5	--
NB-03	MFR	54	45	55	61	--	55	1	5	--
NB-04	MFR	55	46	55	61	--	56	1	5	--
NB-05	MFR	55	46	55	61	--	56	1	5	--
NB-06	SFR	55	46	55	61	--	56	1	5	--
NB-07	SFR	53	45	55	61	--	54	1	5	--
NB-08	SFR	53	45	55	61	--	54	1	5	--
NB-09	SFR	53	45	55	61	--	54	1	5	--
NB-10	MFR	66	59	62	67	--	67	1	5	--
NB-11	SFR	55	47	55	61	--	56	1	5	--
NB-12	MFR	63	50	60	65	--	63	0	5	--
NB-13	MFR	67	59	62	67	--	68	1	3	--
NB-14	MFR	53	44	54	60	--	54	1	5	--
NB-15	MFR	67	59	62	67	--	68	1	3	--
NB-15B	MFR	57	50	56	62	--	58	1	5	--
NB-16	MFR	68	64	63	68	Moderate	69	1	3	--
NB-17	MFR	67	59	62	67	--	68	1	3	--
NB-18	MFR	68	62	63	68	--	69	1	3	--
NB-19	SFR	65	57	61	66	--	66	1	5	--
NB-20	SFR	55	46	55	61	--	56	1	5	--
NB-21	MFR	66	57	62	67	--	67	1	5	--

			FTA Impact Assessment				CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Ldn in dBA)	Predicted Project Noise (Ldn in dBA)	FTA Moderate Impact Threshold, Project Noise (Ldn in dBA)	FTA Severe Impact Threshold, Project Noise (Ldn in dBA)	FTA Level of Impact before Mitigation[2]	Predicted Future Noise Level (Ldn in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before Mitigation[3]
NB-22	MFR	66	56	61	67	--	66	0	5	--
NB-23	MFR	66	57	62	67	--	67	1	5	--
NB-24	SFR	55	47	55	61	--	56	1	5	--
NB-25	SFR	66	57	61	67	--	67	1	5	--
NB-26	SFR	55	47	55	61	--	56	1	5	--
NB-27	SFR	55	47	55	61	--	56	1	5	--
NB-28	SFR	55	47	56	61	--	56	1	5	--
NB-29	MFR	69	62	64	69	--	70	1	3	--
NB-30	SFR	55	46	55	61	--	56	1	5	--
NB-31	SFR	55	46	55	61	--	56	1	5	--
NB-32	SFR	55	47	55	61	--	56	1	5	--
NB-33	SFR	55	46	55	61	--	56	1	5	--
NB-34	SFR	55	48	55	61	--	56	1	5	--
NB-35	SFR	55	46	55	61	--	56	1	5	--
NB-36	SFR	55	46	55	61	--	56	1	5	--
NB-37	SFR	58	49	57	62	--	59	1	5	--
NB-38	SFR	55	46	55	61	--	56	1	5	--
NB-39	SFR	55	48	55	61	--	56	1	5	--
NB-40	MFR	58	49	57	62	--	59	1	5	--
NB-41	MFR	67	53	62	67	--	67	0	3	--
NB-42	SFR	69	44	64	69	--	69	0	3	--
SB-01	MFR	56	47	56	61	--	57	1	5	--
SB-02	SFR	56	47	56	61	--	57	1	5	--

		FTA Impact Assessment					CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Ldn in dBA)	Predicted Project Noise (Ldn in dBA)	FTA Moderate Impact Threshold, Project Noise (Ldn in dBA)	FTA Severe Impact Threshold, Project Noise (Ldn in dBA)	FTA Level of Impact before Mitigation[2]	Predicted Future Noise Level (Ldn in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before Mitigation[3]
SB-03	MFR	59	44	57	63	--	59	0	5	--
SB-04	MFR	55	48	55	61	--	56	1	5	--
SB-05	MFR	54	45	55	61	--	55	1	5	--
SB-06	MFR	67	61	62	68	--	68	1	3	--
SB-07	MFR	55	46	55	61	--	56	1	5	--
SB-08	MFR	67	60	62	68	--	68	1	3	--
SB-09	MFR	55	46	55	61	--	56	1	5	--
SB-10	MFR	54	47	55	61	--	55	1	5	--
SB-11	MFR	68	62	63	68	--	69	1	3	--
SB-12	MFR	55	46	55	61	--	56	1	5	--
SB-13	MFR	67	59	62	67	--	68	1	3	--
SB-14	MFR	68	64	63	68	Moderate	69	1	3	--
SB-15	MFR	68	63	63	68	Moderate	69	1	3	--
SB-16	MFR	55	46	55	61	--	56	1	5	--
SB-17	MFR	57	49	56	62	--	58	1	5	--
SB-18	MFR	67	61	62	68	--	68	1	3	--
SB-19	MFR	67	60	62	68	--	68	1	3	--
SB-20	MFR	66	56	61	67	--	66	0	5	--
SB-21	MFR	66	58	62	67	--	67	1	5	--
SB-22	SFR	66	56	61	67	--	66	0	5	--
SB-23	SFR	52	44	54	60	--	53	1	5	--
SB-24	SFR	65	55	61	66	--	65	0	5	--
SB-25	SFR	55	47	55	61	--	56	1	5	--

			FTA Impact Assessment				CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Ldn in dBA)	Predicted Project Noise (Ldn in dBA)	FTA Moderate Impact Threshold, Project Noise (Ldn in dBA)	FTA Severe Impact Threshold, Project Noise (Ldn in dBA)	FTA Level of Impact before Mitigation[2]	Predicted Future Noise Level (Ldn in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before Mitigation[3]
SB-26	MFR	65	54	61	66	--	65	0	5	--
SB-27	MFR	52	44	54	60	--	53	1	5	--
SB-28	SFR	56	49	56	61	--	57	1	5	--
SB-29	SFR	65	55	61	66	--	65	0	5	--
SB-30	SFR	56	47	56	61	--	57	1	5	--
SB-31	SFR	66	55	61	67	--	66	0	5	--
SB-32	SFR	56	47	56	61	--	57	1	5	--
SB-33	SFR	55	47	55	61	--	56	1	5	--
SB-34	SFR	53	45	55	61	--	54	1	5	--
SB-35	SFR	55	47	55	61	--	56	1	5	--
SB-36	SFR	55	47	55	61	--	56	1	5	--
SB-37	SFR	56	47	56	61	--	57	1	5	--
SB-38	SFR	55	46	55	61	--	56	1	5	--
SB-39	SFR	59	45	57	63	--	59	0	5	--
SB-40	SFR	56	50	56	62	--	57	1	5	--

Notes: L_{dn} = 24-hour day-night level; dBA = A-weighted decibel; MFR = multi-family residence; SFR = single-family residence
[1] Cluster locations are shown in Appendix B
[2] FTA level of impact is determined by comparing the predicted project noise to the FTA moderate and severe impact thresholds.
[3] CEQA impact is determined by comparing the predicting increase to the CEQA allowable increase impact threshold.
Source: ATS Consulting, 2014

Table 4-2: Predicted Noise Levels for Build Alternative 1, Category 3 (Institutional) Receivers

			FTA Impact Assessment				CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Leq in dBA)	Predicted Project Noise (Leq in dBA)	FTA Moderate Impact Threshold, Project Noise (Leq in dBA)	FTA Severe Impact Threshold, Project Noise (Leq in dBA)	FTA Level of Impact before mitigation[2]	Predicted Future Noise Level (Leq in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before mitigation[3]
NB-A	School	69	60	69	74	--	70	1	3	--
NB-B	School	69	61	69	74	--	70	1	3	--
NB-C	Church	68	56	68	73	--	68	0	3	--
NB-D	School	62	45	64	69	--	62	0	5	--
NB-E	School	73	61	70	77	--	73	0	3	--
NB-F	School	71	59	70	75	--	71	0	3	--
NB-G	Church	67	55	67	72	--	67	0	3	--
NB-H	Church	66	52	66	72	--	66	0	5	--
NB-I	School	70	50	69	75	--	70	0	3	--
NB-J	School	71	61	70	75	--	71	0	3	--
NB-K	School	72	61	70	76	--	72	0	3	--
NB-L	School	71	60	70	75	--	71	0	3	--
NB-M	School	71	61	70	75	--	71	0	3	--
NB-N	School	62	49	64	69	--	62	0	5	--
SB-A	School	62	44	64	70	--	62	0	5	--
SB-B	School	71	57	70	75	--	71	0	3	--
SB-C	School	65	61	66	71	--	66	1	5	--
SB-D	School	67	61	67	72	--	68	1	3	--
SB-E	School	71	55	70	75	--	71	0	3	--
SB-F	Church	69	61	69	74	--	70	1	3	--
SB-G	Park	70	62	69	74	--	71	1	3	--
SB-H	Church	70	49	69	74	--	70	0	3	--

			FTA Impact Assessment				CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Leq in dBA)	Predicted Project Noise (Leq in dBA)	FTA Moderate Impact Threshold, Project Noise (Leq in dBA)	FTA Severe Impact Threshold, Project Noise (Leq in dBA)	FTA Level of Impact before mitigation[2]	Predicted Future Noise Level (Leq in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before mitigation[3]
SB-I	Church	71	51	70	75	--	71	0	3	--
SB-J	School	66	39	66	72	--	66	0	5	--
SB-K	Church	71	61	70	75	--	71	0	3	--
SB-L	School	71	61	70	75	--	71	0	3	--
SB-M	School	71	61	70	75	--	71	0	3	--

Notes: L_{eq} = Equivalent continuous sound level; dBA = A-weighted decibel
[1] Cluster locations are shown in Appendix B
[2] FTA level of impact is determined by comparing the predicted project noise to the FTA moderate and severe impact thresholds.
[3] CEQA impact is determined by comparing the predicting increase to the CEQA allowable increase impact threshold
Source: ATS Consulting, 2014

4.3.2 Vibration

Rubber-tired vehicles such as buses on smooth, maintained roadways generally do not cause perceptible vibration. The FTA guidance manual advises that no vibration impact is likely and no analysis is needed for rubber-tired vehicles operating on smooth roadway. Therefore, vibration from the Curb-Running BRT Alternative would have no adverse effect under the FTA guidance.

There are no applicable state and local operational vibration criteria. Therefore, the FTA impact thresholds are also adopted as the state and local significance thresholds. Under FTA guidance, Build Alternative 1 would have no significant vibration impact and would not expose people to or generate excessive groundborne vibration or groundborne noise.

4.4 Build Alternative 2 – Median-Running BRT Alternative

4.4.1 Noise

Changes in noise levels as a result of Build Alternative 2 would be from an increase in bus traffic and the relocation of some bus traffic from the curbside lanes to median lanes. As a result of the project, the headways for both the Metro Rapid 761 line and the Metro Local 233 line would be reduced. The bus noise predictions are based on reference level measurements of the Metro Orange Line buses. Additional information on the bus noise prediction model is included in Appendix C.

Table 4-3 presents the noise impact assessment using the FTA and CEQA impact thresholds for Category 2, residential, receivers. Table 4-4 presents the same information for Category 3, institutional, receivers. The tables present predicted levels for clusters of sensitive receivers identified in the project area. The locations of the clusters of sensitive receivers are included in Appendix B.

The FTA severe noise impact threshold is used as the federal significance threshold for operational noise impacts. Severe noise impact is not predicted at any clusters of sensitive receivers. Therefore, there is no adverse noise effect for Build Alternative 2. There are also no moderate noise impacts predicted for Build Alternative 2.

The local significance thresholds for operational noise impacts are based on the *L.A. CEQA Thresholds Guide*. A significant impact is identified if the predicted future noise level is 5 decibels greater than the existing noise level at any sensitive receiver, or if there is a 3 decibel increase at any sensitive receiver where the predicted future noise level is at least 70 dBA. The predicted future noise level is the decibel sum of the existing noise level and the predicted project noise level. The predicted future noise level does not exceed the local significance threshold at any sensitive receivers. Therefore, there is less-than significant noise impact for Build Alternative 2.

Table 4-3: Predicted Noise Levels for Build Alternative 2, Category 2 (Residential) Receivers

			FTA Impact Assessment				CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Ldn in dBA)	Predicted Project Noise (Ldn in dBA)	FTA Moderate Impact Threshold, Project Noise (Ldn in dBA)	FTA Severe Impact Threshold, Project Noise (Ldn in dBA)	FTA Level of Impact (before Mitigation)[2]	Predicted Future Noise Level (Ldn in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before Mitigation[3]
NB-01	MFR	54	45	55	61	--	55	1	5	--
NB-02	MFR	54	45	55	61	--	55	1	5	--
NB-03	MFR	54	45	55	61	--	55	1	5	--
NB-04	MFR	55	46	55	61	--	56	1	5	--
NB-05	MFR	55	46	55	61	--	56	1	5	--
NB-06	SFR	55	46	55	61	--	56	1	5	--
NB-07	SFR	53	45	55	61	--	54	1	5	--
NB-08	SFR	53	45	55	61	--	54	1	5	--
NB-09	SFR	53	45	55	61	--	54	1	5	--
NB-10	MFR	66	57	62	67	--	67	1	5	--
NB-11	SFR	55	47	55	61	--	56	1	5	--
NB-12	MFR	63	54	60	65	--	64	1	5	--
NB-13	MFR	67	57	62	67	--	67	0	3	--
NB-14	MFR	53	44	54	60	--	54	1	5	--
NB-15	MFR	67	57	62	67	--	67	0	3	--
NB-15B	MFR	57	50	56	62	--	58	1	5	--
NB-16	MFR	68	58	63	68	--	68	0	3	--
NB-17	MFR	67	57	62	67	--	67	0	3	--
NB-18	MFR	68	58	63	68	--	68	0	3	--
NB-19	SFR	65	56	61	66	--	66	1	5	--
NB-20	SFR	55	46	55	61	--	56	1	5	--
NB-21	MFR	66	56	62	67	--	66	0	5	--

			FTA Impact Assessment				CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Ldn in dBA)	Predicted Project Noise (Ldn in dBA)	FTA Moderate Impact Threshold, Project Noise (Ldn in dBA)	FTA Severe Impact Threshold, Project Noise (Ldn in dBA)	FTA Level of Impact (before Mitigation)[2]	Predicted Future Noise Level (Ldn in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before Mitigation[3]
NB-22	MFR	66	56	61	67	--	66	0	5	--
NB-23	MFR	66	56	62	67	--	66	0	5	--
NB-24	SFR	55	46	55	61	--	56	1	5	--
NB-25	SFR	66	55	61	67	--	66	0	5	--
NB-26	SFR	55	46	55	61	--	56	1	5	--
NB-27	SFR	55	47	55	61	--	56	1	5	--
NB-28	SFR	55	47	56	61	--	56	1	5	--
NB-29	MFR	69	57	64	69	--	69	0	3	--
NB-30	SFR	55	46	55	61	--	56	1	5	--
NB-31	SFR	55	46	55	61	--	56	1	5	--
NB-32	SFR	55	46	55	61	--	56	1	5	--
NB-33	SFR	55	46	55	61	--	56	1	5	--
NB-34	SFR	55	48	55	61	--	56	1	5	--
NB-35	SFR	55	46	55	61	--	56	1	5	--
NB-36	SFR	55	46	55	61	--	56	1	5	--
NB-37	SFR	58	49	57	62	--	59	1	5	--
NB-38	SFR	55	46	55	61	--	56	1	5	--
NB-39	SFR	55	48	55	61	--	56	1	5	--
NB-40	MFR	58	49	57	62	--	59	1	5	--
NB-41	MFR	67	53	62	67	--	67	0	3	--
NB-42	SFR	69	51	64	69	--	69	0	3	--
SB-01	MFR	56	46	56	61	--	56	0	5	--
SB-02	SFR	56	47	56	61	--	57	1	5	--

			FTA Impact Assessment				CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Ldn in dBA)	Predicted Project Noise (Ldn in dBA)	FTA Moderate Impact Threshold, Project Noise (Ldn in dBA)	FTA Severe Impact Threshold, Project Noise (Ldn in dBA)	FTA Level of Impact (before Mitigation)[2]	Predicted Future Noise Level (Ldn in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before Mitigation[3]
SB-03	MFR	59	50	57	63	--	60	1	5	--
SB-04	MFR	55	48	55	61	--	56	1	5	--
SB-05	MFR	54	45	55	61	--	55	1	5	--
SB-06	MFR	67	57	62	68	--	67	0	3	--
SB-07	MFR	55	46	55	61	--	56	1	5	--
SB-08	MFR	67	57	62	68	--	67	0	3	--
SB-09	MFR	55	46	55	61	--	56	1	5	--
SB-10	MFR	54	47	55	61	--	55	1	5	--
SB-11	MFR	68	58	63	68	--	68	0	3	--
SB-12	MFR	55	46	55	61	--	56	1	5	--
SB-13	MFR	67	57	62	67	--	67	0	3	--
SB-14	MFR	68	58	63	68	--	68	0	3	--
SB-15	MFR	68	57	63	68	--	68	0	3	--
SB-16	MFR	55	46	55	61	--	56	1	5	--
SB-17	MFR	57	48	56	62	--	58	1	5	--
SB-18	MFR	67	56	62	68	--	67	0	3	--
SB-19	MFR	67	57	62	68	--	67	0	3	--
SB-20	MFR	66	56	61	67	--	66	0	5	--
SB-21	MFR	66	57	62	67	--	67	1	5	--
SB-22	SFR	66	56	61	67	--	66	0	5	--
SB-23	SFR	52	44	54	60	--	53	1	5	--
SB-24	SFR	65	56	61	66	--	66	1	5	--
SB-25	SFR	55	47	55	61	--	56	1	5	--

			FTA Impact Assessment				CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Ldn in dBA)	Predicted Project Noise (Ldn in dBA)	FTA Moderate Impact Threshold, Project Noise (Ldn in dBA)	FTA Severe Impact Threshold, Project Noise (Ldn in dBA)	FTA Level of Impact (before Mitigation)[2]	Predicted Future Noise Level (Ldn in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before Mitigation[3]
SB-26	MFR	65	56	61	66	--	66	1	5	--
SB-27	MFR	52	44	54	60	--	53	1	5	--
SB-28	SFR	56	49	56	61	--	57	1	5	--
SB-29	SFR	65	56	61	66	--	66	1	5	--
SB-30	SFR	56	47	56	61	--	57	1	5	--
SB-31	SFR	66	56	61	67	--	66	0	5	--
SB-32	SFR	56	47	56	61	--	57	1	5	--
SB-33	SFR	55	47	55	61	--	56	1	5	--
SB-34	SFR	53	45	55	61	--	54	1	5	--
SB-35	SFR	55	47	55	61	--	56	1	5	--
SB-36	SFR	55	47	55	61	--	56	1	5	--
SB-37	SFR	56	47	56	61	--	57	1	5	--
SB-38	SFR	55	46	55	61	--	56	1	5	--
SB-39	SFR	54	46	55	61	--	55	1	5	--
SB-40	SFR	56	50	56	62	--	57	1	5	--

Notes: L_{dn} = 24-hour day-night level; dBA = A-weighted decibel; MFR = multi-family residence; SFR = single-family residence
[1] Cluster locations are shown in Appendix B
[2] FTA level of impact is determined by comparing the predicted project noise to the FTA moderate and severe impact thresholds.
[3] CEQA impact is determined by comparing the predicting increase to the CEQA allowable increase impact threshold
Source: ATS Consulting, 2014

Table 4-4: Predicted Noise Levels for Build Alternative 2, Category 3 (Institutional) Receivers

		FTA Impact Assessment						CEQA Impact Assessment		
Cluster ID[1]	Cluster Description	Existing Noise Level (Leq in dBA)	Predicted Project Noise (Leq in dBA)	FTA Moderate Impact Threshold, Project Noise(Leq in dBA)	FTA Severe Impact Threshold, Project Noise(Leq in dBA)	FTA Level of Impact (before Mitigation)[2]	Predicted Future Noise Level (Leq in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before Mitigation[3]
NB-A	School	69	54	69	74	--	69	0	3	--
NB-B	School	69	54	69	74	--	69	0	3	--
NB-C	Church	68	53	68	73	--	68	0	3	--
NB-D	School	62	45	64	69	--	62	0	5	--
NB-E	School	73	56	70	77	--	73	0	3	--
NB-F	School	71	55	70	75	--	71	0	3	--
NB-G	Church	67	54	67	72	--	67	0	3	--
NB-H	Church	66	53	66	72	--	66	0	5	--
NB-I	School	70	53	69	75	--	70	0	3	--
NB-J	School	71	55	70	75	--	71	0	3	--
NB-K	School	72	56	70	76	--	72	0	3	--
NB-L	School	71	55	70	75	--	71	0	3	--
NB-M	School	71	55	70	75	--	71	0	3	--
NB-N	School	62	49	64	69	--	62	0	5	--
SB-A	School	62	44	64	70	--	62	0	5	--
SB-B	School	71	54	70	75	--	71	0	3	--
SB-C	School	65	55	66	71	--	65	0	5	--
SB-D	School	67	55	67	72	--	67	0	3	--
SB-E	School	71	54	70	75	--	71	0	3	--
SB-F	Church	69	55	69	74	--	69	0	3	--
SB-G	Park	70	56	69	74	--	70	0	3	--
SB-H	Church	70	52	69	74	--	70	0	3	--

		FTA Impact Assessment					CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Leq in dBA)	Predicted Project Noise (Leq in dBA)	FTA Moderate Impact Threshold, Project Noise(Leq in dBA)	FTA Severe Impact Threshold, Project Noise(Leq in dBA)	FTA Level of Impact (before Mitigation)[2]	Predicted Future Noise Level (Leq in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before Mitigation[3]
SB-I	Church	71	53	70	75	--	71	0	3	--
SB-J	School	66	46	66	72	--	66	0	5	--
SB-K	Church	71	56	70	75	--	71	0	3	--
SB-L	School	71	56	70	75	--	71	0	3	--
SB-M	School	71	56	70	75	--	71	0	3	--

Notes: L_{eq} = Equivalent continuous sound level; dBA = A-weighted decibel
[1] Cluster locations are shown in Appendix B
[2] FTA level of impact is determined by comparing the predicted project noise to the FTA moderate and severe impact thresholds.
[3] CEQA impact is determined by comparing the predicting increase to the CEQA allowable increase impact threshold
Source: ATS Consulting, 2014

4.4.2 Vibration

Rubber-tired vehicles such as buses on smooth, maintained roadways generally do not cause perceptible vibration. The FTA guidance manual advises that no vibration impact is likely and no analysis is needed for rubber-tired vehicles operating on smooth roadway. Therefore, the vibration from the Median-Running BRT Alternative would have no adverse effect under the FTA guidance.

There are no applicable state and local operational vibration criteria. Therefore, the FTA impact thresholds are also adopted as the state and local significance thresholds. Under FTA guidance, Build Alternative 2 would have no significant vibration impact and would not expose people to or generate excessive groundborne vibration or groundborne noise.

4.5 Build Alternative 3 – Low-Floor LRT/Tram Alternative

4.5.1 Noise

Changes in noise levels as a result of Build Alternative 3 would be from an introduction of low-floor LRT/trams and removing all existing buses from Van Nuys Boulevard in the project area. The low-floor LRT/tram noise predictions are based on reference level measurements of the Metro Gold Line vehicles and the bus noise predictions are based on reference level measurements of the Metro Orange Line buses. Additional information on the noise prediction models is included in Appendix C.

Table 4-5 presents the noise impact assessment using the FTA and CEQA impact thresholds for Category 2, residential, receivers. Table 4-6 presents the same information for Category 3, institutional, receivers. The tables present predicted levels for clusters of sensitive receivers identified in the project area. The locations of the clusters of sensitive receivers are shown in Appendix B.

The severe noise impact threshold is used as the federal significance threshold for operational noise impacts. Severe noise impacts are predicted at three clusters of sensitive receivers (SB-38B, SB-40, and SB-43). There are 34 residential units within the three clusters where severe noise impacts are predicted. Therefore, there is an adverse noise effect predicted at 34 residential units for Build Alternative 3.

According to FTA guidance, mitigation measures should be implemented for severe noise impacts unless there are compelling reasons why mitigation is not feasible. For moderate noise impacts, noise mitigation should be considered and adopted when it is considered reasonable. The FTA guidance manual recommends taking into account the number of affected sites, the increase over existing noise levels, and the cost of the mitigation among other factors when determining if mitigation for moderate impacts is reasonable. Mitigation measures are suggested for moderate impacts in Section 5.1.3.1; however, final decisions on the implementation of mitigation measures for moderate impacts should weigh project specific factors related to reasonableness. Moderate noise impacts are predicted at 30 clusters of Category 2 sensitive receivers. There are 494 residential units within the 30 clusters where moderate noise impacts are predicted. Therefore, there is a minor adverse noise effect predicted at 494 residential units.

The local significance thresholds for operational noise impacts are based on the *LA CEQA Thresholds Guide*. A significant impact is identified if the predicted future noise level is 5 decibels greater than the existing noise level at any sensitive receiver, or if there is a 3 decibel increase at any sensitive

Table 4-5: Predicted Noise Levels for Build Alternative 3, Category 2 (Residential) Receivers

			FTA Impact Assessment				CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Ldn in dBA)	Predicted Project Noise (Ldn in dBA)	FTA Moderate Impact Threshold, Project Noise (Ldn in dBA)	FTA Severe Impact Threshold, Project Noise (Ldn in dBA)	FTA Level of Impact (before Mitigation)[2]	Predicted Future Noise Level (Ldn in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact (Before Mitigation)[3]
NB-01	MFR	54	53	55	61	--	57	3	5	--
NB-02	MFR	54	53	55	61	--	57	3	5	--
NB-03	MFR	54	53	55	61	--	57	3	5	--
NB-04	MFR	55	54	55	61	--	58	3	5	--
NB-05	MFR	55	53	55	61	--	57	2	5	--
NB-06	SFR	55	53	55	61	--	57	2	5	--
NB-07	SFR	53	52	55	61	--	56	3	5	--
NB-08	SFR	53	52	55	61	--	56	3	5	--
NB-09	SFR	53	52	55	61	--	56	3	5	--
NB-10	MFR	66	63	62	67	Moderate	68	2	5	--
NB-11	SFR	55	54	55	61	--	58	3	5	--
NB-12	MFR	63	61	60	65	Moderate	65	2	5	--
NB-13	MFR	67	62	62	67	Moderate	68	1	3	--
NB-14	MFR	53	52	54	60	--	56	3	5	--
NB-15	MFR	67	62	62	67	Moderate	68	1	3	--
NB-15B	MFR	57	57	56	62	Moderate	60	3	5	--
NB-16	MFR	68	37	63	68	--	68	0	3	--
NB-17	MFR	67	62	62	67	Moderate	68	1	3	--
NB-18	MFR	68	58	63	68	--	68	0	3	--
NB-19	SFR	65	63	61	66	Moderate	67	2	5	--
NB-20	SFR	55	54	55	61	--	58	3	5	--
NB-21	MFR	66	63	62	67	Moderate	68	2	5	--
NB-22	MFR	66	63	61	67	Moderate	68	2	5	--
NB-23	MFR	66	62	62	67	Moderate	67	1	5	--
NB-24	SFR	55	54	55	61	--	58	3	5	--
NB-25	SFR	66	62	61	67	Moderate	67	1	5	--
NB-26	SFR	55	54	55	61	--	58	3	5	--

			FTA Impact Assessment				CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Ldn in dBA)	Predicted Project Noise (Ldn in dBA)	FTA Moderate Impact Threshold, Project Noise (Ldn in dBA)	FTA Severe Impact Threshold, Project Noise (Ldn in dBA)	FTA Level of Impact (before Mitigation)[2]	Predicted Future Noise Level (Ldn in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact (Before Mitigation)[3]
NB-27	SFR	55	54	55	61	--	58	3	5	--
NB-28	SFR	55	54	56	61	--	58	3	5	--
NB-29	MFR	69	57	64	69	--	69	0	3	--
NB-30	SFR	55	54	55	61	--	58	3	5	--
NB-31	SFR	55	54	55	61	--	58	3	5	--
NB-32	SFR	55	54	55	61	--	58	3	5	--
NB-33	SFR	55	54	55	61	--	58	3	5	--
NB-34	SFR	55	56	55	61	Moderate	59	4	5	--
NB-35	SFR	55	54	55	61	--	58	3	5	--
NB-36	SFR	55	54	55	61	--	58	3	5	--
NB-37	SFR	58	56	57	62	--	60	2	5	--
NB-38	SFR	55	54	55	61	--	58	3	5	--
NB-39	SFR	55	56	55	61	Moderate	59	4	5	--
NB-40	MFR	58	58	57	62	Moderate	61	3	5	--
NB-41	MFR	67	56	62	67	--	67	0	3	--
NB-42	SFR	69	58	64	69	--	69	0	3	--
SB-01	MFR	56	54	56	61	--	58	2	5	--
SB-02	SFR	56	54	56	61	--	58	2	5	--
SB-03	MFR	59	58	57	63	Moderate	62	3	5	--
SB-04	MFR	55	55	55	61	Moderate	58	3	5	--
SB-05	MFR	54	53	55	61	--	57	3	5	--
SB-06	MFR	67	61	62	68	--	68	1	3	--
SB-07	MFR	55	53	55	61	--	57	2	5	--
SB-08	MFR	67	61	62	68	--	68	1	3	--
SB-09	MFR	55	54	55	61	--	58	3	5	--
SB-10	MFR	54	55	55	61	Moderate	58	4	5	--
SB-11	MFR	68	58	63	68	--	68	0	3	--
SB-12	MFR	55	54	55	61	--	58	3	5	--

			FTA Impact Assessment				CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Ldn in dBA)	Predicted Project Noise (Ldn in dBA)	FTA Moderate Impact Threshold, Project Noise (Ldn in dBA)	FTA Severe Impact Threshold, Project Noise (Ldn in dBA)	FTA Level of Impact (before Mitigation)[2]	Predicted Future Noise Level (Ldn in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact (Before Mitigation)[3]
SB-13	MFR	67	62	62	67	Moderate	68	1	3	--
SB-14	MFR	68	--[4]	63	68	--	68	0	3	--
SB-15	MFR	68	--[4]	63	68	--	68	0	3	--
SB-16	MFR	55	54	55	61	--	58	3	5	--
SB-17	MFR	57	56	56	62	Moderate	60	3	5	--
SB-18	MFR	67	60	62	68	--	68	1	3	--
SB-19	MFR	67	61	62	68	--	68	1	3	--
SB-20	MFR	66	63	61	67	Moderate	68	2	5	--
SB-21	MFR	66	62	62	67	Moderate	67	1	5	--
SB-22	SFR	66	63	61	67	Moderate	68	2	5	--
SB-23	SFR	52	51	54	60	--	55	3	5	--
SB-24	SFR	65	63	61	66	Moderate	67	2	5	--
SB-25	SFR	55	54	55	61	--	58	3	5	--
SB-26	MFR	65	63	61	66	Moderate	67	2	5	--
SB-27	MFR	52	51	54	60	--	55	3	5	--
SB-28	SFR	56	56	56	61	Moderate	59	3	5	--
SB-29	SFR	65	63	61	66	Moderate	67	2	5	--
SB-30	SFR	56	54	56	61	--	58	2	5	--
SB-31	SFR	66	62	61	67	Moderate	67	1	5	--
SB-32	SFR	56	54	56	61	--	58	2	5	--
SB-33	SFR	55	54	55	61	--	58	3	5	--
SB-34	SFR	53	52	55	61	--	56	3	5	--
SB-35	SFR	55	54	55	61	--	58	3	5	--
SB-36	SFR	55	54	55	61	--	58	3	5	--
SB-37	SFR	56	54	56	61	--	58	2	5	--
SB-38A	SFR	55	54	55	61	--	58	3	5	--
SB-38B	SFR	54	70	55	61	Severe	70	16	5	Yes
SB-39	SFR	54	73	55	61	Severe	73	19	5	Yes

Cluster ID[1]	Cluster Description	Existing Noise Level (Ldn in dBA)	FTA Impact Assessment: Predicted Project Noise (Ldn in dBA)	FTA Moderate Impact Threshold, Project Noise (Ldn in dBA)	FTA Severe Impact Threshold, Project Noise (Ldn in dBA)	FTA Level of Impact (before Mitigation)[2]	CEQA Impact Assessment: Predicted Future Noise Level (Ldn in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact (Before Mitigation)[3]
SB-40	SFR	56	56	56	62	Moderate	59	3	5	--
SB-41	SFR	66	57	61	67	--	67	1	5	--
SB-42	SFR	66	59	61	67	--	67	1	5	--
SB-43	MFR	68	68	63	68	Severe	71	3	3	Yes
SB-44	MFR	68	66	63	68	Moderate	70	2	3	--
SB-45	MFR	72	61	65	71	--	72	0	3	--
SB-46	Hotel	74	66	65	72	Moderate	75	1	3	--
SB-47	SFR	73	63	65	72	--	73	0	3	--
SB-48	SFR	69	58	64	69	--	69	0	3	--
SB-49	SFR	71	63	65	70	--	72	1	3	--
SB-50	SFR	70	56	65	70	--	70	0	3	--
SB-51	SFR	76	56	65	74	--	76	0	3	--

Notes: L_{dn} = 24-hour day-night level; dBA = A-weighted decibel; MFR = multi-family residence; SFR = single-family residence
[1] Cluster locations are shown in Appendix B
[2] FTA level of impact is determined by comparing the predicted project noise to the FTA moderate and severe impact thresholds.
[3] CEQA impact is determined by comparing the predicting increase to the CEQA allowable increase impact threshold
[4] The decrease in noise due to the removal of buses is greater than the increase in noise from the addition of the low-floor LRT/tram.
[5] The high increase in noise at these receivers is due to potential wheel squeal and the removal of a building that would increase traffic noise levels.
Source: ATS Consulting, 2014

Table 4-6: Predicted Noise Levels for Build Alternative 3, Category 3 (Institutional) Receivers

			FTA Impact Threshold				CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Leq in dBA)	Predicted Project Noise (Leq in dBA)	FTA Moderate Impact Threshold, Project Noise (Leq in dBA)	FTA Severe Impact Threshold, Project Noise (Leq in dBA)	FTA Level of Impact before Mitigation[2]	Predicted Future Noise Level (Leq in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before Mitigation[3]
NB-A	School	69	50	69	74	--	69	0	3	--
NB-B	School	69	--[2]	69	74	--	69	0	3	--
NB-C	Church	68	58	68	73	--	68	0	3	--
NB-D	School	62	52	64	69	--	62	0	5	--
NB-E	School	73	57	70	77	--	73	0	3	--
NB-F	School	71	55	70	75	--	71	0	3	--
NB-G	Church	67	59	67	72	--	68	1	3	--
NB-H	Church	66	59	66	72	--	67	1	5	--
NB-I	School	70	59	69	75	--	70	0	3	--
NB-J	School	71	55	70	75	--	71	0	3	--
NB-K	School	72	57	70	76	--	72	0	3	--
NB-L	School	71	53	70	75	--	71	0	3	--
NB-M	School	71	57	70	75	--	71	0	3	--
NB-N	School	62	50	64	69	--	62	0	5	--
SB-A	School	62	50	64	70	--	62	0	5	--
SB-B	School	71	58	70	75	--	71	0	3	--
SB-C	School	65	53	66	71	--	65	0	5	--
SB-D	School	67	53	67	72	--	67	0	3	--
SB-E	School	71	59	70	75	--	71	0	3	--
SB-F	Church	69	55	69	74	--	69	0	3	--
SB-G	Park	70	--[4]	69	74	--	70	0	3	--

Cluster ID[1]	Cluster Description	Existing Noise Level (Leq in dBA)	FTA Impact Threshold: Predicted Project Noise (Leq in dBA)	FTA Impact Threshold: FTA Moderate Impact Threshold, Project Noise (Leq in dBA)	FTA Impact Threshold: FTA Severe Impact Threshold, Project Noise (Leq in dBA)	FTA Impact Threshold: FTA Level of Impact before Mitigation[2]	CEQA Impact Assessment: Predicted Future Noise Level (Leq in dBA)	CEQA Impact Assessment: Predicted Increase (Future minus Existing, dB)	CEQA Impact Assessment: CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact Assessment: CEQA Impact before Mitigation[3]
SB-H	Church	70	59	69	74	--	70	0	3	--
SB-I	Church	71	59	70	75	--	71	0	3	--
SB-J	School	66	53	66	72	--	66	0	5	--
SB-K	Church	71	55	70	75	--	71	0	3	--
SB-L	School	71	54	70	75	--	71	0	3	--
SB-M	School	71	52	70	75	--	71	0	3	--

Notes: L_{eq} = Equivalent continuous sound level; dBA = A-weighted decibel
[1] Cluster locations are shown in Appendix B
[2] FTA level of impact is determined by comparing the predicted project noise to the FTA moderate and severe impact thresholds.
[3] CEQA impact is determined by comparing the predicting increase to the CEQA allowable increase impact threshold
[4] The decrease in noise due to the removal of buses is greater than the increase in noise from the addition of the low-floor LRT/tram.
Source: ATS Consulting, 2014

receiver where the predicted future noise level is at least Ldn 70 dBA. The predicted future noise level is the decibel sum of the existing noise level and the predicted project noise level. The predicted future noise level exceeds the local significance threshold at three clusters of sensitive receivers (SB-38B, SB-39, and SB-43). There are 34 residential units within the three clusters of sensitive receivers that exceed the local significance threshold. Therefore, there is a significant noise impact at 34 residential units for Build Alternative 3. These are the same residential units where severe noise impacts are predicted using the FTA impact thresholds.

4.5.2 Vibration

Vibration levels from low-floor LRT/tram operations were predicted for each cluster of sensitive receivers. The clusters used for impact assessment are shown in Appendix B. The predictions were developed with vibration measurements from Metro Gold Line vehicles and vibration propagation data collected throughout the project area. More information on the vibration prediction model is included in Appendix C.

Table 4-7 and Table 4-8 present the predicted vibration levels, the FTA impact threshold, and the clusters where vibration impacts are predicted. Predicted vibration levels are higher at clusters located closer to the proposed tracks. The predicted vibration levels from low-floor LRT/tram operations exceed the FTA impact threshold at 17 clusters of residential sensitive receivers and at one institutional land use. There are 634 residential units within the clusters of sensitive receivers where vibration impacts are predicted. Before mitigation, there is an adverse vibration effect at 634 residential units and one institutional land use for Build Alternative 3. The clusters with predicted vibration impacts are located near the vibration propagation measurements sites with high LSTM levels. High LSTM levels indicate efficient vibration propagation.

Table 4-7: Predicted Vibration Levels for Build Alternative 3, Category 2 (Residential) Receivers

Cluster ID[1]	Cluster Description	Distance to Near Track	Predicted L_v under Build Alt. (Band Max[2])	1/3 Octave Band[3]	FTA Impact Threshold (VdB)	Impact?	FTA Threshold Exceedance (VdB)
NB-01	MFR	274	56	31.5	72	--	--
NB-02	MFR	274	55	31.5	72	--	--
NB-03	MFR	272	56	31.5	72	--	--
NB-04	MFR	213	58	31.5	72	--	--
NB-05	MFR	221	57	31.5	72	--	--
NB-06	SFR	218	58	31.5	72	--	--
NB-07	SFR	294	55	31.5	72	--	--
NB-08	SFR	296	54	31.5	72	--	--
NB-09	SFR	290	55	31.5	72	--	--
NB-10	MFR	62	77	31.5	72	Yes	5
NB-11	SFR	245	70	31.5	72	-	-
NB-12	MFR	110	73	31.5	72	Yes	1
NB-13	MFR	54	77	31.5	72	Yes	5
NB-14	MFR	327	67	31.5	72	-	-
NB-15	MFR	55	77	31.5	72	Yes	5
NB-15B	MFR	149	71	31.5	72	--	--
NB-16	MFR	40	78	31.5	72	Yes	6
NB-17	MFR	59	77	31.5	72	Yes	5

Cluster ID[1]	Cluster Description	Distance to Near Track	Predicted L_v under Build Alt. (Band Max[2])	1/3 Octave Band[3]	FTA Impact Threshold (VdB)	Impact?	FTA Threshold Exceedance (VdB)
NB-18	MFR	52	78	31.5	72	Yes	6
NB-19	SFR	68	68	31.5	72	--	--
NB-20	SFR	202	61	31.5	72	--	--
NB-21	MFR	63	69	31.5	72	--	--
NB-22	MFR	59	68	31.5	72	--	--
NB-23	MFR	55	68	31.5	72	--	--
NB-24	SFR	182	62	31.5	72	--	--
NB-25	SFR	61	68	31.5	72	--	--
NB-26	SFR	176	62	31.5	72	--	--
NB-27	SFR	181	62	31.5	72	--	--
NB-28	SFR	181	62	31.5	72	--	--
NB-29	MFR	51	70	31.5	72	--	--
NB-30	SFR	207	61	31.5	72	--	--
NB-31	SFR	189	61	31.5	72	--	--
NB-32	SFR	184	62	31.5	72	--	--
NB-33	SFR	201	61	31.5	72	--	--
NB-34	SFR	203	61	31.5	72	--	--
NB-35	SFR	196	61	31.5	72	--	--
NB-36	SFR	195	61	31.5	72	--	--
NB-37	SFR	109	65	31.5	72	--	--
NB-38	SFR	209	61	31.5	72	--	--
NB-39	SFR	212	61	31.5	72	--	--
NB-40	MFR	108	64	31.5	72	--	--
NB-41	MFR	140	55	31.5	72	--	--
NB-42	SFR	308	51	31.5	72	--	--
SB-01	MFR	196	59	31.5	72	--	--
SB-02	SFR	191	59	31.5	72	--	--
SB-03	MFR	277	56	31.5	72	--	--
SB-04	MFR	222	57	31.5	72	--	--
SB-05	MFR	257	56	31.5	72	--	--
SB-06	MFR	51	78	31.5	72	Yes	6
SB-07	MFR	218	69	31.5	72	-	-
SB-08	MFR	52	77	31.5	72	Yes	5
SB-09	MFR	204	69	31.5	72	-	-
SB-10	MFR	264	68	31.5	72	-	-
SB-11	MFR	50	78	31.5	72	Yes	6
SB-12	MFR	217	69	31.5	72	-	-
SB-13	MFR	59	77	31.5	72	Yes	5
SB-14	MFR	47	78	31.5	72	Yes	6
SB-15	MFR	39	78	31.5	72	Yes	6
SB-16	MFR	198	69	31.5	72	-	-
SB-17	MFR	118	72	31.5	72	Yes	0
SB-18	MFR	49	77	31.5	72	Yes	5
SB-19	MFR	50	77	31.5	72	Yes	5

Cluster ID[1]	Cluster Description	Distance to Near Track	Predicted L_v under Build Alt. (Band Max[2])	1/3 Octave Band[3]	FTA Impact Threshold (VdB)	Impact?	FTA Threshold Exceedance (VdB)
SB-20	MFR	64	67	31.5	72	--	--
SB-21	MFR	56	68	31.5	72	--	--
SB-22	SFR	66	68	31.5	72	--	--
SB-23	SFR	358	57	31.5	72	--	--
SB-24	SFR	69	67	31.5	72	--	--
SB-25	SFR	190	61	31.5	72	--	--
SB-26	MFR	68	66	31.5	72	--	--
SB-27	MFR	377	56	31.5	72	--	--
SB-28	SFR	187	61	31.5	72	--	--
SB-29	SFR	76	67	31.5	72	--	--
SB-30	SFR	184	61	31.5	72	--	--
SB-31	SFR	73	66	31.5	72	--	--
SB-32	SFR	185	61	31.5	72	--	--
SB-33	SFR	184	61	31.5	72	--	--
SB-34	SFR	275	58	31.5	72	--	--
SB-35	SFR	185	61	31.5	72	--	--
SB-36	SFR	192	61	31.5	72	--	--
SB-37	SFR	180	61	31.5	72	--	--
SB-38A	SFR	207	61	31.5	72	--	--
SB-38B	SFR	260	63	31.5	72	--	--
SB-39	SFR	78	66	31.5	72	--	--
SB-40	SFR	232	67	31.5	72	--	--
SB-41	SFR	131	55	31.5	72	--	--
SB-42	SFR	130	55	31.5	72	--	--
SB-43	MFR	32	76	63	72	Yes	4
SB-44	MFR	49	66	63	72	--	--
SB-45	MFR	164	54	31.5	72	--	--
SB-46	Hotel	48	67	63	72	--	--
SB-47	SFR	92	57	50	72	--	--
SB-48	SFR	111	56	31.5	72	--	--
SB-49	SFR	115	55	31.5	72	--	--
SB-50	SFR	189	53	31.5	72	--	--
SB-51	SFR	185	53	31.5	72	--	--

Notes: L_v = vibration velocity level; VdB = decibels referenced to 1 microinch per second; MFR = multi-family residence; SFR = single-family residence
[1] Cluster locations are shown in Appendix B
[2] The band maximum is the vibration level from the maximum 1/3 octave band of the L_{max} spectra
[3] The 1/3 octave band in which the band maximum occurs
Source: ATS Consulting, 2014

Table 4-8: Predicted Vibration Levels for Build Alternative 3, Category 3 (Institutional) Receivers

Cluster ID[1]	Cluster Description	Distance to Near Track	Predicted L_v under Build Alt. (Band Max)	1/3 Octave Band	FTA Impact Threshold (VdB)	Impact?	FTA Threshold Exceedance (VdB)
NB-A	School	63	70	31.5	78	--	--
NB-B	School	60	70	31.5	78	--	--
NB-C	Church	75	69	31.5	78	--	--
NB-D	School	258	56	31.5	78	--	--
NB-E	School	78	74	31.5	78	--	--
NB-F	School	73	77	31.5	78	--	--
NB-G	Church	59	76	31.5	78	--	--
NB-H	Church	75	75	31.5	78	--	--
NB-I	School	90	66	31.5	78	--	--
NB-J	School	47	69	31.5	78	--	--
NB-K	School	46	70	31.5	78	--	--
NB-L	School	46	69	31.5	78	--	--
NB-M	School	46	70	31.5	78	--	--
NB-N	School	609	54	31.5	78	--	--
SB-A	School	223	58	31.5	78	--	--
SB-B	School	62	70	31.5	78	--	--
SB-C	School	81	72	31.5	78	--	--
SB-D	School	80	72	31.5	78	--	--
SB-E	School	91	70	31.5	78	--	--
SB-F	Church	61	79	31.5	78	Yes	1
SB-H	Church	99	65	31.5	78	--	--
SB-I	Church	78	65	31.5	78	--	--
SB-J	School	406	56	31.5	78	--	--
SB-K	Church	48	69	31.5	78	--	--
SB-L	School	49	69	31.5	78	--	--
SB-M	School	49	69	31.5	78	--	--

There is no state or local vibration impact threshold, so the FTA impact threshold is also used as the state/local significance threshold. Therefore, before mitigation, there is a significant vibration impact predicted at 610 residential units and one institutional land use. Under the guidelines in the *LA CEQA Thresholds Guide*, Build Alternative 3 would expose people to or generate excessive groundborne vibration levels.

Typically, impacts from groundborne noise levels are not assessed for at-grade transit systems because the airborne noise masks the groundborne noise. There is no tunnel section associated with Build Alternative 3, so groundborne noise levels are not assessed. More discussion on the relationship between groundborne vibration levels, groundborne noise levels, and airborne noise levels is included in Appendix D.

