APPENDIX H
Noise and Vibration Assessment

MOFFETT PARK SPECIFIC PLAN NOISE AND VIBRATION ASSESSMENT

Sunnyvale, California

October 27, 2022

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INTRODUCTION

The Moffett Park Specific Plan (MPSP) area consists of the northernmost developable portion of the City of Sunnyvale and is bound by State Route 237 (SR 237) to the south; Moffett Federal Airfield and a golf course to the west; San Francisco Bay, the former Sunnyvale landfill, Sunnyvale Materials Recovery and Transfer (SMaRT®) Station, water pollution control plant (WPCP), wastewater treatment ponds, an open-water pond, and Caribbean Drive to the north; and Caribbean Drive and Baylands Park to the east. The total size of the area is approximately 1,270 acres.

The City adopted the MPSP in 2004 and has amended it in 2006, 2009, 2011, 2013, and 2016. All of the MPSP amendments were focused on including additional sites as Moffett Park Transit Oriented Development (MP-TOD) which allows higher floor area ratio (FAR) to accommodate Class A office. None of the amendments changed the total buildout envisioned for Moffett Park. The MPSP area had long been home to several large corporate campuses. The adopted MPSP allows for a maximum buildout of 24.33 million square feet of commercial and office/Research & Development (R&D)/industrial uses. Currently, the MPSP area is developed with approximately 18.5 million square feet of office/R&D/industrial, commercial uses (including restaurants and hotels), and institutional (including a fire station, post office, government offices, and community college) uses. The proposed project is a comprehensive, City-initiated update of the MPSP. The proposed MPSP provides a vision and guiding principles, development standards, and design guidelines for future development within the MPSP area.

The proposed MPSP would allow the addition of residential uses and an increase in the allowable office/R&D and commercial uses within the MPSP area. The proposed MPSP update would allow for a net increase of 20,000 residential units (where there are no residential units existing today), 650,000 square feet of commercial uses, 10.0 million square feet of office/industrial/R&D uses, and 200,000 square feet of institutional uses beyond what is currently existing and recently approved. As a result, the buildout of the proposed MPSP (which would include existing, recently approved, and proposed uses) would result in a total of 20,000 residential units and approximately 33.5 million square feet of commercial, office/industrial/R&D, and institutional uses. A summary of the existing, allowed, and proposed development within the MPSP area is provided in Table 1.

This report evaluates the project's potential to result in significant impacts with respect to applicable California Environmental Quality Act (CEQA) guidelines. The report is divided into three sections: 1) the Setting Section provides a brief description of the fundamentals of environmental noise and groundborne vibration, summarizes applicable regulatory criteria, and discusses ambient noise conditions in the project vicinity; 2) the Plan Consistency Analysis section discusses noise and land use compatibility utilizing policies in the City's General Plan; and, 3) the Impacts and Mitigation Measures Section describes the significance criteria used to evaluate project impacts, provides a discussion of each project impact, and presents mitigation measures, where necessary, to mitigate project impacts to a less-than-significant level.

TABLE 1 Summary of Existing, Recently Approved, Allowed, and Proposed Development within MPSP

	Res. Units	Comm.	Office/ Ind./ R&D	Institutional	Total Non-Res.
		Square Feet			
Existing Development	0	305,304[1]	18,102,203[2]	126,122[3]	18,533,629
Existing Development + Recently Approved but not yet Constructed Projects	0	515,303	22,000,000	126,122[3]	22,641,425
Allowed Development under the Adopted MPSP[3]	0	230,000	24,100,000[4]	None Specified	24,330,000[5]
Allowed Development under the Proposed MPSP	20,000	1,165,303	32,000,000	326,000	33,491,303
Net Change (D-A)	*20,000*	*859,999*	*13,897,797*	*199,878*	*14,957,674*
Net Change (D-B)	*20,000*	*650,000[6]*	*10,000,000*	*199,878*	*10,849,878*
Net Change (D-C)	*20,000*	*935,303*	*7,900,000*	*326,000*	*9,161,303*

[1] Existing commercial square footage includes retail and hospitality uses.

[2.] Existing office/industrial/R&D uses includes ancillary commercial uses.

[3] Existing institutional uses include the fire station, post office, government offices, Veteran Affairs research center, and community college.

[4] The adopted MPSP allows ancillary commercial uses as part of this 24.1 million square feet.

[5] City of Sunnyvale. *Moffett Park Specific Plan.* Updated 2013. Table 2.1, page 10.

[6] Commercial land uses include retail and hospitality uses. City Council approved for study, 500,000 square feet of retail uses. In addition, the project would include about 150,000 square feet of hospitality.