4.6 Build Alternative 4 – LRT Alternative

4.6.1 Noise

Changes in noise levels as a result of Build Alternative 4 would be from an introduction of LRVs and a decrease in the volume of buses. Metro Rapid Line 761 would be removed from Van Nuys Boulevard in the project area and Metro Local Line 233 service would be preserved with decreased headways. The LRT noise predictions are based on reference level measurements of the Metro Gold Line and the bus noise predictions are based on reference level measurements of the Metro Orange Line buses. Additional information on the noise prediction models is included in Appendix C.

Table 4-9 presents the noise impact assessment using the FTA and CEQA impact thresholds for Category 2, residential, receivers. Table 4-10 presents the same information for Category 3, institutional, receivers. The tables present predicted noise levels for clusters of sensitive receivers identified in the project area. The locations of the clusters of sensitive receivers are shown in Appendix B.

The FTA severe noise impact threshold is used as the federal significance threshold for operational noise impacts. Severe noise impacts are predicted at two clusters of sensitive receivers (SB-38B and SB-40). There are 10 residential units within the clusters of sensitive receivers where noise impacts are predicted. Therefore, there is an adverse noise effect predicted at 10 residential units for Build Alternative 4.

According to FTA guidance, mitigation measures should be implemented for severe noise impacts unless there are compelling reasons why mitigation is not feasible. For moderate noise impacts, noise mitigation should be considered and adopted when it is considered reasonable. The FTA guidance manual recommends taking into account the number of affected sites, the increase over existing noise levels, and the cost of the mitigation among other factors when determining if mitigation for moderate impacts is reasonable. Mitigation measures are suggested for moderate impacts in Section 5.1.4.1; however, final decisions on the implementation of mitigation measures for moderate impacts should weigh project specific factors related to reasonableness. Moderate noise impacts are predicted at 59 clusters of Category 2 sensitive receivers. Within these 59 clusters of sensitive receivers, there are 759 residential units. Therefore, there is a minor adverse noise effect predicted at 759 residential units.

The local significance thresholds for operational noise impacts are based on the *L.A. CEQA Thresholds Guide*. A significant impact is identified if the predicted future noise level is 5 decibels greater than the existing noise level at any sensitive receiver, or if there is a 3 decibel increase at any sensitive receiver where the predicted future noise level is at least Ldn 70 dBA. The predicted future noise level is the decibel sum of the existing noise level and the predicted project noise level. The predicted future noise level exceeds the local significance threshold at two clusters of sensitive receivers (SB-38B and SB-39) and there are 10 residential units within the two clusters. There is a significant noise impact at 10 residential units for Build Alternative 4. These are the same residential units where severe noise impacts are predicted using the FTA impact thresholds.

For Build Alternative 4, the LRT alignment would vary between three different options depending on the location of the MSF facility. However, the variations would only affect sensitive receivers near the tunnel section and therefore would not affect predicted noise levels. The levels presented in Table 4-9 and Table 4-10 are valid for all three MSF options.

Table 4-9: Predicted Noise Levels for Build Alternative 4, Category 2 (Residential) Receivers

			FTA Impact Assessment				CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Ldn in dBA)	Predicted Project Noise (Ldn in dBA)	FTA Moderate Impact Threshold, Project Noise (Ldn in dBA)	FTA Severe Impact Threshold, Project Noise (Ldn in dBA)	FTA Level of Impact before Mitigation[2]	Predicted Future Noise Level (Ldn in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before Mitigation[3]
NB-01	MFR	54	54	55	61	--	57	3	5	--
NB-02	MFR	54	54	55	61	--	57	3	5	--
NB-03	MFR	54	54	55	61	--	57	3	5	--
NB-04	MFR	55	--[4]	55	61	--	58	3	5	--
NB-05	MFR	55	--[4]	55	61	--	55	0	5	--
NB-06	SFR	55	--[4]	55	61	--	55	0	5	--
NB-07	SFR	53	--[4]	55	61	--	55	0	5	--
NB-08	SFR	53	--[4]	55	61	--	53	0	5	--
NB-09	SFR	53	--[4]	55	61	--	53	0	5	--
NB-10A	MFR	66	--[4]	62	67	--	53	0	5	--
NB-10B	MFR	66	--[4]	62	67	--	66	0	5	--
NB-10C	MFR	66	65	62	67	Moderate	69	3	5	--
NB-11A	SFR	54	--[4]	55	61	--	54	0	5	--
NB-11B	SFR	55	49	55	61	--	56	1	5	--
NB-11C	SFR	55	56	55	61	Moderate	59	4	5	--
NB-12	MFR	63	63	60	65	Moderate	66	3	5	--
NB-13	MFR	67	65	62	67	Moderate	69	2	3	--
NB-14	MFR	53	53	54	60	--	56	3	5	--
NB-15	MFR	67	65	62	67	Moderate	69	2	3	--
NB-15B	MFR	57	59	56	62	Moderate	61	4	5	--
NB-16	MFR	68	65	63	68	Moderate	70	2	3	--
NB-17	MFR	67	65	62	67	Moderate	69	2	3	--
NB-18	MFR	68	64	63	68	Moderate	69	1	3	--
NB-19	SFR	65	65	61	66	Moderate	68	3	5	--
NB-20	SFR	55	55	55	61	Moderate	58	3	5	--

			FTA Impact Assessment				CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Ldn in dBA)	Predicted Project Noise (Ldn in dBA)	FTA Moderate Impact Threshold, Project Noise (Ldn in dBA)	FTA Severe Impact Threshold, Project Noise (Ldn in dBA)	FTA Level of Impact before Mitigation[2]	Predicted Future Noise Level (Ldn in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before Mitigation[3]
NB-21	MFR	66	65	62	67	Moderate	69	3	5	--
NB-22	MFR	66	63	61	67	Moderate	68	2	5	--
NB-23	MFR	66	65	62	67	Moderate	69	3	5	--
NB-24	SFR	55	56	55	61	Moderate	59	4	5	--
NB-25	SFR	66	65	61	67	Moderate	69	3	5	--
NB-26	SFR	55	56	55	61	Moderate	59	4	5	--
NB-27	SFR	55	56	55	61	Moderate	59	4	5	--
NB-28	SFR	55	56	56	61	Moderate	59	4	5	--
NB-29	MFR	69	65	64	69	Moderate	70	1	3	--
NB-30	SFR	55	55	55	61	Moderate	58	3	5	--
NB-31	SFR	55	55	55	61	Moderate	58	3	5	--
NB-32	SFR	55	56	55	61	Moderate	59	4	5	--
NB-33	SFR	55	55	55	61	Moderate	58	3	5	--
NB-34	SFR	55	57	55	61	Moderate	59	4	5	--
NB-35	SFR	55	55	55	61	Moderate	58	3	5	--
NB-36	SFR	55	55	55	61	Moderate	58	3	5	--
NB-37	SFR	58	58	57	62	Moderate	61	3	5	--
NB-38	SFR	55	55	55	61	Moderate	58	3	5	--
NB-39	SFR	55	57	55	61	Moderate	59	4	5	--
NB-40	MFR	58	58	57	62	Moderate	61	3	5	--
NB-41	MFR	67	60	62	67	--	68	1	3	--
NB-42	SFR	69	56	64	69	--	69	0	3	--
SB-01	MFR	56	55	56	61	--	59	3	5	--
SB-02	SFR	56	44	56	61	--	56	0	5	--
SB-03	MFR	59	--[4]	57	63	--	59	0	5	--
SB-04	MFR	55	--[4]	55	61	--	55	0	5	--
SB-05	MFR	54	--[4]	55	61	--	54	0	5	--
SB-06	MFR	67	56	62	68	--	67	0	3	--

		FTA Impact Assessment					CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Ldn in dBA)	Predicted Project Noise (Ldn in dBA)	FTA Moderate Impact Threshold, Project Noise (Ldn in dBA)	FTA Severe Impact Threshold, Project Noise (Ldn in dBA)	FTA Level of Impact before Mitigation[2]	Predicted Future Noise Level (Ldn in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before Mitigation[3]
SB-07A	MFR	55	--[4]	55	61	--	55	0	5	--
SB-07B	MFR	55	50	55	61	--	56	1	5	--
SB-08	MFR	67	65	62	68	Moderate	69	2	3	--
SB-09	MFR	55	55	55	61	Moderate	58	3	5	--
SB-10	MFR	54	56	55	61	Moderate	58	4	5	--
SB-11	MFR	68	65	63	68	Moderate	70	2	3	--
SB-12	MFR	55	55	55	61	Moderate	58	3	5	--
SB-13	MFR	67	65	62	67	Moderate	69	2	3	--
SB-14	MFR	68	65	63	68	Moderate	70	2	3	--
SB-15	MFR	68	65	63	68	Moderate	70	2	3	--
SB-16	MFR	55	55	55	61	Moderate	58	3	5	--
SB-17	MFR	57	57	56	62	Moderate	60	3	5	--
SB-18	MFR	67	65	62	68	Moderate	69	2	3	--
SB-19	MFR	67	65	62	68	Moderate	69	2	3	--
SB-20	MFR	66	65	61	67	Moderate	69	3	5	--
SB-21	MFR	66	65	62	67	Moderate	69	3	5	--
SB-22	SFR	66	65	61	67	Moderate	69	3	5	--
SB-23	SFR	52	53	54	60	--	56	4	5	--
SB-24	SFR	65	65	61	66	Moderate	68	3	5	--
SB-25	SFR	55	55	55	61	Moderate	58	3	5	--
SB-26	MFR	65	62	61	66	Moderate	67	2	5	--
SB-27	MFR	52	52	54	60	--	55	3	5	--
SB-28	SFR	56	58	56	61	Moderate	60	4	5	--
SB-29	SFR	65	64	61	66	Moderate	68	3	5	--
SB-30	SFR	56	56	56	61	Moderate	59	3	5	--
SB-31	SFR	66	64	61	67	Moderate	68	2	5	--
SB-32	SFR	56	56	56	61	Moderate	59	3	5	--
SB-33	SFR	55	56	55	61	Moderate	59	4	5	--

Cluster ID[1]	Cluster Description	Existing Noise Level (Ldn in dBA)	FTA Impact Assessment				CEQA Impact Assessment			
			Predicted Project Noise (Ldn in dBA)	FTA Moderate Impact Threshold, Project Noise (Ldn in dBA)	FTA Severe Impact Threshold, Project Noise (Ldn in dBA)	FTA Level of Impact before Mitigation[2]	Predicted Future Noise Level (Ldn in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before Mitigation[3]
SB-34	SFR	53	54	55	61	--	57	4	5	--
SB-35	SFR	55	55	55	61	Moderate	58	3	5	--
SB-36	SFR	55	55	55	61	Moderate	58	3	5	--
SB-37	SFR	56	56	56	61	Moderate	59	3	5	--
SB-38A	SFR	55	57	55	61	Moderate	59	4	5	--
SB-38B	SFR	54	70	55	61	Severe	70	16[5]	5	Yes
SB-39	SFR	54	72	55	61	Severe	72	18[5]	5	Yes
SB-40	SFR	56	52	56	62	--	57	1	5	--

Notes: L_{dn} = 24-hour day-night level; dBA = A-weighted decibel; MFR = multi-family residence; SFR = single-family residence
[1] Cluster locations are shown in Appendix B
[2] FTA level of impact is determined by comparing the predicted project noise to the FTA moderate and severe impact thresholds.
[3] CEQA impact is determined by comparing the predicting increase to the CEQA allowable increase impact threshold
[4] There is no predicted project noise level for sensitive receivers located near the tunnel section.
[5] The high increase in noise at these receivers is due to potential wheel squeal and the removal of a building that would increase traffic noise levels.
Source: ATS Consulting, 2014

Table 4-10: Predicted Noise Levels for Build Alternative 4, Category 3 (Institutional) Receivers

		FTA Impact Assessment					CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Leq in dBA)	Predicted Project Noise (Leq in dBA)	FTA Moderate Impact Threshold, Project Noise (Leq in dBA)	FTA Severe Impact Threshold, Project Noise (Leq in dBA)	FTA Level of Impact before Mitigation	Predicted Future Noise Level (Leq in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before Mitigation
NB-A	School	69	62	69	74	--	70	1	3	--
NB-B	School	69	61	69	74	--	70	1	3	--
NB-C	Church	68	--	68	73	--	--	--	3	--
NB-D	School	62	--	64	69	--	--	--	5	--
NB-E	School	73	--	70	77	--	--	--	3	--
NB-F	School	71	--	70	75	--	--	--	3	--
NB-G	Church	67	61	67	72	--	68	1	3	--
NB-H	Church	66	62	66	72	--	67	1	5	--
NB-I	School	70	61	69	75	--	71	1	3	--
NB-J	School	71	63	70	75	--	72	1	3	--
NB-K	School	72	63	70	76	--	73	1	3	--
NB-L	School	71	63	70	75	--	72	1	3	--
NB-M	School	71	63	70	75	--	72	1	3	--
NB-N	School	62	60	64	69	--	64	2	5	--
SB-A	School	62	52	64	70	--	62	0	5	--
SB-B	School	71	62	70	75	--	72	1	3	--
SB-C	School	65	--[4]	66	71	--	--[4]	--[4]	5	--
SB-D	School	67	--[4]	67	72	--	--[4]	--[4]	3	--
SB-E	School	71	--[4]	70	75	--	--[4]	--[4]	3	--
SB-F	Church	69	--[4]	69	74	--	--[4]	--[4]	3	--
SB-G	Park	70	59	69	74	--	70	0	3	--

		FTA Impact Assessment					CEQA Impact Assessment			
Cluster ID[1]	Cluster Description	Existing Noise Level (Leq in dBA)	Predicted Project Noise (Leq in dBA)	FTA Moderate Impact Threshold, Project Noise (Leq in dBA)	FTA Severe Impact Threshold, Project Noise (Leq in dBA)	FTA Level of Impact before Mitigation	Predicted Future Noise Level (Leq in dBA)	Predicted Increase (Future minus Existing, dB)	CEQA Impact Threshold, Allowable Increase, (dB)	CEQA Impact before Mitigation
SB-H	Church	70	61	69	74	--	71	1	3	--
SB-I	Church	71	59	70	75	--	71	0	3	--
SB-J	School	66	55	66	72	--	66	0	5	--
SB-K	Church	71	63	70	75	--	72	1	3	--
SB-L	School	71	63	70	75	--	72	1	3	--
SB-M	School	71	63	70	75	--	72	1	3	--

Notes: L_{eq} = Equivalent continuous sound level; dBA = A-weighted decibel
[1] Cluster locations are shown in Appendix B
[2] FTA level of impact is determined by comparing the predicted project noise to the FTA moderate and severe impact thresholds.
[3] CEQA impact is determined by comparing the predicting increase to the CEQA allowable increase impact threshold
[4] There is no predicted project noise level for sensitive receivers located near the tunnel section.
Source: ATS Consulting, 2014

4.6.2 Vibration

Vibration levels from LRT operations were predicted for each cluster of sensitive receivers. The clusters used for impact assessment are shown in Appendix B. The predictions were developed with vibration measurements from Metro Gold Line vehicles and vibration propagation data collected throughout the project area. More information on the vibration prediction model is included in Appendix C.

Table 4-11 and Table 4-12 present the predicted vibration levels, the FTA impact threshold, and the clusters where vibration impacts are predicted for residential and institutional land uses, respectively. Predicted vibration levels are higher at clusters located closer to the proposed tracks and at clusters where trains will be traveling at higher speeds in the tunnel and in the Metrolink ROW. The predicted vibration levels from LRT operations exceed the FTA impact threshold at 21 clusters of residential sensitive receivers and two institutional land uses. There are a total of 640 residential units within the clusters of sensitive receivers where vibration impacts are predicted. Before mitigation, there is an adverse vibration effect at 640 residential units and two institutional land uses for Build Alternative 4. The clusters with predicted vibration impacts are located near the vibration propagation measurements sites with high LSTM levels. High LSTM levels indicate efficient vibration propagation. The majority of vibration impacts predicted for Build Alternative 4 were also predicted for Build Alternative 3.

There is no state or local vibration impact threshold, so the FTA impact threshold is also used as the state/local significance threshold. Therefore, before mitigation, there is a significant vibration impact predicted at 640 residential units and two institutional land uses. Under the guidelines in the *LA CEQA Thresholds Guide*, Build Alternative 4 would expose people to or generate excessive groundborne vibration levels.

Typically, impacts from groundborne noise are not assessed for at-grade transit systems because the airborne noise masks the groundborne noise. More discussion on the relationship between Appendix D. Impacts from groundborne noise levels are assessed for the clusters of sensitive receivers that are near the tunnel section, because they will not be exposed to airborne noise from the LRVs. The predicted groundborne noise levels are shown in Table 4-13 for Category 2, residential receivers and in Table 4-14 for Category 3, institutional, receivers. There are two clusters of residential sensitive receivers where groundborne noise impacts are predicted and six clusters of institutional receivers where groundborne noise impacts are predicted.

For Build Alternative 4, the LRT alignment would vary between three options depending on the location of the MSF facility. The variations would only affect sensitive receivers near the tunnel section. Predicted vibration levels for the sensitive receiver clusters that would be affected by MSF options B and C are shown at the bottom of Table 4-10 through Table 4-14. For Option B, an additional groundborne vibration impacts are predicted at cluster NB-6 and additional groundborne noise impacts are predicted at clusters NB-5 and NB-6. Vibration impacts are predicted at cluster NB-6 because it is located near a crossover. Crossovers can increase vibration levels by up to 10 decibels. For Options B and C, an additional ground borne noise impact is identified at cluster SB-5, an institutional land use.

Table 4-11: Predicted Vibration Levels for Build Alternative 4, Category 2 (Residential) Receivers

Cluster ID[1]	Cluster Description	Distance to Near Track	Predicted L_v under Build Alt. (Band Max[2])	1/3 Octave Band[3]	FTA Impact Threshold (VdB)	Impact?	FTA Threshold Exceedance (VdB)
NB-01	MFR	274	57	31.5	72	--	--
NB-02	MFR	274	57	31.5	72	--	--
NB-03	MFR	272	57	31.5	72	--	--
NB-04	MFR	213	63	31.5	72	--	--
NB-05	MFR	221	63	31.5	72	--	--
NB-06	SFR	218	63	31.5	72	--	--
NB-07	SFR	294	60	31.5	72	--	--
NB-08	SFR	296	60	31.5	72	--	--
NB-09	SFR	290	60	31.5	72	--	--
NB-10A	MFR	62	80	31.5	72	Yes	8
NB-10B	MFR	57	78	31.5	72	Yes	6
NB-10C	MFR	55	78	31.5	72	Yes	6
NB-11A	SFR	245	72	31.5	72	Yes	0
NB-11B	SFR	195	71	31.5	72	--	-
NB-11C	SFR	182	71	31.5	72	--	-
NB-12	MFR	110	74	31.5	72	Yes	2
NB-13	MFR	54	78	31.5	72	Yes	6
NB-14	MFR	327	68	31.5	72	--	-
NB-15	MFR	55	78	31.5	72	Yes	6
NB-15B	MFR	146	72	31.5	72	Yes	0
NB-16	MFR	40	80	31.5	72	Yes	8
NB-17	MFR	59	78	31.5	72	Yes	6
NB-18	MFR	52	78	31.5	72	Yes	6
NB-19	SFR	68	68	31.5	72	--	--
NB-20	SFR	202	61	31.5	72	--	--
NB-21	MFR	63	68	31.5	72	--	--
NB-22	MFR	59	67	31.5	72	--	--
NB-23	MFR	55	69	31.5	72	--	--
NB-24	SFR	182	62	31.5	72	--	--
NB-25	SFR	61	69	31.5	72	--	--
NB-26	SFR	176	62	31.5	72	--	--
NB-27	SFR	181	62	31.5	72	--	--
NB-28	SFR	181	62	31.5	72	--	--
NB-29	MFR	51	70	31.5	72	--	--
NB-30	SFR	207	61	31.5	72	--	--
NB-31	SFR	189	60	31.5	72	--	--
NB-32	SFR	184	61	31.5	72	--	--
NB-33	SFR	201	61	31.5	72	--	--
NB-34	SFR	203	61	31.5	72	--	--
NB-35	SFR	196	61	31.5	72	--	--
NB-36	SFR	195	61	31.5	72	--	--
NB-37	SFR	109	65	31.5	72	--	--

Cluster ID[1]	Cluster Description	Distance to Near Track	Predicted L_v under Build Alt. (Band Max[2])	1/3 Octave Band[3]	FTA Impact Threshold (VdB)	Impact?	FTA Threshold Exceedance (VdB)
NB-38	SFR	209	61	31.5	72	--	--
NB-39	SFR	212	61	31.5	72	--	--
NB-40	MFR	108	65	31.5	72	--	--
NB-41	MFR	140	68	31.5	72	--	--
NB-42	SFR	308	51	31.5	72	--	--
SB-01	MFR	196	60	31.5	72	--	--
SB-02	SFR	191	61	31.5	72	--	--
SB-03	MFR	277	59	31.5	72	--	--
SB-04	MFR	222	63	31.5	72	--	--
SB-05	MFR	257	61	31.5	72	--	--
SB-06	MFR	51	78	31.5	72	Yes	6
SB-07A	MFR	218	73	31.5	72	Yes	1
SB-07B	MFR	216	70	31.5	72	--	-
SB-08	MFR	52	78	31.5	72	Yes	6
SB-09	MFR	204	70	31.5	72	--	-
SB-10	MFR	264	69	31.5	72	--	-
SB-11	MFR	50	79	31.5	72	Yes	7
SB-12	MFR	217	70	31.5	72	--	-
SB-13	MFR	59	78	31.5	72	Yes	6
SB-14	MFR	47	79	31.5	72	Yes	7
SB-15	MFR	39	80	31.5	72	Yes	8
SB-16	MFR	198	71	31.5	72	--	-
SB-17	MFR	118	74	31.5	72	Yes	2
SB-18	MFR	49	79	31.5	72	Yes	7
SB-19	MFR	50	79	31.5	72	Yes	7
SB-20	MFR	64	68	31.5	72	--	--
SB-21	MFR	56	69	31.5	72	--	--
SB-22	SFR	66	68	31.5	72	--	--
SB-23	SFR	358	58	31.5	72	--	--
SB-24	SFR	69	68	31.5	72	--	--
SB-25	SFR	190	62	31.5	72	--	--
SB-26	MFR	68	66	31.5	72	--	--
SB-27	MFR	377	56	31.5	72	--	--
SB-28	SFR	187	62	31.5	72	--	--
SB-29	SFR	76	67	31.5	72	--	--
SB-30	SFR	184	62	31.5	72	--	--
SB-31	SFR	73	68	31.5	72	--	--
SB-32	SFR	185	62	31.5	72	--	--
SB-33	SFR	184	62	31.5	72	--	--
SB-34	SFR	275	59	31.5	72	--	--
SB-35	SFR	185	60	31.5	72	--	--
SB-36	SFR	192	62	31.5	72	--	--
SB-37	SFR	180	62	31.5	72	--	--
SB-38A	SFR	207	62	31.5	72	--	--

Cluster ID[1]	Cluster Description	Distance to Near Track	Predicted L_v under Build Alt. (Band Max[2])	1/3 Octave Band[3]	FTA Impact Threshold (VdB)	Impact?	FTA Threshold Exceedance (VdB)
SB-38B	SFR	260	62	31.5	72	--	--
SB-39	SFR	78	65	31.5	72	--	--
SB-40	SFR	232	64	31.5	72	--	--
NB-05 Opt. B	MFR	127	68	31.5	72	--	--
NB-05 Opt. C	MFR	221	63	31.5	72	--	--
NB-06 Opt. B	SFR	69	84	31.5	72	Yes	12
NB-06 Opt. C	SFR	202	64	31.5	72	--	--
NB-07 Alt B,C	SFR	291	60	31.5	72	--	--
NB-08 Alt B,C	SFR	295	60	31.5	72	--	--

Notes: L_v = vibration velocity level; VdB = decibels referenced to 1 microinch per second; MFR = multi-family residence; SFR = single-family residence
[1] Cluster locations are shown in Appendix B
[2] The band maximum is the vibration level from the maximum 1/3 octave band of the L_{max} spectra
[3] The 1/3 octave band in which the band maximum occurs
Source: ATS Consulting, 2014

Table 4-12: Predicted Vibration Levels for Build Alternative 4, Category 3 (Institutional) Receivers

Cluster ID[1]	Cluster Description	Distance to Near Track	Predicted L_v under Build Alt. (Band Max[2])	1/3 Octave Band[3]	FTA Impact Threshold (VdB)	Impact?	FTA Threshold Exceedance (VdB)
NB-A	School	63	71	31.5	78	--	--
NB-B	School	60	71	31.5	78	--	--
NB-C	Church	75	69	31.5	78	--	--
NB-D	School	258	60	31.5	78	--	--
NB-E	School	78	73	31.5	78	--	--
NB-F	School	73	80	31.5	78	Yes	2
NB-G	Church	59	77	31.5	78	--	--
NB-H	Church	75	76	31.5	78	--	--
NB-I	School	90	66	31.5	78	--	--
NB-J	School	47	70	31.5	78	--	--
NB-K	School	46	71	31.5	78	--	--
NB-L	School	46	72	31.5	78	--	--
NB-M	School	46	73	31.5	78	--	--
NB-N	School	135	69	31.5	78	--	--
SB-A	School	223	59	31.5	78	--	--
SB-B	School	62	71	31.5	78	--	--
SB-C	School	81	72	31.5	78	--	--
SB-D	School	80	73	31.5	78	--	--
SB-E	School	91	71	31.5	78	--	--
SB-F	Church	61	82	31.5	78	Yes	4
SB-H	Church	99	66	31.5	78	--	--
SB-I	Church	78	65	31.5	78	--	--
SB-J	School	406	57	31.5	78	--	--
SB-K	Church	48	70	31.5	78	--	--
SB-L	School	49	70	31.5	78	--	--
SB-M	School	49	70	31.5	78	--	--

Notes: L_v = vibration velocity level; VdB = decibels referenced to 1 microinch per second; MFR = multi-family residence; SFR = single-family residence
[1] Cluster locations are shown in Appendix B
[2] The band maximum is the vibration level from the maximum 1/3 octave band of the L_{max} spectra
[3] The 1/3 octave band in which the band maximum occurs
Source: ATS Consulting, 2014

Table 4-13: Predicted Groundborne Noise Level for Build Alternative 4, Category 2 (Residential) Receivers

Cluster ID[1]	Cluster Description	Distance to Near Track	Predicted L_A under Build Alt. (L_{max} in dBA)	FTA Impact Threshold (dBA)	Impact?	FTA Threshold Exceedance (dBA)
NB-4	MFR	213	32	35	--	--
NB-5	MFR	221	32	35	--	--
NB-6	SFR	218	32	35	--	--
NB-7	SFR	294	29	35	--	--
NB-8	SFR	296	29	35	--	--
NB-9	SFR	290	29	35	--	--
NB-10A	MFR	62	47	35	Yes	12
NB-11A	SFR	57	35	35	Yes	0
SB-2	SFR	191	30	35	--	--
SB-3	MFR	277	29	35	--	--
SB-4	MFR	222	32	35	--	--
SB-5	MFR	257	30	35	--	--
NB-05 Opt. B	MFR	127	37	35	Yes	2
NB-05 Opt. C	MFR	221	32	35	--	--
NB-06 Opt. B	SFR	69	52	35	Yes	17
NB-06 Opt. C	SFR	202	33	35	--	--
NB-07 Alt B,C	SFR	291	29	35	--	--
NB-08 Alt B,C	SFR	295	29	35	--	--

Notes: L_A = A-weighted sound level; dBA = A-weighted decibels; MFR = multi-family residence; SFR = single-family residence
[1] Cluster locations are shown in Appendix B
Source: ATS Consulting, 2014

Table 4-14: Predicted Groundborne Noise Level for Build Alternative 4, Category 3 (Institutional) Receivers

Cluster ID[1]	Cluster Description	Distance to Near Track	Predicted L_v under Build Alt. (L_{eq} in dBA)	FTA Impact Threshold (dBA)	Impact?	FTA Threshold Exceedance (dBA)
NB-D	School	258	29	40	--	--
NB-E	School	78	41	40	Yes	1
NB-F	School	73	48	40	Yes	8
SB-C	School	81	41	40	Yes	1
SB-D	School	80	41	40	Yes	1
SB-E	School	91	40	40	Yes	0
SB-F	Church	61	49	40	Yes	9
SB-E Alt B,C	School	78	41	40	Yes	1

Notes: L_A = A-weighted sound level; dBA = A-weighted decibels; MFR = multi-family residence; SFR = single-family residence
[1] Cluster locations are shown in Appendix B
Source: ATS Consulting, 2014

4.7 Ancillary Equipment

Traction power substation (TPSS) units are the only ancillary equipment associated with the proposed project that has the potential to cause noise impacts. TPSS units are not required for Build Alternatives 1 or 2. There are 12 proposed TPSS locations and the proposed sites are the same for Build Alternatives 3 and 4.

It is common to include noise limits in the specifications for TPSS units to minimize the potential for noise impacts from TPSS noise. The specifications generally include maximum noise limits for potential noise generators, such as the transformer hum and any cooling systems. The cooling fans are the major noise source on many modern TPSS units and the transformer hum is usually inaudible except very close to the TPSS unit.

The first step in controlling TPSS noise is to include a noise limit in the purchase specifications for TPSS units. The recommended limit is that the maximum noise level not exceed 50 dBA at a distance of 50 feet from any part of a TPSS unit. More information on the recommended noise limit for the TPSS unit is included in Appendix C.

Under the *L.A. CEQA Threshold's Guide,* a significant impact is identified if the predicted future noise level is 5 decibels greater than the existing noise level at any sensitive receiver, or if there is a 3 decibel increase at any sensitive receiver where the predicted future noise level is at least 70 dBA. Table 4-15 presents the TPSS noise prediction results for the cluster of sensitive receivers located closest to each TPSS site. Noise impacts are predicted at five clusters of sensitive receivers, which are all located within 15 feet of a TPSS site. Mitigation measures for the TPSS units are presented in Chapter 5.

Table 4-15: Predicted Noise Levels for TPSS Units

TPSS Site	Closest Cluster ID[1]	Distance, TPSS to Cluster	Existing Noise (L_{dn} in dBA)	TPSS Noise (L_{dn} in dBA)	Future Noise (L_{dn} in dBA)	Increase, dBA	Impact?
3A	None	--	--	--	--	--	No
3B	None	--	--	--	--	--	No
4A	SB-01	61	57	55	59	2	No
4B	NB-03	15	53	67	67	14	Yes
5A	None	--	--	--	--	--	No
5B	NB-09	266	52	42	53	1	No
6A	NB-17	15	67	67	70	3	Yes
6B	NB-15B	15	60	67	68	8	Yes
7A	NB-21	15	67	67	70	3	Yes
7B	SB-33	125	57	48	58	1	No
8A	NB-44	15	52	67	67	15	Yes
8B	SB-39	160	55	46	55	0	No

[1] Cluster locations are shown in Appendix B
Source: ATS Consulting, 2014

4.8 MSF

Noise sources associated with MSFs include carwashes, blowdown facilities, repair shops, vehicles movements across track switches, potential squeal noise from tight radius curves within the facility and vehicular traffic into and out of the facility. Details on the noise prediction model for the MSF are included in Appendix C. The following three locations have been identified as potential sites for the MSF:

- Option A straddling the Orange Line between Kester Avenue and Vesper Avenue;
- Option B located south of the Metrolink tracks on the west side of Van Nuys Boulevard.; and
- Option C located north of the Metrolink tracks on the west side of Van Nuys Boulevard.

The locations of the three MSF options and the sensitive receivers near each option are shown in Figure 4-1.

Figure 4-1: Aerial Photographs Showing MSF Sites and Sensitive Receivers

Table 4-16 shows the noise analysis for MSF Option A. Three residential land use clusters will be exposed to noise from activities related to Option A. The predicted noise from activities at the Option A site will exceed the FTA moderate impact threshold at the three clusters of sensitive receivers (MSF1, MSF2, and MSF3). The predicted noise from activities at the Option A site will exceed the FTA severe impact threshold at one sensitive receiver cluster (MSF3). The predicted noise from activities at the Option A site will exceed the CEQA impact threshold at cluster MSF3.

Table 4-17 shows the noise analysis for MSF Option B. One residential land use cluster will be exposed to noise from activities related to Option B. The predicted noise from activities at the Option B site will not exceed the FTA impact threshold or the CEQA impact threshold at any sensitive receivers.

Table 4-18 shows the noise analysis for MSF Option C. Three residential land use clusters and one church will be exposed to noise from activities related to Option C. The predicted noise from activities at the Option C site will exceed the FTA moderate impact threshold at three clusters of sensitive receivers (MSF6, MSF7, and MSF8). The predicted noise from activities at the Option C site

Table 4-16: Predicted Noise from Potential MSF Option A

Activity	Estimated L_{dn} (dBA) at Category 2 Sensitive Receivers		
	MSF1[1]	MSF3[1]	MSF4[1]
Train Movements on Shop and Yard Tracks	50	60	56
Maintenance Shops	40	42	40
Car Wash	57	52	62
Vehicular Traffic Into/Out of Parking	21	21	21
Total MSF Noise	58	61	63
Existing Noise Level	58	58	58
FTA Threshold for Moderate Noise Impact	57	57	57
Moderate Impact (Yes/No)	Yes	Yes	Yes
FTA Threshold for Severe Noise Impact	62	62	62
Severe Impact (Yes/No)	No	No	Yes
Total Future Noise Level	61	62	64
CEQA Impact Threshold	63	63	63
CEQA Impact (Yes/No)	No	No	Yes

[1] Label for the sensitive receiver cluster. The locations of the sensitive receiver clusters are shown in Appendix B.
Source: ATS Consulting, 2014.

Table 4-17: Predicted Noise from Potential MSF Option B

Activity	Estimated L_{dn}, dBA at Receiver MSF5
Train Movements on Shop and Yard Tracks	46
Maintenance Shops	43
Car Wash	54
Vehicular Traffic Into/Out of Parking	47
Total MSF Noise	56
Existing Noise Level	58
FTA Threshold for Moderate Noise Impact	57
Moderate Impact (Yes/No)	No
FTA Threshold for Severe Noise Impact	62
Severe Impact (Yes/No)	No
Total Future Noise Level	60
CEQA Impact Threshold	63
CEQA Impact (Yes/No)	No

[1] Label for the sensitive receiver cluster. The locations of the sensitive receiver clusters are shown in Appendix B.
Source: ATS Consulting, 2014

Table 4-18: Predicted Noise from Potential MSF Option C

Activity	Estimated Ldn, dBA at Category 2 Receivers			Estimated Leq, dBA at Category 3 Receivers
	MSF6	MSF7	MSF8	MSF9
Train Movements on Shop and Yard Tracks	50	63	60	56
Maintenance Shops	37	45	47	36
Car Wash	54	59	60	45
Vehicular Traffic Into/Out of Parking	20	21	22	45
Total MSF Noise	57	67	62	57
Existing Noise Level	58	58	58	52
FTA Threshold for Moderate Noise Impact	57	57	57	59
Moderate Impact (Yes/No)	Yes	Yes	Yes	No
FTA Threshold for Severe Noise Impact	62	62	62	65
Severe Impact (Yes/No)	No	Yes	Yes	No
Total Future Noise Level	60	67	63	58
CEQA Impact Threshold	63	63	63	57
CEQA Impact (Yes/No)	No	Yes	Yes	Yes

[1] Label for the sensitive receiver cluster. The locations of the sensitive receiver clusters are shown in Appendix B.
Source: ATS Consulting, 2014

will exceed the FTA severe impact threshold at two clusters of sensitive receivers (MSF7 and MSF8). The predicted noise from activities at the Option C site will exceed the CEQA impact threshold at clusters MSF7, MSF8, and MSF9.

The summary of noise impacts from the potential MSF locations is as follows:

MSF Option A: *Moderate noise impacts are predicted at clusters MSF1, MSF2 and MSF3. Severe noise impact is predicted at cluster MSF4. CEQA noise impacts are predicted at clusters MSF 2 and MSF4.*

- **Cluster MSF1**: At MSF1 the predicted MSF noise levels exceed the moderate impact threshold at 8 dwelling units.
- **Cluster MSF2**: At MSF2 the predicted MSF noise levels exceed the moderate impact threshold at 5 dwelling units. There are no outdoor areas of frequent use at this receiver.
- **Cluster MSF3**: At MSF3 the predicted MSF noise levels exceed the severe impact threshold at 22 dwelling units.

MSF Option B: *There are no noise impacts predicted for this option.*

MSF Option C: *Moderate noise impact is predicted at cluster MSF8. Severe impact is predicted at cluster MSF7. CEQA noise impacts are predicted at clusters MSF7, MSF8 and MSF9.*

- **Cluster MSF7**: At MSF7 the predicted MSF noise levels exceed the moderate impact threshold at 24 dwelling units. There are no outdoor areas of frequent use at this receiver.
- **Cluster MSF8**: At MSF8 the predicted MSF noise levels exceed the moderate impact threshold at 26 dwelling units. There are no outdoor areas of frequent use at this receiver.
- **Cluster MSF9**: This receiver is a church. There are no outdoor areas of frequent use at this receiver.

4.9 Construction Impacts

4.9.1 No-Build Alternative

Under the No Build Alternative, no new infrastructure would be built within the study area as part of the project. There are no construction noise or vibration impacts associated with the No Build Alternative.

4.9.2 TSM Alternative

The TSM Alternative would include relatively low-cost transit service improvements such as increased bus frequencies or minor modifications to the roadway network. Additional TSM Alternative transit improvements that may be considered include, but are not limited to, traffic signalization improvements, bus stop amenities/improvements, and bus schedule restructuring. These improvements would require only light construction equipment, and any construction would be of very short duration. Impacts associated with the TSM Alternative would be minor adverse under NEPA and less than significant under CEQA.

4.9.3 Build Alternative 1 – Curb-Running BRT Alternative

4.9.3.1 Construction Noise

The construction of BRT guideways requires the use of heavy earthmoving equipment, pneumatic tools, generators, concrete pumps, and similar equipment. Table 4-19 shows the equipment likely to be used during the noisiest periods of construction, the typical noise generated by this equipment, estimated usage factors (percent of time the equipment is operating under full load), and the predicted Leq for an eight hour work shift.

Project construction would typically take place between the hours of 7 a.m. and 9 p.m. within the City of Los Angeles, in accordance with the Los Angeles Municipal Code Section 41.40(a) and 7 a.m. and 6 p.m. within the City of San Fernando, in accordance with San Fernando City Code Section 34-28(10). If it is necessary for construction to occur outside of these hours, Metro may seek a variance from Municipal Code requirements.

As shown in Table 4-19, the predicted noise level from a typical 8 hour work shift is 86 dBA at 50 feet. The daytime Leq at receivers on Van Nuys Boulevard range from 65 to 70 dBA. The *L.A. CEQA Thresholds Guide* defines a significant impact on noise levels if construction activities lasting more than one day would exceed existing ambient exterior noise levels by 10 dBA or more at a sensitive land use. The predicted construction noise level exceeds the existing ambient level by more than 15 dBA. The predicted construction noise levels also exceed the City of San Fernando limit of 70 dB. Therefore, there would be significant impact on noise levels from construction for Build Alternative 1.

FTA guidance is to apply local limits when feasible in the construction noise impact assessment. The limits in the *L.A. CEQA Thresholds Guide* are adopted as the federal significance threshold. Therefore, an adverse effect from construction noise using the federal significance threshold is predicted for Build Alternative 1.

Actual construction noise levels would depend on means and methods decided upon by the contractor, which are not available at this time. The predicted construction noise levels are based on a hypothetical scenario for the purposes of modeling. The Construction Management Plan should include a noise analysis to identify specific impacts and to determine the most appropriate noise mitigation measures. Construction noise mitigation measures are discussed in Chapter 5.

Table 4-19: Construction Noise Predictions for Build Alternative 1

Equipment	Typical Noise Level 50 ft from Source	Usage Factor (% of time under full load)	L_{eq} @ a Distance of 50 (8 hr work shift)
Earthmover (bulldozer, front-end loader, etc.)	85 dBA	30 %	80 dBA
Mobile Crane	83 dBA	10 %	73 dBA
Dump Truck	88 dBA	20%	81 dBA
Pneumatic Tools	85 dBA	20%	78 dBA
Generator	78 dBA	30%	73 dBA
Compressor	81 dBA	30%	76 dBA
Combined			86 dBA

Source: ATS Consulting, 2014

4.9.3.2 Construction Vibration

Some construction activities, such as pavement breaking and the use of tracked vehicles (e.g., bulldozers), could result in perceptible levels of groundborne vibration. However, these activities would be limited in duration and vibration levels are likely to be well below thresholds for minor cosmetic building damage.

The FTA damage risk vibration limits for different building types are shown in Section 2.1.3.2. The recommended limit for non-engineered timber and masonry buildings is 0.2 in/sec PPV (peak particle velocity). Predicted vibration levels referenced to distances of 25 feet and 50 feet from the equipment are shown in Table 4-20. The predicted level for the vibratory roller does exceed the impact threshold for sensitive receivers located within 25 feet of the construction activity.

The FTA damage risk vibration limits area adopted as both the federal and local significance thresholds. Vibration generated from the vibratory roller could result in an adverse effect and a significant impact for Build Alternative 1. Mitigation measures for construction vibration are presented in Chapter 5. In the event that other vibration generating equipment needs to be used for a sustained period of time closer than 25 feet to sensitive receivers the Construction Management Plan should also include measures to minimize those potential vibration impacts during construction.

Table 4-20: Construction Vibration Predictions for Build Alternative 1

Equipment	PPV at 25 ft (in/sec)	PPV at 50 ft (in/sec)
Vibratory Roller	0.21	0.07
Hoe Ram	0.09	0.03
Large Bulldozer	0.09	0.03
Caisson Drilling	0.09	0.03
Loaded Trucks	0.08	0.03
Jackhammer	0.04	0.01
Small Bulldozer	0.003	0.001

Source: ATS Consulting, 2014.

4.9.4 Build Alternative 2 – Median-Running BRT Alternative

4.9.4.1 Construction Noise

The construction of BRT guideways requires the use of heavy earthmoving equipment, pneumatic tools, generators, concrete pumps, and similar equipment. Table 4-21 shows the equipment likely to be used during the noisiest periods of construction, the typical noise generated by this equipment, estimated usage factors (percent of time the equipment is operating under full load), and the predicted Leq for an eight hour work shift.

Project construction would typically take place between the hours of 7 a.m. and 9 p.m. within the City of Los Angeles, in accordance with the Los Angeles Municipal Code Section 41.40(a) and 7 a.m. and 6 p.m. within the City of San Fernando, in accordance with San Fernando City Code Section 34-28(10).

As shown in Table 4-21, the predicted noise level from a typical 8 hour work shift is 86 dBA at 50 feet. The daytime Leq at receivers on Van Nuys Boulevard range from 65 to 70 dBA. The *L.A. CEQA*

Thresholds Guide defines a significant impact on noise levels if construction activities lasting more than one day would exceed existing ambient exterior noise levels by 10 dBA or more at a sensitive land use. The predicted construction noise level exceeds the existing ambient level more than 15 dBA. The predicted construction noise levels also exceed the City of San Fernando limit of 70 dB. Therefore, there would be significant impact on noise levels from construction for Build Alternative 2.

FTA guidance is to apply local limits when feasible in the construction noise impact assessment. The limits in the *L.A. CEQA Thresholds Guide* are adopted as the federal significance threshold. Therefore, an adverse effect from construction noise using the federal significance threshold is predicted for Build Alternative 2.

Actual construction noise levels would depend on means and methods decided upon by the contractor, which are not available at this time. The predicted construction noise levels are based on a hypothetical scenario for the purposes of modeling. The Construction Management Plan should include a noise analysis to identify specific impacts and to determine the most appropriate noise mitigation measures. Construction noise mitigation measures are discussed in Chapter 5.

Table 4-21: Construction Noise Predictions for Build Alternative 2

Equipment	Typical Noise Level 50 ft from Source	Usage Factor (% of time under full load)	L_{eq} (8 hr work shift)
Earthmover (bulldozer, front-end loader, etc.)	85 dBA	30 %	80 dBA
Mobile Crane	83 dBA	10 %	73 dBA
Dump Truck	88 dBA	20%	81 dBA
Pneumatic Tools	85 dBA	20%	78 dBA
Generator	78 dBA	30%	73 dBA
Compressor	81 dBA	30%	76 dBA
Combined			86 dBA

Source: ATS Consulting, 2014.

4.9.4.2 Vibration

Some activities, such as pavement breaking and the use of tracked vehicles (e.g., bulldozers), could result in perceptible levels of groundborne vibration. However, these activities would be limited in duration and vibration levels are likely to be well below thresholds for minor cosmetic building damage.

The FTA damage risk vibration limits for different building types are shown in Section 2.1.3.2. The recommended limit for non-engineered timber and masonry buildings is 0.2 in/sec PPV (peak particle velocity). Predicted vibration levels referenced to distances of 25 feet and 50 feet from the equipment are shown in Table 4-22. The predicted level for the vibratory roller does exceed the damage risk vibration limits for sensitive receivers located within 25 feet of the construction activity.

The FTA damage risk vibration limits area adopted as both the federal and local significance thresholds. Vibration generated from the vibratory roller could result in an adverse effect and a significant impact for Build Alternative 2. Mitigation measures for construction vibration are presented in Chapter 5. In the event that other vibration generating equipment needs to be used for a sustained period of time closer than 25 feet to sensitive receivers the Construction Management Plan should also include measures to minimize those potential vibration impacts during construction.

Table 4-22: Construction Vibration Predictions for Build Alternative 2

Equipment	PPV at 25 ft (in/sec)	PPV at 50 ft (in/sec)
Vibratory Roller	0.21	0.07
Hoe Ram	0.09	0.03
Large Bulldozer	0.09	0.03
Caisson Drilling	0.09	0.03
Loaded Trucks	0.08	0.03
Jackhammer	0.04	0.01
Small Bulldozer	0.003	0.001

Source: ATS Consulting, 2014.

4.9.5 Build Alternative 3 – Low-Floor LRT/Tram Alternative

4.9.5.1 Construction Noise

The construction of the rail guideway requires the use of heavy earth-moving equipment, pneumatic tools, generators, concrete pumps, and similar equipment. Table 4-23 shows the equipment likely to be used during the noisiest periods of construction, the typical noise generated by this equipment, estimated usage factors (percent of time the equipment is operating under full load), and the predicted Leq for an eight hour work shift. Generally, the two proposed rail alternatives (Build Alternatives 3 and 4) require more construction than the two BRT alternatives; this is reflected in the higher estimated usage factor for the two proposed rail alternatives compared to the BRT alternatives.

Project construction would typically take place between the hours of 7 a.m. and 9 p.m. within the City of Los Angeles, in accordance with the Los Angeles Municipal Code Section 41.40(a) and 7 a.m. and 6 p.m. within the City of San Fernando, in accordance with San Fernando City Code Section 34-28(10). If it is necessary for construction to occur outside of these hours, Metro may seek a variance from Municipal Code requirements.

As shown in Table 4-23, the predicted noise level from a typical 8 hour work shift is 87 dBA at 50 feet. The daytime Leq at receivers on Van Nuys Boulevard range from 65 to 70 dBA. The *L.A. CEQA Thresholds Guide* defines a significant impact on noise levels if construction activities lasting more than one day would exceed existing ambient exterior noise levels by 10 dBA or more at a sensitive land use. The predicted construction noise level exceeds the existing ambient level by more than 15 dBA. The predicted construction noise levels also exceed the City of San Fernando limit of 70 dB. Therefore, there would be significant impact on noise levels from construction for Build Alternative 3.

FTA guidance is to apply local limits when feasible in the construction noise impact assessment. The limits in the *L.A. CEQA Thresholds Guide* are adopted as the federal significance threshold. Therefore, an adverse effect from construction noise using the federal significance threshold is predicted for Build Alternative 3.

Actual construction noise levels would depend on means and methods decided upon by the contractor, which are not available at this time. The predicted construction noise levels are based on a hypothetical scenario for the purposes of modeling. The Construction Management Plan should include a noise analysis to identify specific impacts and to determine the most appropriate noise mitigation measures. Construction noise mitigation measures are discussed in Chapter 5.

Table 4-23: Construction Noise Predictions for Build Alternative 3

Equipment	Typical Noise Level 50 ft from Source	Usage Factor (% of time under full load)	Leq (8-hr work shift)
Earthmover (bulldozer, front-end loader, etc.)	85 dBA	40 %	81 dBA
Mobile Crane	83 dBA	20 %	76 dBA
Dump Truck	88 dBA	30%	83 dBA
Pneumatic Tools	85 dBA	30%	80 dBA
Generator	78 dBA	40%	74 dBA
Compressor	81 dBA	40%	77 dBA
Combined			87 dBA

Source: ATS Consulting, 2014.

4.9.5.2 Construction Vibration

Some construction activities, such as pavement breaking and the use of tracked vehicles (e.g., bulldozers), could result in perceptible levels of groundborne vibration. However, these activities would be limited in duration and vibration levels are likely to be well below thresholds for minor cosmetic building damage.

The FTA damage risk vibration limits for different building types are shown in Section 2.1.3.2. The recommended limit for non-engineered timber and masonry buildings is 0.2 in/sec PPV (peak particle velocity). Predicted vibration levels referenced to distances of 25 feet and 50 feet from the equipment are shown in Table 4-24. The predicted level for the vibratory roller does exceed the damage risk vibration limits for sensitive receivers located within 25 feet of the construction activity.

The FTA damage risk vibration limits area adopted as both the federal and local significance thresholds. Vibration generated from the vibratory roller could result in an adverse effect and a significant impact for Build Alternative 3. Mitigation measures for construction vibration are presented in Chapter 5. In the event that other vibration generating equipment needs to be used for a sustained period of time closer than 25 feet to sensitive receivers the Construction Management Plan should also include measures to minimize those potential vibration impacts during construction.

Table 4-24: Construction Vibration Predictions for Build Alternative 3

Equipment	PPV at 25 ft (in/sec)	PPV at 50 ft (in/sec)
Vibratory Roller	0.21	0.07
Hoe Ram	0.09	0.03
Large Bulldozer	0.09	0.03
Caisson Drilling	0.09	0.03
Loaded Trucks	0.08	0.03
Jackhammer	0.04	0.01
Small Bulldozer	0.003	0.001

Source: ATS Consulting, 2014.

4.9.6 Build Alternative 4 – LRT Alternative

4.9.6.1 Construction Noise

The construction of the rail guideway requires the use of heavy earth-moving equipment, pneumatic tools, generators, concrete pumps, and similar equipment. Table 4-25 shows the equipment likely to be used during the noisiest periods of construction, the typical noise generated by this equipment, estimated usage factors (percent of time the equipment is operating under full load), and the predicted Leq for an eight hour work shift. Generally, the two proposed rail alternatives (Build Alternatives 3 and 4) require more construction than the two BRT alternatives; this is reflected in the higher estimated usage factor for the two proposed rail alternatives compared to the BRT alternatives.

Project construction would typically take place between the hours of 7 a.m. and 9 p.m. within the City of Los Angeles, in accordance with the Los Angeles Municipal Code Section 41.40(a) and 7 a.m. and 6 p.m. within the City of San Fernando, in accordance with San Fernando City Code Section 34-28(10).

As shown in Table 4-25, the predicted noise level from a typical 8 hour work shift is 87 dBA at 50 feet. The daytime Leq at receivers on Van Nuys Boulevard range from 65 to 70 dBA. The *L.A. CEQA Thresholds Guide* defines a significant impact on noise levels if construction activities lasting more than one day would exceed existing ambient exterior noise levels by 10 dBA or more at a sensitive land use. The predicted construction noise level exceeds the existing ambient level more than 15 dBA. The predicted construction noise levels also exceed the City of San Fernando limit of 70 dB. Therefore, there would be significant impact on noise levels from construction for Build Alternative 4.

FTA guidance is to apply local limits when feasible in the construction noise impact assessment. The limits in the *L.A. CEQA Thresholds Guide* are adopted as the federal significance threshold. Therefore, an adverse effect from construction noise using the federal significance threshold is predicted for Build Alternative 4.

Pile drivers may also be used for construction of the underground stations. Impact pile drivers could generate noise levels up to 100 dBA. Although pile driving is not a continuous noise source that would last over a day or more, pile driving can generate noise levels much greater than the ambient over shorter durations, and noise mitigation measures should be incorporated when pile driving is performed close to noise sensitive receivers.

Actual construction noise levels would depend on means and methods decided upon by the contractor, which are not available at this time. The predicted construction noise levels are based on a hypothetical scenario for the purposes of modeling. The Construction Management Plan should include a noise analysis to identify specific impacts and to determine the most appropriate noise mitigation measures. Construction noise mitigation measures are discussed in Chapter 5.

Impacts resulting from the construction of Alternative 4 would be similar to those that would occur under Alternative 3, and the proposed mitigation measures for Alternative 3 above would also apply to construction of Alternative 4. One exception is that Alternative 4 includes tunneling, which is not included in Alternative 3. Noise impacts from tunnel boring machines are expected to be less-than-significant, because operations take place underground.

Recently, a tunnel boring machine was used for the Metro Gold Line Eastside Extension. No noise complaints associated with ground-borne noise from the TBM or mine trains used for the Gold Line were received.

Table 4-25: Construction Noise Predictions, Build Alternative 4

Equipment	Typical Noise Level 50 ft from Source	Usage Factor (% of time under full load)	L_{eq} (8-hr work shift)
Earthmover (bulldozer, front-end loader, etc.)	85 dBA	40 %	81 dBA
Mobile Crane	83 dBA	20 %	76 dBA
Dump Truck	88 dBA	30%	83 dBA
Pneumatic Tools	85 dBA	30%	80 dBA
Generator	78 dBA	40%	74 dBA
Compressor	81 dBA	40%	77 dBA
Combined			87 dBA

Source: ATS Consulting, 2014.

4.9.6.2 Construction Vibration

Some construction activities, such as pile driving, pavement breaking, and the use of tracked vehicles (e.g., bulldozers), could result in perceptible levels of groundborne vibration. However, most these activities would be limited in duration and vibration levels are likely to be well below thresholds for minor cosmetic building damage. Ground-borne noise and vibration impacts associated with tunneling are likely to be less than significant because tunneling will only take place within the Van Nuys Boulevard street ROW. However, an assessment of tunneling operations should be including in the Construction Vibration Control Plan because ground-borne noise and vibration levels from tunneling are highly dependent on the means and methods selected by the contractor. If the Metro ground-borne noise limits or ground-borne vibration limits are exceeded during tunneling, the contractor will be required to take actions to reduce vibrations to acceptable levels. Such actions could include reducing the muck train speed, additional rail and tie isolation, and more frequent rail and wheel maintenance.

The FTA damage risk vibration limits for different building types are shown in Section 2.1.3.2. The recommended limit for non-engineered timber and masonry buildings is 0.2 in/sec PPV (peak particle velocity). Predicted vibration levels referenced to a distance of 25 feet and 50 feet from the equipment are shown in Table 4-26. The activities where predicted vibration levels would exceed the impact threshold at sensitive receivers are pile driving and using the vibratory roller.

The FTA damage risk vibration limits area adopted as both the federal and local significance thresholds. Vibration generated from pile driving or using the vibratory roller could result in an adverse effect and a significant impact. Mitigation measures for construction vibration are presented in Chapter 5. In the event that other equipment needs to be used for a sustained period of time closer than 25 feet to sensitive receivers, the Construction Management Plan should also include measures to minimize vibration impacts during construction.

4.10 Cumulative Impacts

The cumulative impacts assessment uses the planning document *SCAG Regional Transportation Plan/Sustainable Communities Strategy* (RTP/SCS) to determine if the possible effects of the project are individually limited but cumulatively considerable with respect to noise and vibration.

Table 4-26: Construction Vibration Predictions for Build Alternative 4

Equipment	PPV at 25 ft (in/sec)	PPV at 50 ft (in/sec)
Pile Driver (Impact)	1.52	0.54
Pile Driver (Sonic)	0.73	0.26
Vibratory Roller	0.21	0.07
Hoe Ram	0.09	0.03
Large Bulldozer	0.09	0.03
Caisson Drilling	0.09	0.03
Loaded Trucks	0.08	0.03
Jackhammer	0.04	0.01
Small Bulldozer	0.003	0.001

Source: ATS Consulting, 2014.

4.10.1 No-Build Alternative

The no build alternative would result in no noise impacts and no vibration impacts, so it would not contribute to any cumulative impacts.

4.10.2 TSM Alternative

The TSM alternative would likely result in less than one decibel increase in noise levels, which is a less-than-significant impact. The SCAG RTP/SCS planning document identifies the California High Speed Rail (CAHSR) project as a project that may arrive within the study area of this analysis before the 2040 Horizon Year. However, the CAHSR project would be located in the Metrolink ROW and the less-than significant noise impact from the TSM alternative would be limited to sensitive receivers along Van Nuys Boulevard. Therefore, the TSM alternative would not contribute to any cumulative noise impacts.

The TSM alternative would result in no vibration impacts, so it would not contribute to any cumulative vibration impacts.

4.10.3 Build Alternative 1 – Curb-Running BRT Alternative

Build Alternative 1 would result in less-than-significant noise impacts. The SCAG RTP/SCS planning document identifies the California High Speed Rail (CAHSR) project as a project that may arrive within the study area of this analysis before the 2040 Horizon Year. If the CAHSR project were constructed in the Metrolink ROW on San Fernando Road, it would likely result in a significant noise impact and require noise mitigation. Because the construction noise levels associated with the Curb-Running BRT Alternative could increase ambient noise levels by as much as 15 to 20 decibels, the project's contribution would be cumulatively considerable over the temporary construction period.

Build Alternative 1 would result in no vibration impacts, so it would not contribute to any cumulative vibration impacts.

4.10.4 Build Alternative 2 – Median-Running BRT Alternative

Build Alternative 2 would result in less-than-significant noise impacts. The SCAG RTP/SCS planning document identifies the California High Speed Rail (CAHSR) project as a project that may arrive within the study area of this analysis before the 2040 Horizon Year. If the CAHSR project were constructed in the Metrolink ROW on San Fernando Road, it would likely result in a significant noise impact and require noise mitigation. Therefore, Build Alternative 2 is not expected to contribute to cumulative noise impacts that are individually limited but cumulatively considerable.

Build Alternative 2 would result in no vibration impacts, so it would not contribute to any cumulative vibration impacts.

4.10.5 Build Alternative 3 – Low-Floor LRT/Tram Alternative

Recommended construction noise mitigation measures would reduce temporary construction noise levels; however, temporary construction noise impacts would still remain significant and unavoidable. Because roadway noise is the primary source of existing noise in the corridor, increases in roadway traffic volumes over time due to cumulative growth and development could also increase ambient noise levels in the area. However, future increases in roadway traffic are expected to result in a less than 1-decibel increase in community noise levels. The estimated increase in noise from the Low-Floor LRT/Tram Alternative, however, would be significant. Consequently, the cumulative impacts due to operational noise from Alternative 3 and roadway traffic would be significant. However, the mitigation measures identified below would reduce the operational noise impacts due to Alternative 3 to a less-than-significant level; therefore, the noise impacts of Alternative 3 would not be cumulatively considerable after mitigation.

A possibly significant source of noise along the San Fernando Road portion of the corridor is the CASHR Project. If the CAHSR Project were constructed in the Metrolink ROW on San Fernando Road, it would likely result in a significant noise impact and require noise mitigation. However, it is not known whether CAHSR noise impacts could be mitigated to a less-than-significant level. Therefore, although the potential increase in noise levels along San Fernando due to the Low-Floor

LRT/Tram Alternative would be less than significant after mitigation, the minor increase in remaining noise due to the Low-Floor LRT/Tram Alternative, when combined with other future sources of noise along San Fernando Road, such as the CAHSR Project,

Build Alternative 3 would result in less-than significant vibration impacts with mitigation incorporated at sensitive receivers along Van Nuys Boulevard and would not result in any vibration impacts at sensitive receivers along the Metrolink ROW. Because there is no predicted vibration impact at sensitive receivers near the Metrolink ROW and potential impacts from the CAHSR project would be limited to sensitive receivers near the Metrolink ROW, Build Alternative 3 would not contribute to any cumulative vibration impacts.

4.10.6 Build Alternative 4 – Light Rail Transit Alternative

Alternative 4's contribution to any cumulative impacts would be similar to those described above for Alternative 3.

Build Alternative 4 would result in less-than significant vibration impacts with mitigation incorporated at sensitive receivers along Van Nuys Boulevard and would not result in any vibration impacts at sensitive receivers along the Metrolink ROW. Because there is no predicted vibration impact at sensitive receivers near the Metrolink ROW and potential impacts from the CAHSR project would be limited to sensitive receivers near the Metrolink ROW, Build Alternative 4 would not contribute to any cumulative vibration impacts.

Chapter 5
Mitigation Measures

5.1 Operational Mitigation Measures

Impact predictions and proposed mitigation measures for all build alternatives are based on designs that are subject to further refinement. During Final Design, data that affects the impact predictions may change, such as proposed headways or precise locations of stations. Accordingly, the impacts and mitigation measures are subject to refinement as well.

No noise or vibration impacts were predicted for the No Build Alternative or the TSM Alternative, so no mitigation measures are recommended for those alternatives. Recommended operational mitigation measures for Build Alternatives 1 through 4 are discussed in the following sections.

5.1.1 Build Alternative 1 – Curb-Running BRT Alternative

5.1.1.1 Noise

Moderate noise impacts were predicted at three clusters of receivers for Build Alternative 1. The impacts were predicted at the residential sensitive receivers located closest to Van Nuys Boulevard as a result of introducing additional bus traffic in the curb-running lanes. The predicted noise levels exceeded the moderate noise impact threshold by no more than one decibel.

According to FTA guidance, mitigation measures should be implemented for severe noise impacts unless there are compelling reasons why mitigation is not feasible. The FTA severe noise impact threshold is adopted as the federal significance threshold. For moderate noise impact, noise mitigation should be considered and adopted when it is considered reasonable. The FTA guidance manual recommends taking into account the number of affected sites, the increase over existing noise levels, and the cost of mitigation among other factors when determining if mitigation for moderate impacts is reasonable. Table 5-1 shows the existing noise level, the noise contributed by the project, and the predicted total future noise level for each of the sensitive receiver clusters where moderate noise impact is predicted. The increase over existing noise levels due to the project by no more than one decibel; therefore, no noise mitigation is recommended for these moderate noise impacts.

Table 5-1: Summary of Build Alternative 1 Noise Impacts

Sensitive Receiver ID	Existing Noise Level (Ldn in dBA)	Predicted Project Noise Level under Build Alternative (Ldn in dBA)	Predicted Future Noise Level under Build Alternative (Ldn in dBA)	Increase over Existing (dB)	Number of Impacted Units
NB-16	68	64	69	1	20
SB-14	68	64	69	1	25
SB-15	68	63	69	1	14

Source: ATS Consulting, 2014.

5.1.1.2 Vibration

There are no vibration impacts predicted for Build Alternative 1. Therefore, no vibration mitigation measures are recommended.

5.1.2 Build Alternative 2 – Median-Running BRT Alternative

5.1.2.1 Noise

There are no noise impacts predicted for Build Alternative 2. Therefore, no noise mitigation measures are recommended.

5.1.2.2 Vibration

There are no vibration impacts predicted for Build Alternative 2. Therefore, no vibration mitigation measures are recommended.

5.1.3 Build Alternative 3 – Low-Floor LRT/Tram Alternative

5.1.3.1 Noise

Severe noise impacts were predicted at three residential receiver clusters and moderate noise impacts were predicted at 30 residential receiver clusters. The low-floor LRT/tram is noisier than the existing buses because:

- a two-car low-floor LRV/tram on embedded track at 35 mph is expected to generate approximately 5 dB more noise (in terms of SEL) than an accelerating bus, and
- The low-floor LRT/tram would have lower headways than the existing bus lines that would be removed from the study area as part of the project.

According to FTA guidance, mitigation measures should be implemented for severe noise impacts unless there are compelling reasons why mitigation is not feasible. The FTA severe noise impact threshold is adopted as the federal significance threshold. For moderate noise impact, noise mitigation should be considered and adopted when it is considered reasonable. The FTA guidance manual recommends taking into account the number of affected sites, the increase over existing noise levels, and the cost of mitigation among other factors when determining if mitigation for moderate impacts is reasonable.

Sound walls are the most common approach to reduce noise impacts from surface transportation sources. However, constructing sound walls for the majority of the impacted receivers is not a feasible or desirable option because (1) there is a narrow right-of-way and it would be difficult to accommodate a sound wall, (2) the wall would have to be interrupted frequently for cross streets and would reduce visibility for automobiles at intersections, and (3) it could introduce a visual impact to the community.

Noise mitigation measures that may be implemented to reduce noise to below the FTA thresholds are described below:

- **Specify low-noise vehicles –** Low-floor LRT/tram vehicles can be designed to achieve lower noise levels generated at the wheel/rail interface. Specifying a vehicle with a reference sound level of 75 dBA Lmax at 50 feet and 40 mph on ballast and tie track for a two car train would result in a 3 dB reduction in the predicted noise levels. Manufacturers can achieve low-noise specifications with a combination of vehicle skirts, a well-designed suspension, and under-car absorption. Low-noise vehicles are currently being used on a recently constructed light rail extension in Salt Lake City and noise measurements at the San Diego Trolley system also show that those vehicles generate low noise levels compared to many other systems[1]. To maintain low-noise levels on the system, it would also be necessary to commit to regular rail grinding and wheel-truing.
- **Building sound insulation** – Sound insulation of residences and buildings will increase the outdoor-to-indoor noise reduction. Although this approach has no effect on noise at exterior areas, it may be the best choice for sites where noise barriers are not feasible or desirable or for buildings where indoor sensitivity is of most concern. Substantial improvements in building sound insulation (approximately 5 to 10 decibels) can often be achieved by adding an extra layer of glazing to the windows, by sealing any holes in exterior surfaces that act as sound leaks, and by providing forced ventilation and air-conditioning so windows do not need to be opened for ventilation.
- **Apply absorptive materials to the concrete track bed** – Although not common, there are several examples of this approach being used as a noise mitigation measure on Asian and European transit systems. However, this option may be difficult to implement in a right-of-way where there are many cross-streets.

Two of the clusters where severe noise impacts are predicted are located near the intersection of Van Nuys Boulevard and San Fernando Road where a row of buildings would be removed. Project noise sources at these receivers include noise from the low-floor LRT/tram, potential for wheel-squeal due to the curve, and an increase in traffic noise due to the removal of a row of buildings. The noise at these receivers could be further mitigated with friction control to eliminate wheel squeal and a sound wall to mitigate the increase in traffic noise and the low-floor LRT/Tram noise. Friction control may consist of installing lubricators on the rail or using an onboard lubrication system that applies lubrication directly to the wheel. A sound wall would be feasible at this location because the tracks would not be in the median of the roadway. The proposed location of the sound wall is shown in Figure B-12 in Appendix B.

The recommended noise mitigation measure for third severe noise impact (at cluster SB-43) is to specify and procure low-noise vehicles. Low-noise vehicles with a reference sound level of 75 dBA Lmax at 50 feet and 40 mph for a 2 car train would reduce the predicted noise level by 3 decibels at all receivers. This noise reduction would be sufficient to reduce the severe noise impact to below the severe impact threshold and many of the predicted moderate noise impacts to below the moderate impact threshold.

According to FTA guidance, final determinations on mitigation for moderate noise impacts should take into account the increase over existing noise levels, the cost of mitigation, and other project specific factors. Engineering or operational constraints specific to the project that are finalized further

[1] Information on low-noise vehicles is from "Noise Measurements on San Diego Trolley", presented by Hugh Saurenman at the Wheel-Rail Interface Seminar 2012 and from correspondence with E. Gregory Thorpe of Utah Transit Authority, February 25, 2014.

along in the design process would determine if specifying a low-noise vehicle is a practical and reasonable mitigation measure. If it is determined that specifying a low-noise vehicle is not a practical and reasonable mitigation measure, building sound insulation should be considered to mitigate the severe noise impact.

Building sound insulation is also an alternative mitigation measure for the moderate noise impacts. Similar to the specification of low-noise vehicles, the final determination on whether building sound insulation is implemented should take into account the increase over existing noise levels, the cost of mitigation, and other project specific factors, such as whether a low-noise vehicle was specified. Final determination on whether building sound insulation is a reasonable mitigation measure for moderate noise impacts should be decided further along in the design process.

The recommended mitigation measures are summarized in Table 5-2. With recommended mitigation incorporated, the predicted noise levels would be reduced to below the FTA severe noise impact threshold. For Build Alternative 3, there would be no adverse noise effect with mitigation incorporated under the federal significance threshold and a less-than-significant noise impact under the state/local significance threshold.

Table 5-2: Recommended Noise Mitigation Measures, Build Alternative 3

Mitigation Measure	Estimated Noise Reduction	Affected Receivers	Comments
Sound Wall	-5 to -10 dB	SB-38B, SB-39	Sound wall should be about 600 feet in length. Wall height and noise reduction should be determined during Final Design.
Friction Control	-10 dB	SB-38B, and SB-39	Friction control should be incorporated into the design for the curve at Van Nuys Boulevard and San Fernando Road to eliminate wheel squeal.
Low-noise vehicle specification	-2 to -3 dB	All	Low-noise vehicle specification should include vehicle skirts and under-car absorption. Commitments to regular rail grinding and wheel truing are necessary to maintain low noise levels. Final determination on whether it is practical to specify a low-noise vehicle would be determined further along in the design process.

Source: ATS Consulting, 2014.

5.1.3.2 Vibration

The vibration analysis predicted impact at 16 clusters of residential receivers and one institutional land use. Mitigation measures that may be implemented to reduce groundborne vibration to below the FTA impact threshold are described below:

- **Continuous mat floating slab**: A continuous mat floating slab is a variation on a traditional floating slab. A continuous mat, similar to a ballast mat, would be placed underneath a concrete slab in place of elastomeric or steel-coil springs. For embedded track, the rails would be embedded in the mat-supported slab using the same basic design as used for standard embedded track. A continuous mat floating slab is cheaper than a traditional floating slab; however, it provides less reduction in vibration levels.

- **Vibration isolated embedded track**: The most common design for embedded track on modern light rail systems is to use a rubber "boot" around the rail with the rail and boot embedded in concrete. The standard booted embedded track system is relatively stiff and does not provide much isolation. However, several suppliers have developed embedded track systems that incorporate much softer rubber elements. An example is QTrack, a proprietary embedded track system supplied by Pandrol/CDM. It is a fastenerless continuously supported track with rubber profiles decoupling the whole rail from its environment. QTrack provides similar reduction in vibration levels compared to a continuous mat floating slab.
- **Floating slab**: A floating slab consists of a concrete slab supported by elastomeric or steel coil springs. For embedded track, the rails would be embedded in the spring-supported slab using the same basic design as used for standard embedded track. Floating slab is the most expensive mitigation measure; however, it provides the most reduction in vibration levels.

The predicted vibration levels could be reduced to below the FTA impact thresholds at all sensitive receivers with traditional floating slab track. However, further study of the impacted sensitive receivers may show that a continuous mat floating slab or QTrack, would provide sufficient vibration reduction because the analysis includes many conservative assumptions. Further study could lead to refinements on the following assumptions included in the analysis:

- Force density measurements of a vehicle similar to that specified for the project on embedded track. The FDL used in the analysis is presented in Appendix D, and is based on measurements of a Metro Gold Line vehicle traveling on ballast-and-tie track.
- Site specific LSTM data. The analysis may over-predict the LSTM at some sensitive receivers because the analysis uses the highest LSTM from the group of measurement sites closest to the receiver. Also, future LSTM measurements could include measurements inside specific buildings to determine if the buildings are attenuating vibration levels.
- A 15*log(speed) adjustment is used to account for vehicle speeds below 50 mph. However, the FTA guidance manual recommends an adjustment of 20*log(speed). The 15*log(speed) adjustment is used because it is consistent with recent measurement results and is a conservative assumption. However, FDL measurements of LRVs traveling 30-35 mph may eliminate the need for this assumption.
- A +5 dB safety factor is included in the analysis because of the potential for building amplification, uncertainty in the force density level, and uncertainty in the LSTM levels. Further study and measurements could justify a reduction in the safety factor.

The recommended vibration mitigation measures are presented in Table 5-3. There is no state or local vibration impact threshold, so the FTA impact threshold is used as the federal and state/local significance threshold. With the recommended mitigation incorporated, the predicted vibration levels would be reduced to below the FTA vibration impact threshold. For Build Alternative 3, there would be minimal adverse vibration effect with mitigation incorporated under the federal significance threshold and a less than significant noise impact under the state/local significance threshold.

5.1.4 Build Alternative 4 – LRT Alternative

5.1.4.1 Noise

Severe noise impacts were predicted at two residential sensitive receiver clusters and moderate noise impacts were predicted 59 residential sensitive receiver clusters. The LRVs are expected to generate more noise than the existing buses because:

- a three-car LRV on embedded track at 35 mph is about 7 dB noisier (in terms of SEL) than an accelerating bus, and
- the LRT would operate more frequently than the bus line that is being removed from the project area.

Table 5-3: Recommended Vibration Mitigation Measures, Build Alternative 3

Mitigation Measure	Affected Receivers	Approximate Distance	Comments
Floating slab	All predicted receivers with impact[1]	5,500 ft[2]	Resonant frequency and other design considerations should be finalized during Final Design.
Alternative: Further study may show continuous mat floating slab or QTrack is sufficient	All predicted receivers with impact[1]	5,500 ft[2]	Further study may include FDL measurements and site-specific LSTM measurements.

[1] The predicted receivers with impact are shown in table form in Chapter 4 and graphically in Appendix B
[2] Approximate distance is given in linear feet.
Source: ATS Consulting, 2014-

According to FTA guidance, mitigation measures should be implemented for severe noise impacts unless there are compelling reasons why mitigation is not feasible. The FTA severe noise impact threshold is adopted as the federal significance threshold. For moderate noise impact, noise mitigation should be considered and adopted when it is considered reasonable. The FTA guidance manual recommends taking into account the number of affected sites, the increase over existing noise levels, and the cost of mitigation among other factors when determining if mitigation for moderate impacts is reasonable.

Sound walls are a common approach to reduce noise impacts from surface transportation sources. However, constructing sound walls for the majority of the impacted receivers is not a feasible or desirable option because (1) there is a narrow right-of-way and it would be difficult to accommodate a sound wall, (2) the wall would have to be interrupted frequently for cross streets and would reduce visibility for automobiles at intersections, and (3) it could introduce a visual impact to the community.

Noise mitigation measures that may be implemented to reduce noise to below the FTA thresholds are described below:

- **Specify low-noise vehicles –** Light-rail vehicles can be designed to achieve lower noise levels generated at the wheel/rail interface. Specifying a vehicle with a reference sound level of 75 dBA Lmax at 50 feet and 40 mph on ballast and tie track for a two car train would result in a 3 dB reduction in the predicted noise levels. Manufacturers can achieve low-noise specifications with a combination of vehicle skirts, a well-designed suspension, and under-car absorption. Low-noise vehicles are currently being used on a recently constructed streetcar line in Salt Lake City and noise measurements at the San Diego Trolley system also show that those vehicles generate low noise levels compared to many other systems. To maintain low-noise levels on the system, it would also be necessary to commit to regular rail grinding and wheel-truing.
- **Building sound insulation** – Sound insulation of residences and buildings improve the outdoor-to-indoor noise reduction. Although this approach has no effect on noise in exterior areas, it may be the best choice for sites where noise barriers are not feasible or desirable or for buildings where indoor sensitivity is of most concern. Substantial improvements in building sound insulation

(approximately 5 to 10 decibels) can often be achieved by adding an extra layer of glazing to the windows, by sealing any holes in exterior surfaces that act as sound leaks, and by providing forced ventilation and air-conditioning so windows do not need to be opened for ventilation.

- **Install ballast-and-tie track –** Ballast is an absorptive material so it reflects less noise than a concrete track bed. As a result, ballast-and-tie track systems are about 3 decibels quieter than traditional embedded track systems.
- **Apply absorptive materials to the concrete track bed** – Although not common, there are several examples of this approach being used as a noise mitigation measure on Asian and European transit systems. However, this option is very difficult to implement in a right-of-way where there are many cross-streets.

The two clusters where severe noise impacts are predicted are located near the intersection of Van Nuys Boulevard and San Fernando Road where a row of buildings would be removed. Project noise sources at these receivers include noise from the LRT, potential for wheel-squeal due to a curve in the alignment, and an increase in traffic noise due to the removal of a row of buildings. The noise at these receivers could be further mitigated with friction control to eliminate wheel squeal and a sound wall to mitigate the increase in traffic noise and the LRT noise. Friction control may consist of installing lubricators on the rail or using an onboard lubrication system that applies lubrication directly to the wheel. A sound wall would be feasible at this location because the tracks would not be in the median of the roadway. The proposed location of the sound wall is shown in Figure B-12 in Appendix B.

In addition to the severe noise impacts, moderate noise impacts are predicted at 58 clusters of sensitive receivers. The recommended noise mitigation measure for moderate noise impacts is to specify and procure low-noise vehicles. Low-noise vehicles would reduce the predicted noise level by 2 to 3 decibels at all receivers. This noise reduction would be sufficient to reduce many of the predicted moderate noise impacts to below the impact threshold. According to FTA guidance, final determinations on mitigation for moderate noise impacts should take into account the increase over existing noise levels, the cost of mitigation, and other project specific factors. Engineering or operational constraints specific to the project that are finalized further along in the design process will determine if specifying a low-noise vehicle is a practical and reasonable mitigation measure.

An alternative mitigation measure for moderate noise impacts is building sound insulation. Similar to the specification of low-noise vehicles, the final determination on whether building sound insulation is implemented should take into account the increase over existing noise levels, the cost of mitigation, and other project specific factors, such as whether a low-noise vehicle was specified. Final determination on whether building sound insulation is a reasonable mitigation measure for moderate noise impacts should be decided further along in the design process.

The recommended mitigation measures are summarized in Table 5-4. With recommended mitigation incorporated, the predicted noise levels would be reduced to below the FTA severe noise impact threshold. For Build Alternative 4, there would be no adverse noise effect with mitigation incorporated under the federal significance threshold and a less-than-significant noise impact under the state/local significance threshold.

Table 5-4: Recommended Noise Mitigation Measures, Build Alternative 4

Mitigation Measure	Estimated Noise Reduction	Affected Receivers	Comments
Sound Wall	-5 to -10 dB	SB-38B, SB-39	Sound wall should be about 600 feet in length. Wall height and noise reduction should be determined during Final Design.
Friction Control	-10 dB	SB-38B, and SB-39	Friction control should be incorporated into the design for the curve at Van Nuys Boulevard and San Fernando Road to eliminate wheel squeal.
Low-noise vehicle specification	-2 to -3 dB	All	Low-noise vehicle specification should include vehicle skirts and under-car absorption. Commitments to regular rail grinding and wheel truing are necessary to maintain low noise levels. Final determination on whether it is practical to specify a low-noise vehicle would be determined further along in the design process.

Source: ATS Consulting, 2014,

5.1.4.2 Vibration

The vibration analysis predicted the following groundborne vibration and groundborne noise impacts:

- Groundborne vibration impact at 20 clusters of Category 2, residential, receivers
- Groundborne vibration impact at two Category 3, institutional, receivers
- Groundborne noise impact at two clusters of Category 2 receivers
- Groundborne noise impact at six Category 3 receivers

Mitigation measures that may be implemented to reduce groundborne vibration and groundborne noise levels to below the FTA impact threshold are described below:

- **Continuous mat floating slab**: A continuous mat floating slab is a variation on a traditional floating slab. A continuous mat, similar to a ballast mat, would be placed underneath a concrete slab in place of elastomeric or steel-coil springs. For embedded track, the rails would be embedded in the mat-supported slab using the same basic design as used for standard embedded track. A continuous mat floating slab is cheaper than a traditional floating slab; however, it provides less reduction in vibration levels.
- **Vibration isolated embedded track**: The most common design for embedded track on modern light rail systems is to use a rubber "boot" around the rail with the rail and boot embedded in concrete. The standard booted embedded track system is relatively stiff and does not provide much isolation. However, several suppliers have developed embedded track systems that incorporate much softer rubber elements. An example is QTrack, a proprietary embedded track system supplied by Pandrol/CDM. It is a fastenerless continuously supported track with rubber profiles decoupling the whole rail from its environment. QTrack provides similar reduction in vibration levels compared to a continuous mat floating slab.
- **Floating slab**: A floating slab consists of a concrete slab supported by elastomeric or steel coil springs. For embedded track, the rails would be embedded in the spring-supported slab using the

same basic design as used for standard embedded track. Floating slab is the most expensive mitigation measure; however, it provides the most reduction in vibration levels.

The predicted vibration levels could be reduced to below the FTA impact thresholds at all sensitive receivers with traditional floating slab track. However, further study of the impacted sensitive receivers may show that a continuous mat floating slab or QTrack would provide sufficient vibration reduction because the analysis includes many conservative assumptions. Further study could lead to refinements on the following assumptions included in the analysis:

- Force density measurements of a vehicle similar to that specified for the project on embedded track. The FDL used in the analysis is presented in Appendix D, and is based on measurements of a Metro Gold Line vehicle traveling on ballast-and-tie track.
- Site specific LSTM data. The analysis may over-predict the LSTM at some sensitive receivers because the analysis uses the highest LSTM from the group of measurement sites closest to the receiver. Also, future LSTM measurements could include measurements inside specific buildings to determine if the buildings are attenuating vibration levels.
- A 15*log(speed) adjustment is used to account for vehicle speeds below 50 mph. However, the FTA guidance manual recommends an adjustment of 20*log(speed). The 15*log(speed) adjustment is used because it is consistent with recent measurement results and is a conservative assumption. However, FDL measurements of LRVs traveling 30-35 mph may eliminate the need for this assumption.
- A +5 dB safety factor is included in the analysis because of the potential for building amplification, uncertainty in the force density level, and uncertainty in the LSTM levels. Further study and measurements could justify a reduction in the safety factor.

The recommended vibration mitigation measures are presented in Table 5-5. There is no state or local vibration impact threshold, so the FTA impact threshold is used as the federal and state/local significance threshold. With the recommended mitigation incorporated, the predicted vibration levels would be reduced to below the FTA vibration impact threshold. For Build Alternative 3, there would be no adverse vibration effect with mitigation incorporated under the federal significance threshold and a less than significant noise impact under the state/local significance threshold.

Table 5-5: Recommended Vibration Mitigation Measures, Build Alternative 4

Mitigation Measure	Affected Receivers	Approximate Distance	Comments
Floating slab	All receivers where impact is predicted[1]	5,200 ft[2]	Resonant frequency and other design considerations should be finalized during Final Design.
Alternative: Further study may show continuous mat floating slab or QTrack is sufficient	All receivers where impact is predicted[1]	5,200 ft[2]	Further study may include FDL measurements and site-specific LSTM measurements.

[1] The predicted receivers with impact are shown in table form in Chapter 4 and graphically in Appendix B
[2] Approximate distance is given in linear feet.
Source: ATS Consulting, 2014

5.1.5 Ancillary Equipment Mitigation Measures

Noise impacts are predicted near 5 of the proposed TPSS sites. Noise mitigation options for TPSS units include:

- Include a noise limit in the purchase specifications for TPSS units. The recommended limit is that the maximum level not exceed 50 dBA at a distance of 50 feet from any part of a TPSS unit.
- Locate the unit within the parcel as far from sensitive receivers as feasible. If possible, orient the cooling fans away from sensitive receivers. The cooling fans are a major noise source on modern TPSS units, and if the units are located strategically within the proposed parcel, additional mitigation may not be necessary.
- Build a sound enclosure around the TPSS unit to reduce noise levels at sensitive receivers.

5.1.6 MSF Mitigation Measures

Noise impacts are predicted at sensitive receivers near MSF Options A and C. Noise mitigation options of the MSF include:

- Use low-impact frogs at crossovers, where feasible.
- Construct the car wash facility to limit noise at nearby sensitive receivers. The analysis uses a conservative reference noise level for the car wash facility, assuming an open facade will be facing the residences.
- When the MSF site is selected and the layout is finalized, update the noise impact analysis to reflect any changes. If possible, include noise measurements at a similar facility. A more detailed study may show that mitigation measures are not needed.

5.2 Construction Mitigation Measures

5.2.1 Construction Noise

Without noise mitigation, construction of all four Build Alternatives are expected to exceed the noise limits in the *L.A. CEQA Thresholds Guide* and the limit in the San Fernando City municipal code. Construction noise impacts can be reduced with operational methods, scheduling, equipment choice, and acoustical treatments. The following best-practice noise mitigation measures should be implemented to minimize annoyance from construction noise:

- The contractor should be required to develop a Noise Control Plan that demonstrates how he will achieve the appropriate noise limits. The Plan should include measurements of existing noise, a list of major pieces of construction equipment that will be used, and prediction of noise levels at the closest sensitive receivers (including residences, hotels, schools, churches, and similar facilities).
- Adequately notify the public of construction operations and schedules.
- Whenever possible, conduct all construction activities during the daytime and during weekdays.
- Where feasible, use alternative mitigation measures that would result in lower sound levels. Use the best available control technologies to limit excessive noise when working near residences.
- Where practical, erect temporary noise barriers between noisy activities and noise-sensitive receivers. Use moveable noise barriers at the site of the construction activity, if possible.
- Implement noise-deadening measures for truck loading and operations. Use lined or covered storage bins, conveyors, and chutes with noise-deadening material.
- Avoid impact pile driving where possible. Where geological conditions permit, use quieter alternatives such as drilled piles or a vibratory pile driver.

5.2.2 Construction Vibration

It is unlikely that vibration from construction activities will exceed the thresholds for minor cosmetic damage to buildings. In the event that equipment producing high levels of vibration such as pile driving may approach those limits, the Construction Noise Control Plan should also include measures to minimize vibration impact during constriction. Also, representatives from the project should be available to discuss vibration related complaints and take appropriate action to minimize the intrusion. Appropriate vibration mitigation measures include:

- minimizing the use of tracked vehicles,
- avoiding vibratory compaction,
- where feasible, using less vibration intensive construction equipment or techniques near sensitive receivers such as using cast-in-place drilled hole caissons or drilled piers rather than impact driven piles,
- and vibration monitoring near sensitive receivers to ensure thresholds are not exceeded during activities that generate high vibration levels.

Chapter 6
Impacts Remaining After Mitigation

For all alternatives, where impacts are predicted mitigation measures are recommended that would reduce predicted noise and vibration levels to below the federal and state/local significance thresholds. There are no predicted significant impacts remaining after mitigation.

Chapter 7
CEQA Determination

In conformance with CEQA, noise and vibration generated by the different project alternatives were evaluated to determine if the project would cause significant noise or vibration impact. The thresholds set forth in the *L.A. CEQA Thresholds Guide* and summarized in Section 2.3.2 are applied as the significance thresholds. The predicted noise and vibration levels and the significance thresholds were used to answer the checklist of questions in Appendix G of the state *CEQA Statute and Guidelines* related to noise and vibration. The following sections detail the CEQA determination for each alternative.

7.1 No Build

There is no predicted change in noise or vibration levels for the No Build Alternative. The No Build Alternative would result in the following:

- Would not expose people to or generate noise levels in excess of standards established in the local general plan or noise ordinance or in the applicable standards of other agencies.
- Would not result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project.
- Would not expose people within 2 miles of the Whiteman Airport to excessive noise levels. The Whiteman airport is a general aviation airport located within 2 miles of the study area.
- Would not expose people to or generate excessive groundborne vibration or groundborne noise levels.
- Would not result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above existing levels after mitigation for construction noise.

7.2 TSM

The noise and vibration impact analysis concluded that the TSM Alternative would result in the following:

- Would not expose people to or generate noise levels in excess of standards established in the local general plan or noise ordinance or in the applicable standards of other agencies.
- Would not result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project.
- Would not expose people within 2 miles of the Whiteman Airport to excessive noise levels. The Whiteman airport is a general aviation airport located within 2 miles of the study area.
- Would not expose people to or generate excessive groundborne vibration or groundborne noise levels.
- Would not result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above existing levels.

The operational noise and vibration impact assessments did not predict any significant impacts. No mitigation measures were recommended.

7.3 Build Alternative 1

The noise and vibration impact analysis concluded that Build Alternative 1 would result in the following:

- Would not expose people to or generate noise levels in excess of standards established in the local general plan or noise ordinance or in the applicable standards of other agencies.
- Would not result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project.
- Would not expose people within 2 miles of the Whiteman Airport to excessive noise levels. The Whiteman airport is a general aviation airport located within 2 miles of the study area.
- Would not expose people to or generate excessive groundborne vibration or groundborne noise levels.
- Would not result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above existing levels after mitigation for construction noise.

The noise and vibration from the construction of the Curb-Running BRT Alternative would be temporary; however, due to the increase in noise levels above ambient levels, the Curb-Running BRT Alternative would still result in significant and unavoidable impacts, even with mitigation incorporated.

7.4 Build Alternative 2

The noise and vibration impact analysis concluded that Build Alternative 2 would result in the following:

- Would not expose people to or generate noise levels in excess of standards established in the local general plan or noise ordinance or in the applicable standards of other agencies.
- Would not result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project.
- Would not expose people within 2 miles of the Whiteman Airport to excessive noise levels.
- Would not expose people to or generate excessive groundborne vibration or groundborne noise levels.
- Would not result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above existing levels after mitigation for construction noise.

The noise and vibration from the construction of the Median-Running BRT Alternative would be temporary; however, due to the increase in noise levels above ambient levels, the Median-Running BRT Alternative would still result in a significant and unavoidable impact, even with mitigation incorporated.

7.5 Build Alternative 3

The noise and vibration impact analysis concluded that Build Alternative 3 would result in the following:

- Would not expose people to or generate noise levels in excess of standards established in the local general plan or noise ordinance or in the applicable standards of other agencies with mitigation incorporated.
- Would not result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project with mitigation incorporated.
- Would not expose people within 2 miles of the Whiteman Airport to excessive noise levels after mitigation.
- Would not expose people to or generate excessive groundborne vibration or groundborne noise levels with mitigation incorporated.
- Would not result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above existing levels after mitigation for construction noise.

Before mitigation, significant noise impact was predicted at 10 residential receivers and significant vibration impact was predicted at 60 residential receivers and one institutional receiver. Recommended mitigation measures are presented in Chapter 5.

The noise and vibration from construction of the Low-Floor LRT/Tram Alternative would be temporary; however, due to the increase in noise levels above ambient levels, the Low-Floor LRT/Tram Alternative would still result in a significant and unavoidable impact, even with implementation of proposed mitigation measures.

The noise and vibration from operation of the Low-Floor LRT/Tram Alternative would result in less-than-significant impacts with implementation of proposed mitigation measures.

7.6 Build Alternative 4

The noise and vibration impact analysis concluded that Build Alternative 4 would result in the following:

- Would not expose people to or generate noise levels in excess of standards established in the local general plan or noise ordinance or in the applicable standards of other agencies with mitigation incorporated.
- Would not result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project with mitigation incorporated.
- Would not expose people within 2 miles of the Whiteman Airport to excessive noise levels with mitigation incorporated.
- Would not expose people to or generate excessive groundborne vibration or groundborne noise levels with mitigation incorporated.
- Would not result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above existing levels after mitigation for construction noise.

The noise and vibration from construction of the LRT Alternative would be temporary; however, due to the increase in noise levels above ambient levels, the LRT Alternative would still result in significant and unavoidable impacts, even with implementation of proposed mitigation measures.

The noise and vibration from operation of the LRT Alternative would result in less-than-significant impacts with implementation of proposed mitigation measures.

Chapter 8
References

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Appendix A
Background on Noise and Vibration

Fundamental Noise Concepts

Noise is typically defined as unwanted or undesirable sound. The basic parameters of environmental noise that affect human response to sound are the following:

1. intensity or level;
2. frequency content; and
3. variation with time.

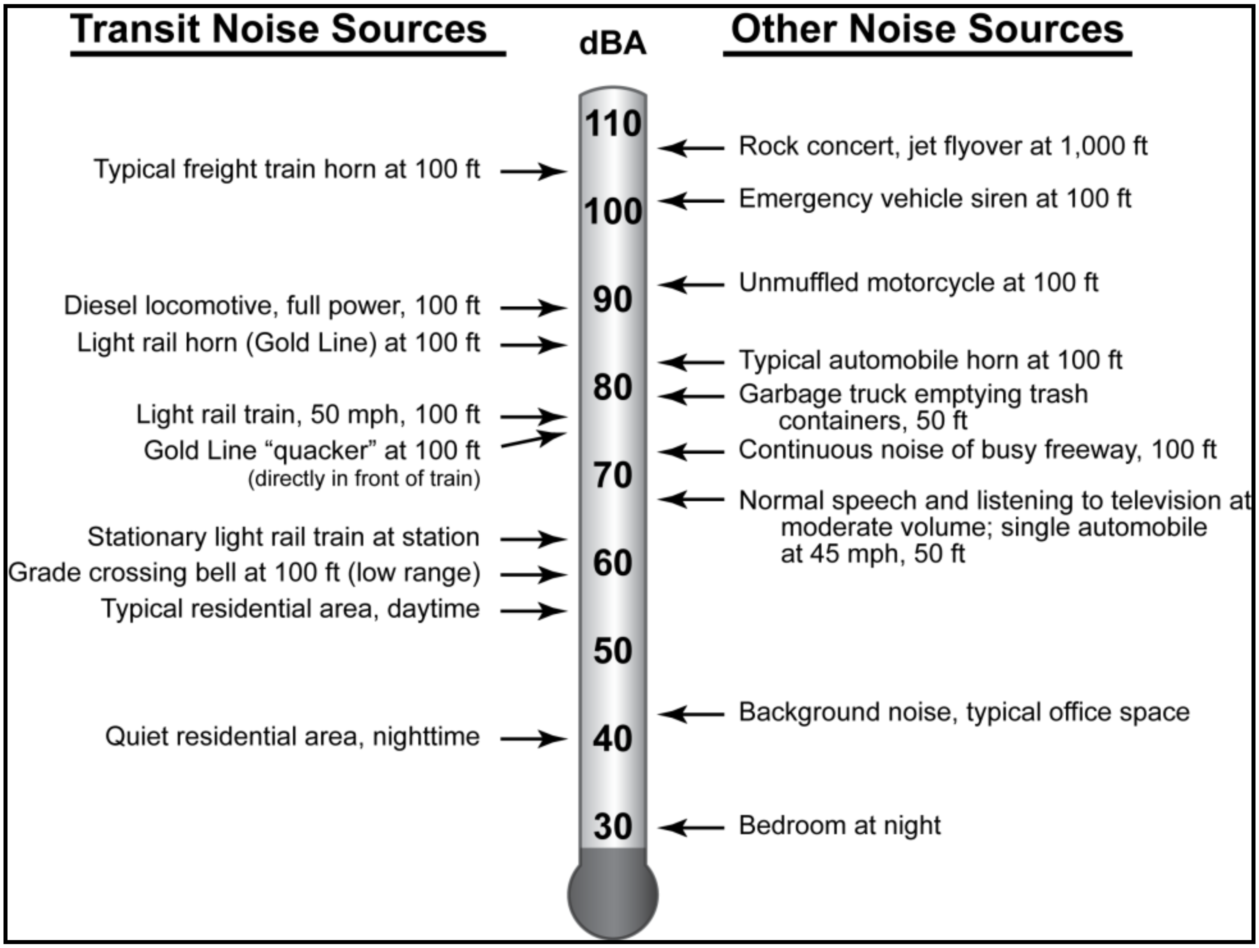
The intensity of sound is determined by how greatly the sound pressure fluctuates above and below the atmospheric pressure, and is expressed on a logarithmic scale in units of decibels (dB). By using this scale, the range of normally encountered sound can be expressed by values between 0 and 120 dB. The dB scale corresponds to how humans perceive sound loudness. On a relative basis, a 3 dB change in sound level generally represents a noticeable change in loudness, whereas a 10 dB change is typically perceived as a doubling (or halving) in the loudness of a sound.