SETTING

Fundamentals of Environmental Noise

Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. The objectionable nature of sound could be caused by its *pitch* or its *loudness*. *Pitch* is the height or depth of a tone or sound, depending on the relative rapidity (*frequency*) of the vibrations by which it is produced. Higher pitched signals sound louder to humans than sounds with a lower pitch. *Loudness* is intensity of sound waves combined with the reception characteristics of the ear. Intensity may be compared with the height of an ocean wave in that it is a measure of the amplitude of the sound wave.

In addition to the concepts of pitch and loudness, there are several noise measurement scales which are used to describe noise in a particular location. A *decibel (dB)* is a unit of measurement which indicates the relative amplitude of a sound. The zero on the decibel scale is based on the lowest

sound level that the healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 decibels represents a ten-fold increase in acoustic energy, while 20 decibels is 100 times more intense, 30 decibels is 1,000 times more intense, etc. There is a relationship between the subjective noisiness or loudness of a sound and its intensity. Each 10 decibel increase in sound level is perceived as approximately a doubling of loudness over a fairly wide range of intensities. Technical terms are defined in Table 2.

There are several methods of characterizing sound. The most common in California is the *A-weighted sound level (dBA).* This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Representative outdoor and indoor noise levels in units of dBA are shown in Table 3. Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This *energy-equivalent sound/noise descriptor* is called L_{eq}. The most common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration.

The scientific instrument used to measure noise is the sound level meter. Sound level meters can accurately measure environmental noise levels to within about plus or minus 1 dBA. Various computer models are used to predict environmental noise levels from sources, such as roadways and airports. The accuracy of the predicted models depends upon the distance the receptor is from the noise source. Close to the noise source, the models are accurate to within about plus or minus 1 to 2 dBA.

Since the sensitivity to noise increases during the evening and at night -- because excessive noise interferes with the ability to sleep -- 24-hour descriptors have been developed that incorporate artificial noise penalties added to quiet-time noise events. The *Community Noise Equivalent Level* (*CNEL*) is a measure of the cumulative noise exposure in a community, with a 5 dB penalty added to evening (7:00 pm - 10:00 pm) and a 10 dB addition to nocturnal (10:00 pm - 7:00 am) noise levels. The *Day/Night Average Sound Level* (*DNL* or L_{dn}) is essentially the same as CNEL, with the exception that the evening time period is dropped and all occurrences during this three-hour period are grouped into the daytime period.

Effects of Noise

Sleep and Speech Interference

The thresholds for speech interference indoors are about 45 dBA if the noise is steady and above 55 dBA if the noise is fluctuating. Outdoors the thresholds are about 15 dBA higher. Steady noises of sufficient intensity (above 35 dBA) and fluctuating noise levels above about 45 dBA have been shown to affect sleep. Interior residential standards for multi-family dwellings are set by the State of California at 45 dBA L_{dn}. Typically, the highest steady traffic noise level during the daytime is about equal to the L_{dn} and nighttime levels are 10 dBA lower. The standard is designed for sleep and speech protection and most jurisdictions apply the same criterion for all residential uses. Typical structural attenuation is 12 to 17 dBA with open windows. With closed windows in good condition, the noise attenuation factor is around 20 dBA for an older structure and 25 dBA for a

newer dwelling. Sleep and speech interference is therefore possible when exterior noise levels are about 57 to 62 dBA L_{dn} with open windows and 65 to 70 dBA L_{dn} if the windows are closed. Levels of 55 to 60 dBA are common along collector streets and secondary arterials, while 65 to 70 dBA is a typical value for a primary/major arterial. Levels of 75 to 80 dBA are normal noise levels at the first row of development outside a freeway right-of-way. In order to achieve an acceptable interior noise environment, bedrooms facing secondary roadways need to be able to have their windows closed, those facing major roadways and freeways typically need special glass windows.