The frequency content of noise is related to the tone or pitch of the sound, and is expressed based on the rate of the air pressure fluctuations in cycles per second called hertz (Hz). The human ear can detect frequencies from about 20 Hz to 17,000 Hz; however, the sensitivity of human hearing varies with frequency. The A-weighting system is commonly used when measuring environmental noise to which humans are most sensitive. This system provides a single-number descriptor that correlates with the subjective human response. Sound levels measured using this weighting system are called "A-weighted" sound levels and are expressed as "dBA." Figure A-1 provides relative examples of A-weighted sound levels from common indoor and outdoor sounds.

Environmental sound constantly fluctuates over time. As a result, there are several different metrics that are commonly used to characterize sound over time. The metrics used in this report to characterize sound environments are:

- **Maximum Sound Level (L_{max})** is the maximum sound level that occurs during an event such as a train passing. L_{max} is the maximum sound level using the slow setting on a standard sound level meter.
- **Equivalent Sound Level (L_{eq})** is the most common means of characterizing fluctuating community noise. L_{eq} represents a constant sound that, over a specified period of time, has the same sound energy as the time-varying sound. In other words, L_{eq} is an energy average of the sound for a given period of time. In this report, the L_{eq} is usually given for a 1-hour time period. L_{eq} is used by the FTA to evaluate noise effects from proposed transit project at institutional land uses such as schools, churches, and libraries.
- **Day-Night Sound Level (L_{dn})** is essentially a 24 hour L_{eq} with an adjustment to reflect the greater sensitivity of most people to nighttime noise. The adjustment is a 10 dB penalty for all sound that occurs between the hours of 10:00 p.m. to 7:00 a.m. L_{dn} is the most common measure of total community noise over a 24-hour period and is used by the FTA to evaluate noise from proposed transit projects in residential areas.

Figure A-1: Sound Levels of Typical Indoor and Outdoor Sources



Source: FTA, 2006

- **Community Noise Exposure Level (CNEL)** CNEL is the time average of all A-weighted sound levels for a 24-hour period with a 10 dBA penalty added to the sound levels that occur between the hours of 10:00 p.m. and 7:00 a.m., and a 5 dBA penalty added to the sound levels which occur between the hours of 7:00 p.m. and 10:00 p.m. These penalties attempt to account for increased human sensitivity to noise environment during the quieter nighttime periods, particularly when residents may be sleeping. CNEL is often used as a metric for determining noise impacts in State of California and City of Los Angeles guidelines. CNEL is slightly more sensitive to nighttime noise than the L_{dn} metric (used by the FTA); however, the two metrics generally differ by less than 1 dB.
- **Percent Exceedance Level (L_{XX})** is the sound level that is exceeded for a certain percentage of the measurement period. For example, L_{99} is the sound level exceeded during 99 percent of the measurement period. For a 1 hour period, L_{99} is the sound level exceeded for all except 36 seconds of the hour, which is very close to the minimum sound level. L_1 represents typical maximum sound levels, L_{33} is approximately equal to L_{eq} when free-flowing traffic is the dominant noise source, and L_{50} is the median sound level.

- **Sound Exposure Level (SEL)** is a measure of the acoustic energy of an event such as a train passing. The acoustic energy of the event is compressed into a 1 second period. SEL increases as the sound level of the event increases and as the duration of the event increases. It is often used as an intermediate value in calculating overall metrics such as L_{eq} and L_{dn}.

Fundamental Vibration Concepts

Groundborne vibration travels from a source through the soil and may cause perceptible shaking or vibration inside buildings. In this report, groundborne vibration is expressed in terms of velocity. Velocity is the preferred measure for evaluating groundborne vibration from transit projects because it is typically considered to correspond best with human sensitivity to vibration.

Similar to noise, groundborne vibration can be expressed using a logarithmic scale in units of decibels. In this report, groundborne vibration is expressed in terms of the root-mean-square (RMS) vibration velocity level in decibels (VdB). The abbreviation VdB is used in place of dB to avoid confusing vibration decibels with sound decibels.

Figure A-2 illustrates typical groundborne vibration levels for common sources and criteria for human and structural response to groundborne vibration. As the figure illustrates, the range of interest for vibration is approximately 50 to 100 VdB (from imperceptible background vibration to the threshold of potential damage). The approximate threshold of human perception to vibration is 65 VdB. Humans generally do not find vibration from light-rail transit operations annoying until the vibration exceeds 70 to 75 VdB.

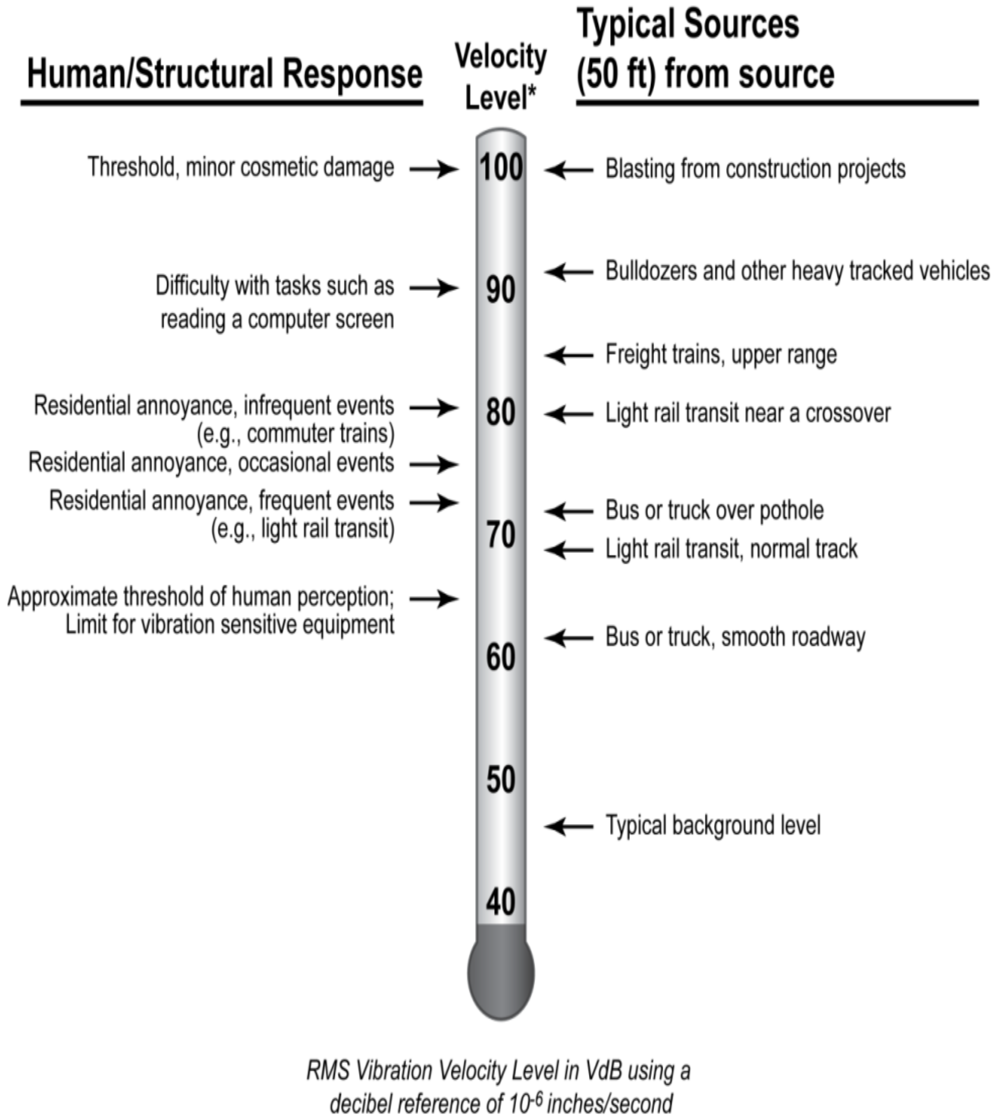
Peak particle velocity (PPV) is an alternate metric for describing vibration levels. PPV is the maximum instantaneous positive or negative peak of the vibration signal. PPV is often used as a metric for impacts from construction vibration, but it is not considered suitable for evaluating human response because it takes some time for the human body to respond to vibration signals.

Transit Noise and Vibration Sources

The following noise and vibration sources will be evaluated as part of the noise and vibration impact analysis for the project:

- **Light-Rail Vehicle (LRV) Operations** – This is the normal noise from the operation of light-rail vehicles and includes noise from steel wheels rolling on steel rails (wheel/rail noise) and from propulsion motors, air conditioning, and other auxiliary equipment on the vehicles. As expected, the wheel/rail noise increases with speed. At speeds greater than 20 to 30 mph, the wheel/rail noise usually dominates noise from the vehicle auxiliary equipment. Train operations may also create groundborne vibration that is intrusive to occupants of buildings when the tracks are approximately 100 feet or closer to buildings. However, the vibration from LRT operations is almost never sufficient to cause even minor cosmetic damage to buildings.
- **Bus Rapid Transit Operations** – This is the noise from the operation of buses in the proposed rapid transit corridor. The noise from operations includes buses accelerating and breaking, idling at stops, and tire-pavement noise from the tires rolling on the pavement.
- **Traffic Noise** – The project would result in changes in automobile traffic patterns and volumes and bus traffic patterns and volumes. The change in noise level as a result of the change in traffic patterns is included in the noise analysis.

Figure A-2: Typical Groundborne Vibration Levels and Criteria



Source: FTA, 2006

- **Audible Warnings** – Audible warnings are required by the California Public Utilities Commission at all gate-protected at-grade LRT/roadway crossings. The required audible warnings are ringing bells that are located on the masts of the crossing gates and the sounding of horns located on the lead vehicle of the trains. Audible warnings are included in the analysis for Alternative 4.
- **Special Trackwork** – Alternatives 3 and 4 will require special trackwork. The most common special trackwork are turnouts and crossovers. Turnouts and crossovers for light-rail transit require special trackwork where two rails cross. The special fixture used where two rails cross is referred to as a "frog." Standard frogs have gaps, and the train wheels must "jump" across the gap. The wheels striking the ends of the gap increase noise and vibration levels.

- **Ancillary Equipment** – Traction power substations (TPSS) are the only ancillary equipment associated with LRT or trams that could create noise impacts. Ventilation fans provided at each substation are the dominant noise source for most modern TPSS units. There is no ancillary equipment associated with the BRT Alternatives. Noise from TPSS units is included in the analysis for Alternatives 3 and 4.
- **Maintenance and Storage Facility (MSF) –** A MSF would be constructed as part of Alternatives 3 and 4. In addition to provided storage space for the light-rail vehicles, the MSF would
- **Construction Noise and Vibration** – All the sources discussed previously are associated with operation of the project. Similar to any other major infrastructure project, construction would require use of heavy equipment that generates relatively high noise and vibration levels.

Appendix B

Inventory of Sensitive Receivers

Table B-1: Inventory of Sensitive Receivers

Receiver ID	Receiver Description	Location	Number of Units	Distance to NT Alternative 1	Distance to NT Alternative 2	Distance to NT Alternative 3	Distance to NT Alternative 4
NB-01	MFR	Sylmar between Kittridge and Haynes West side	12	245	268	274	274
NB-02	MFR	14429 Kittridge St	16	245	268	275	274
NB-03	MFR	6715-6727 Sylmar Ave	20	245	277	273	272
NB-04	MFR	14436 Valerio St	16	183	210	213	213
NB-05	MFR	14435 Valerio St	25	197	219	224	221
NB-06	SFR	7441 Sylmar Ave – 14431 Cohasset St	8	194	218	218	218
NB-07	SFR	8053-8015 Tilden Ave	8	274	296	303	294
NB-08	SFR	Tilden between Titus and Lanark West side	10	278	300	305	296
NB-09	SFR	14417 Burton St – 8201 Tilden Ave	6	273	294	294	290
NB-10	MFR	Van Nuys between Parthenia and Osborne South Side	84	33	54	54	--
NB-10A	MFR	8790-8770 Van Nuys Blvd	6	--	--	--	63
NB-10B	MFR	8850-8802 Van Nuys Blvd	36	--	--	--	55

Receiver ID	Receiver Description	Location	Number of Units	Distance to NT Alternative 1	Distance to NT Alternative 2	Distance to NT Alternative 3	Distance to NT Alternative 4
NB-10C	MFR	8930-8862 Van Nuys Blvd	42	--	--	--	55
NB-11	SFR	Tilden between Parthenia and Osborne	25	159	180	180	--
NB-11A	SFR	8787-8763 Tilden Ave	5	--	--	--	183
NB-11B	SFR	8855-8793 Tilden Ave	11	--	--	--	181
NB-11C	SFR	2nd row between 8861 Tilden and Osborne	9	--	--	--	181
NB-12	MFR	14555 Osborne St	80	85	108	114	110
NB-13	MFR	9248-9200 Van Nuys Blvd	52	29	49	55	54
NB-14	MFR	9261-9149 Wakefield Ave	48	302	322	328	327
NB-15	MFR	9450-9300 Van Nuys Blvd	56	29	49	55	55
NB-15B	MFR	14540-14530 Plummer St	7	119	149	149	146
NB-16	MFR	9510 Van Nuys Blvd	20	20	45	46	40
NB-17	MFR	9618-9600 Van Nuys Blvd	12	32	52	58	59
NB-18	MFR	14598-9628 Van Nuys Blvd	64	23	43	49	52
NB-19	SFR	14300-14246 Van Nuys Blvd	8	44	68	68	68
NB-20	SFR	14263-14221 Hoyt St	7	178	202	202	202
NB-21	MFR	14140-14104 Van Nuys Blvd	11	38	58	59	63

Receiver ID	Receiver Description	Location	Number of Units	Distance to NT Alternative 1	Distance to NT Alternative 2	Distance to NT Alternative 3	Distance to NT Alternative 4
NB-22	MFR	14066-14060 Van Nuys Blvd	12	41	69	65	59
NB-23	MFR	14018-14002 Van Nuys Blvd	3	37	65	64	55
NB-24	SFR	2nd row between Arleta and Lev	3	164	192	191	182
NB-25	SFR	Van Nuys between Lev and Bartee	5	43	75	73	61
NB-26	SFR	2nd row between Lev Bartee South side	4	158	190	188	176
NB-27	SFR	2nd row between Bartee and Vena South side	4	163	184	184	181
NB-28	SFR	10176-10172 Vena Ave	2	158	181	181	181
NB-29	MFR	13801 Hoyt St	4	23	48	48	51
NB-30	SFR	13769-13715 Hoyt St	12	186	214	213	207
NB-31	SFR	10377-10371 Rincon Ave	2	171	199	199	189
NB-32	SFR	2nd row between Amboy and Rincon South side	4	166	194	190	184
NB-33	SFR	2nd row between Omelveny and Amboy South side	4	176	204	200	201
NB-34	SFR	2nd row between Haddon and Omelveny South side	4	178	211	202	203

Receiver ID	Receiver Description	Location	Number of Units	Distance to NT Alternative 1	Distance to NT Alternative 2	Distance to NT Alternative 3	Distance to NT Alternative 4
NB-35	SFR	2nd row between Oneida and Haddon South side	4	171	192	198	196
NB-36	SFR	2nd row between Kewen and Oneida South side	3	171	204	202	195
NB-37	SFR	10558-10552 Kewen Ave	4	85	106	106	109
NB-38	SFR	2nd row between Telfair and Cayuga South side	4	185	218	214	209
NB-39	SFR	2nd row between Tamarack and Telfair South side	4	188	209	215	212
NB-40	MFR	2nd row between El Dorado and Tamarack South side	16	84	108	108	108
NB-41	MFR	101 Park Ave	12	244	244	538	140
NB-42	SFR	Frank Modungo between Village Way and Hubbard	16	372	372	286	308
NB-43	SFR	14061-14077 Hoyt St	3	--	--	--	--
NB-44	SFR	10716-10710 Ilex Ave	2	--	--	--	--
SB-01	MFR	6840 Vesper-Ave 14521 Hartland St	16	156	197	196	196
SB-02	SFR	14555-14515 Hart St	2	151	187	187	191

Receiver ID	Receiver Description	Location	Number of Units	Distance to NT Alternative 1	Distance to NT Alternative 2	Distance to NT Alternative 3	Distance to NT Alternative 4
SB-03	MFR	14554-14530 Vose St	8	236	272	272	277
SB-04	MFR	2nd row between Gault and Vose North side	5	180	228	228	222
SB-05	MFR	2nd row between Valerio and Wyandotte North side	24	236	261	264	257
SB-06	MFR	8849-8803 Van Nuys Blvd	36	25	47	47	52
SB-07	MFR	Tobias between Parthenia and Rayen	42	190	212	212	--
SB-07A	MFR	8760-8728 Tobias Ave	18	--	--	--	218
SB-07B	MFR	8844-8800 Tobias Ave	24	--	--	--	216
SB-08	MFR	9041 Van Nuys-Blvd 14605 Rayen St	71	27	53	54	52
SB-09	MFR	8938 Tobias Ave- 14625 Rayen St	36	180	206	206	204
SB-10	MFR	9050 Tobias Ave	4	240	267	266	264
SB-11	MFR	9257-9147 Van Nuys Blvd	56	23	44	49	50
SB-12	MFR	9256-9148 Tobias Ave	29	190	211	216	217
SB-13	MFR	9301 Vincennes St	18	31	56	60	59
SB-14	MFR	Van Nuys between Gledhill and Vincennes	25	19	43	43	47

Receiver ID	Receiver Description	Location	Number of Units	Distance to NT Alternative 1	Distance to NT Alternative 2	Distance to NT Alternative 3	Distance to NT Alternative 4
SB-15	MFR	9429 Van Nuys Blvd	14	19	48	48	39
SB-16	MFR	14619 Gledhill St	10	178	207	207	198
SB-17	MFR	14610 Plummer St	8	99	128	127	118
SB-18	MFR	9607-9601 Van Nuys Blvd	10	25	57	51	49
SB-19	MFR	9758 Vesper Ave-14599 Van Nuys Ave	14	27	47	53	50
SB-20	MFR	14419 Van Nuys Blvd-9851 Canterbury Ave	19	39	63	63	64
SB-21	MFR	14265 Van Nuys Blvd	16	32	56	56	56
SB-22	SFR	14237-14163 Van Nuys Blvd	7	42	62	62	66
SB-23	SFR	14254-14200 Pinney St	8	334	354	354	358
SB-24	SFR	14147-14115 Van Nuys Blvd	7	46	66	70	69
SB-25	SFR	14180 Claretta St-10044 Woodale Ave	8	167	187	191	190
SB-26	MFR	14073-14055 Van Nuys Blvd	6	50	70	74	68
SB-27	MFR	2nd row between Pacoima Channel and Arleta Ave North side	4	359	379	383	377

Receiver ID	Receiver Description	Location	Number of Units	Distance to NT Alternative 1	Distance to NT Alternative 2	Distance to NT Alternative 3	Distance to NT Alternative 4
SB-28	SFR	2nd row between Lev and Arleta North side	4	156	184	185	187
SB-29	SFR	Van Nuys between Bartee and Lev North side	7	46	66	67	76
SB-30	SFR	2nd row between Bartee and Lev North side	4	154	174	174	184
SB-31	SFR	10168 Bartee Ave-13947 Van Nuys Blvd	2	43	69	75	73
SB-32	SFR	2nd row between Vena and Bartee North side	4	155	181	187	185
SB-33	SFR	10224-10218 Vena Ave	2	157	183	186	184
SB-34	SFR	13844-13838 Pinney St	2	249	275	274	275
SB-35	SFR	13740-13702 Pinney St	6	166	186	190	185
SB-36	SFR	13676-13642 Pinney St	8	166	186	190	192
SB-37	SFR	10514 Haddon Ave	2	154	180	183	180
SB-38	SFR	Pinney between El Dorado and Telfair	12	183	207	--	--
SB-38A	SFR	10668 Telfair Ave-13402 Pinney St	10	--	--	207	207
SB-38B	SFR	13370-13364 Pinney St	2	--	--	181	260
SB-39	SFR	13350-13326 Pinney St	8	215	240	88	78

Receiver ID	Receiver Description	Location	Number of Units	Distance to NT Alternative 1	Distance to NT Alternative 2	Distance to NT Alternative 3	Distance to NT Alternative 4
SB-40	SFR	2nd row between Filmore and Weidner	6	146	146	149	232
SB-41	SFR	1431-1417½ Celis St	4	--	--	131	--
SB-42	SFR	15541-1527 Celis St	6	--	--	130	--
SB-43	MFR	12165-12157 San Fernando Rd	24	--	--	32	--
SB-44	MFR	12181-12171 San Fernando Rd	20	--	--	49	--
SB-45	MFR	12215 San Fernando Rd	6	--	--	164	--
SB-46	Hotel	14710 Bleeker St	9	--	--	48	--
SB-47	SFR	1st row East corner Trailer Park Bleeker St	3	--	--	92	--
SB-48	SFR	2nd row East Side Trailer Park Bleeker St	12	--	--	111	--
SB-49	SFR	1st row East corner Trailer Park San Fernando Rd	2	--	--	115	--
SB-50	SFR	2nd row East Side Trailer Park San Fernando Rd	9	--	--	189	--

Receiver ID	Receiver Description	Location	Number of Units	Distance to NT Alternative 1	Distance to NT Alternative 2	Distance to NT Alternative 3	Distance to NT Alternative 4
SB-51	SFR	1st row NE Side Trailer Park San Fernando Rd	5	--	--	185	--

Figure B-1: Sensitive Receiver Locations, Sylvan Street to Kittridge Street

Figure B-2: Sensitive Receiver Locations, Kittridge Street to Gault Street

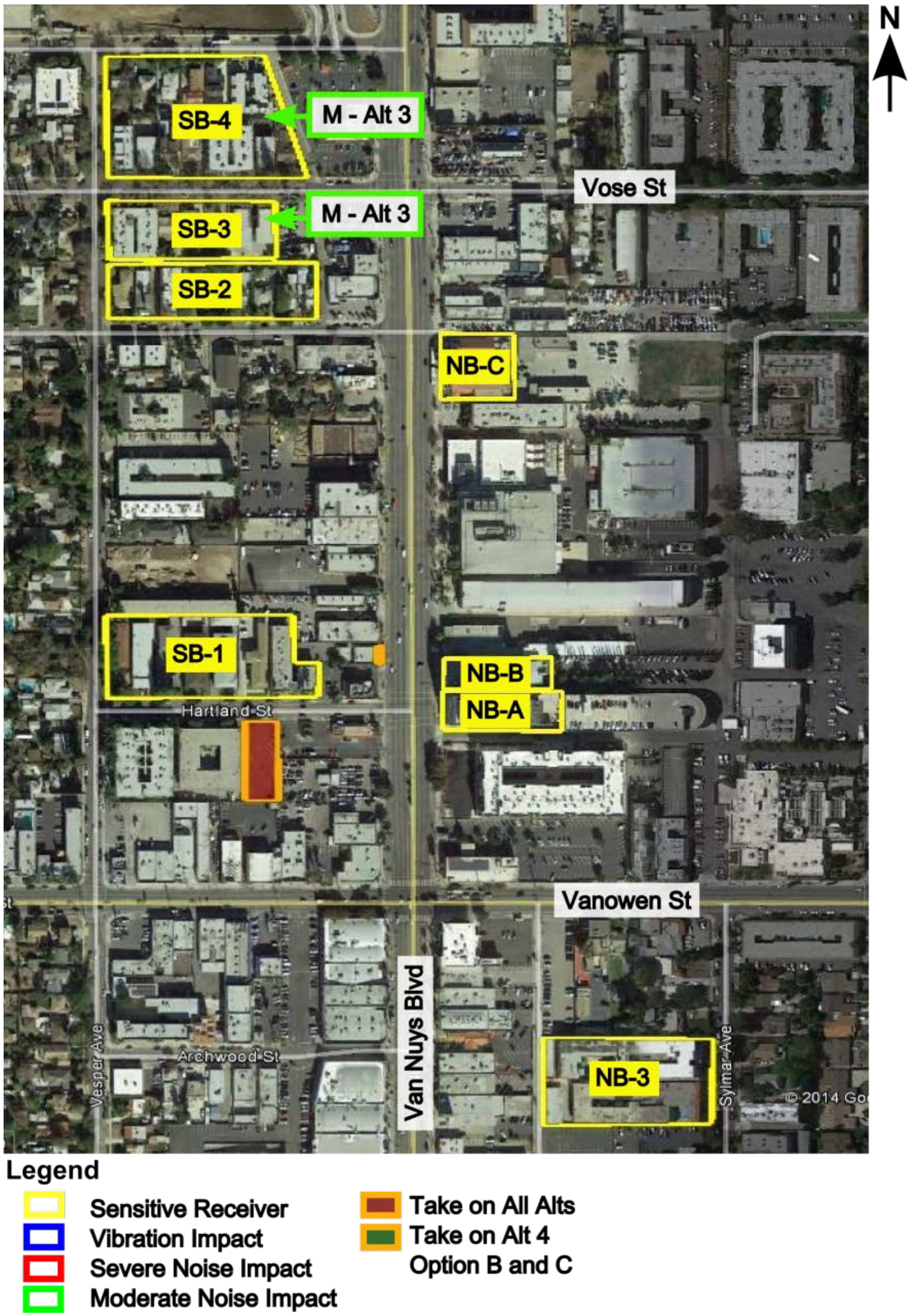


Figure B-3: Sensitive Receiver Locations, Gault Street to Covello Street

Figure B-4: Sensitive Receiver Locations, Blythe Street to Roscoe Boulevard

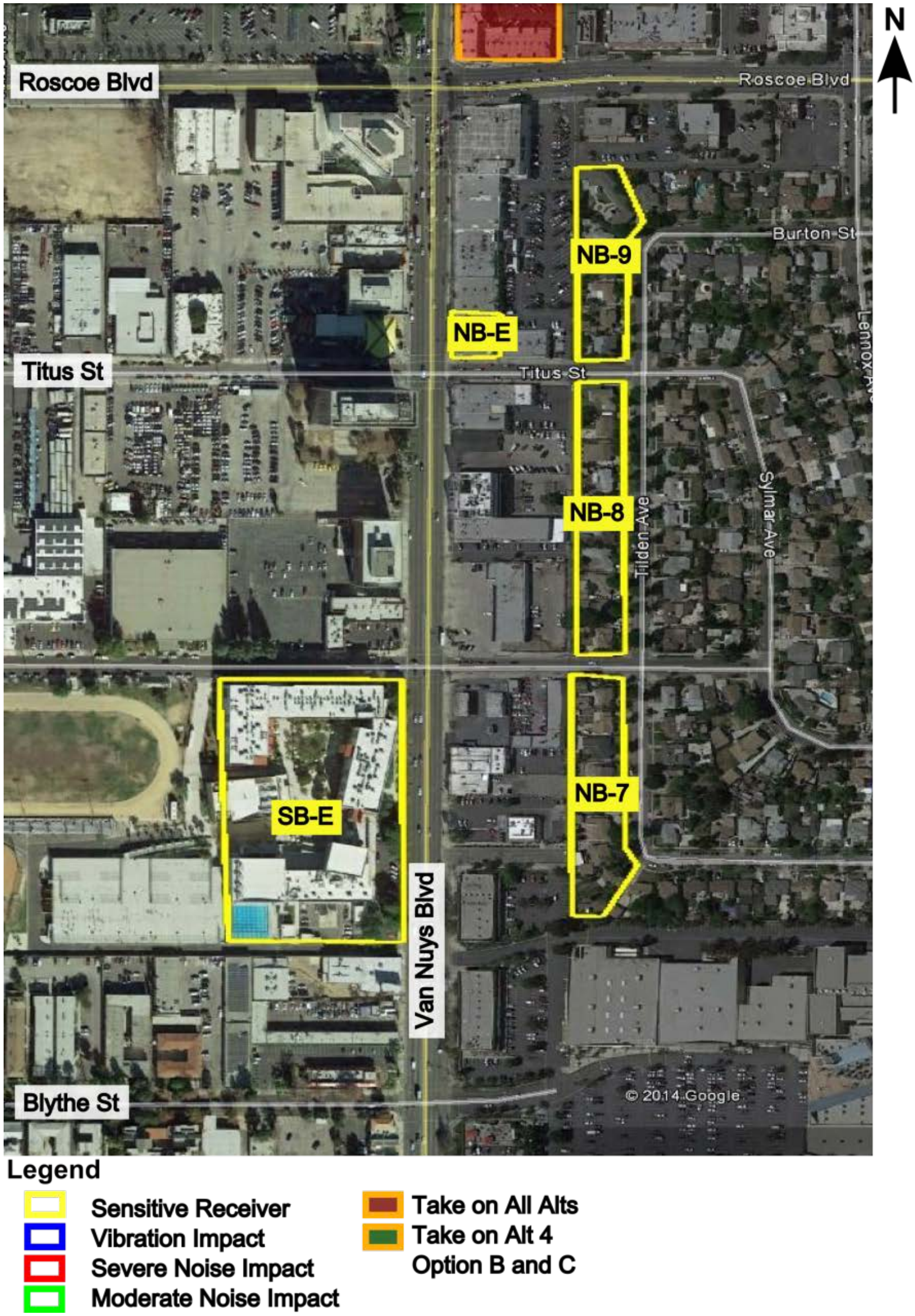


Figure B-5: Sensitive Receiver Locations, Parthenia Street to Osborne Street

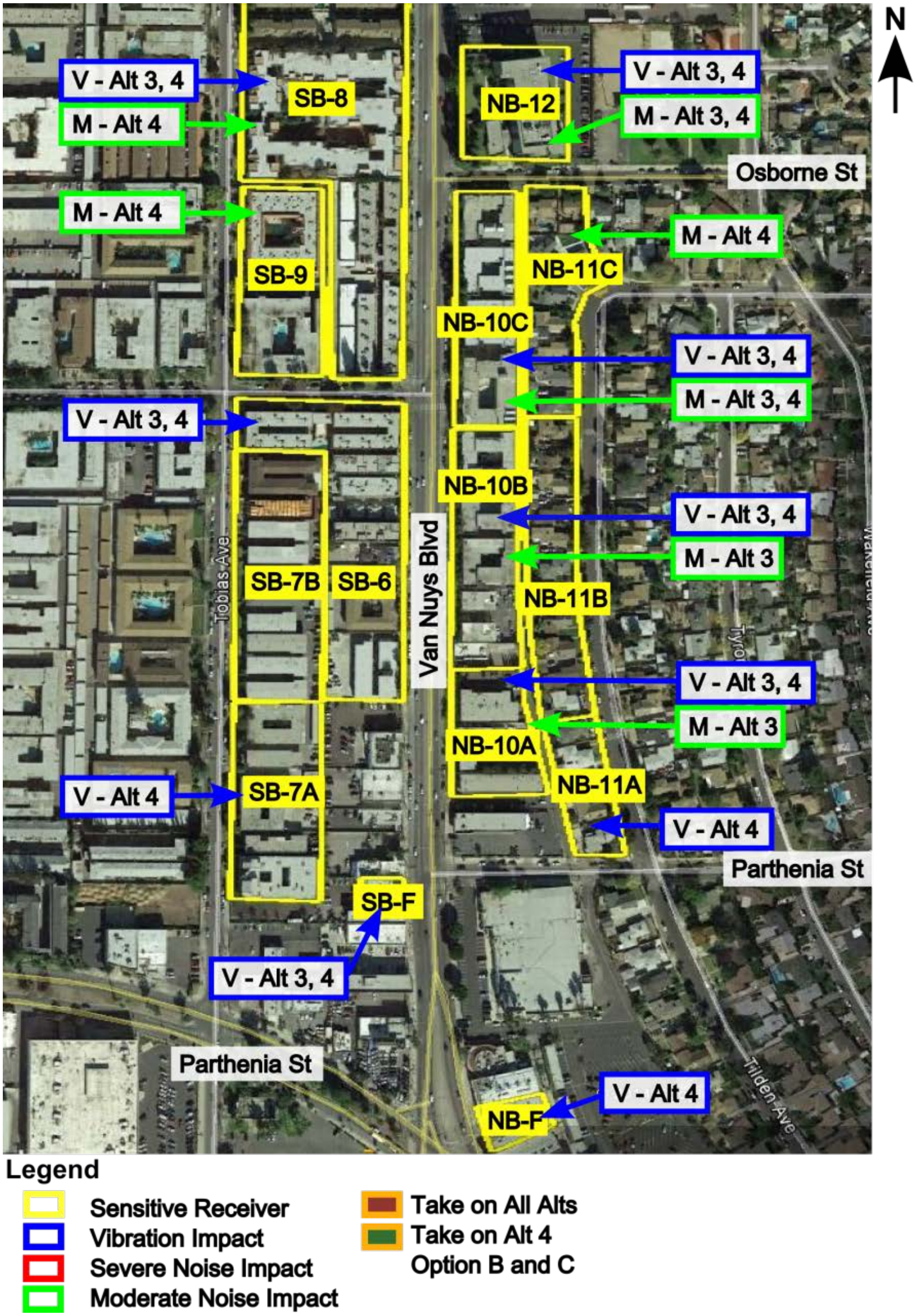


Figure B-6: Sensitive Receiver Locations, Osborne Street to Gledhill Street

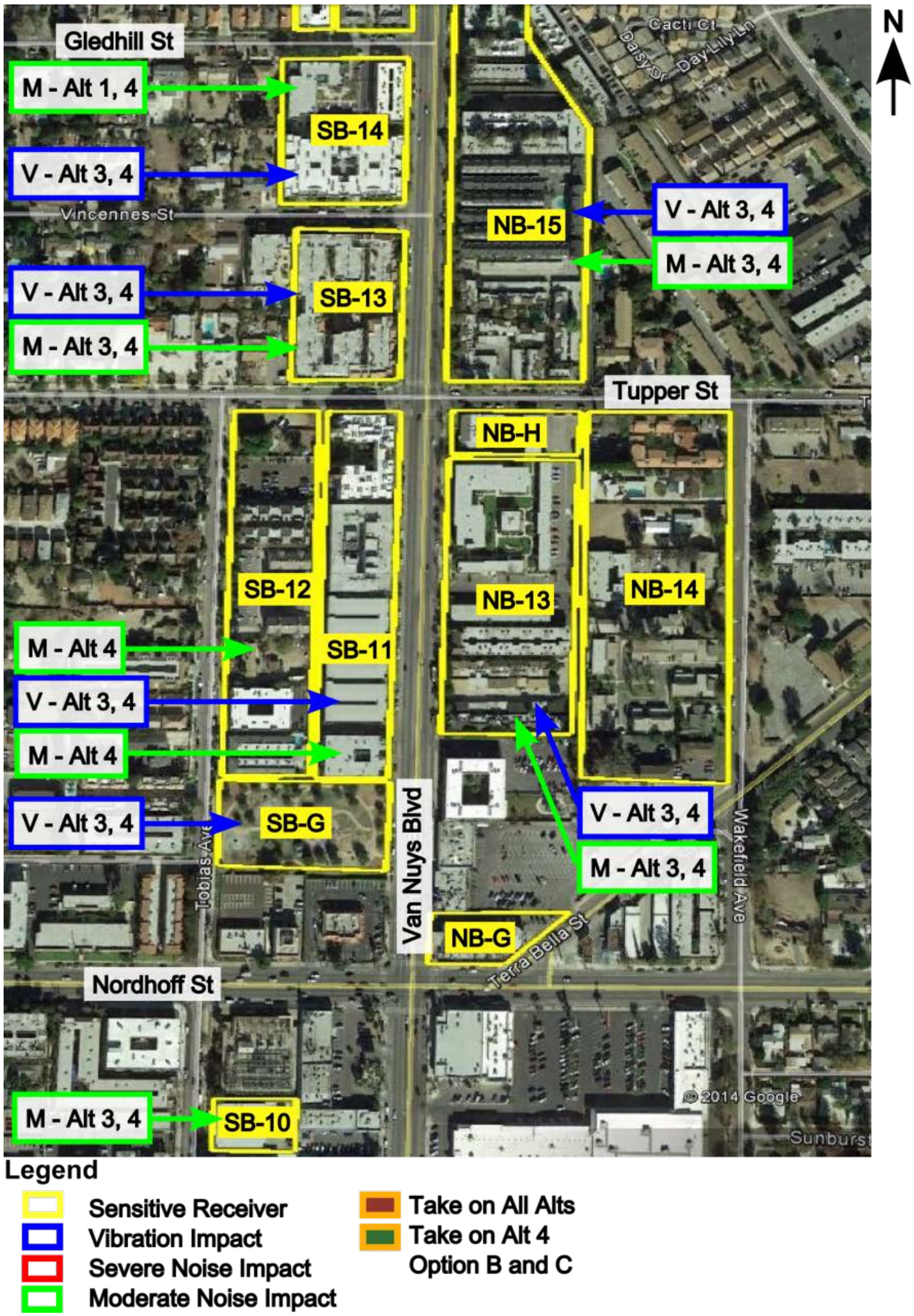


Figure B-7: Sensitive Receiver Locations, Gledhill Street to Woodman Avenue

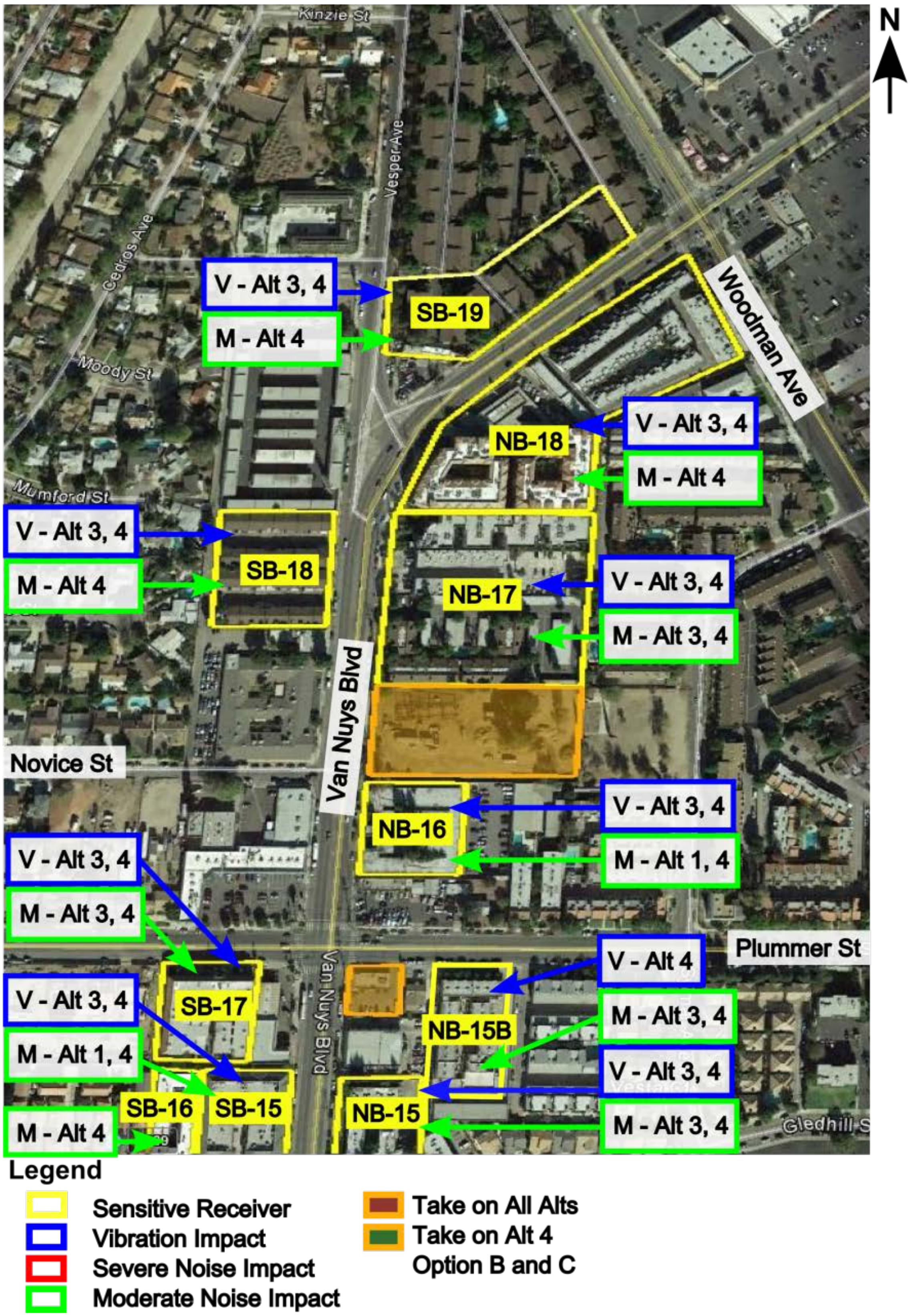


Figure B-8: Sensitive Receiver Locations, Woodman Avenue to Beachy Avenue

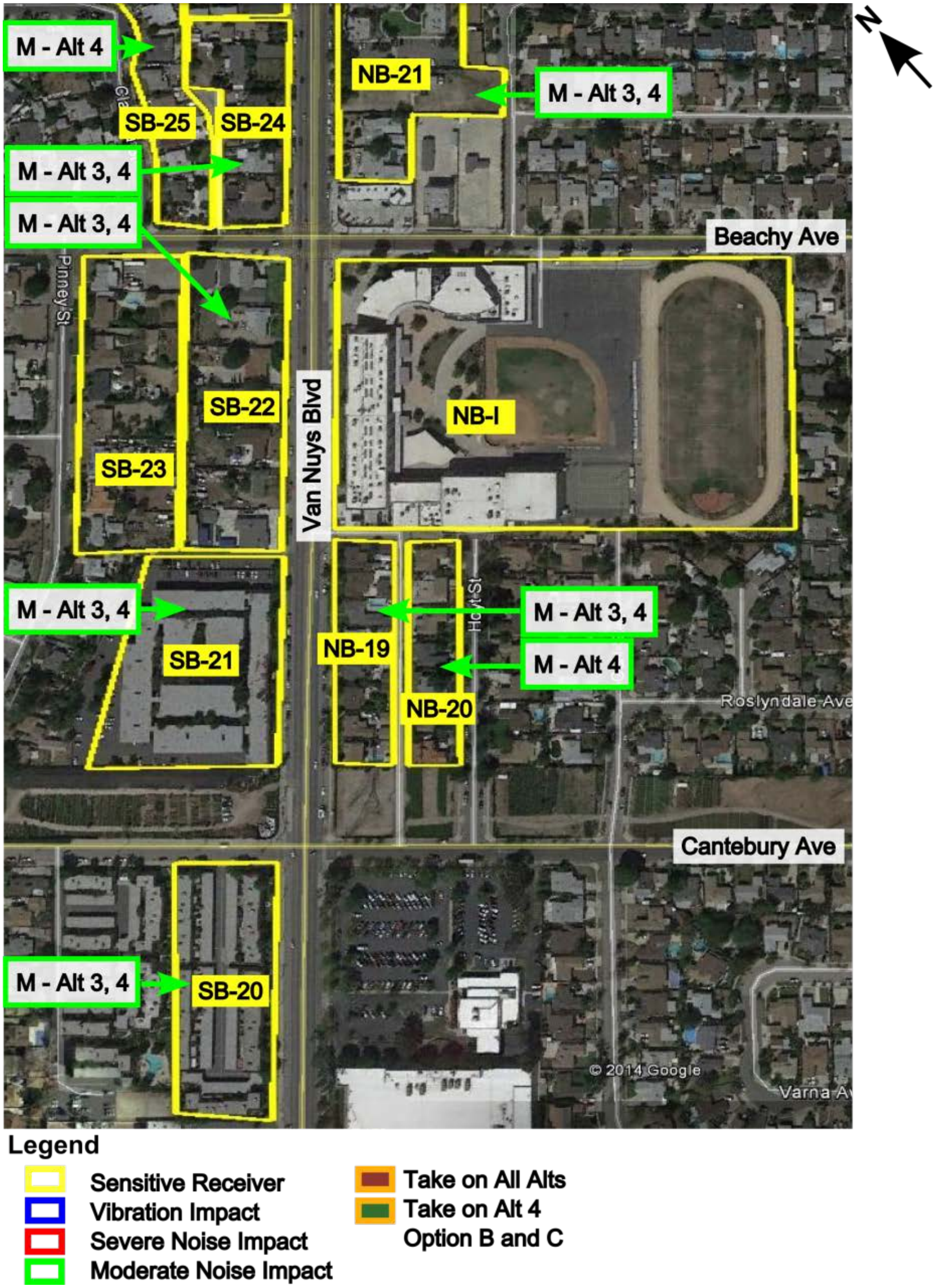


Figure B-9: Sensitive Receiver Locations, Pacoima Channel to I-5 Freeway

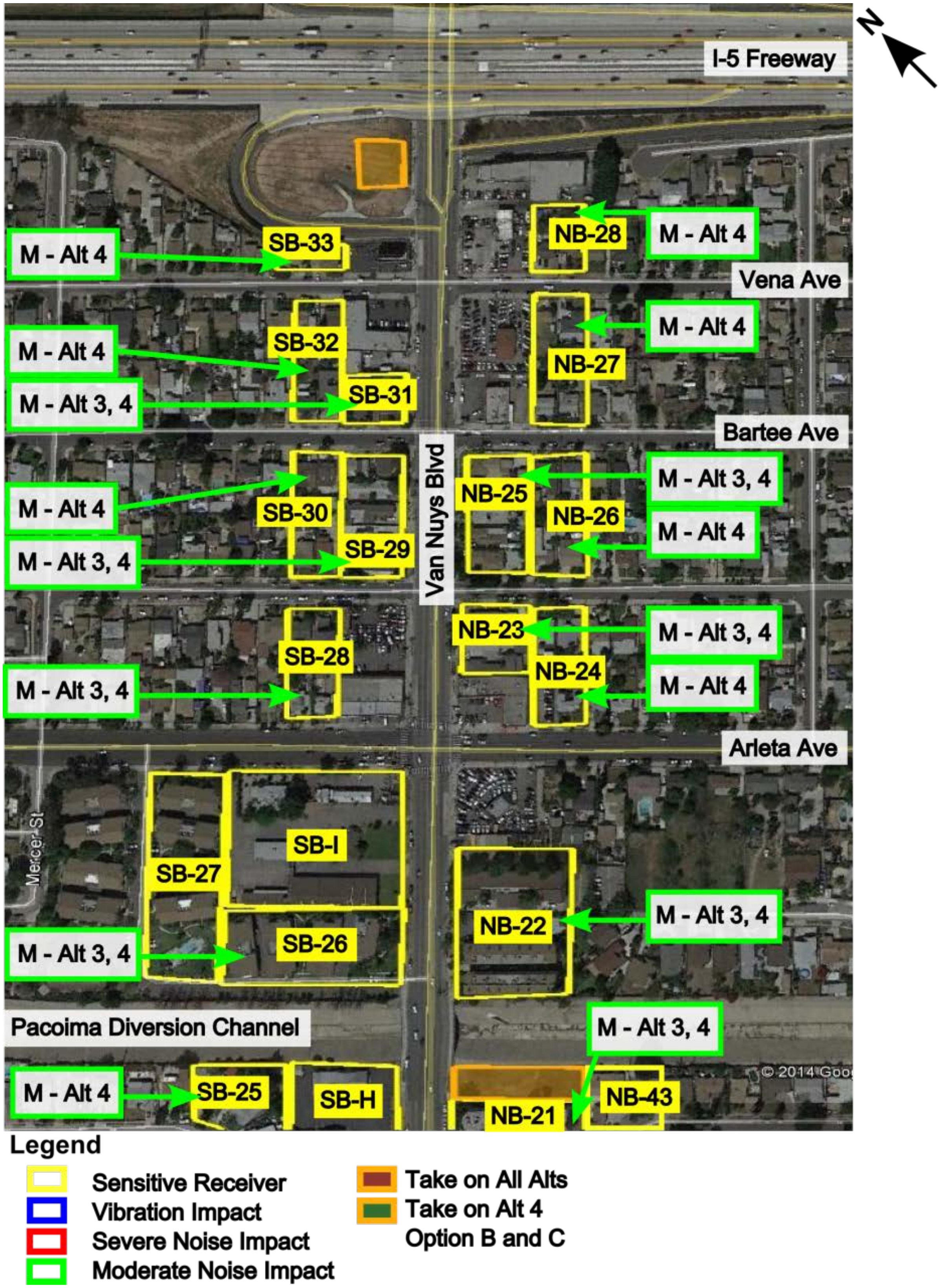


Figure B-10: Sensitive Receiver Locations, I-5 Freeway to Haddon Avenue

Figure B-11: Sensitive Receiver Locations, Haddon Avenue to San Fernando Road

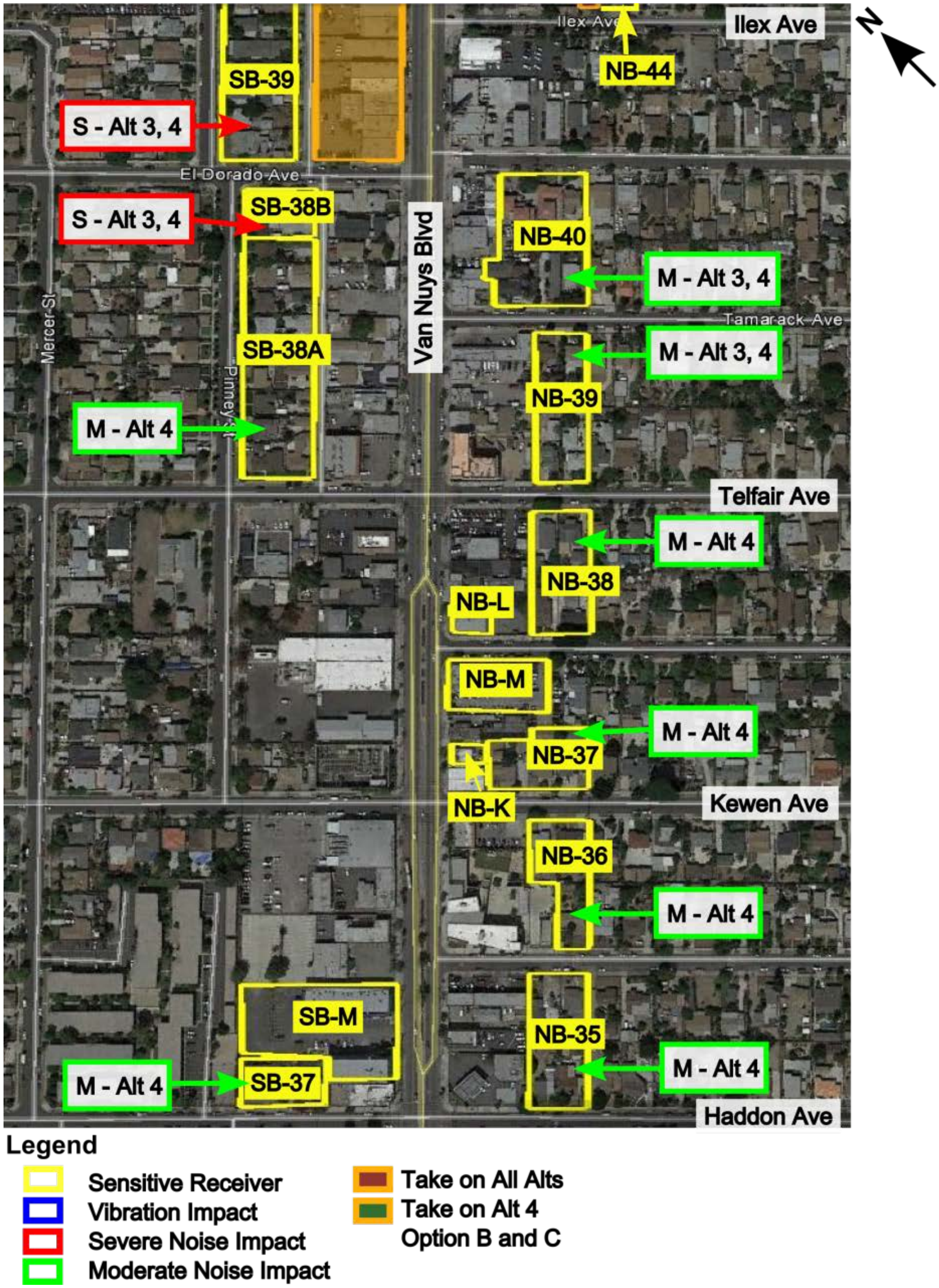


Figure B-12: Sensitive Receiver Locations, Van Nuys Boulevard to Weidner Street

Figure B-13: Sensitive Receiver Locations, Park Avenue to Maclay Avenue

Figure B-14: Sensitive Receiver Locations, Maclay Avenue to Sylmar/San Fernando Metrolink Station

Figure B-15: Sensitive Receiver Locations, Cluster NB-49 to NB-51

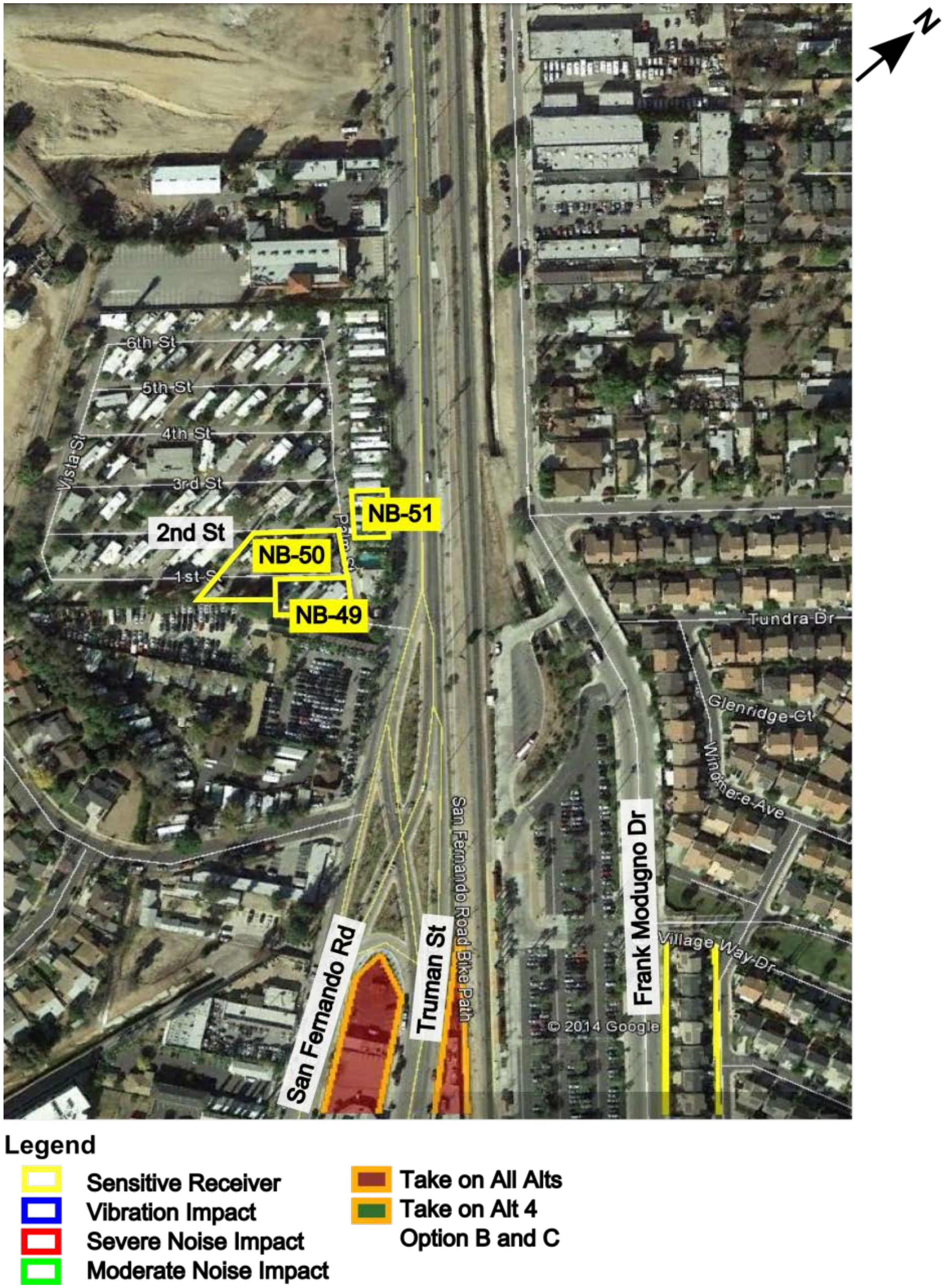


Figure B-16: Sensitive Receiver Locations, Cluster SB-41

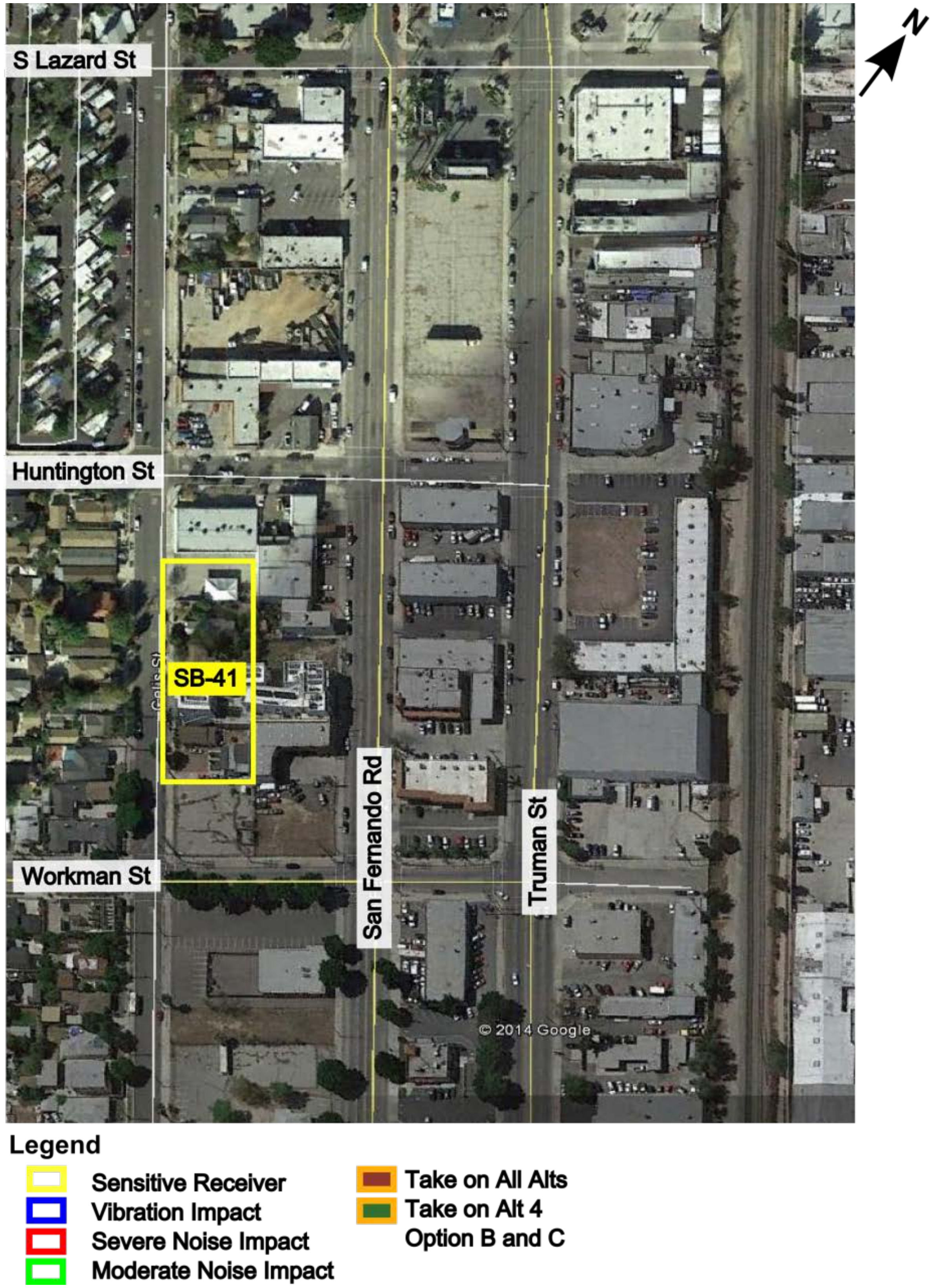


Figure B-17: Sensitive Receiver Locations, MSF Option A

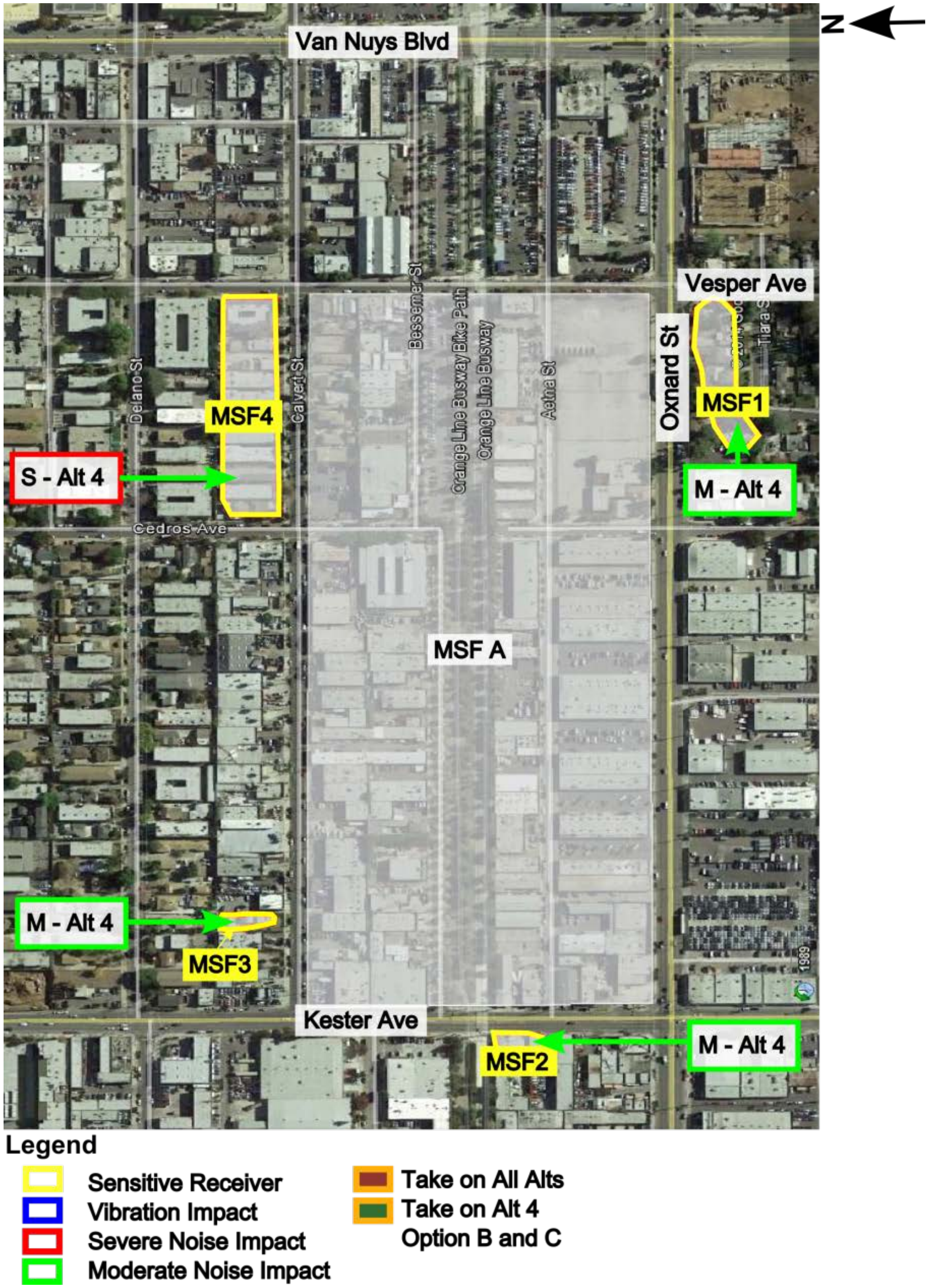
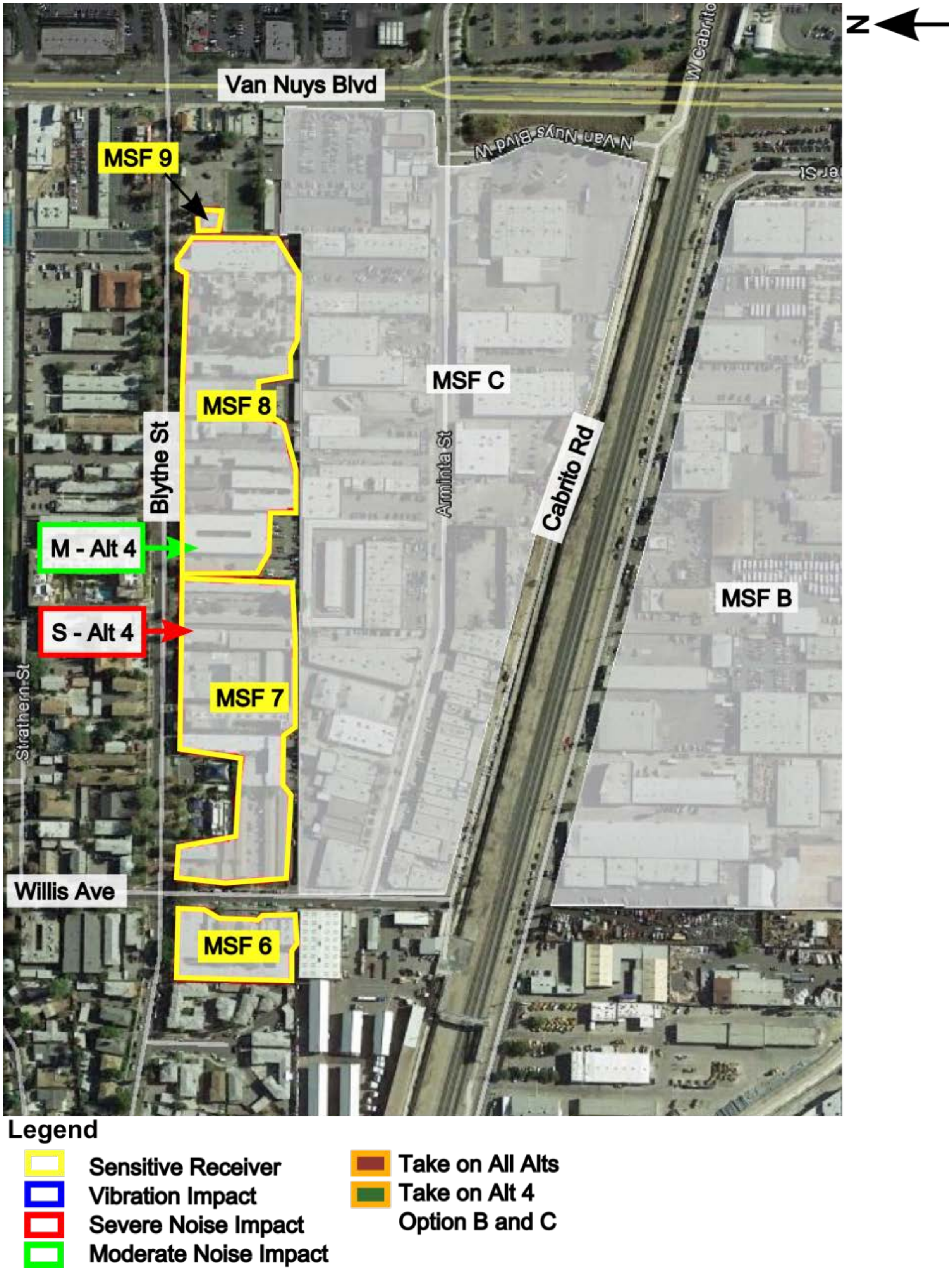


Figure B-18: Sensitive Receiver Locations, MSF Option B

Figure B-19: Sensitive Receiver Locations, MSF Option C



Appendix C

Noise Prediction Models

This section describes the models that were used to predict noise related to each of the project alternatives. A noise prediction model is presented for each of the following noise sources:

1. BRT, Low-floor LRT/Tram, and LRT Operations
2. Audible Warning devices
3. Special Trackwork and Wheel Squeal
4. TPSS Units
5. Maintenance and Storage Facility
6. Changes to Noise Levels Outside of the Project Area
7. Construction

The FTA noise impact thresholds apply to the total project noise. For alternatives where multiple noise sources are part of the project, the project noise is the logarithmic sum of the predicted noise levels for all relevant noise sources.

Noise Prediction Model for BRT, Low-floor LRT/Tram, and LRT Operations

The noise prediction model for BRT, low-floor LRT/tram, and LRT operations follows the noise impact assessment methodology for detailed noise predictions presented in the FTA Guidance Manual and incorporates assumptions on operating conditions specific to each alternative, including speeds, vehicle type, and headways.

The operating conditions are used with formulas included in the FTA Guidance Manual to predict the noise levels at each sensitive receiver. The principal formula is:

$$Ldn = SEL_{ref} + 10\log\left(events_{day} + events_{night} x10\right) - 10\log\left({}^{Dist}/_{Dist_{ref}}\right) + SpeedAdj + Shielding - 49.4$$

where:

Ldn	=	Day-night sound level in A-weighted decibels (dBA)
SEL_{ref}	=	Reference SEL in dBA at 50 ft, 40 mph for the vehicle (bus, low-floor LRV/tram, or LRV)
$events_{day}$	=	The number of bus, low-floor LRV/tram, or LRV events during daytime hours (7 a.m. to 10 p.m.)
$events_{night}$	=	The number of bus, low-floor LRV/tram, or LRV events during nighttime hours (10 p.m. to 7 a.m.)
Dist	=	The distance from the facade of the sensitive receiver to the lane or track centerline

$Dist_{ref}$	=	The reference SEL distance (50 ft)
SpeedAdj	=	An adjustment to account the speed of the bus, low-floor LRV/tram, or LRV as it passes the sensitive receiver
Shielding	=	An adjustment to account for any acoustical shielding, such as intervening building rows, experienced by the sensitive receiver

The shielding adjustments are used when the bus, low-floor LRV/tram or LRV does not have a direct line-of-sight to the sensitive receiver, such as when the LRV is entering or exiting the tunnel, or when the sensitive receiver is located behind a row of existing buildings. The shielding adjustments applied in the impact analysis use the formulas in the FTA Guidance Manual.

The FTA Guidance Manual also presents formulas to account for ground absorption; however, they have not been used for this analysis. The FTA Guidance Manual recommends that ground absorption is zero for areas with hard ground, such as pavement. We assume the entire project area has hard ground; therefore, it would not be appropriate to include a ground absorption adjustment in this analysis.

The reference SEL, number of events, and speed adjustment depend on operating conditions specific to each alternative. Details on the reference SEL and the proposed operating conditions for each alternative are discussed in the following sections.

Reference Sound Exposure Level and Speed Adjustments

SEL, or sound exposure level, is a measure of the acoustic energy of an event such as a train or bus passing. SEL increases as the sound level of the event increases and as the duration of the event increases. It is used in the analysis as an intermediate value in calculating overall metrics such as Leq and Ldn. Lmax is the maximum sound level that occurs during an event. The SEL for a bus or train event can be calculated using the measured Lmax.

The SEL for bus events used in the analysis to predict bus noise levels is based on noise measurements of Metro Orange Line Buses. Measurements were conducted at two locations: 1) east of the Van Nuys Orange Line station as buses were traveling at a cruising speed of 30 to 35 mph and 2) at the Van Nuys Orange Line station as buses were pulling into and out of the station. The measurement results are shown in Table C-1 and Figure C-1.

The results show that the SEL for the accelerating bus is greater than the SEL for a bus running at a cruising speed of 34 mph. Buses could potentially be accelerating at any location in the corridor due to red lights or slow traffic. The analysis in this report uses the SEL for accelerating buses (80 dBA at 50 feet) to predict noise levels at all sensitive receivers to ensure that noise levels from buses are not under-predicted. No adjustment for speed is included in the analysis; the analysis assumes noise from accelerating buses is independent of speed.

The noise from Metro Orange Line buses was measured at two distances: 25 feet and 50 feet from the buses. The measurement results showed that the bus noise levels decreased with distance at a rate of $20*log(Dist/Dist_{ref})$. The guidance manual suggests modeling the decrease in noise with distance suing the relationship $10*log(Dist/Dist_{ref})$. To ensure bus noise levels are not under-predicted, the analysis uses the measured relationship of $20*log(Dist/Dist_{ref})$ for receivers closer than 50 feet to the proposed project and $10*log(Dist/Dist_{ref})$ for receivers farther than 50 feet from the proposed project.

Table C-1: Bus and LRV Reference Noise Levels

Noise source	Lmax (dBA), 50 feet	SEL (dBA), 50 feet
Bus, accelerating	72	80
Bus, cruising, 34 mph	70	75
LRV[1], 1 car, 40 mph, B&T track	75	80
LRV[1],1-car, 40 mph, Embedded track	NA[2]	83
LRV[1], 1-car, 40 mph, DF Track	NA[2]	84

[1] LRV noise levels apply to low-floor LRVs and standard LRVs
[2] Noise levels were not measured for embedded track and ballast-and-tie track. SELs in table are based on data from FTA Guidance Manual.
Source: ATS Consulting, 2014

The SEL for low-floor LRT/tram and LRT events used in the analysis is based on noise measurements of the Metro Gold Line LRVs in the Cornfield Historic State Park near the Chinatown station and is consistent with the SEL recommended in the FTA Guidance Manual for rail transit vehicles. Measurements of other systems have shown that low-floor LRVs have the same SEL as standard LRVs. The same SEL is used in the analysis for the Low-Floor LRT/Tram Alternative and the LRT Alternative. The LRV noise measurement results are shown in Figure C-1 and Figure C-2. Note that the values in Figure C-1 are adjusted to represent a one-car train traveling at 40 mph at 50 feet using formulas from the FTA Guidance Manual. The measured levels plotted in Figure C-2 are for a 2-car train traveling at 51 mph at 50 feet, and do not include any adjustments.

LRV noise levels depend on track type. The LRV noise measurement was conducted at a ballast-and-tie track section on the Metro Gold Line. The FTA Guidance Manual recommends a +3 dB adjustment to the SEL for embedded track and a +4 dB adjustment to the SEL for direct fixation track. Ballast-and-tie track is quieter than embedded or DF track because ballast is a noise absorptive material. The SEL used in the analysis in this report for the three track types is shown in Figure C-2.

LRV noise levels also depend on speed. At the LRV noise measurement site, trains were traveling at an average speed of 51 mph. In the project area, trains will be traveling at a maximum speed of 35 mph on embedded track section in Van Nuys Boulevard, and up to 65 mph in the tunnel section and the Metrolink right-of-way. In the analysis in this report, the SEL is adjusted for different speeds using a *20*log(speed/speedref)* relationship, as recommended in the FTA guidance manual, where *speed* is the speed of the LRV as it passes the sensitive receiver and $speed_{ref}$ is the speed of the LRV during the reference level measurement. Slower LRV speeds near stations and stop lights were not taken into account in the analysis to ensure LRV noise levels are not under-predicted. Measurements show that under 35 mph the decrease in LRV noise with speed is not as rapid. In addition, trains accelerate up to 35 mph in a relatively short distance.

Figure C-1: Metro Orange Line Measured Bus Noise Levels

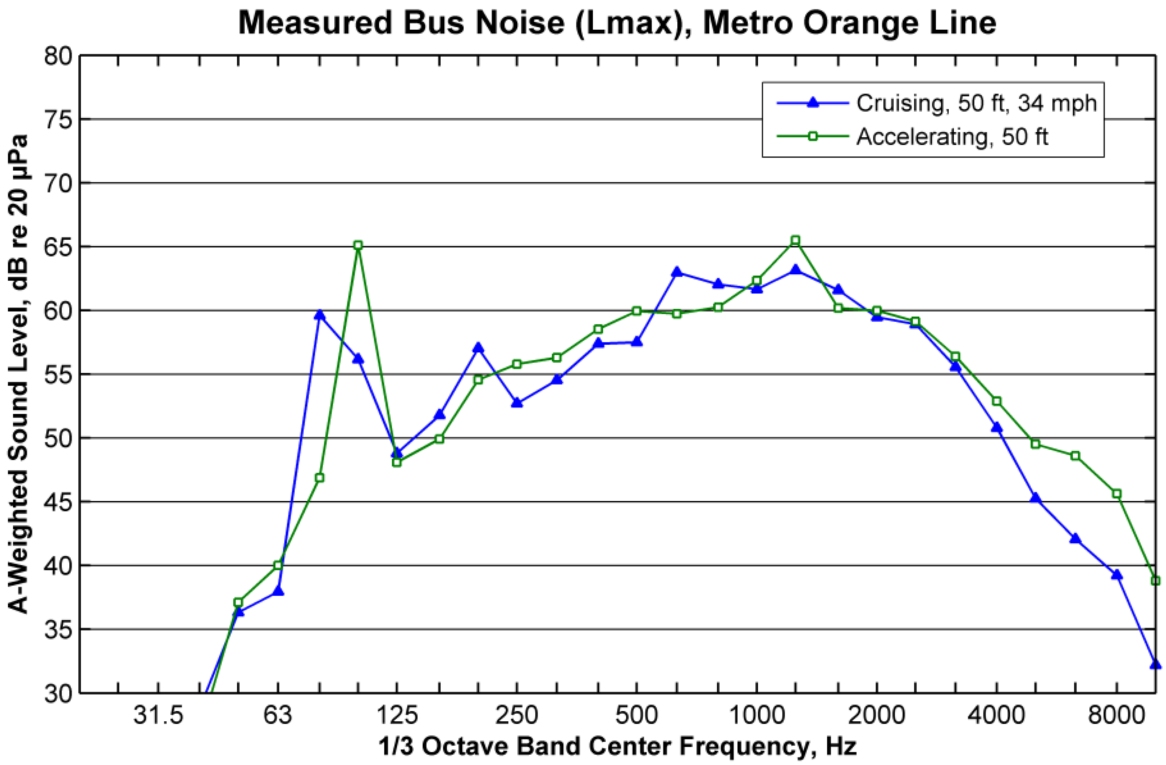
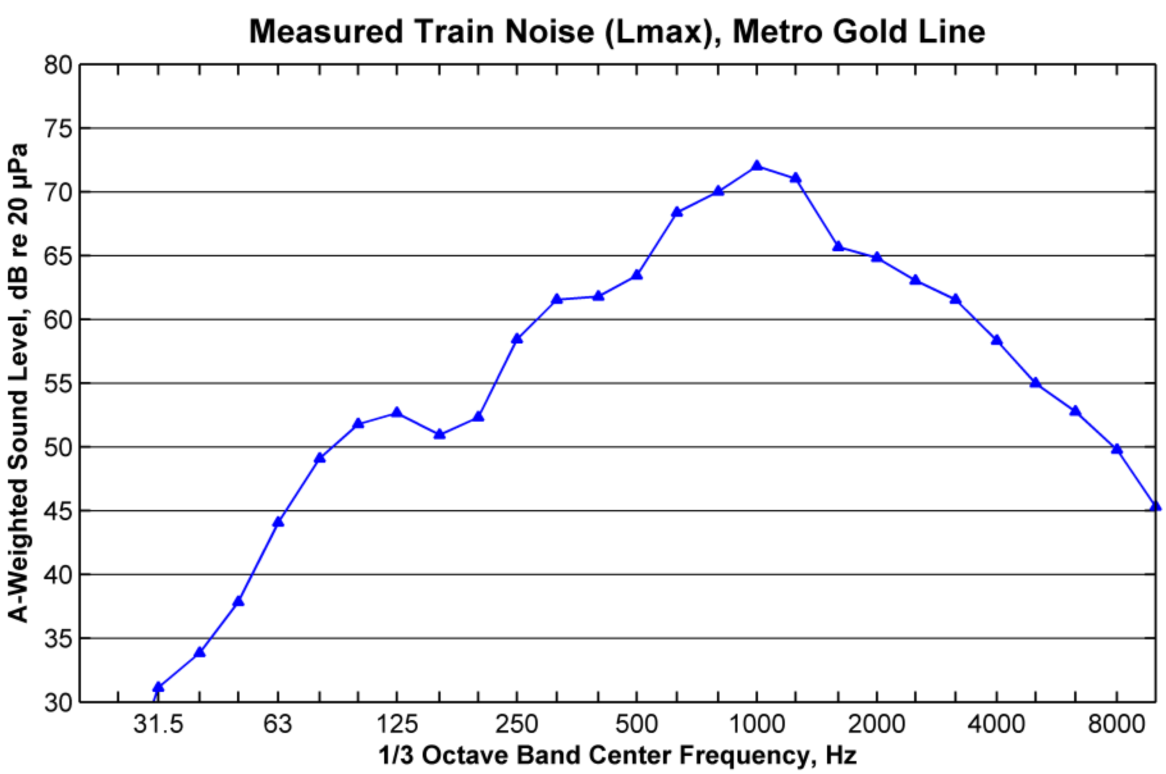


Figure C-2: Metro Gold Line Measured Train Noise Levels at 50 ft, 51 mph, 2-car Train on Ballast-and-Tie Track



Operating Assumptions

Alternative 1: Curb-Running BRT

The Curb-Running BRT Alternative would incorporate 6.7 miles of existing curb lanes along Van Nuys Boulevard between San Fernando Road and the Metro Orange Line for a BRT guideway. The operating conditions that would affect noise levels for the BRT guideway along Van Nuys Boulevard between San Fernando Road and the Metro Orange Line are:

- The curb lanes would be dedicated bus lanes. In some locations, these curb lanes would replace existing street parking.
- The headways of Metro Local Line 233 would be decreased to 8 minute peak and 16 minute off-peak headways. Existing headways are 12 minute peak and 20 minute off peak.
- The headways of Metro Rapid Line 761 would be decreased to 6 minute peak and 12 minute off-peak headways. Existing headways are 10 minute peak and 17.5 minute off-peak.
- Buses would operate at the posted speed limit of 35 mph.

The Curb-Running BRT Alternative would also include 2.5 miles of mixed-flow lanes, where buses would operate in the curb lane along San Fernando Road and Truman Street between Van Nuys Boulevard and Hubbard Avenue. The key operating conditions for the alignment in this area are:

- All traffic lanes would be mixed-flow and buses would operate in the curb lane.
- Metro Local Line 233 does not run in this area. Metro Local Line 224 would continue to operate in this area with no change to existing headways.
- Metro Rapid Line 761 does not currently operate in this area. As part of the project, it would run in this area with 6 minute peak and 12 minute off-peak headways.
- Metro Rapid Line 794 would continue to operate in this area with no change to existing headways.
- Buses would operate at the posted speed limit of 35 mph.

As a part of the project, some curbside parking would be removed and converted into a travel lane, which would result in a shift of both bus and automobile traffic closer to sensitive receivers. Currently; however, all buses must enter the curbside lane to access existing stations and existing automobile traffic enter the curbside lanes to access parking spaces, make right turns, or for travel when there are not vehicles parked in those lanes. A traffic noise model (TNM) analysis shows that the change in noise that would result from the shift in traffic is minimal (less than one decibel). Therefore, the change in noise level that would result from the change in traffic patterns is not included as a noise source in the analysis.

The change in noise levels that would result from the Curb-Running BRT Alternative is from the proposed increase in bus frequencies. The noise level from the higher bus frequencies is predicted using the formulas in the FTA Guidance Manual, the proposed headways, and the measured bus reference SEL of 80 dBA at 50 feet for accelerating buses.

Operating Assumptions for Alternative 2: Median-Running BRT

The Median-Running BRT Alternative would incorporate 6.7 miles of existing curb lanes along Van Nuys Boulevard between San Fernando Road and the Metro Orange Line for a BRT guideway. The operating conditions for the BRT guideway along Van Nuys Boulevard between San Fernando Road and the Metro Orange Line that affect predicted noise levels are:

- The median lanes would be dedicated bus lanes used by the Metro Rapid 761 line. In some locations, existing street parking would be converted to traffic lanes to accommodate the dedicated bus lanes.
- The Metro Local Line 233 would not operate in the dedicated guideway, and would continue to operate as it currently does, but with increased frequency. The headways of Metro Local Line 233 would be decreased to 8 minute peak and 16 minute off-peak headways. Existing headways are 12 minute peak and 20 minute off-peak.
- The headways of Metro Rapid Line 761 would be decreased to 6 minute peak and 12 minute off-peak headways. Existing headways are 10 minute peak and 17.5 minute off-peak.
- Buses would operate at the posted speed limit of 35 mph.

The Median-Running BRT Alternative would also include 2.5 miles of mixed-flow lanes, where buses would operate in the curb lane along San Fernando Road and Truman Street between Van Nuys Boulevard and Hubbard Avenue. The operating conditions for the alignment in this area would be the same as the Curb-Running BRT Alternative:

- All traffic lanes would be mixed-flow and buses would operate in the curb lane.
- Metro Local Line 233 does not run in this area. Metro Local Line 224 would continue to operate in this area with no change to existing headways.
- Metro Rapid Line 761 does not currently operate in this area. As part of the project, it would run in this area with 6 minute peak and 12 minute off-peak headways.
- Metro Rapid Line 794 would continue to operate in this area with no change to existing headways.
- Buses would operate at the posted speed limit of 35 mph.

As a part of the project, some curbside parking would be removed and converted into a travel lane, which would result in a shift of both local bus and automobile traffic closer to sensitive receivers. Currently; however, all buses must enter the curbside lane to access existing stations and existing automobile traffic enter the curbside lanes to access parking spaces, make right turns, or for travel when there are not vehicles parked in those lanes. A traffic noise model (TNM) analysis shows that the change in noise that would result from the shift in traffic is minimal (less than one decibel). Additionally, all existing express bus service and stations will be relocated to the median of Van Nuys Boulevard, farther from receivers. Therefore, the change in noise level that would result from the change in traffic patterns is not included as a noise source in the analysis.

The change in noise levels that would result from the Curb-Running BRT Alternative is from the proposed increase in bus frequencies. The noise level from the higher bus frequencies is predicted using the formulas in the FTA Guidance Manual, the proposed headways, and the measured bus reference SEL of 80 dBA at 50 feet for accelerating buses.

Operating Assumptions for Alternative 3: Low-floor LRT/Tram

The Low-Floor LRT/Tram Alternative would operate along a 9.2-mile route from the Sylmar/San Fernando Metrolink station to the north, to the Metro Orange Line station to the south. The Low-Floor LRT/Tram Alternative would operate in a median dedicated guideway for about 6.7 miles along Van Nuys Boulevard between San Fernando Road and the Van Nuys Orange Line Metro station. The operating conditions that affect noise levels for the low-floor LRT/tram and bus lines along this stretch are:

- The low-floor LRT/tram would operate in a median dedicated guideway with 4 minute peak and 8 minute off-peak headways. The maximum speed of the low-floor LRVs/trams would be the posted speed limit of 35 mph throughout the project corridor. The predicted levels assume low-floor LRVs/trams will operate at 30 mph. Due to the many stations and the frequency of stop-lights, it is unlikely that the low-floor LRV/tram would be regularly operating at more than 30 mph for any significant distance.
- In some locations, existing street parking would be converted to travel lanes to accommodate the dedicated guideway.
- Metro Rapid Line 761 would no longer operate in the project corridor. The Metro Rapid Line 761 would operate between the Metro Orange Line and Westwood with 6 minute peak and 12 minute off-peak headways.
- Metro Local Line 233 would no longer operate in the project corridor. The Metro Local Line 233 would operate only between San Fernando Road and Glenoaks Boulevard with 6 minute peak and 12 minute off-peak headways.

The Low-Floor LRT/Tram alternative would operate in mixed-flow traffic lanes on San Fernando Road between the intersection of San Fernando Road/Van Nuys Boulevard and just north of Wolfskill Street. Between Wolfskill Street and the Sylmar/San Fernando Metrolink station, the low-floor LRT/tram would operate in a median dedicated guideway. There would be no change to existing bus routes in this area.

As a part of the project, some curbside parking would be removed and converted into a travel lane, which would result in a shift of automobile traffic closer to sensitive receivers. A traffic noise model (TNM) analysis shows that the change in noise that would result from the shift in traffic is minimal (less than one decibel). Therefore, the change in noise level that would result from the change in traffic patterns is not included as a noise source in the analysis.

As part of the project, all bus traffic would be removed from Van Nuys Boulevard between the Metro Orange Line station and San Fernando Road. The decrease in bus noise is included in the noise analysis. The project noise that would result from the Low-Floor LRT/Tram Alternative would be the noise generated by new tram/low-floor LRT operations minus the existing bus noise. Existing bus noise levels are predicted using the formulas in the FTA Guidance Manual, the existing bus headways, and the measured bus reference SEL of 80 dBA at 50 feet for accelerating buses. The noise levels from the low-floor LRT/tram operations are predicted using the formulas in the FTA guidance manual, the proposed low-floor LRT/tram headways, and the low-floor LRV/tram reference SEL of 83 dBA at 50 feet for a vehicle traveling 40 mph on embedded track.

Operating Assumptions for Alternative 4: LRT

The LRT Alternative would operate along a 9.2-mile dedicated guideway from the Sylmar/San Fernando Metrolink station to the north to the Metro Orange Line station at the south end of the project area. The operating conditions for the LRT and buses are:

- The LRT would travel in the Antelope Valley Metrolink railroad corridor from the Sylmar/San Fernando Metrolink station to Van Nuys Boulevard. This segment of the alignment will have ballast-and-tie track and a maximum train speed of 65 mph. There will be gate-protected grade crossings and crossing bells at all of the existing Metrolink crossings.
- The LRT would travel in a semi-exclusive right-of-way in the middle of Van Nuys Boulevard from San Fernando Road to the Metro Orange Line station. This section of the alignment will have embedded track and a maximum train speed of 35 mph. The grade-crossings will not have crossing bells.

- There would be an underground segment beneath Van Nuys Boulevard from just north of Parthenia Street to Hart Street. This section of the alignment would have direct fixation track and a maximum train speed of 65 mph.
- The LRT would operate with 6 minute peak headways and 12 minute off-peak headways.
- Metro Rapid Line 761 would no longer operate on Van Nuys Boulevard between San Fernando Road and the Metro Orange Line station.
- Metro Local Line 233 would continue to operate, but with increased headways. The Local Line 233 would operate with 8 minute peak headways and 16 minute off-peak headways.

As a part of the project, some curbside parking would be removed and converted into a travel lane, which would result in a shift of automobile traffic closer to sensitive receivers. A traffic noise model (TNM) analysis shows that the change in noise that would result from the shift in traffic is minimal (less than one decibel). Therefore, the change in noise level that would result from the change in traffic patterns is not included as a noise source in the analysis.

As part of the project, all of the Metro Rapid Line 761 bus traffic would be removed from Van Nuys Boulevard between the Metro Orange Line station and San Fernando Road. However, the bus headways from Metro Local Line 233 would be increased. The project noise that would result from the LRT Alternative would be the noise generated by new LRT Operations minus the existing Metro Rapid Line 761 bus noise plus the additional bus noise from increased headways from Metro Local Line 233. At sensitive receivers near the proposed LRT tunnel, the project noise would only include the changes to bus noise.

The noise levels from the LRT operations are predicted using the formulas in the FTA guidance manual, the proposed LRT headways, the LRT reference SEL presented of 80 dBA at 50 feet for a LRV traveling 40 mph on ballast-and-tie track, and the adjustments for track-type in the FTA guidance manual. The changes in bus noise levels are predicted using the formulas in the FTA Guidance Manual, existing and projected bus frequencies, and the bus reference SEL of 80 dBA at 50 feet for accelerating buses.

Noise Prediction Model for Audible Warnings

The California Public Utilities Commission (CPUC) requires that audible warnings be sounded as light-rail trains approach all gate protected grade crossings. The requirements and general Metro practices for sounding LRV horns are:

- Every light-rail vehicle must be equipped with a bell or horn that generates a sound level of 85 dBA at a distance of 100 feet from the vehicle (CPUC General Order 143B). Most automobile horns generate a sound level of 80 to 85 dBA at a distance of 100 feet, so the LRV horn is a little louder than most automobile horns.
- The LRVs are also equipped with a low-volume horn with a sound level of 75 dBA at 100 feet from the vehicle.
- The LRV operator must sound an audible warning when approaching at-grade crossings protected by automatic crossing signals. The general operating procedure for Metro is to sound the low-volume horn (75 dBA at 100 feet) before at-grade crossings.
- The louder horn is used in case of emergency and at the discretion of the train operator.

The noise analysis for Alternatives 3 and 4 include noise from the low-horn for sensitive receivers located near stations or near grade-crossings. The noise analysis for Alternatives 1 and 2 do not include noise from horns because they would only be used in case of emergency.

Noise Prediction Model for Special Trackwork and Wheel Squeal

Noise from special trackwork is included in the analyses for Alternatives 3 and 4. At turnouts and crossovers, there is a gap in the rail where the two rails cross. The special trackwork installed at this location is called a frog. The wheels striking the ends of the gap increase noise levels near the special trackwork. An adjustment of +6 dB is applied when special trackwork will be located within 300 ft of sensitive receivers.

There are alternatives to typical frogs that could result in lower impact forces and lower noise level increases at sensitive receivers near special trackwork. An example of a low-impact frog is a flange-bearing frog. Flange-bearing frogs are designed with a ramp so the wheels transition onto their flange through the gap in the special trackwork, providing a smoother transition. Another alternative to a typical frog is a weldless boltless manganese (WBM) or monoblock frog. A monoblock frog eliminates the bolted joints and rails and generates a more continuous running surface. Flange-bearing frogs and monoblock frogs result in about +3 dB, which is half the increase of a typical frog. These low-impact frogs can be applied as a mitigation measure if noise impact is identified near special trackwork.

At curves the in project alignment, an additional noise source is wheel squeal. Wheel squeal is the noise produced by the wheel-rail interaction where the radius of a curve is smaller than allowed by the separation of the axles in a wheel set. At receivers near a low-radius curve, a +10 dB adjustment is applied to the predicted noise levels to account for wheel squeal. Wheel squeal can often be eliminated with friction control, such as a lubrication system. The analysis assumes a friction control system would eliminate the wheel squeal, which would be a -10 dB reduction in noise levels.

Noise Prediction Model for TPSS Units

The only ancillary equipment expected to have the potential of causing noise impacts are the traction power substation (TPSS) units. The primary noise source from the TPSS units is from transformer hum and the cooling system. On most modern TPSS units the transformer hum is minimal so only the ventilation and cooling system has the potential to cause noise impacts.

A noise measurement of a TPSS unit used in a residential area along the Los Angeles Metro Gold Line showed that the ventilation fan generated a sound level of 51 dBA at a distance of 40 ft from the fan; which is equivalent to a sound level of 49 dBA at 50 ft. The measured sound level was consistent with the limit of 50 dBA at 50 feet from any side of the TPSS unit that has been included in the purchase specifications for TPSS units on several recently completed light-rail systems.

This analysis assumes a reference noise level of 50 dBA at 50 feet, consistent with the recent measurement and specifications. The following formula is used to estimate TPSS noise associated with Alternatives 3 and 4:

$$Ldn_{TPSS} = 10 * \log\left(15 * 10^{\frac{SPL}{10}} + 9 * 10^{\frac{SPL+10}{10}}\right) - 13.8 + 20 * \log\left({}^{Dist}/_{Dist_{ref}}\right)$$

where:

Ldn_{TPSS} = TPSS day-night sound level

SPL = 50 dBA, sound pressure level of TPSS at 50 feet

Dist = Distance from the TPSS to the receiver

$Dist_{ref}$ = 50 feet, reference distance

Noise Prediction Model for MSFs

The MSF would consist of an enclosed building for the maintenance shops and open area for storage. An employee parking lot may be provided. The MSF would have a single ingress/egress point for the LRVs at each of the potential sites. The LRVs would access the facility via a short segment of track connected to the mainline by one to four turnouts.

Crossover and tight curves are the potential noise sources from the train movement within the storage facility and from ingress and egress of the LRVs at the lead tracks to the mainline. The maintenance shop noise, the movement of trains on the main line adjacent to the facility, the car wash facility and the movement of vehicular traffic in and out of the facility are the other noise source. The noise sources and the assumptions of the activities at the potential MSF sites are described below:

- Traffic on Lead Tracks: The number of trains entering and exiting the storage facility would peak during the hours starting at 6 AM, 8 AM, 3 PM and 5 PM. These are hours when peak operations begin and end. For the 4 hours of peak activity between the main line and the MSF, the number of trains that would enter and exit the facility was assumed to be ten. In addition, there is potential for the trains to enter and exit the facility when there are shift changes and/or trains are pulled out or fed into the mainline through the lead tracks. Therefore, we assumed the number of trains that would enter and exit the facility to be four during each hour when there is no peak activity.
- Crossovers: The crossovers would be sources of impact noise from the wheel banging on the crossover frogs. The crossovers would experience different amounts of traffic depending on their location. We assumed ten trains would pass through the busiest crossover during the peak hour.
- Maintenance Shops: Noise from the maintenance facility could include hammering for minor body work or repair of other components; noise from machines such as the wheel truer, air compressor and metal working equipment; and noise from the HVAC system. Forklift backup alarms and general repair tools could also be intermittent noise sources. For the noise assessment, we have based our predictions on measurements made at the MTA Green Line shops. The maintenance shops are assumed to be a closed facility that will have its doors open most of the time. As a worst case we assumed that the shops will be in operation 24 hours per day.
- Car Wash: We assumed that the car wash will include one vehicle wash bay and servicing area for daily cleaning. The car wash is assumed to be a mechanical system that is operating 50% of the time both day and night. The noise predictions were based on the FTA recommended Lmax reference noise levels of 75 dBA at 50 ft. However, this is a conservative level. Our experience with MTA Green Line car wash facilities is 50 dBA at 50 ft.
- Vehicular Traffic Into/Out of Facility: A parking facility was assumed for each of the MSF options. We assumed 5 peak hours and 4 off-peak hours for vehicle traffic into and outside the facility. The peak hour traffic assumes 10 motor vehicles during the peak and off-peak hours. In addition, three trucks were assumed during the peak hours. Based on the FHWA's algorithm used in the Traffic Noise Model, the reference sound level at 50 feet for autos, SUVs and heavy trucks moving at 30 mph ranges from 65 to 77 dBA. We assumed a reference sound level (Leq) of 77 dBA at 50 feet for vehicles moving at 30 mph. This is a conservative reference level because at low speeds the vehicle noise is dominated by the engine noise, and not the tire-pavement noise.

Noise Prediction Model for Construction

Construction noise levels depend on the number of pieces and type of equipment, their general condition, the amount of time each piece operates per day, the presence of any noise attenuating features such as walls and berms, and the location of the construction activities relative to the sensitive receivers. The majority of these variables are left to the discretion of the contractor so that assessment of construction noise is a professional judgment of the likely means and methods that would be used by the contractor.

The construction of a BRT or LRT guideway requires the use of heavy earthmoving equipment, pneumatic tools, generators, concrete pumps, and similar equipment. TAB shows categories of equipment that are likely to be used and the typical noise generated by this equipment when it is operating at full load. The typical noise levels, along with estimates of what equipment would be used during the loudest phases of the project, and the usage factors (how long the equipment is used) for each category of equipment are used to estimate construction noise levels. The following formula was used to estimate the contribution to workshift Leq of each category of equipment:

$$Leq_{Equip} = SPL_{Equip} + 10*\log(Usage)$$

where:

Leq_{Equip} = contribution to work shift Leq

SPL_{Equip} = sound pressure level at 50 feet, equipment operating at full power,

Usage = percent of work shift that equipment is used at or near full power.

The predicted work shift Leq for all equipment categories are combined to estimate the total work shift Leq at an equivalent distance of 50 feet from the centroid of the construction site. The Leq at sensitive receivers was estimated using the following formula:

$$Leq_R = Leq_{50ft} - 20*\log(D/50)$$

where:

Leq_R = work shift Leq at the receiver location

Leq_{50ft} = calculated Leq at an equivalent distance of 50 feet from the centroid of the construction activity.

D = distance from receiver to the centroid of the construction site in feet.

Table C-2: Typical Noise Emissions of Construction Equipment

Equipment	Typical Noise Level 50 ft from Source
Earthmover (bulldozer, front-end loader, etc.)	85 dBA
Mobile Crane	83 dBA
Dump Truck	88 dBA
Pneumatic Tools	85 dBA
Generator	78 dBA
Compressor	81 dBA

Source: FTA, 2006.

Appendix D
Vibration Prediction Model

The FTA detailed vibration prediction model is an empirical method based on measurements of the vibration propagation characteristics of the soil in the project corridor and measurements of the vibration characteristics of a similar light-rail vehicle. The vibration propagation test is used to determine the line source transfer mobility (LSTM). The LSTM quantifies how easily vibration travels through the soil. The vibration characteristics of the light-rail or low-floor light rail/tram vehicle are quantified by the force density level (FDL). The basic relationship used for the vibration predictions is:

$$Lv = LSTM + FDL + \text{Safety Factor}$$

where:

Lv = Train vibration velocity measured at ground surface,

LSTM = Line source transfer mobility characterizing how easily vibration travels through the soil,

FDL = Force density level that characterizes the vibration forces generated by the train and track,

Safety Factor = Safety factor of +5 dB included in the predictions to ensure predicted groundborne vibration levels are not underestimated.

The LSTM was measured at ten sites throughout the project corridor. The FDL was measured on the Metro Gold Line north of the Chinatown station. Detailed measurement results for the LSTM and FDL are presented in following sections. Also included is a description of the construction vibration prediction model.

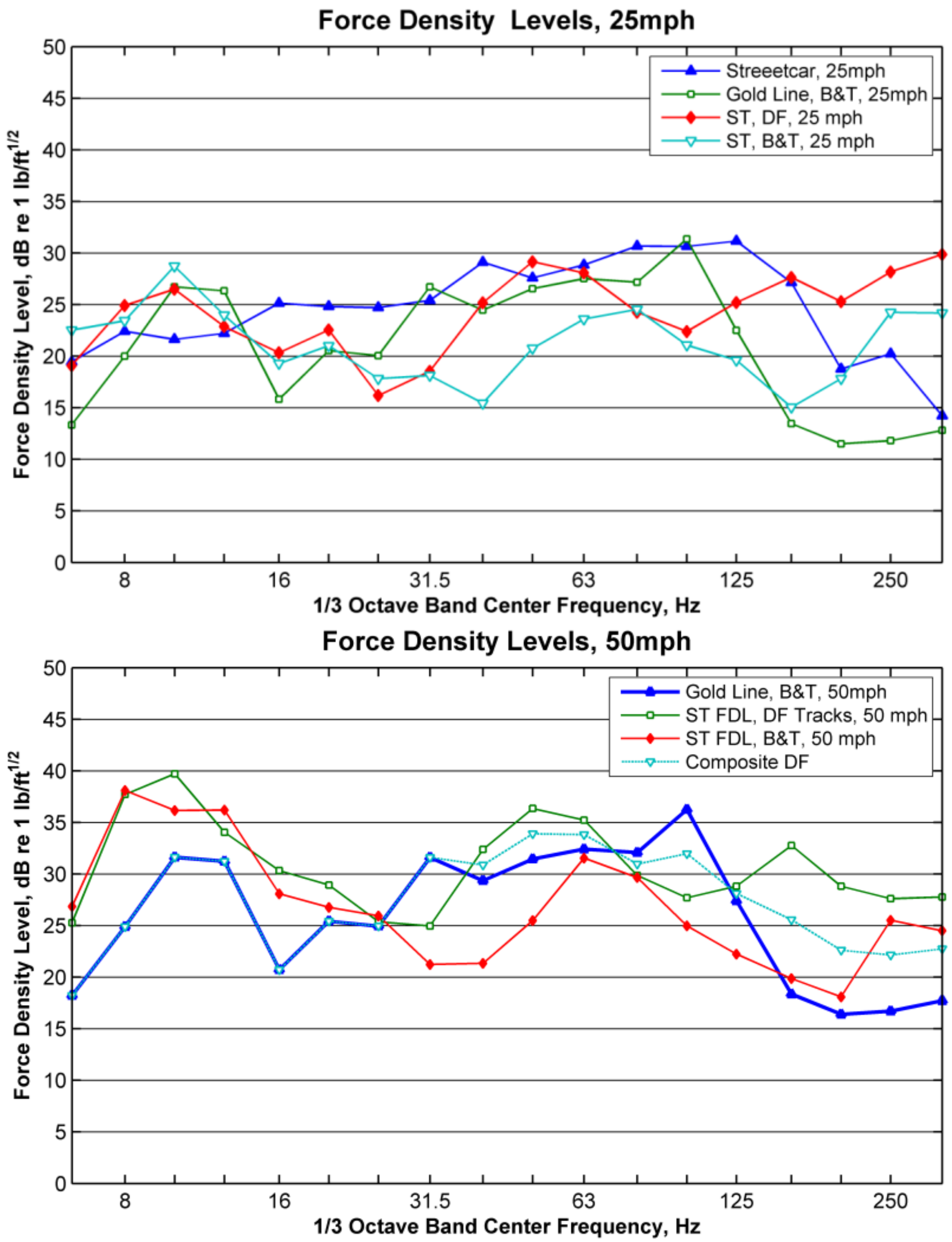
Force Density Level

The force density level (FDL) is a measure of the vibration energy input into the ground by a rail vehicle and the track structure. As the steel wheels of a transit train roll along on the steel rails of the track, the wheels, tracks, vehicle suspension system, and track support system interact to generate vibration forces. This vibration source is represented by the FDL.

It is ideal to measure the FDL at a site with existing operations that have similar vehicles and track structure to the proposed project. FDLs measured at different transit systems show significant variation across the frequency spectrum. Figure D-1 shows 7 different FDL curves measured at transit systems for embedded track, ballast-and-tie track, and direct fixation (DF) track for 25 mph and for 50 mph. A description of the FDLs presented in the figure follows:

- Streetcar FDL was measured on the streetcar systems at an embedded track section in Seattle and Portland. The FDL presented in Figure D-1 is a composite of the measurements made at both systems. Detailed measurement information and a description of how the composite FDL was developed are in *Tempe Streetcar Environmental Assessment, Noise and Vibration Technical Report*, Appendix D and Appendix E.
- Gold Line FDL was measured on the Metro Gold Line system on ballast-and-tie track north of the Chinatown station in the Cornfields State Historic Park. The FDL is a composite of both the Ansaldo Breda and Siemens trains that run on the system, which showed comparable FDL levels. Train speeds during the measurement averaged 53 mph. The Gold Line FDL for 25 mph was estimated using a 15 log (speed) adjustment.

Figure D-1: Force Density Levels at 25 mph and 50 mph



- ST Direct Fixation FDL was measured on the Sound Transit Central Link line. Controlled speed passbys were used to measure the FDL at both 25 mph and 50 mph. (REF - ST Existing Vib.)
- ST Ballast and Tie FDL was measured on the Sound Transit Central Link line along Martin Luther King Blvd. Controlled speed passbys were used to measure the FDL at both 25 mph and 50 mph.

The Gold Line FDL on ballast-and-tie track is the most current FDL measured on the Metro system. The Gold Line FDL, measured on ballast-and-tie track with LRT vehicles traveling 53 mph, was applied in the vibration predictions for all sensitive receivers for Alternatives 3 and 4 with an adjustment for receivers near DF track. The Gold Line FDL was compared to the FDLs from the other systems to determine what adjustments to the FDL are necessary to account for track type, vehicle type, and speed variation. The reasoning behind the adjustments applied is described in the sections below. A summary of the adjustments is provided below.

- Embedded track design: The data show similar FDLs for embedded track and ballast-and-tie track. The same FDL is used for embedded track and ballast-and-tie track sections.
- DF track design: The same FDL is used for DF track and ballast-and-tie track sections.
- Vehicle type: The data show similar FDL for both vehicles currently running on the Metro Gold Line and similar levels for the 70% low floor vehicles running on the Seattle and Portland streetcar systems and the Gold Line vehicles. The same FDL is used for Alternative 3 (low-floor vehicle) and Alternative 4 (typical LRT vehicle) without an adjustment for vehicle type.
- Speed variation: A speed adjustment of 15 log (speed/speedref) is used to account for varying speeds in the project corridor.

Embedded Track Design

The embedded track FDL from Seattle/Portland at 25 mph generally shows good agreement with the Metro Gold Line FDL at 25 mph in the 31.5 Hz to 100 Hz frequency range. This indicates that it is appropriate to use the same FDL for both ballast-and-tie track and embedded track. The finding is consistent with measurements conducted in Portland in 1998 on embedded track and ballast-and-tie track on the same system (REF). Those measurements showed no significant difference between the two track types. FDLs for embedded track at higher speeds are not available because the Portland and Seattle streetcar systems are running at-grade in traffic and are limited to local traffic speeds.

The Gold Line FDL is applied to both ballast-and-tie and embedded track sections in the vibration prediction model for the ESFV corridor. However, the Gold Line East Side Extension does have an embedded track design similar to what is proposed for the ESFV project. Future FDL measurements on the East Side Extension may be used during final design to help refine the vibration predictions and mitigation recommendations for embedded track sections.

Direct Fixation Track Design

There will be direct fixation track in the tunnel segment of Alternative 4. A FDL was measured on the Sound Transit LRT system at both a DF section and a ballast-and-tie section. The FDLs showed good agreement at low-frequencies and generally higher levels for DF track above 31.5 Hz. However, the FDLs for the Metro Gold Line ballast-and-tie track and the ST ballast-and-tie track show peak levels in different frequency bands. The peak levels in the Metro Gold Line FDL are of similar magnitude to the Sound Transit DF FDL.

The Metro Gold Line FDL, measured on ballast-and-tie track, is applied to the DF track sections with an adjustment to account for the potential for higher levels above 31.5 H. Above 31.5 Hz, the FDL used in the predictions for receivers near DF track is the average of the Metro Gold Line FDL and the Sound Transit DF FDL. The average FDL is shown in the bottom graph in Figure D-1 and labeled as "Composite FDL."

The Metro Gold Line East Side Extension does have a tunnel section with DF track similar to what is proposed for the ESFV project. Low profile vibration track (LVT) will be used for the ESFV project and is used on the Gold Line East Side Extension. Future FDL measurements on the East Side Extension may be used during final design to help refine the vibration predictions and mitigation recommendations for the DF track section.

Vehicle Type

The Metro Gold Line FDL was developed from train vibration data from both the Siemens trains and Ansaldo Breda trains that currently run on the line. The vibration data showed no significant difference between the two trains. The light-rail vehicles used for Alternative 4 will be similar to or the same as the vehicles used on the Gold Line, so no adjustment is needed.

The low-floor LRT/tram vehicle used for Alternative 3 will be a 70% or 100% low-floor vehicle. The FDL from Seattle/Portland streetcars are from 70% low-floor vehicles and show good agreement with the Gold Line FDL. There are currently no systems operating with a 100% low-floor vehicle in the U.S., so no FDL data is available. Based on the good agreement between the FDL between the Seattle/Portland FDL and the Metro Gold line FDL, no adjustment is included for vehicle type for Alternative 3.

Speed Variation

The FDL varies with speed. The FTA guidance manual recommends a speed adjustment of $20*log(speed/speed_{ref})$ to the FDL to account for speed in the prediction model when no other data is available. However, FDL measurements with trains operating at varying speeds on the Sound Transit system showed that the speed variation is much more complex than the adjustment suggests and depends on a number of factors.

Detailed FDL measurements for varying speeds are not available for the Metro Gold Line. The Metro Gold Line FDL was measured at 53 mph; however, planned operating speeds in the ESFV corridor are 35 mph for Alternative 4 (LRT) and Alternative 3 (low-floor LRT/tram). An adjustment of $15*log(speed/speed_{ref})$ to the Metro Gold line FDL shows good agreement with the Seattle/Portland FDL which is for a speed of 25 mph. Therefore, an adjustment of $15*log(speed/speed_{ref})$ is used for the vibration predictions. This adjustment is more conservative than the recommendation in the FTA guidance manual for predicting at speeds less than 50 mph.

Line Source Transfer Mobility

Vibration propagation tests were performed at 10 locations along the project right-of-way. The locations of the measurement test sites are shown in Figure D-2 and are labeled V-1 through V-10. The vibration propagation tests are used to calculate the line source transfer mobility (LSTM). The LSTM quantifies how easily vibration travels through the earth. A high LSTM indicates the vibration travels efficiently and there is relatively little attenuation as vibration travels through the earth.The LSTM varies depending on local soil conditions. The LSTM results from the 10 sites were inspected to identify regions that share similar vibration propagation trends. The following procedure was used to develop LSTM estimates for the entire project corridor:

Figure D-2: Vibration Propagation Measurement Sites

1. Combine the LSTMs with similar results into groups.
2. Develop worst-case LSTM curves for each group by enveloping the LSTM results for that group. Data with poor coherence (indicating poor data quality)were not included in the enveloping procedure.
3. Calculate best -fit coefficients for LSTM levels vs. log(distance) for each 1/3 octave band. These best-fit coefficients are used to calculate the LSTM at the set-back distance of the receiver to the LRT tracks. The coefficients are shown in Table D-1 and Table D-2.

After inspection of the results, the eight LSTM measurement sites along Van Nuys Boulevard were combined into three groups. The two LSTM measurement sites near sensitive receivers along the Metrolink right-of-way (V-1 and V-2) were not included in groups because they did not show similar trends to nearby measurement sites. The LSTM results are shown in Figure D-3 through Figure D-6. A brief description of the data follows:

- Site V-1 is located at 12171 San Fernando Road near the Sylmar/San Fernando Metrolink station. The LSTM for site V-1 is used in the predictions for sensitive receivers north of San Fernando Mission Boulevard. The LSTM for site V-1 shows peak levels in the 63 to 80 Hz range.
- Site V-2 is located in San Fernando Park at the intersection of Park Avenue and First Street. The LSTM for site V-2 is used for sensitive receivers between San Fernando Mission Boulevard and Van Nuys Boulevard. The LSTM for site V-2 shows peak levels in the 31.5 to 40 Hz range and shows LSTM levels significantly higher than site V-1.
- Group 1 is comprised of sites V-3 and V-4 and is used in the predictions for sensitive receivers between Woodman Avenue and San Fernando Road. The LSTM for group 1 shows peak levels in the 20 to 31.5 Hz range.
- Group 2 is comprised of sites V-5, V-6, and V-7 and is used in the predictions for sensitive receivers between Parthenia Street and Woodman Avenue. The LSTM for group 2 shows peak levels in the 31.5 to 50 Hz range. The LSTM peak levels for group 2 are about 10 dB higher than the peak levels for group 1.
- Group 3 is comprised of sites V-8, V-9, and V-10 and is used for sensitive receivers between the Orange Line and Parthenia Street. The LSTM for group 3 shows peak levels in the 25 to 31.5 Hz range. The LSTM peak levels for group 3 are about 5 dB lower than the peak levels for group 2.

Groundborne Noise

In addition to feelable vibration, the vibration of room surfaces radiates a low-frequency sound that may be audible. This low-frequency noise is referred to as groundborne noise. The relationship between the predicted groundborne vibration, Lv, and the predicted groundborne noise, La, is:

$$La = Lv + Ka\text{-}wt + Krad,$$

where Ka-wt is the A-weighting adjustment at the 1/3 octave band center frequency and Krad is an adjustment to account for the conversion from vibration velocity level to sound pressure level such as any acoustical absorption in the room. The FTA guidance manual recommends a Krad value of zero for typical residential rooms; however, recent research indicates that a Krad value of -5 dB may be more accurate. This analysis assumes a Krad value of -5 for all sensitive receivers.

Table D-1: Best-Fit Coefficients for LSTM Measurements Sites 1 and 2

1/3 Octave Band	Site 1		Site 2	
	A	B	A	B
6.3	27.6	-13.1	7.9	-1.0
8	34.6	-14.4	21.5	-7.6
10	25.1	-6.6	33.1	-12.0
12.5	26.8	-6.6	39.2	-12.7
16	26.9	-5.4	40.9	-10.2
20	30.3	-5.8	46.9	-10.1
25	37.3	-8.1	61.5	-14.5
31.5	46.3	-11.6	79.6	-21.0
40	60.2	-17.9	96.0	-30.9
50	83.8	-30.3	95.4	-32.4
63	117.9	-50.3	96.2	-35.1
80	118.2	-51.5	84.3	-30.2
100	117.0	-55.0	82.9	-33.2
125	113.8	-57.4	83.8	-36.7
160	102.7	-55.1	72.5	-34.1
200	88.4	-48.8	51.9	-27.0
250	63.5	-36.3	36.4	-20.6
315	29.4	-18.4	12.7	-8.4

Table D-2: Best-Fit Coefficients for LSTM Groups 1, 2, and 3

1/3 Octave Band	Group 1		Group 2		Group 3	
	A	B	A	B	A	B
6.3	13.9	-6.8	29.3	-5.8	47.4	-16.5
8	26.7	-11.9	31.9	-4.5	47.8	-13.3
10	30.0	-10.6	37.9	-6.0	60.9	-17.3
12.5	44.8	-14.7	42.3	-6.6	66.5	-19.0
16	53.9	-14.7	42.6	-5.2	70.0	-20.3
20	57.8	-14.1	45.8	-4.7	65.7	-17.2
25	63.0	-16.2	48.4	-3.7	69.4	-18.1
31.5	60.5	-14.4	67.4	-13.4	77.4	-22.5
40	58.2	-14.0	81.1	-22.3	72.3	-21.4
50	61.5	-17.2	85.0	-26.3	67.3	-19.9
63	70.0	-24.1	72.7	-21.7	70.1	-22.6
80	68.1	-25.3	68.7	-21.1	65.6	-22.6
100	65.4	-25.3	67.4	-23.1	54.2	-19.1
125	69.9	-29.5	64.5	-23.3	62.6	-26.7
160	65.5	-29.5	71.9	-29.4	70.2	-34.8
200	63.6	-33.1	79.9	-36.3	87.4	-46.4
250	70.6	-40.2	36.6	-17.7	87.5	-48.2
315	82.7	-49.9	26.9	-15.6	84.6	-48.4

Figure D-3: LSTM for Measurement Sites V1 and V2

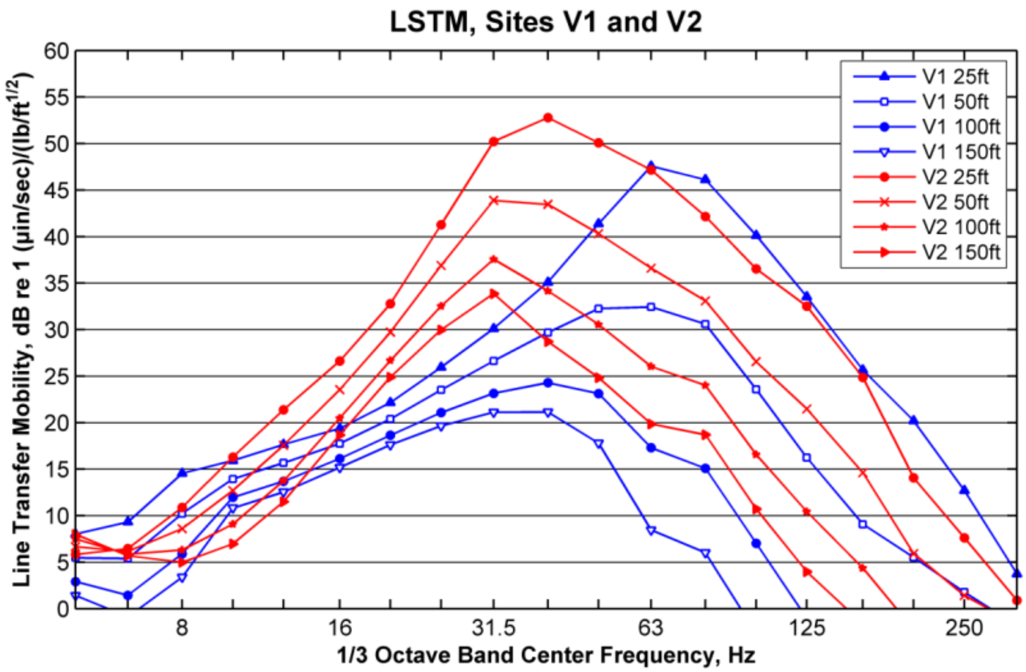


Figure D-4: LSTM for Measurement Sites in Group 1 (V3 and V4)

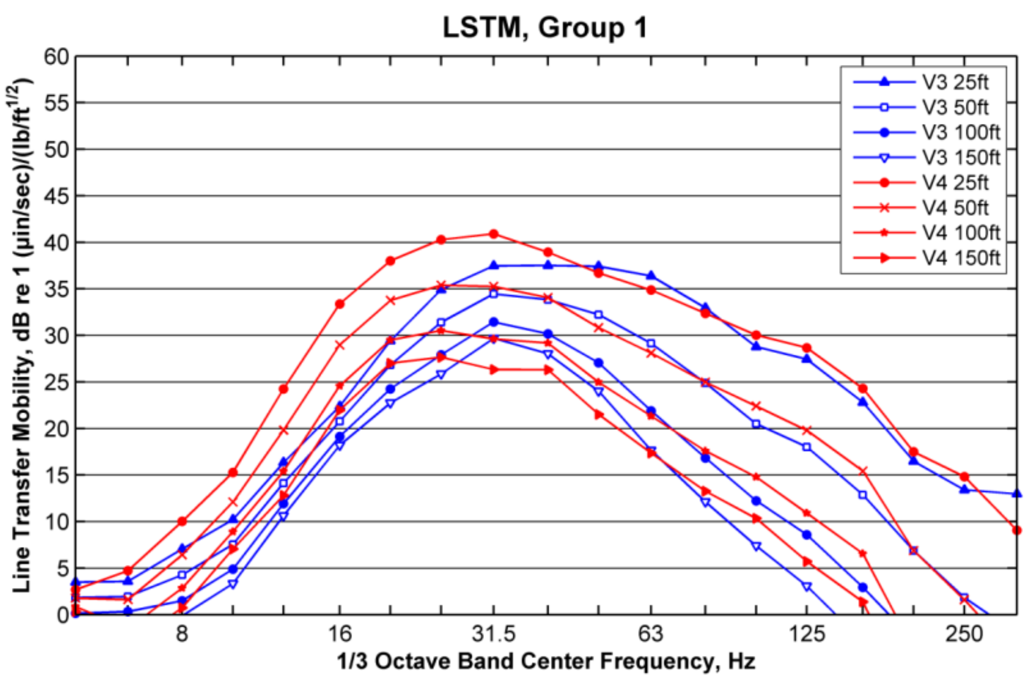
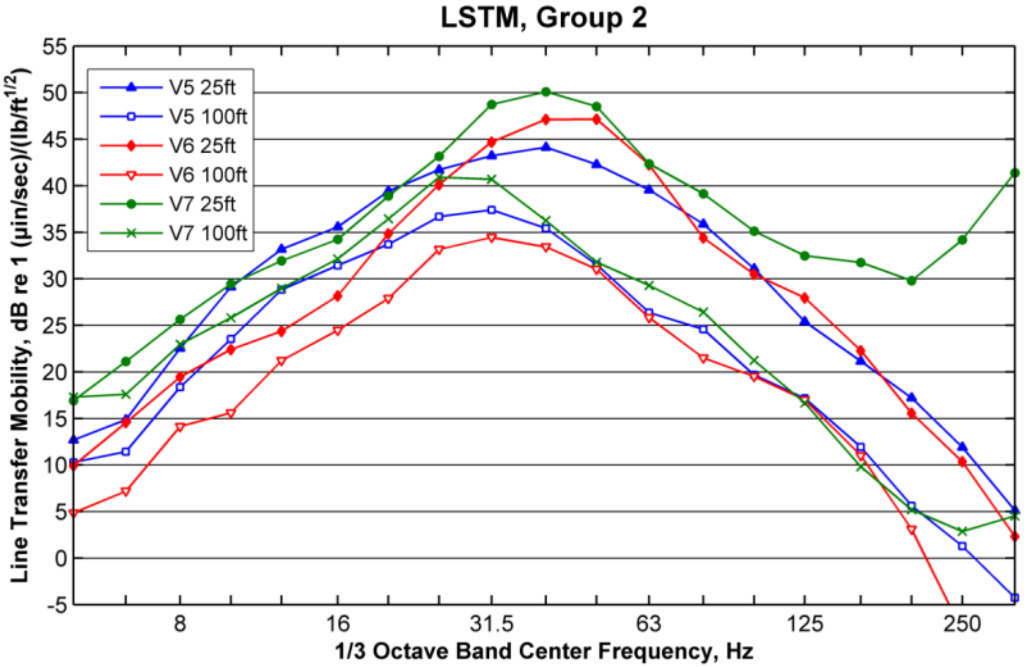
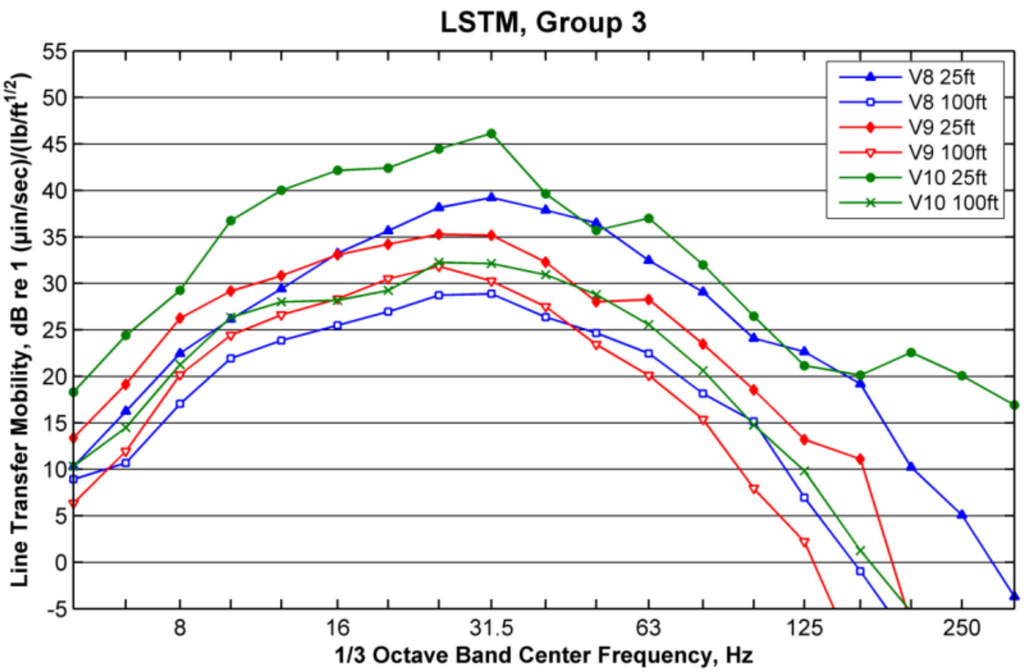


Figure D-5: LSTM for Measurement Sites in Group 2 (V5, V6, and V7)



igure D-6: LSTM for Measurement Sites in Group 3 (Sites V8, V9, and V10)



Potential groundborne noise impacts are typically only evaluated when the train is in a tunnel section because there is no airborne noise. Typically, when the train is above-grade the airborne noise will mask the groundborne noise so it is not necessary to assess for groundborne noise impact.

The Lmax noise level of a Metro Gold Line train traveling at 50 mph on ballast-and-tie track is 78 dBA at 50 feet. A typical residence has an outdoor to indoor sound reduction of 25 dBA. Therefore, the train Lmax inside a residence at 50 feet would be 53 dBA for airborne noise. In the area with the highest LSTM levels, the predicted groundborne noise at 50 feet is 45 dBA. In general, we expect the airborne noise to be 5 to 10 dB greater than the groundborne noise.

Construction Vibration

Some construction activities, such as pile driving, pavement breaking, and the use of tracked vehicles (e.g., bulldozers), could result in perceptible levels of groundborne vibration. However, these activities would be limited in duration and vibration levels for most construction activities are likely to be well below thresholds for minor cosmetic building damage.

The approach used to estimate the vibration levels that would be generated during the construction of the proposed project is as follows:

1. Use the vibration source levels for construction equipment from the FTA guidance manual.
2. Calculate the vibration at the sensitive receiver using the source level in the following formula:

$$PPV_{eq} = PPV_{ref} \times (25/D)^{1.5},$$

where:

PPV_{eq} = peak particle velocity in in/sec of the equipment at the sensitive receiver,

PPV_{ref} = reference vibration level in in/sec at 25 feet,

D = distance from the equipment to the sensitive receiver.

Appendix E
Noise Measurement Results

Long-term noise measurements were conducted at nine sites and short-term noise measurements were conducted at an additional 11 sites. Figure E-1 summarizes the measured noise levels and corresponding moderate and severe impact thresholds at each of the long-term sites. Figure E-2 summarizes the measured noise levels and corresponding moderate and severe impact thresholds for each of the short-term sites. Note that the impact thresholds are the amount of allowable project noise, or noise contributed by the BRT or LRT alternative, not the future allowable noise level. Site descriptions and figures showing 1-second noise levels for each site follows.

Figure E-1: Summary of Long-Term Measurement Sites

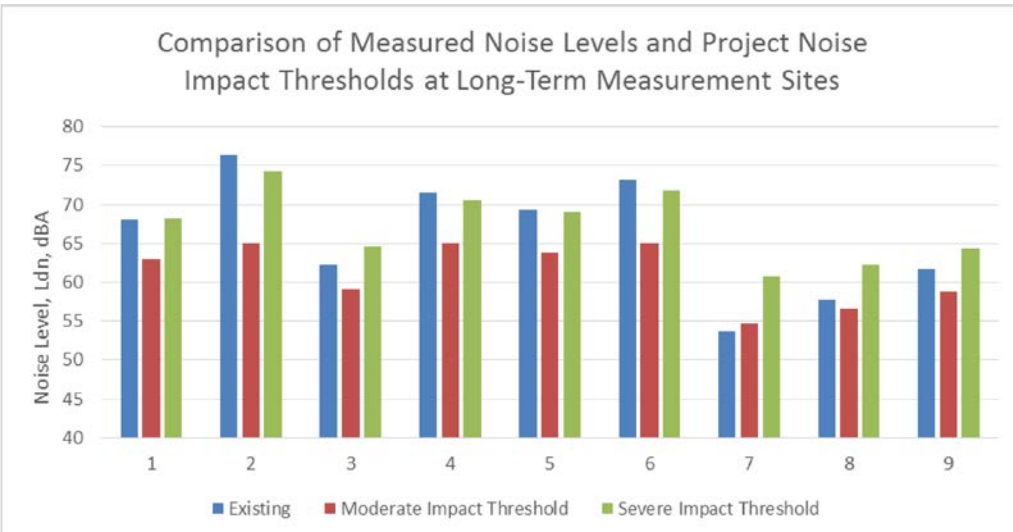
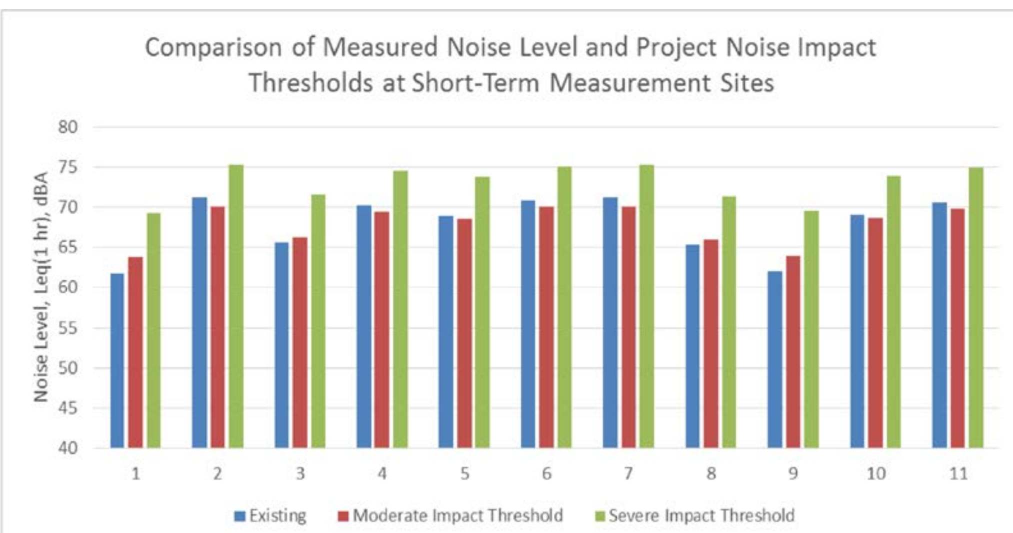


Figure E-2: Summary of Short-Term Measurement Sites

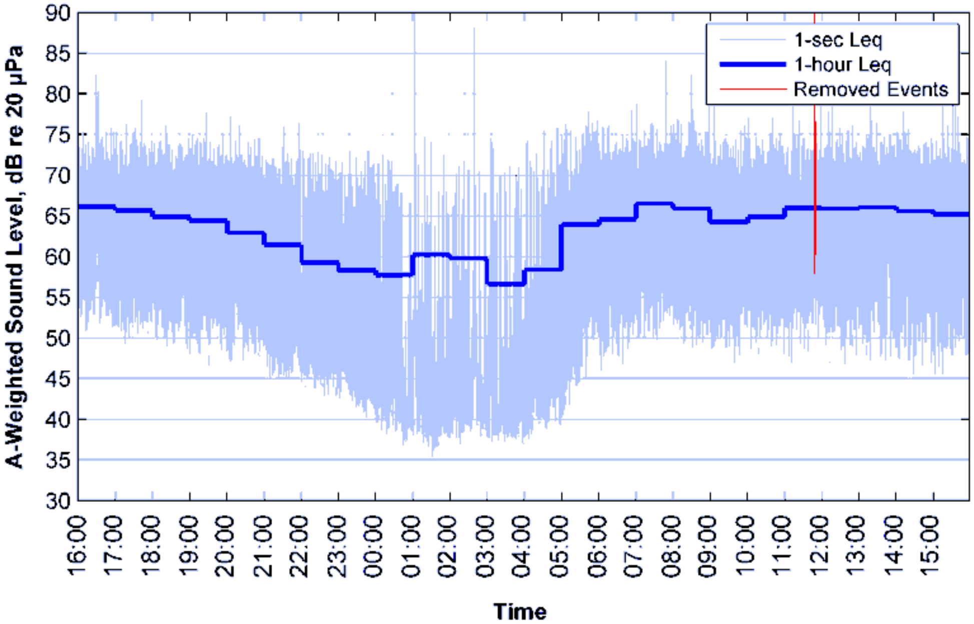


Long-Term Noise Measurement Site LT-1: 12171 San Fernando Rd

Measured Peak Hour Leq: *64.5 dBA*, and Ldn: *68.1 dBA*

Figure E-3: Long-Term Measurement Site LT-1

Figure E-4: Time History of Long-Term Measurement Site LT-1

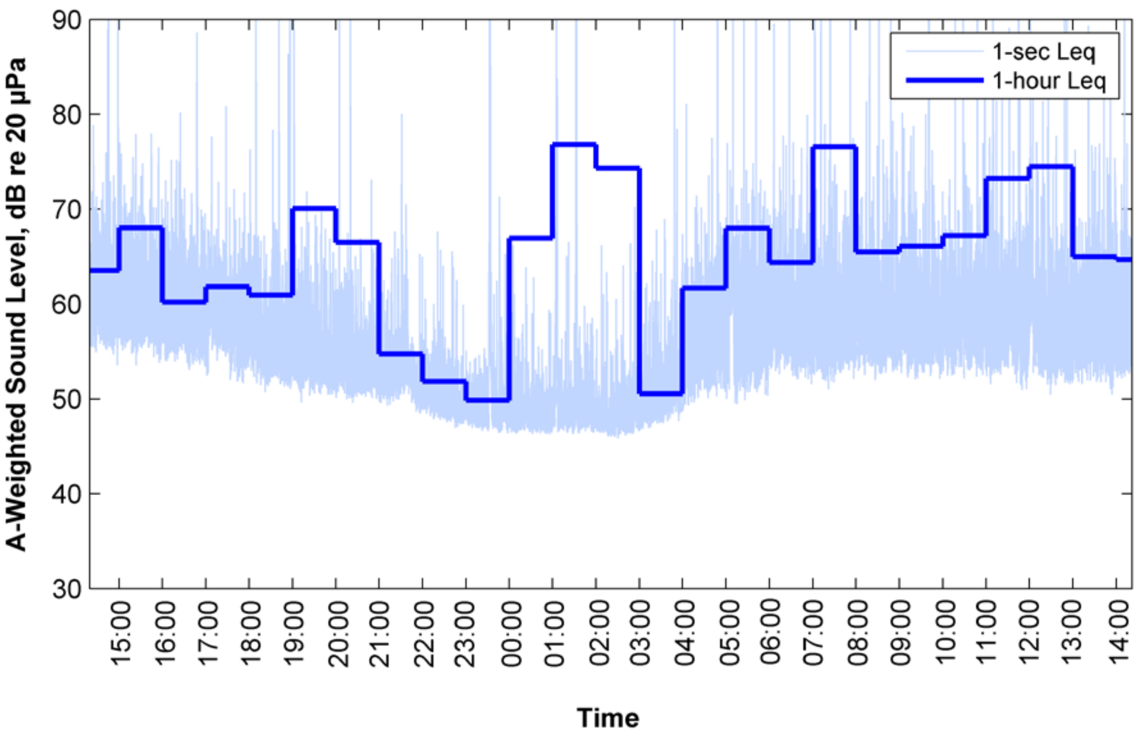


Long-Term Noise Measurement Site LT-2: 101 Park Avenue

Measured Peak Hour Leq: *76.8 dBA*, and Ldn: *76.3 dBA*

Figure E-5: Long-Term Measurement Site LT-2

Figure E-6: Time History of Long-Term Measurement Site LT-2

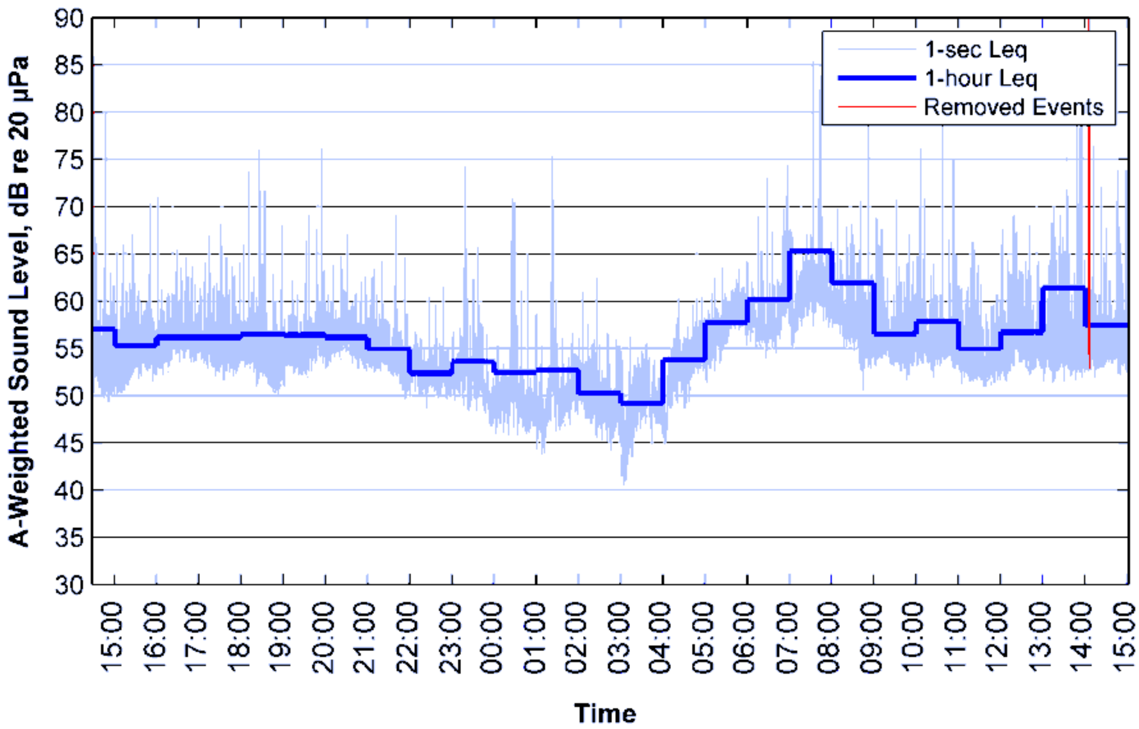


Long-Term Noise Measurement Site LT-3: Pinney St and Haddon St

Measured Peak Hour Leq: *65.2 dBA*, and Ldn: *62.3 dBA*

Figure E-7: Long-Term Measurement Site LT-3

Figure E-8: Time History of Long-Term Measurement Site LT-3

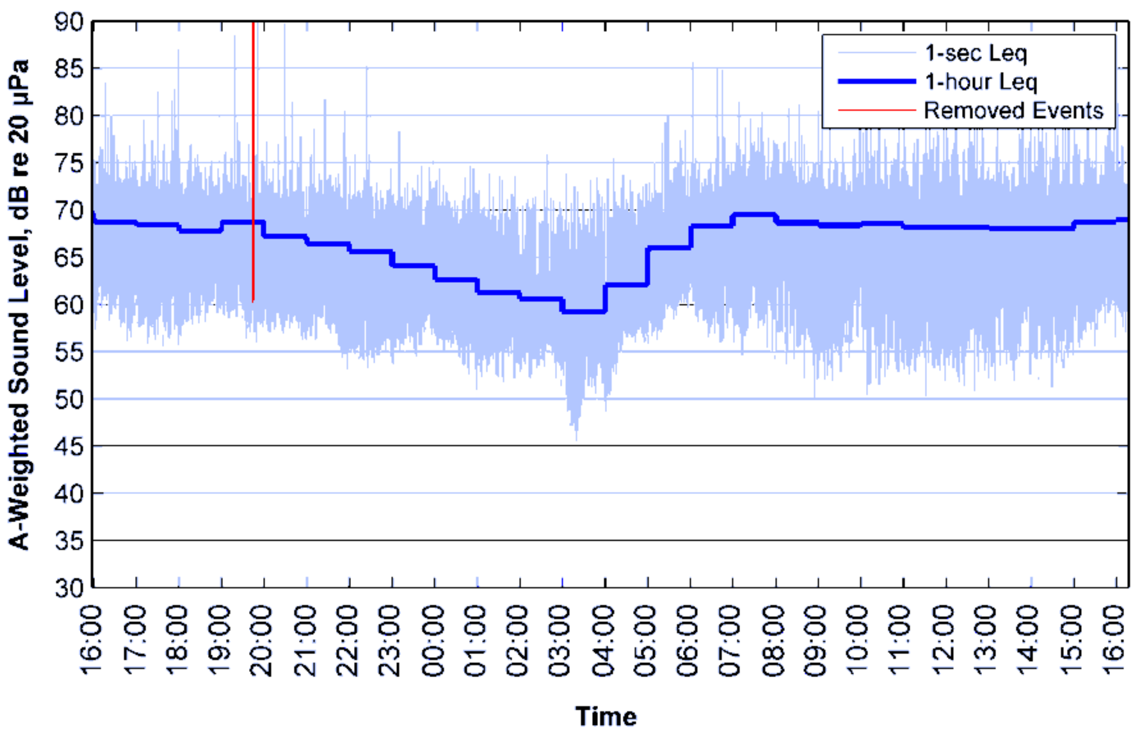


Long-Term Noise Measurement Site LT-4: Van Nuys and Bartee

Measured Peak Hour Leq: *70.2 dBA*, and Ldn: *71.5 dBA*

Figure E-9: Long-Term Measurement Site LT-4

Figure E-10: Time History of Long-Term Measurement Site LT-4



Long-Term Noise Measurement Site LT-5: **Van Nuys and Tupper**

Measured Peak Hour Leq: *70.2 dBA*, and Ldn: *69.3 dBA*

Figure E-11: Long-Term Measurement Site LT-5

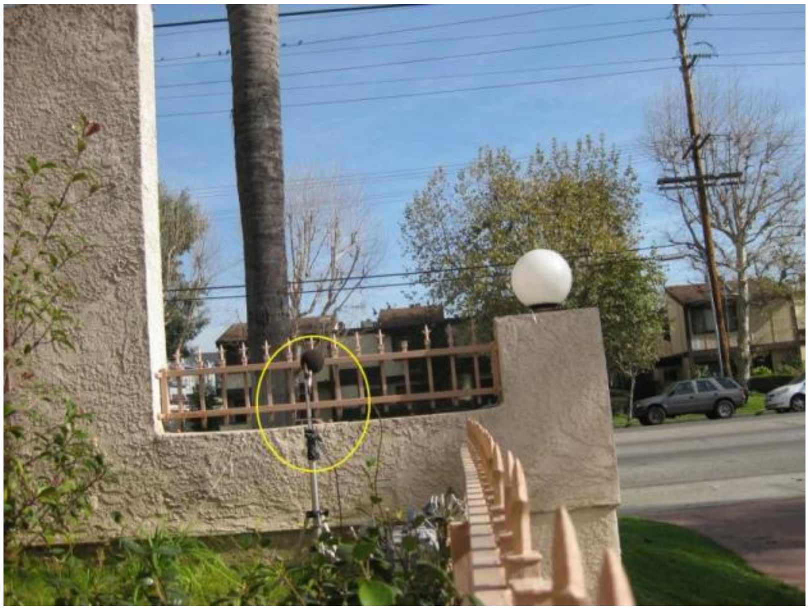
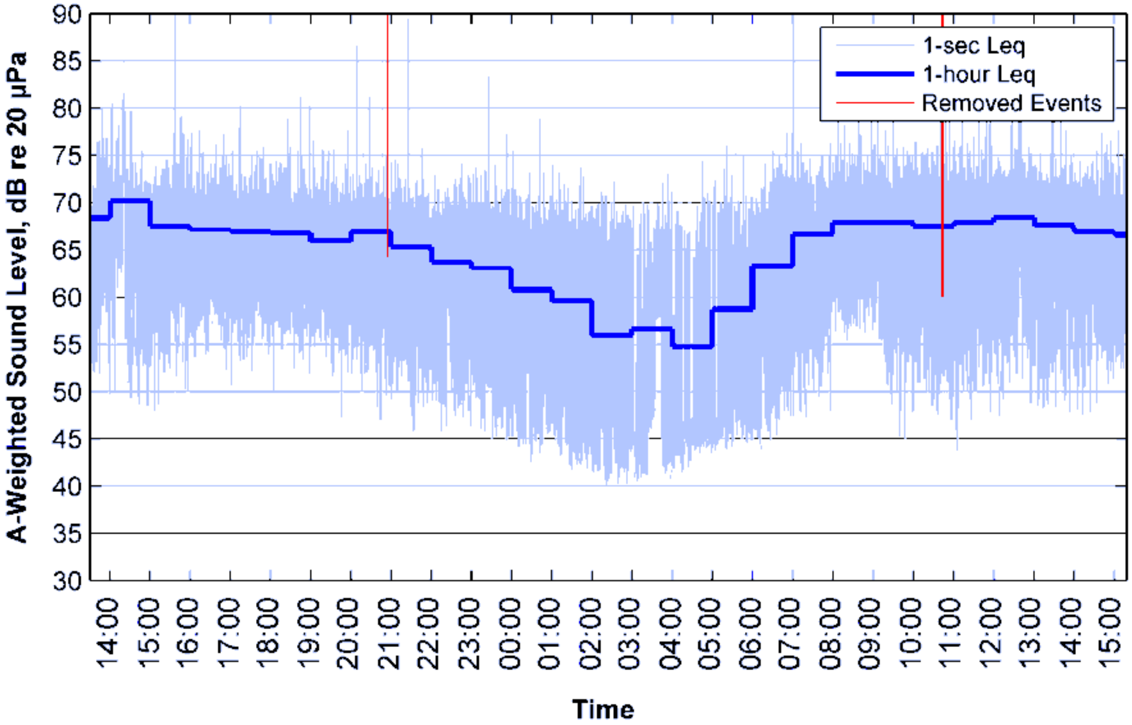


Figure E-12: Time History of Long-Term Measurement Site LT-5

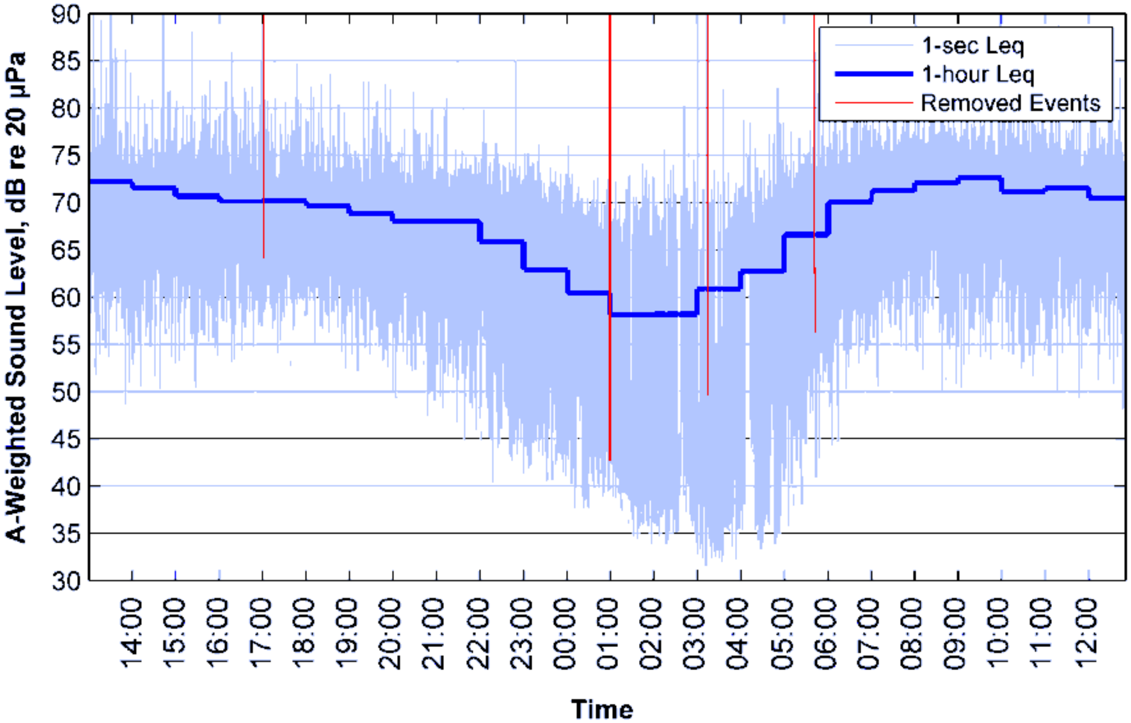


Long-Term Noise Measurement Site LT-6: Van Nuys and Osborne

Measured Peak Hour Leq: *72.6 dBA*, and Ldn: *73.2 dBA*

Figure E-13: Long-Term Measurement Site LT-6

Figure E-14: Time History of Long-Term Measurement Site LT-6

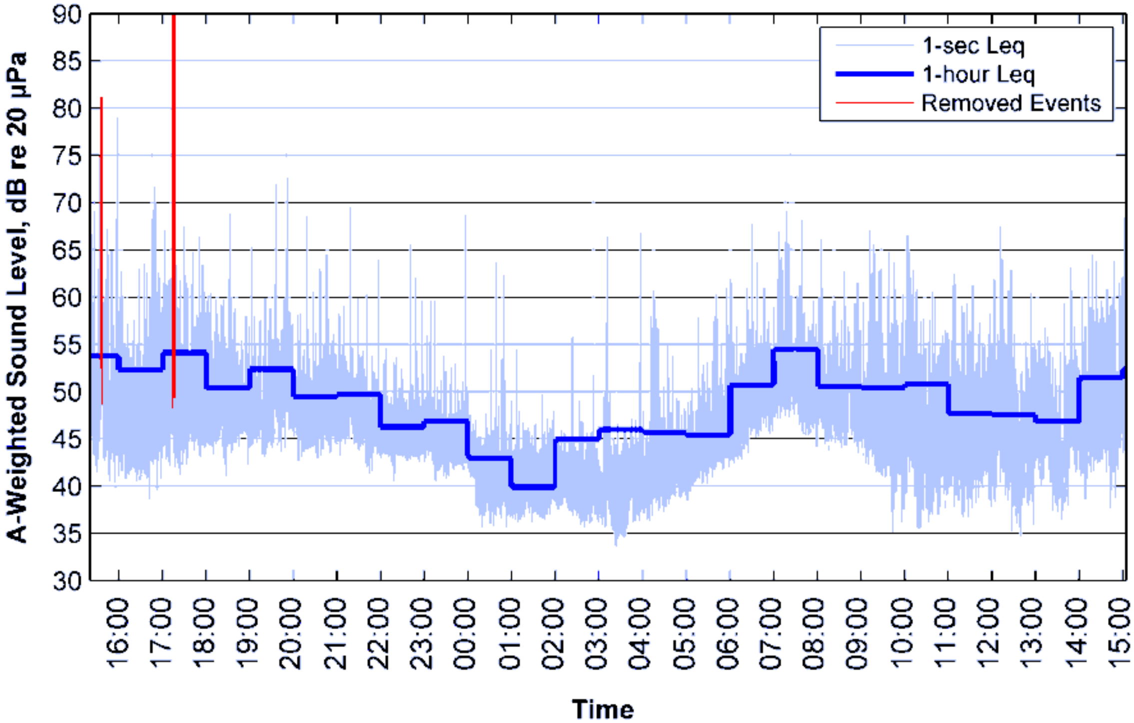


Long-Term Noise Measurement Site LT-7: Tilden Ave

Measured Peak Hour Leq: *54.5 dBA*, and Ldn: *53.7 dBA*

Figure E-15: Long-Term Measurement Site LT-7

Figure E-16: Time History of Long-Term Measurement Site LT-7

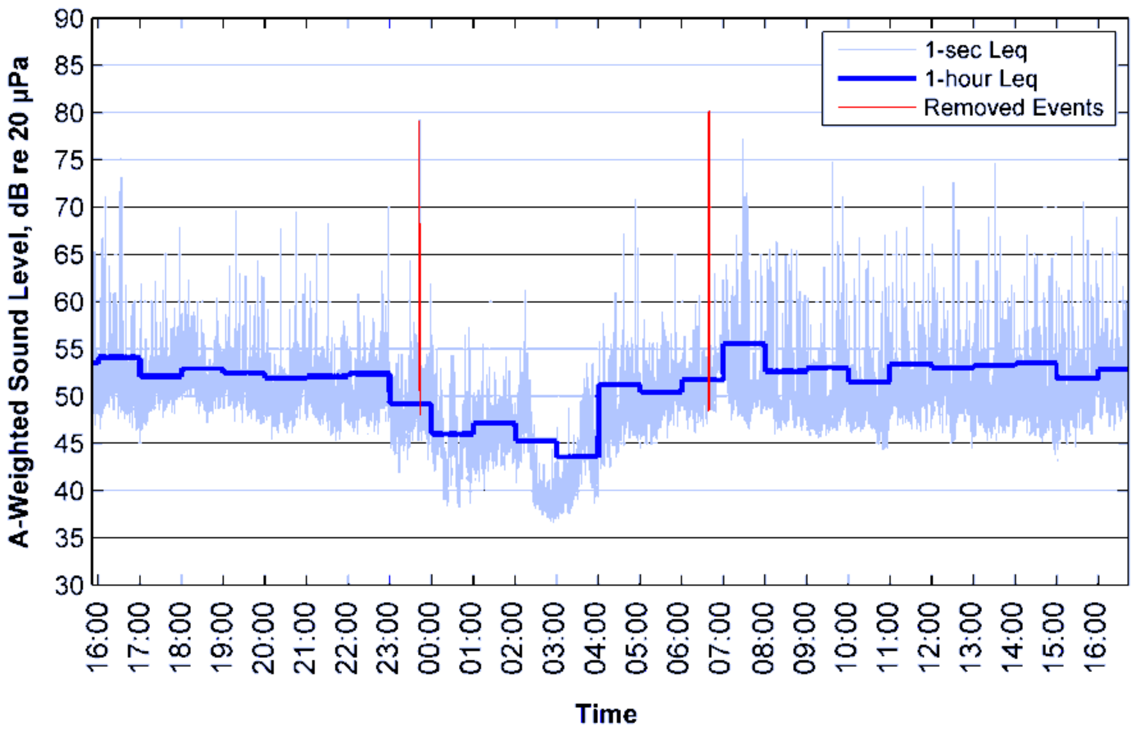


Long-Term Noise Measurement Site LT-8: Sylmar St.

Measured Peak Hour Leq: *55.5 dBA*, and Ldn: *57.7 dBA*

Figure E-17: Long-Term Measurement Site LT-8

Figure E-18: Time History of Long-Term Measurement Site LT-8

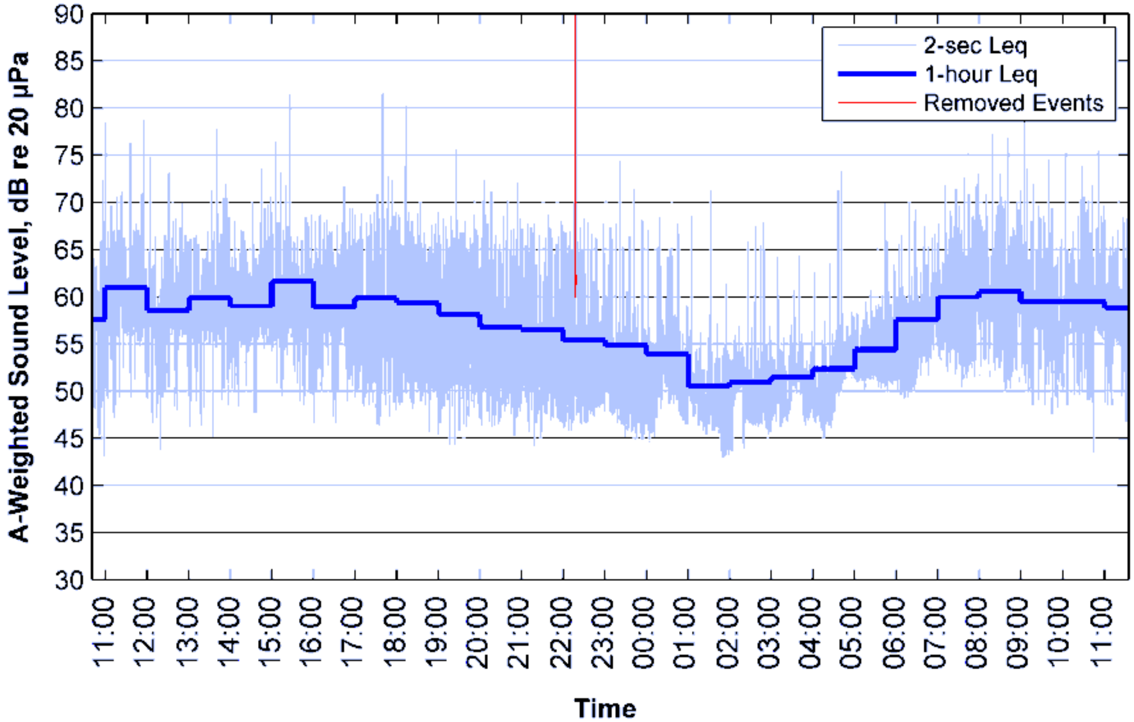


Long-Term Noise Measurement Site LT-9: Circle Dr.

Measured Peak Hour Leq: *61.5 dBA*, and Ldn: *61.8 dBA*

Figure E-19: Long-Term Measurement Site LT-9

Figure E-20: Time History of Long-Term Measurement Site 9

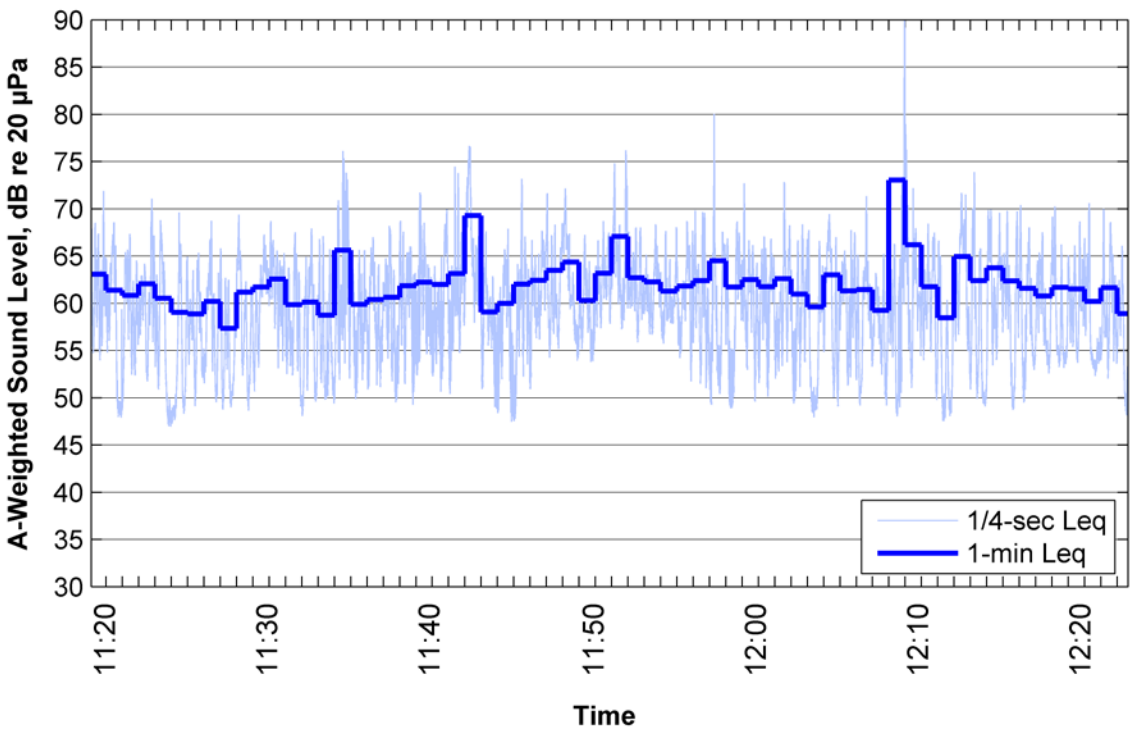


Short Term Noise Measurement Site ST-1: San Fernando Middle School

One-hour Leq: *62 dBA*

Figure E-21: Short-Term Measurement Site ST-1

Figure E-22: Time History of Short-Term Measurement Site ST-1



Short Term Noise Measurement Site ST-2: Pacoima Branch Library

One-hour Leq: 71 *dBA*

Figure E-23: Short-Term Measurement Site ST-2

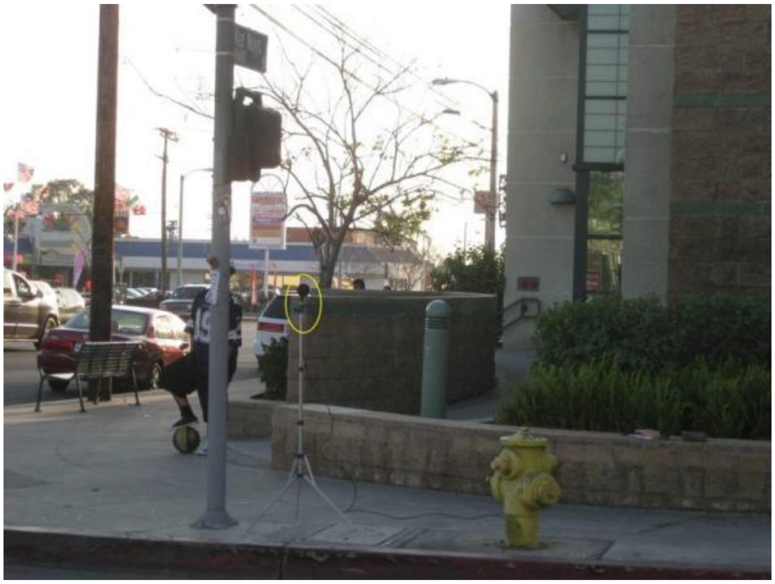
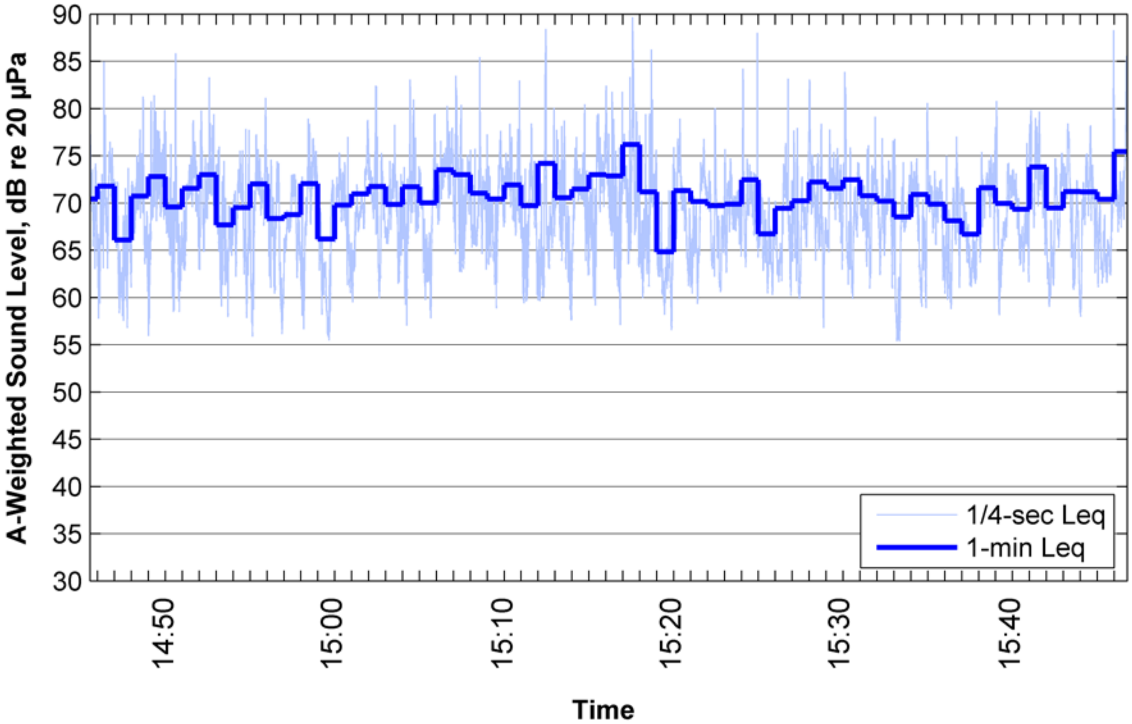


Figure E-24: Time History of Short-Term Measurement Site ST-2



Short Term Noise Measurement Site 3: Mary Immaculate School

One-hour Leq: *65 dBA*

Figure E-25: Short-Term Measurement Site ST-3

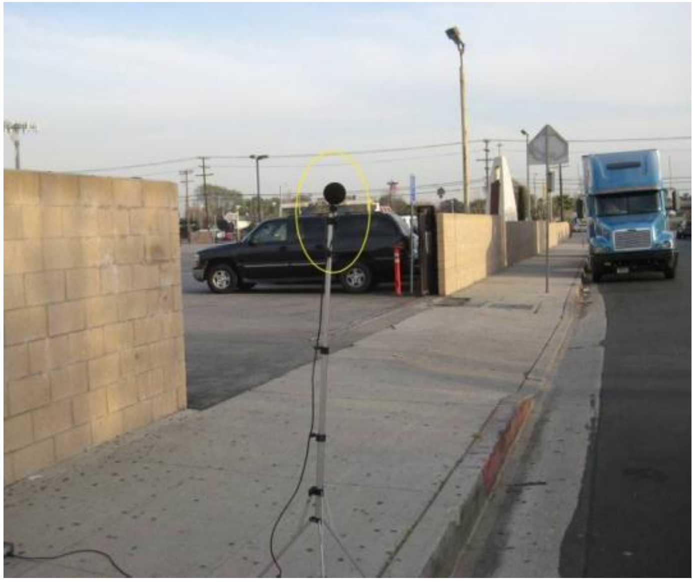
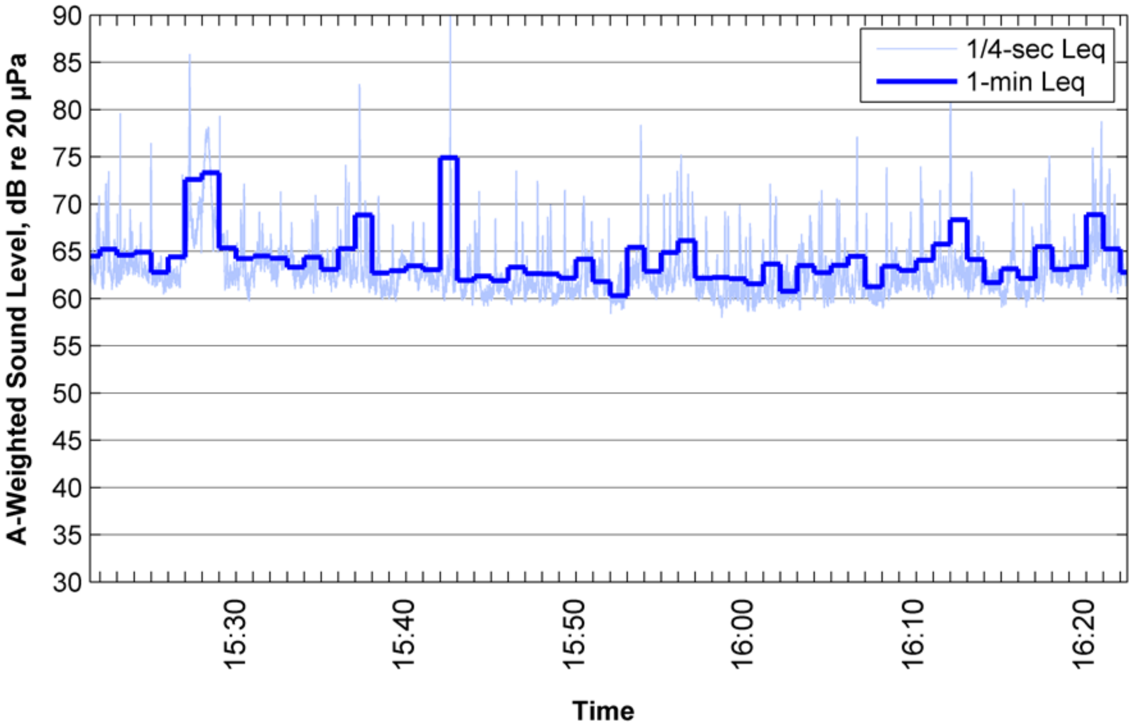


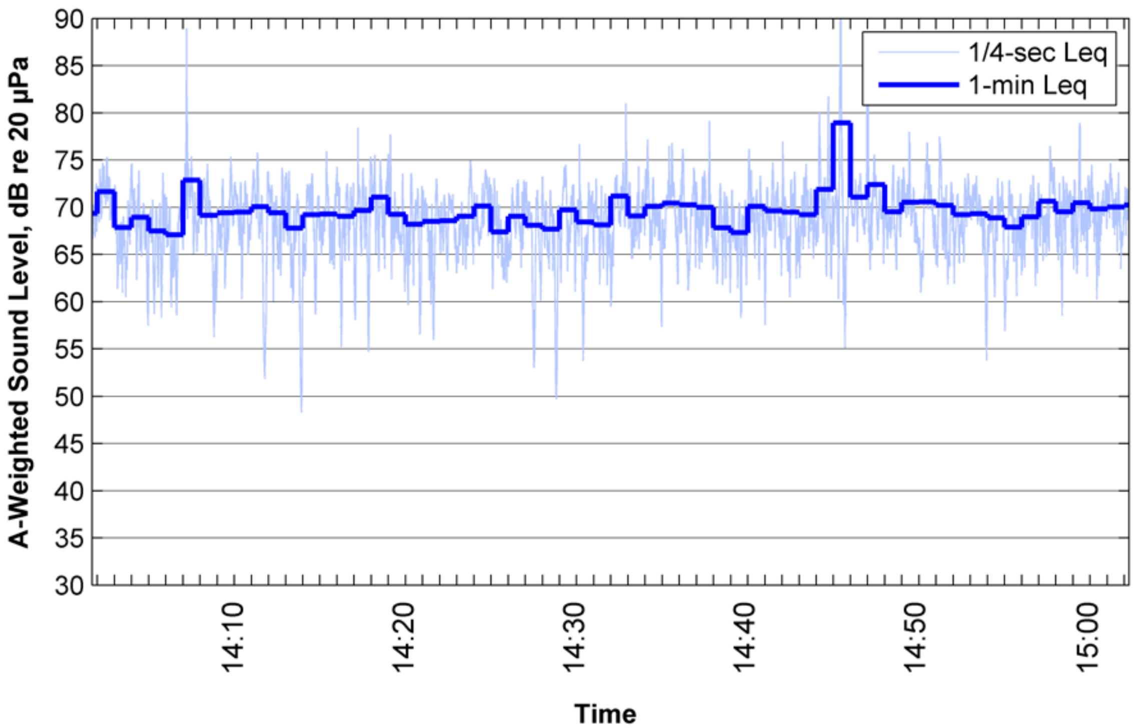
Figure E-26: Time History of Short-Term Measurement Site ST-3



Short Term Noise Measurement Site 4: Arleta High School

One-hour Leq: *70 dBA*

Figure E-27: Time History of Short-Term Measurement Site ST-4



Short Term Noise Measurement Site 5: Imam Bukhari Masjid

One-hour Leq: *69 dBA*

Figure E-28: Short-Term Measurement Site ST-5

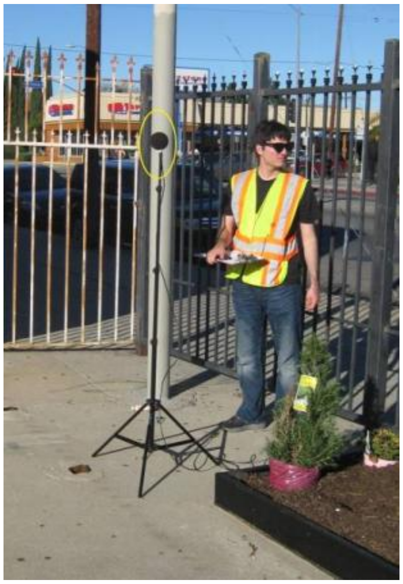
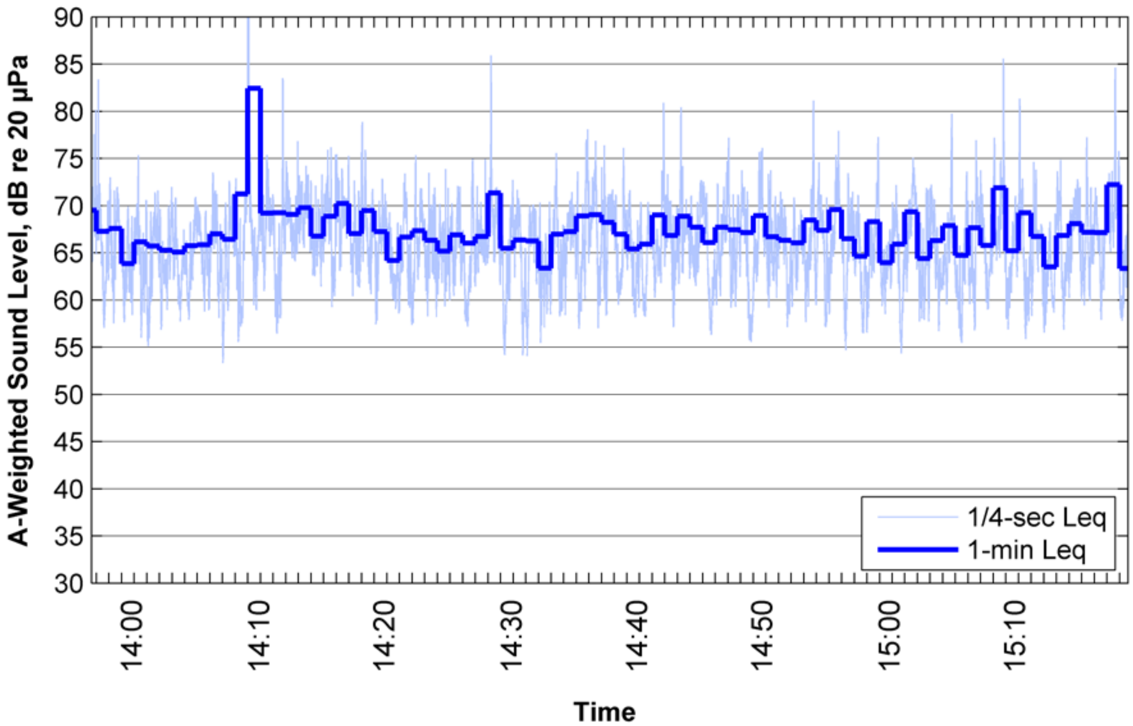


Figure E-29: Time History of Short-Term Measurement Site ST-5



Short Term Noise Measurement Site 6: Western Beauty Institute

One-hour Leq: *71 dBA*

Figure E-30: Short-Term Measurement Site ST-6

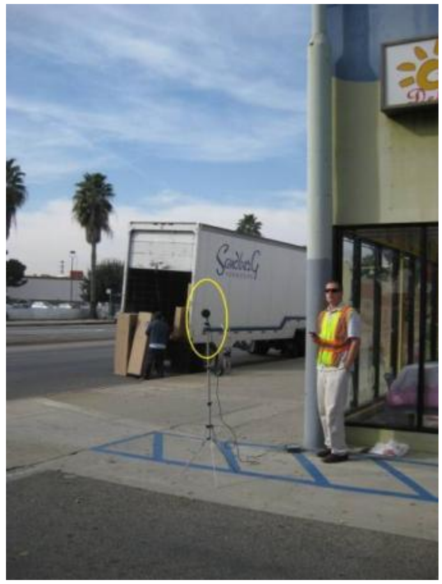
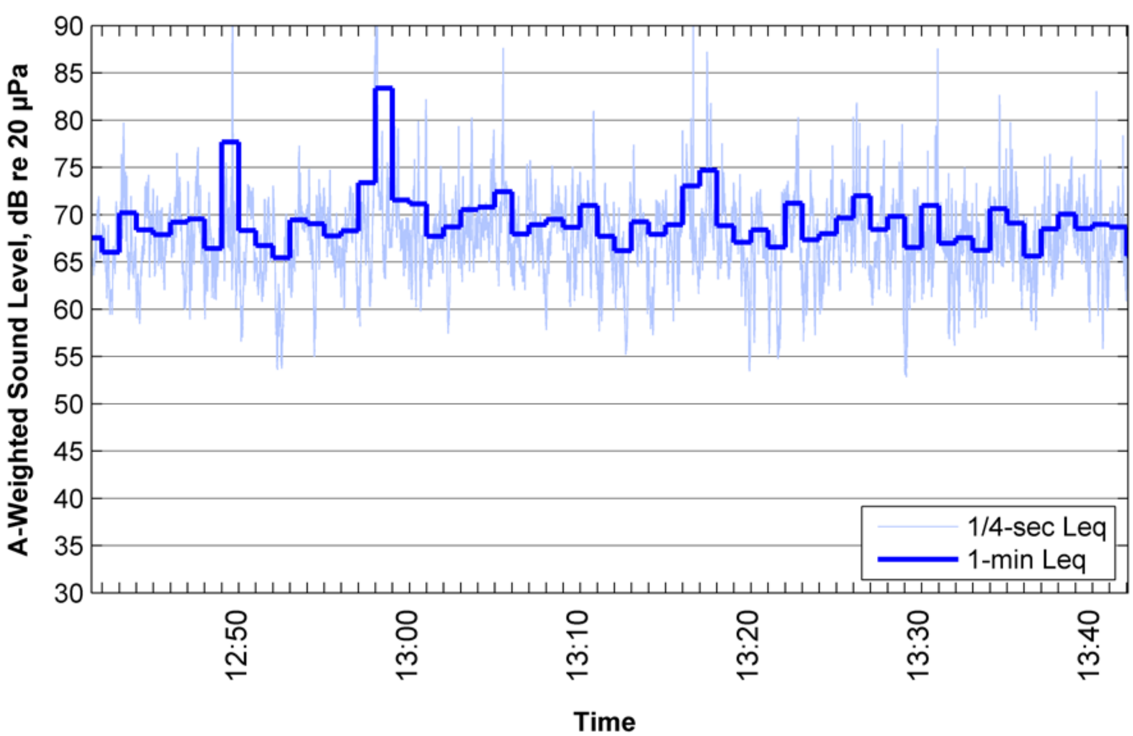


Figure E-31: Time History of Short-Term Measurement Site ST-6



Short Term Noise Measurement Site 7: Panorama College of Nursing

One-hour Leq: *71 dBA*

Figure E-32: Short-Term Measurement Site ST-7

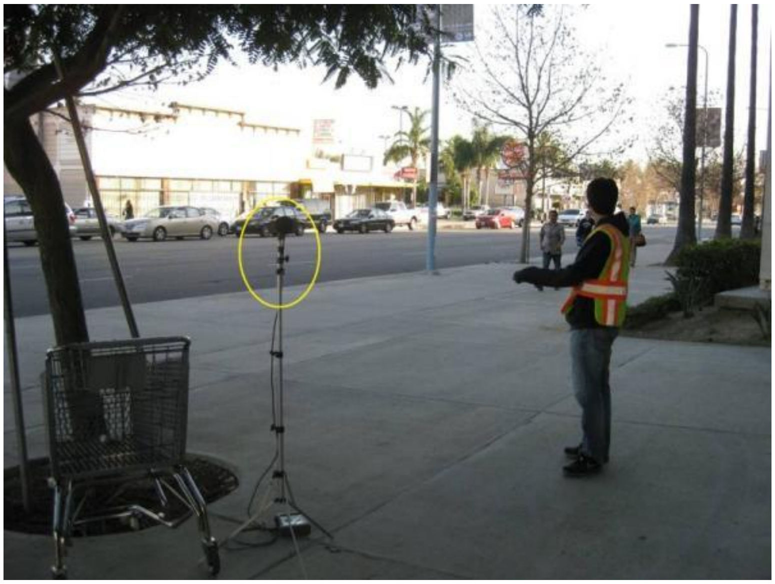
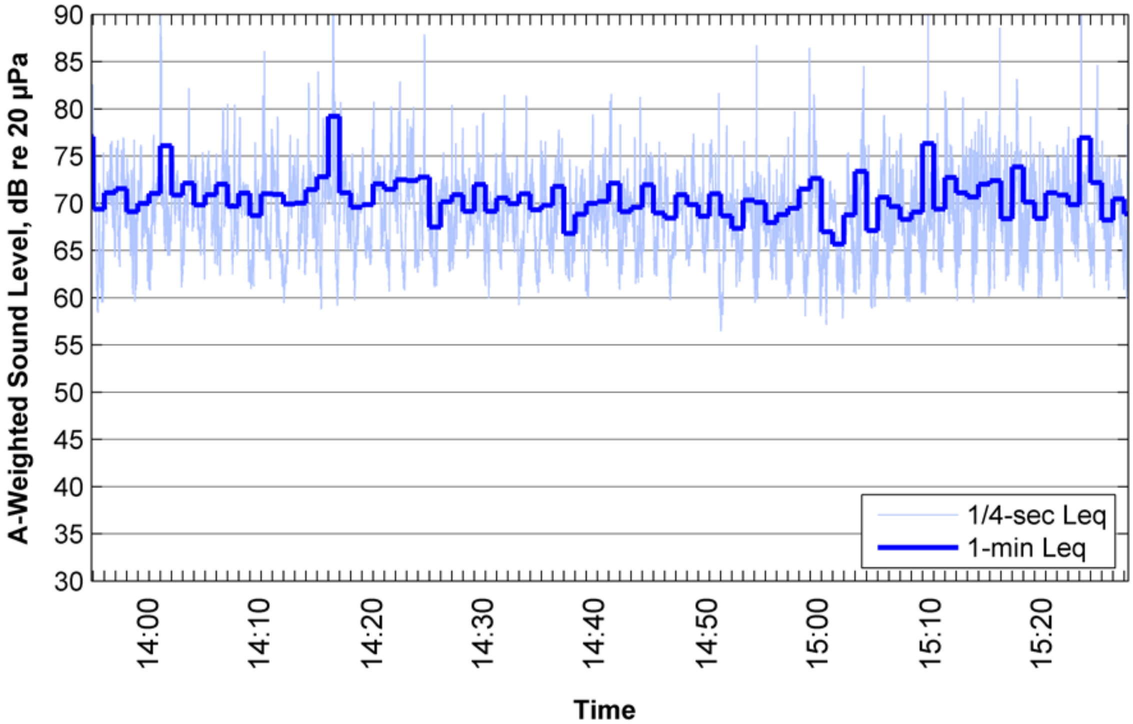


Figure E-33: Time History of Short-Term Measurement Site ST-7

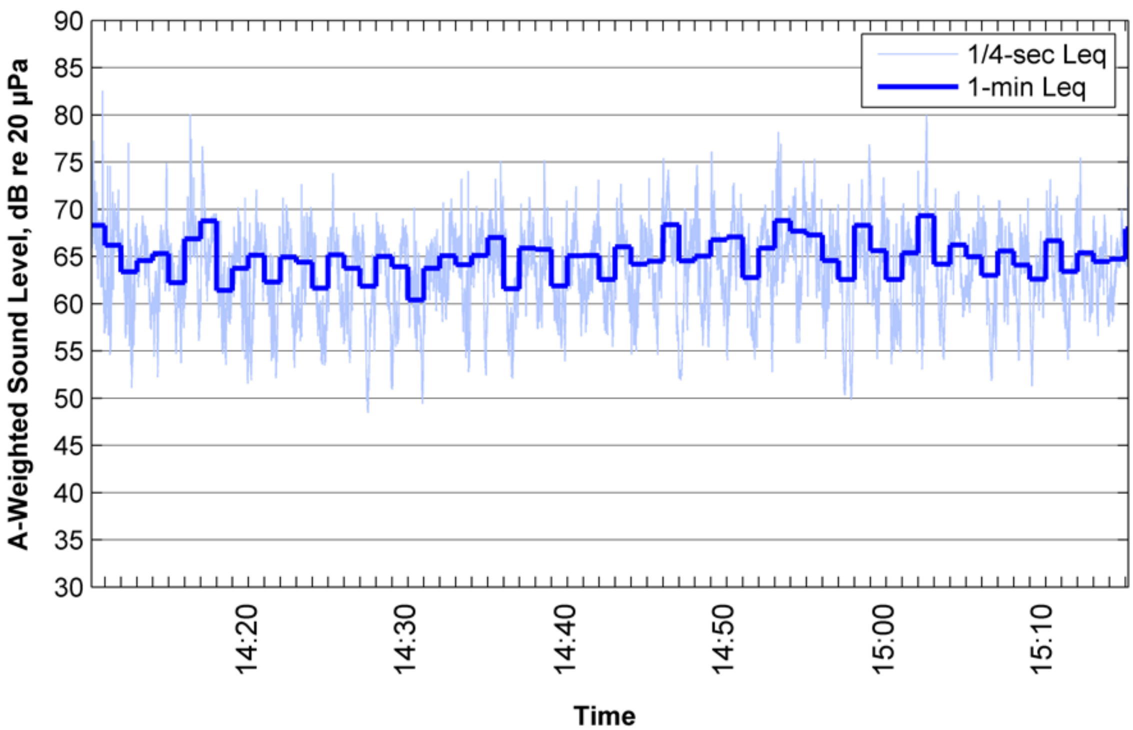


Short Term Noise Measurement Site 8: UEI College

One-hour Leq: *65 dBA*

Figure E-34: Short-Term Measurement Site ST-8

Figure E-35: Time History of Short-Term Measurement Site ST-8

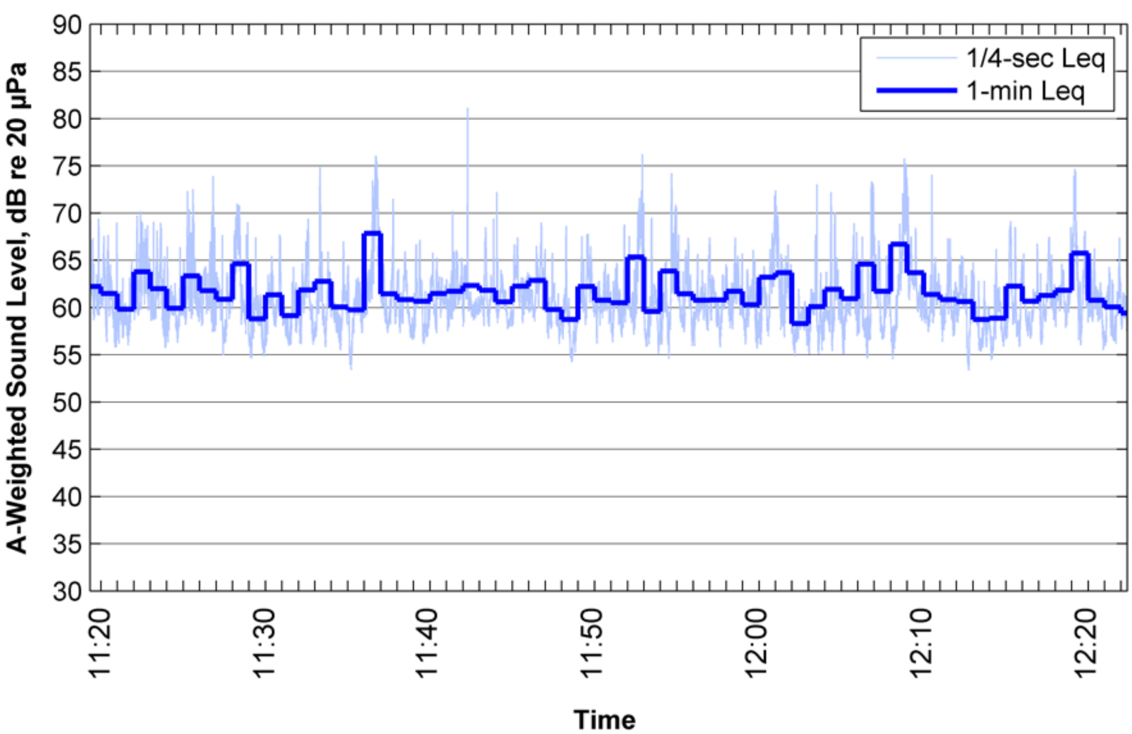


Short Term Noise Measurement Site 9: ICDC College

One-hour Leq: *62 dBA*

Figure E-36: Short-Term Measurement Site ST-9

Figure E-37: Time History of Short-Term Measurement Site ST-9

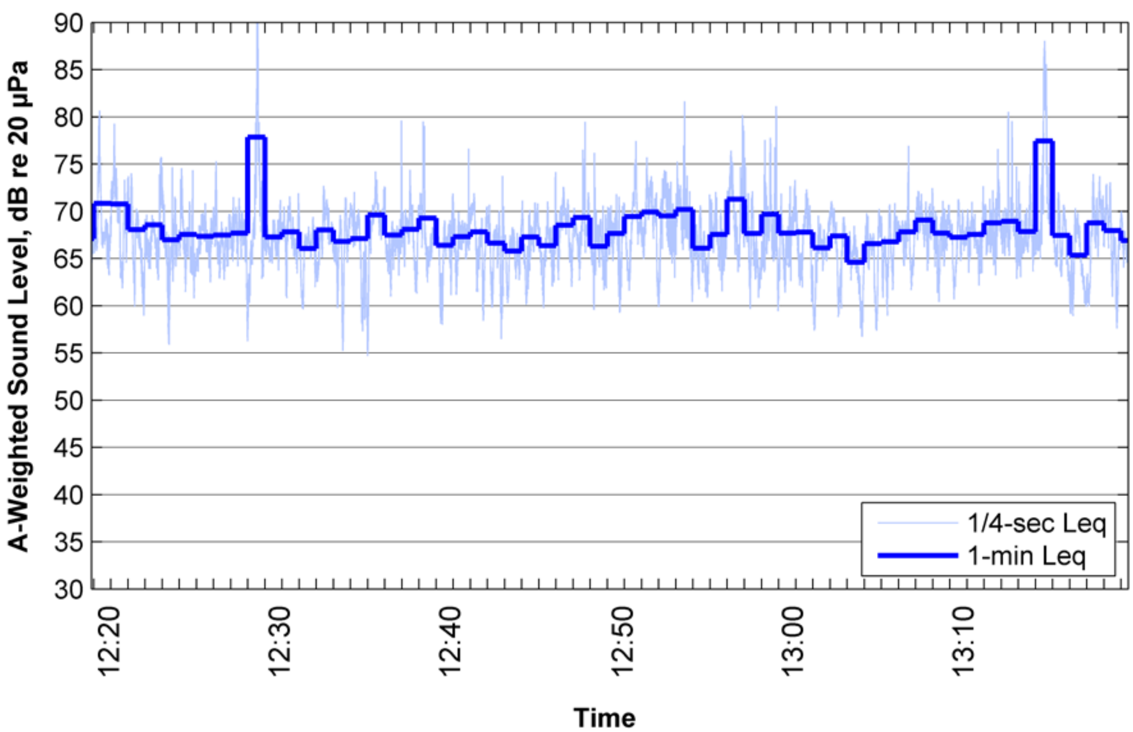


Short Term Noise Measurement Site 10: Champs Charter High School

One-hour Leq: *69 dBA*

Figure E-38: Short-Term Measurement Site ST-10

Figure E-39: Time History of Short-Term Measurement Site ST-10

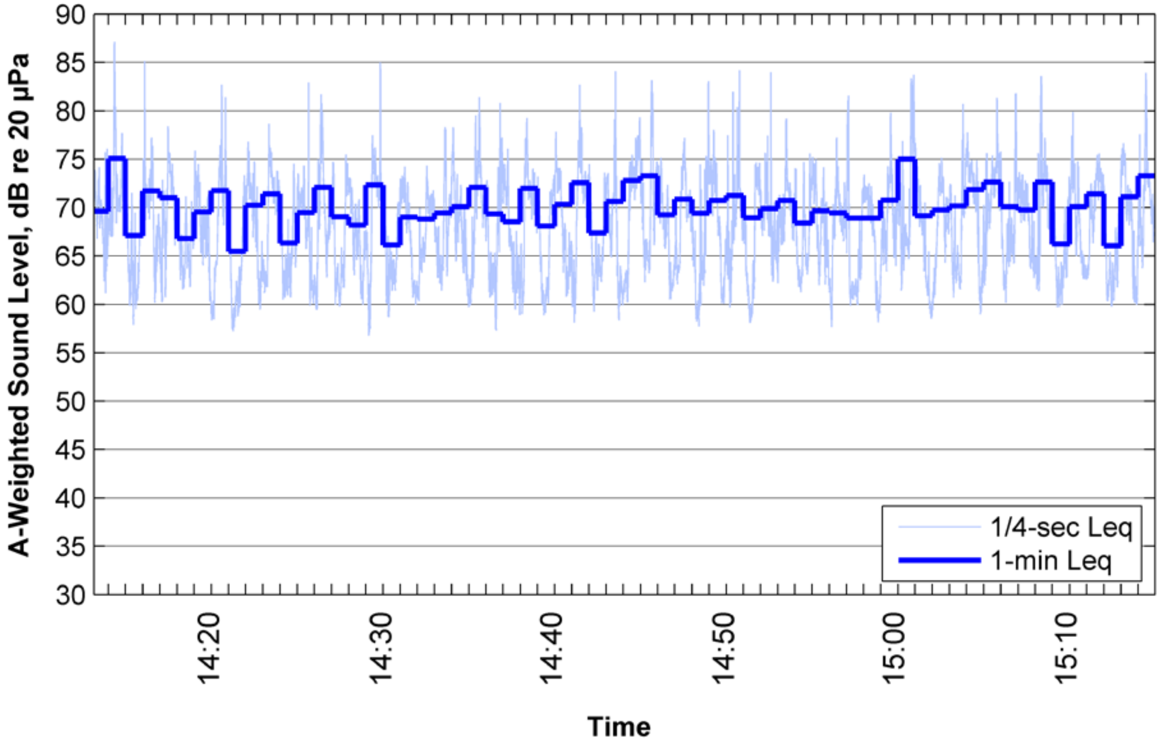


Short Term Noise Measurement Site 11: Preferred College of Nursing

One-hour Leq: *70 dBA*

Figure E-40: Short-Term Measurement Site ST-11

Figure E-41: Time History of Short-Term Measurement Site ST-11



Appendix F

Vibration Propagation Measurement Results

Figure F-1: Map of Vibration Propagation Test Sites

Figure F-2: Site V1 Best Motel, San Fernando Road, Measured LSTM and Coherence

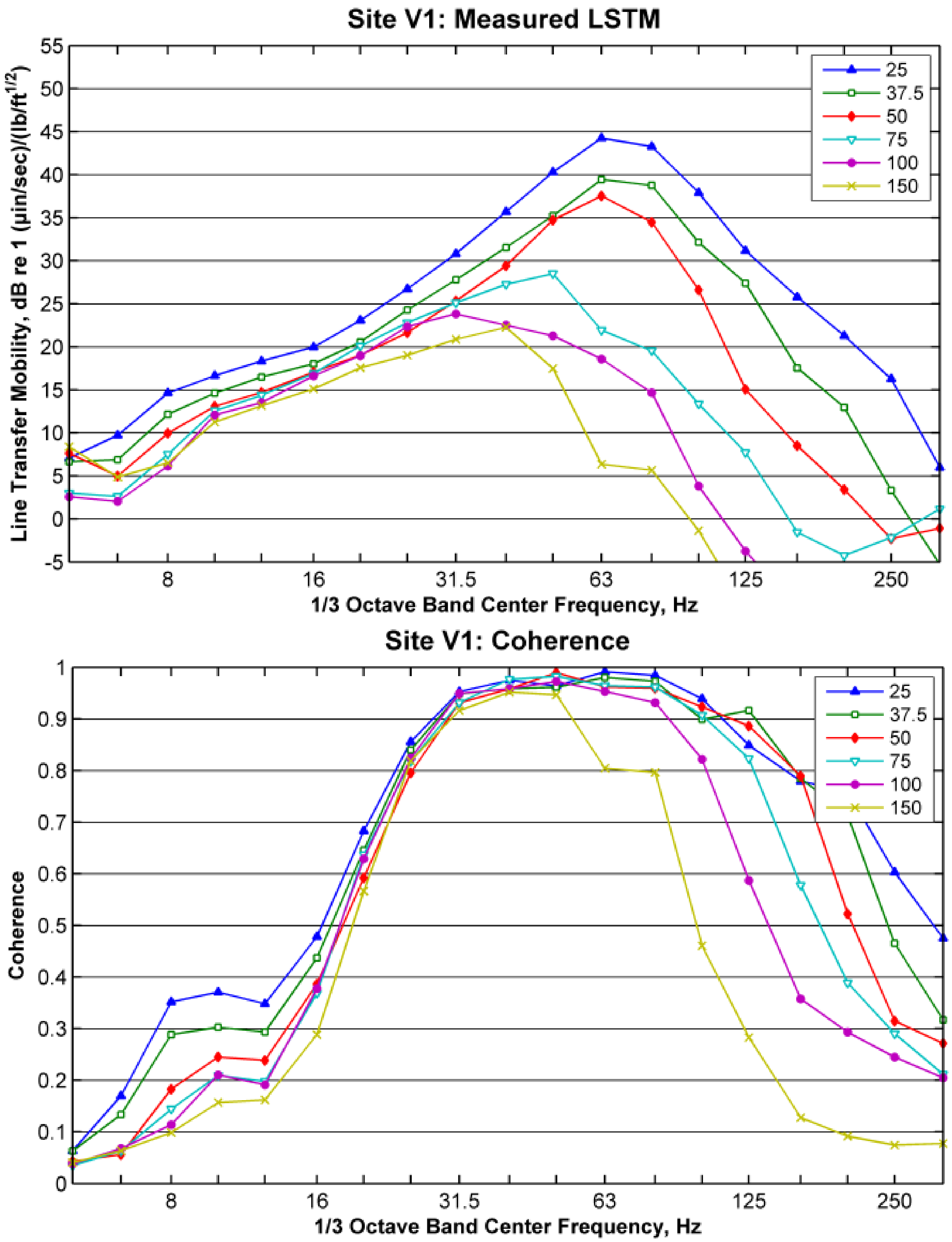


Figure F-3: Site V2-San Fernando Park, Measured LSTM and Coherence

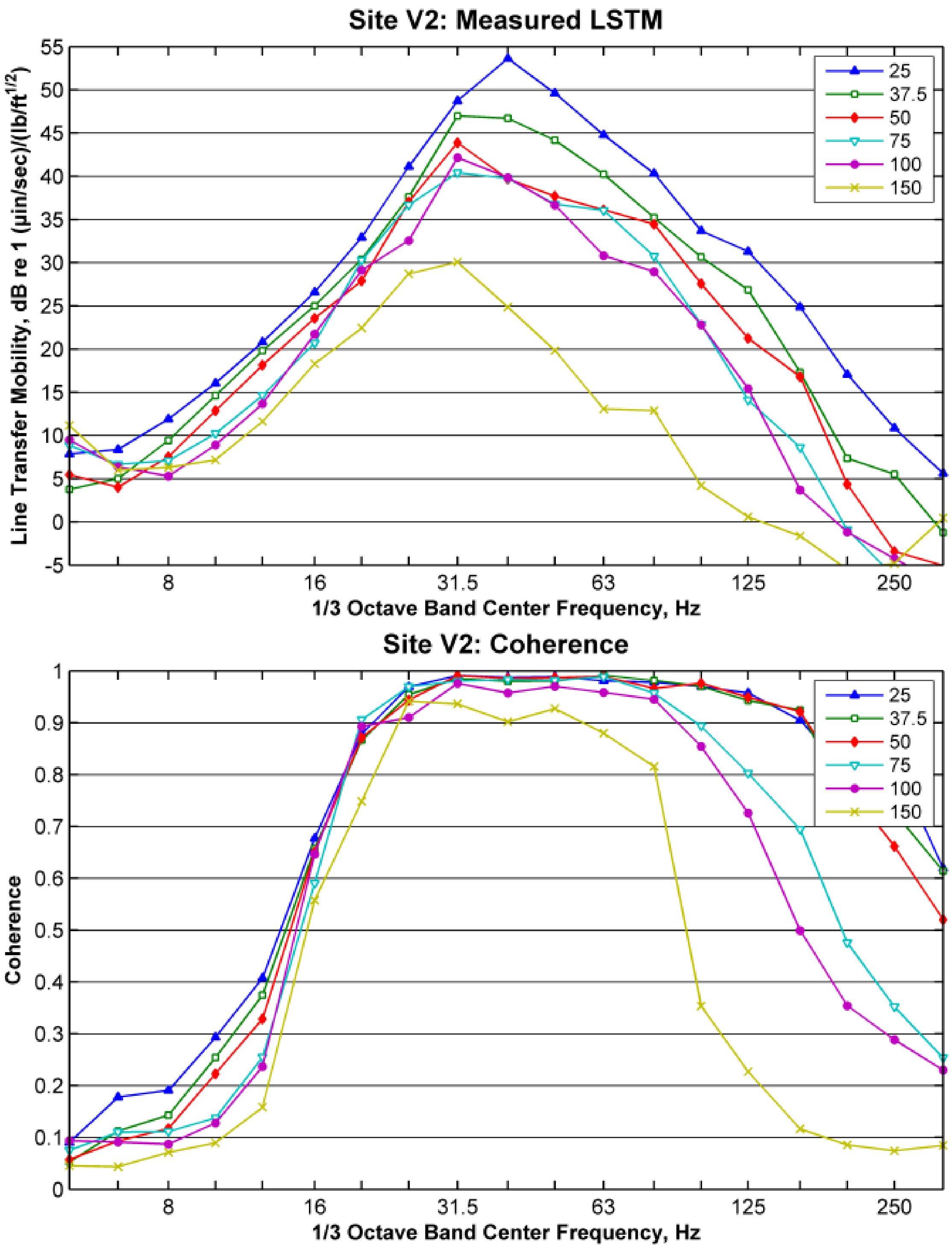
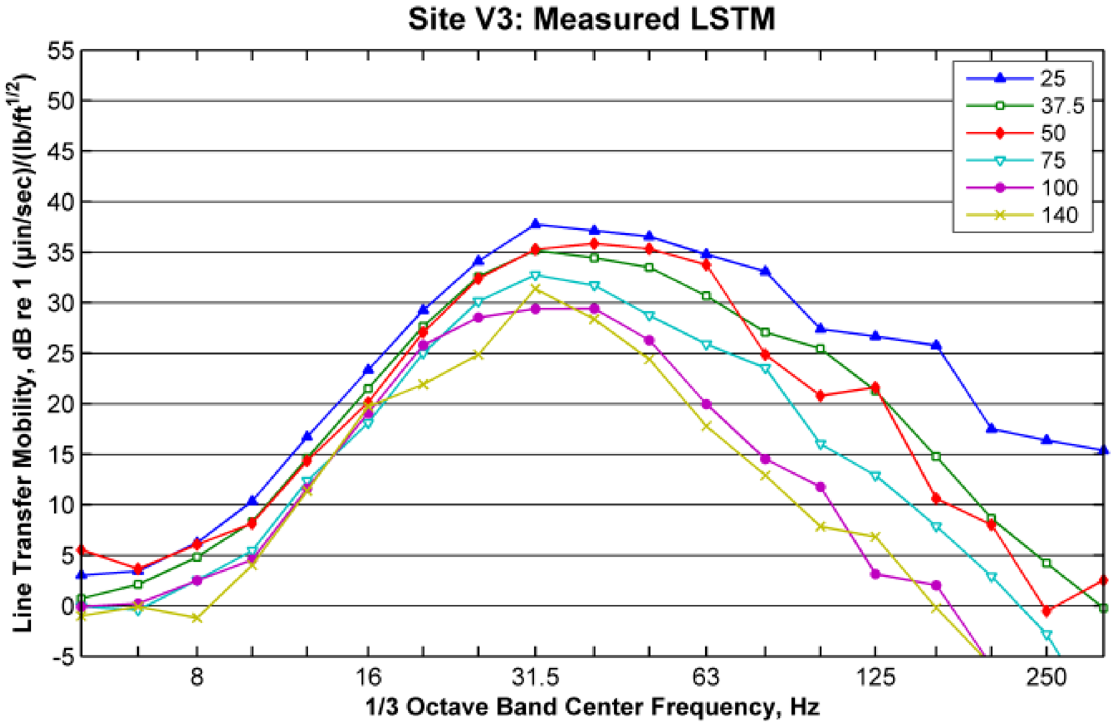


Figure F-4: Site V3- Van Nuys and Omelveny, Measured LSTM and Coherence



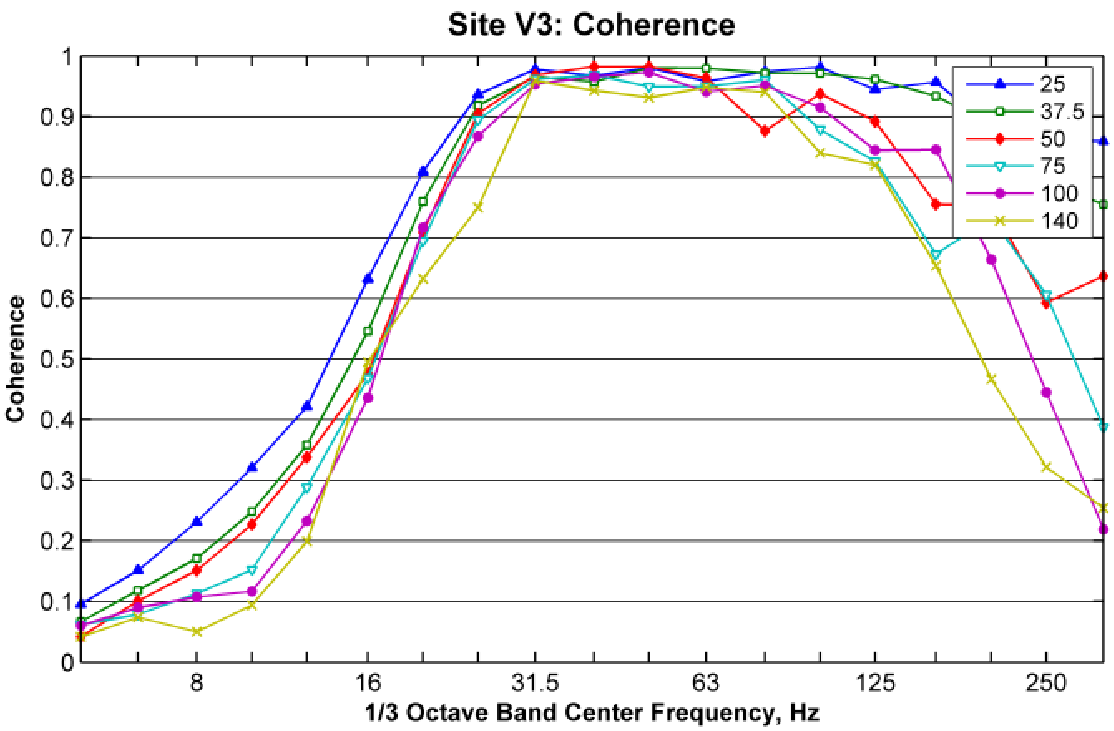
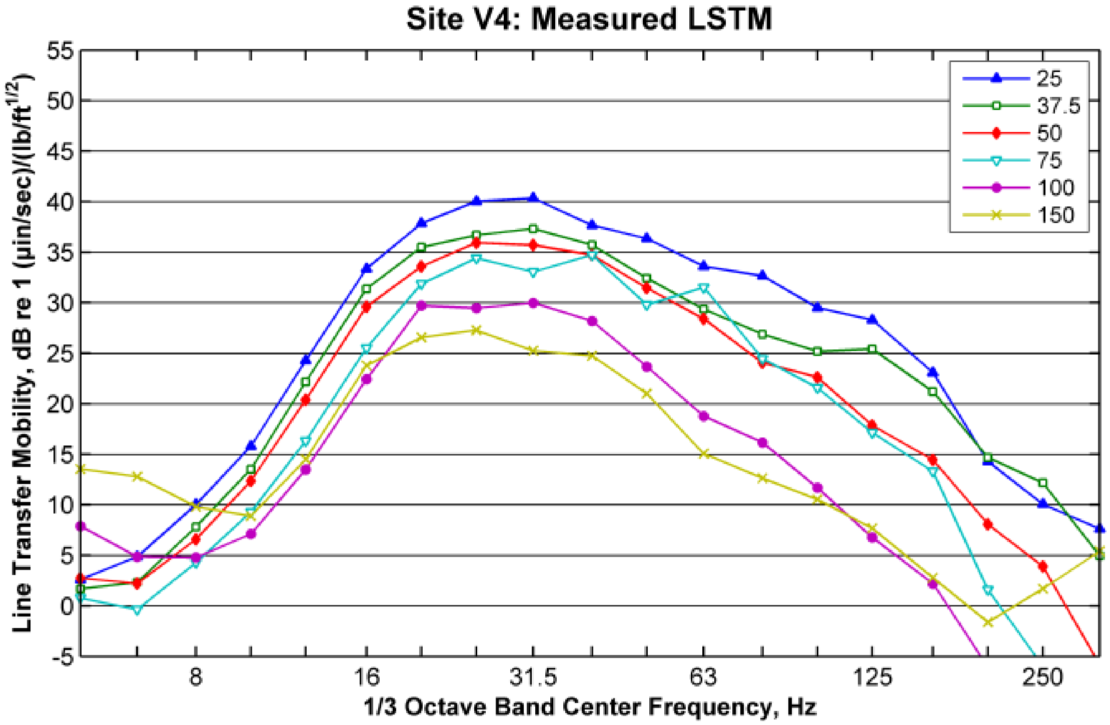


Figure F-5: Site V4- Van Nuys and Canterbury, Measured LSTM and Coherence



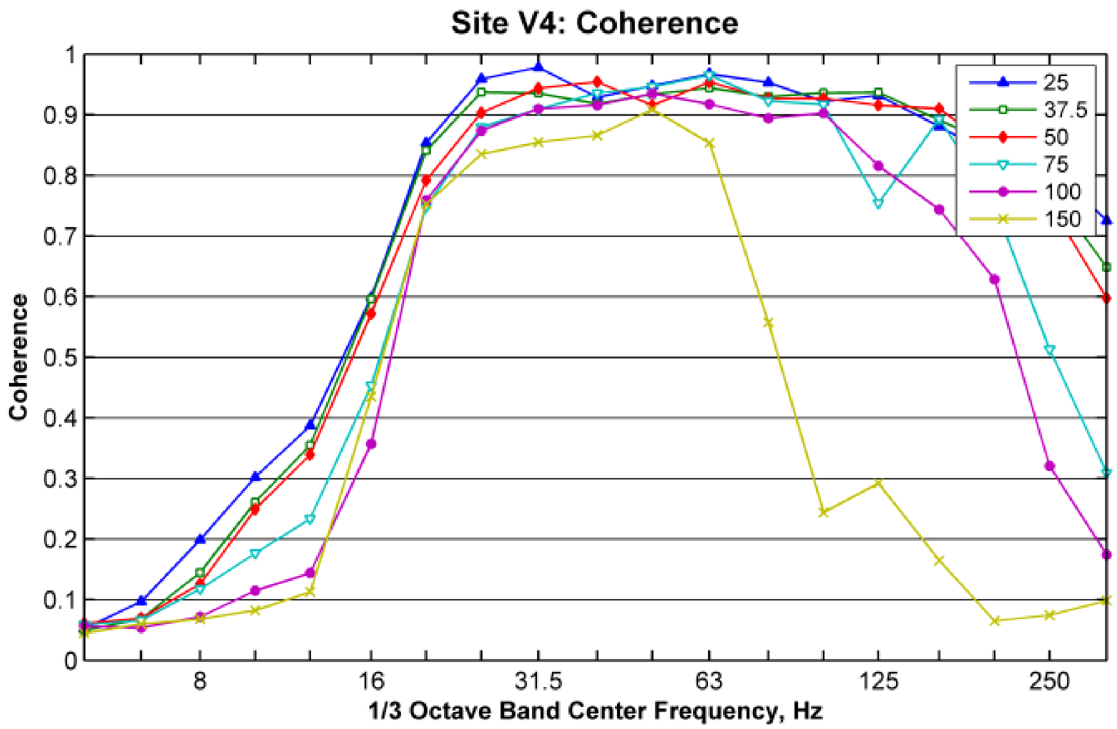


Figure F-6: Site V5- 9404 Van Nuys Blvd, Measured LSTM and Coherence

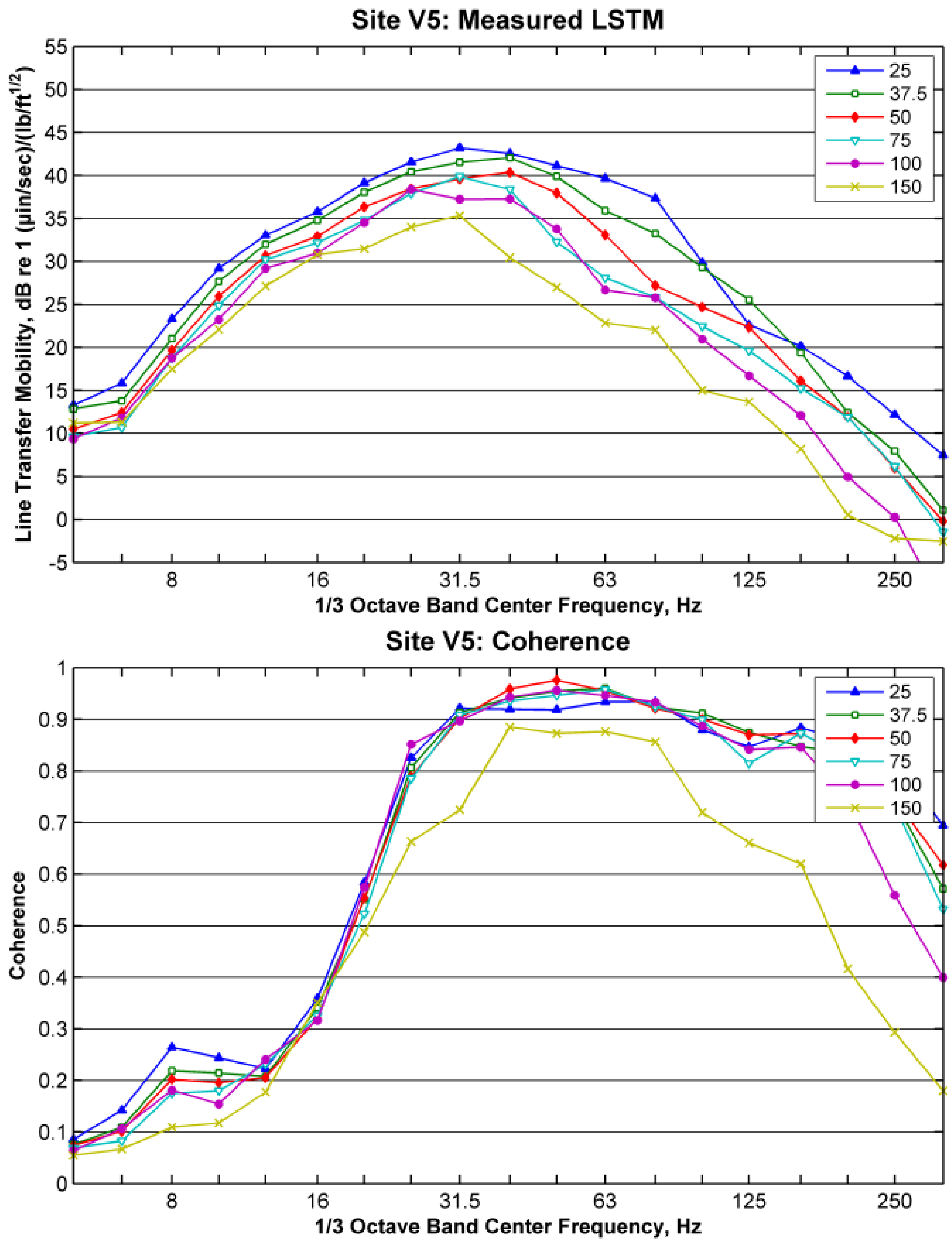


Figure F-7: Site V6-Van Nuys and Nordhoff, Measured LSTM and Coherence

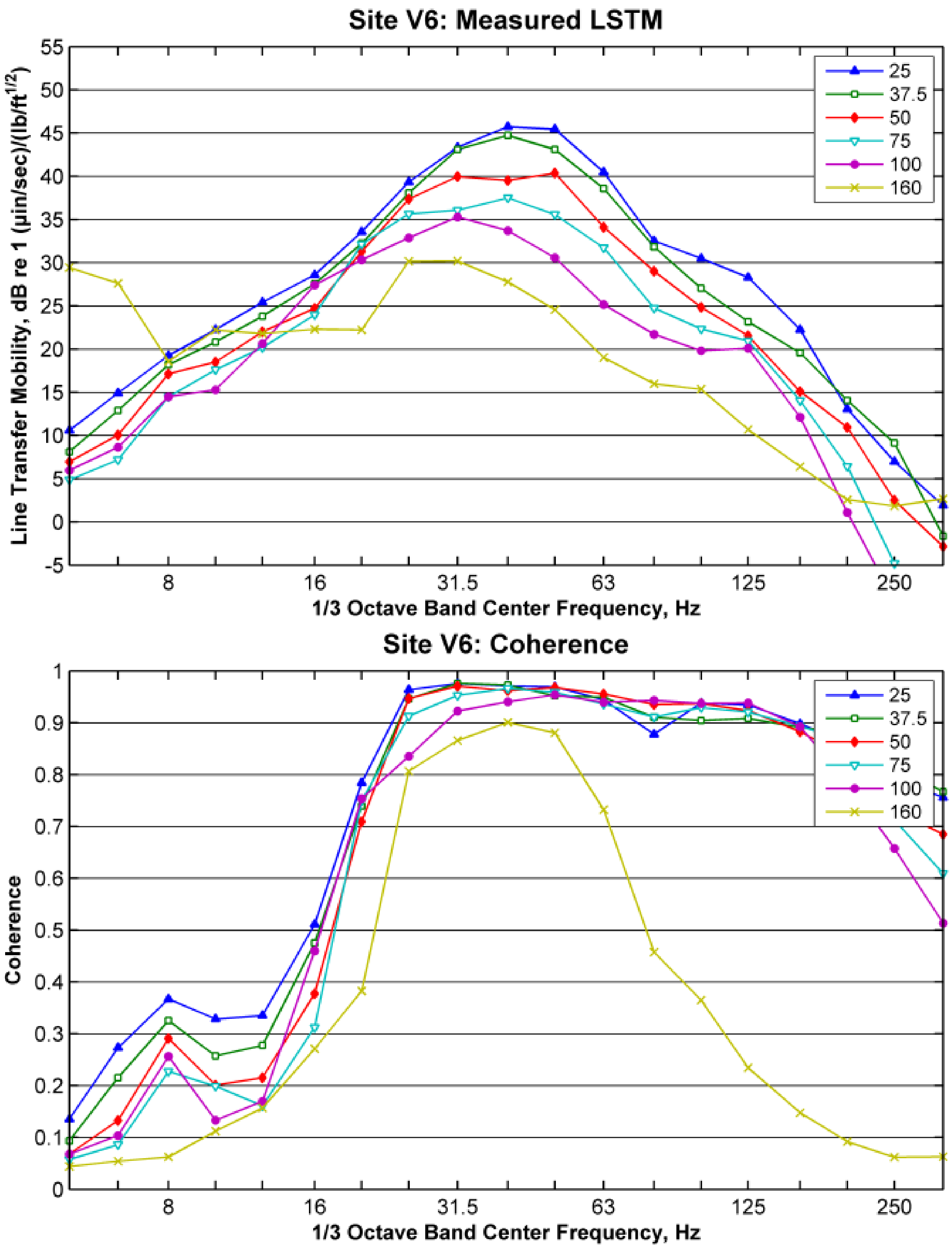


Figure F-8: Site V7-Tobias Park, Measured LSTM and Coherence

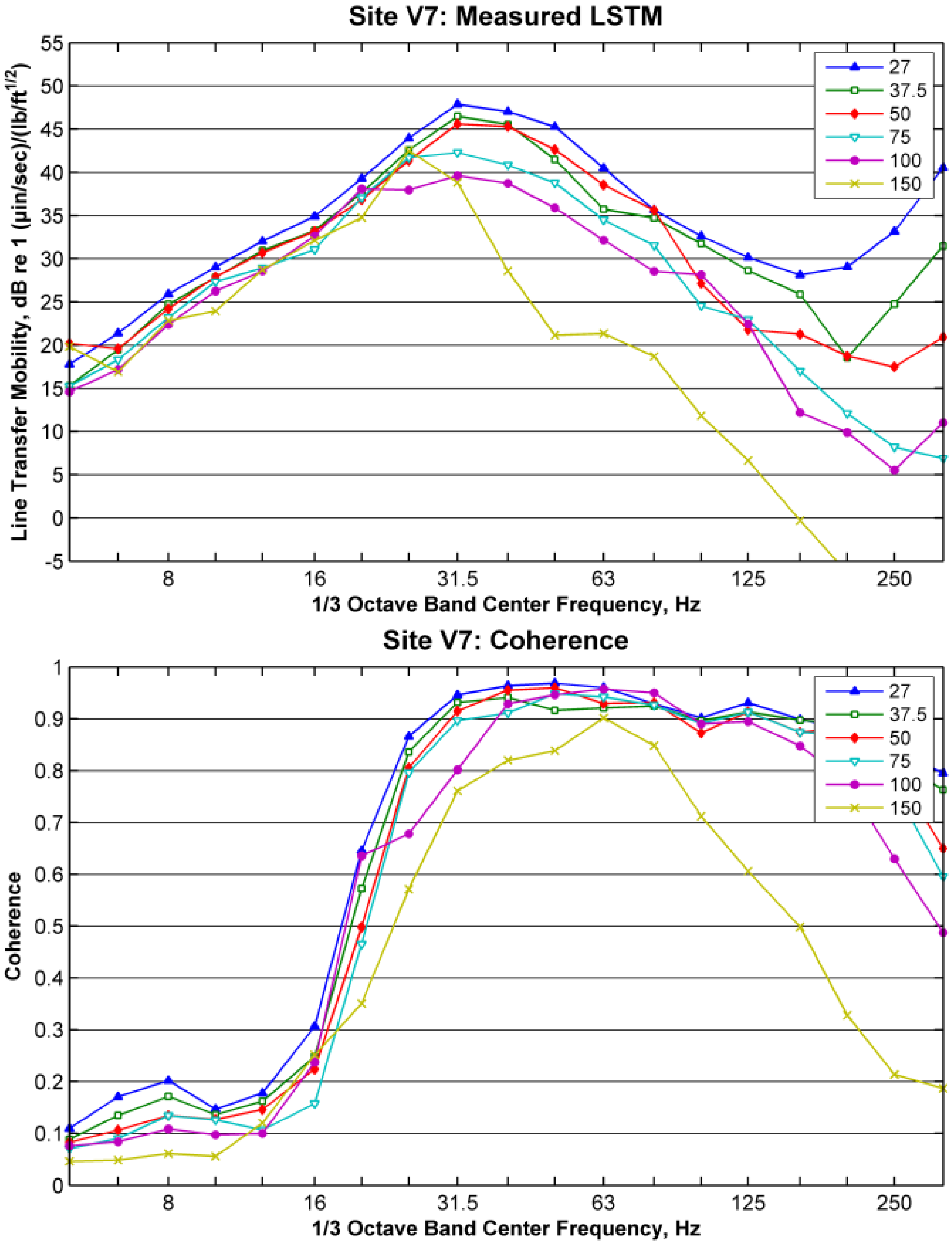


Figure F-9: Site V8-Van Nuys and Lorne, Measured LSTM and Coherence

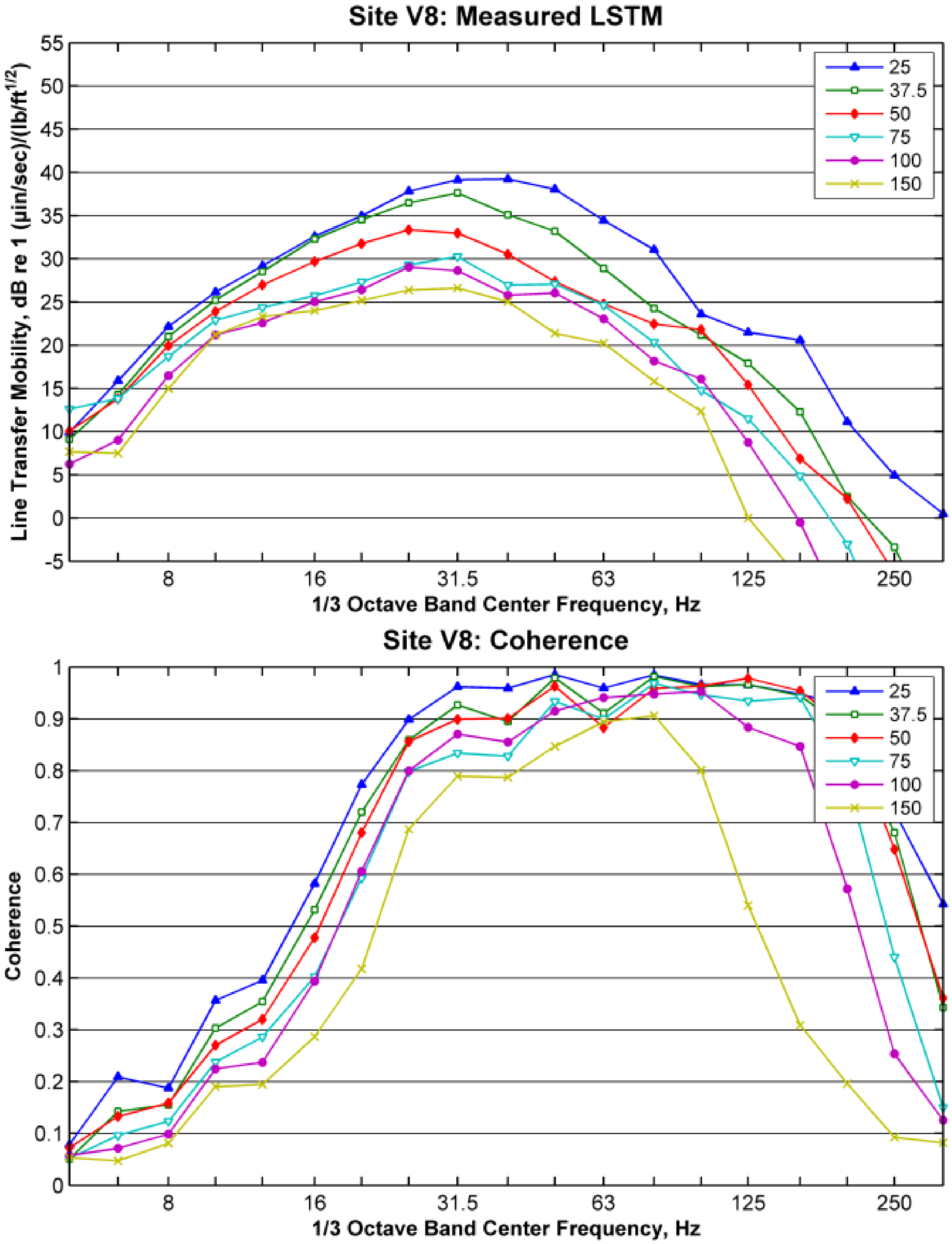


Figure F-10: Site V9-Van Nuys and Sherman, Measured LSTM and Coherence

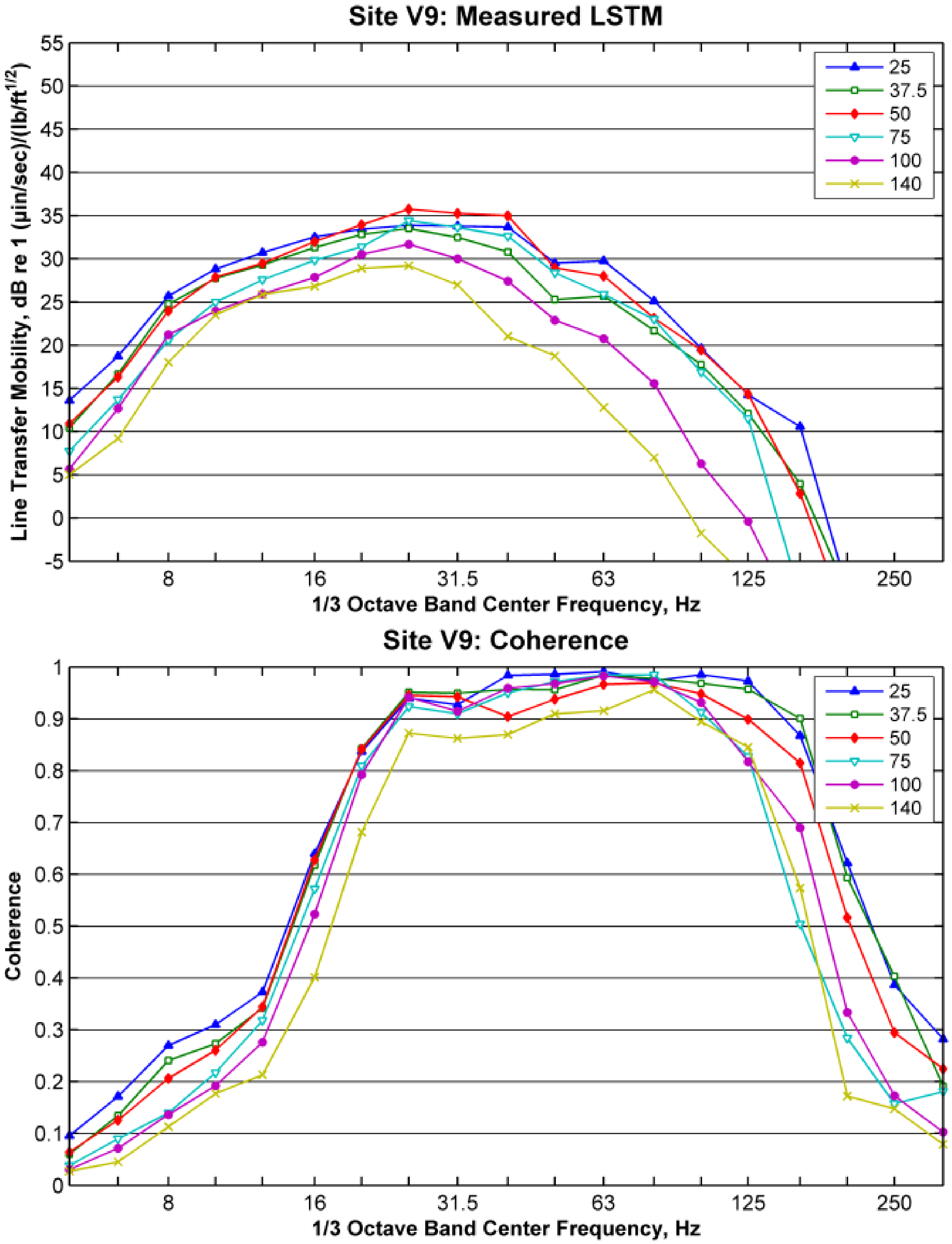


Figure F-11: Site V10- CHAMPS High School, Measured LSTM and Coherence