Annoyance

Attitude surveys are used for measuring the annoyance felt in a community for noises intruding into homes or affecting outdoor activity areas. In these surveys, it was determined that the causes for annoyance include interference with speech, radio and television, house vibrations, and interference with sleep and rest. The L_{dn} as a measure of noise has been found to provide a valid correlation of noise level and the percentage of people annoyed. People have been asked to judge the annoyance caused by aircraft noise and ground transportation noise. There continues to be disagreement about the relative annoyance of these different sources. When measuring the percentage of the population highly annoyed, the threshold for ground vehicle noise is about 50 dBA L_{dn}. At a L_{dn} of about 60 dBA, approximately 12 percent of the population is highly annoyed. When the L_{dn} increases to 70 dBA, the percentage of the population highly annoyed increases to about 25 to 30 percent of the population. There is, therefore, an increase of about 2 percent per dBA between a L_{dn} of 60 to 70 dBA. Between a L_{dn} of 70 to 80 dBA, each decibel increase increases by about 3 percent the percentage of the population highly annoyed. People appear to respond more adversely to aircraft noise. When the L_{dn} is 60 dBA, approximately 30 to 35 percent of the population is believed to be highly annoyed. Each decibel increase to 70 dBA adds about 3 percentage points to the number of people highly annoyed. Above 70 dBA, each decibel increase results in about a 4 percent increase in the percentage of the population highly annoyed.

TABLE 2 Definition of Acoustical Terms Used in this Report

Term	Definition
Decibel, dB	A unit describing, the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20 micro Pascals.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micro Pascals (or 20 micro Newtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e. g., 20 micro Pascals). Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hz and 20,000 Hz. Infrasonic sound are below 20 Hz and Ultrasonic sounds are above 20,000 Hz.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
Equivalent Noise Level, L_{eq}	The average A-weighted noise level during the measurement period.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
L_{01}, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Day/Night Noise Level, L_{dn} or DNL	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 pm and 7:00 am.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 pm to 10:00 pm and after addition of 10 decibels to sound levels measured in the night between 10:00 pm and 7:00 am.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

Source: Handbook of Acoustical Measurements and Noise Control, Harris, 1998.

TABLE 3 Typical Noise Levels in the Environment

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	110 dBA	Rock band
Jet fly-over at 1,000 feet		
	100 dBA	
Gas lawn mower at 3 feet		
	90 dBA	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	80 dBA	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawn mower, 100 feet	70 dBA	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	60 dBA	
		Large business office
Quiet urban daytime	50 dBA	Dishwasher in next room
Quiet urban nighttime	40 dBA	Theater, large conference room
Quiet suburban nighttime		
	30 dBA	Library
Quiet rural nighttime		Bedroom at night, concert hall (background)
	20 dBA	
		Broadcast/recording studio
	10 dBA	
	0 dBA	

Source: Technical Noise Supplement (TeNS), California Department of Transportation, September 2013.

Fundamentals of Groundborne Vibration

Ground vibration consists of rapidly fluctuating motions or waves with an average motion of zero. Several different methods are typically used to quantify vibration amplitude. One method is the Peak Particle Velocity (PPV). The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. In this report, a PPV descriptor with units of mm/sec or in/sec is used to evaluate construction generated vibration for building damage and human complaints. Table 4 displays the reactions of people and the effects on buildings that continuous or frequent intermittent vibration levels produce. The guidelines in Table 4 represent syntheses of vibration criteria for human response and potential damage to buildings resulting from construction vibration.

Construction activities can cause vibration that varies in intensity depending on several factors. The use of pile driving and vibratory compaction equipment typically generates the highest construction related groundborne vibration levels. Because of the impulsive nature of such activities, the use of the PPV descriptor has been routinely used to measure and assess groundborne vibration and almost exclusively to assess the potential of vibration to cause damage and the degree of annoyance for humans.

The two primary concerns with construction-induced vibration, the potential to damage a structure and the potential to interfere with the enjoyment of life, are evaluated against different vibration limits. Human perception to vibration varies with the individual and is a function of physical setting and the type of vibration. Persons exposed to elevated ambient vibration levels, such as people in an urban environment, may tolerate a higher vibration level.

Structural damage can be classified as cosmetic only, such as paint flaking or minimal extension of cracks in building surfaces; minor, including limited surface cracking; or major, that may threaten the structural integrity of the building. Safe vibration limits that can be applied to assess the potential for damaging a structure vary by researcher. The damage criteria presented in Table 4 include several categories for ancient, fragile, and historic structures, the types of structures most at risk to damage. Most buildings are included within the categories ranging from “Historic and some old buildings” to “Modern industrial/commercial buildings”. Construction-induced vibration that can be detrimental to the building is very rare and has only been observed in instances where the structure is at a high state of disrepair and the construction activity occurs immediately adjacent to the structure.

The annoyance levels shown in Table 4 should be interpreted with care since vibration may be found to be annoying at lower levels than those shown, depending on the level of activity or the sensitivity of the individual. To sensitive individuals, vibrations approaching the threshold of perception can be annoying. Low-level vibrations frequently cause irritating secondary vibration, such as a slight rattling of windows, doors, or stacked dishes. The rattling sound can give rise to exaggerated vibration complaints, even though there is very little risk of actual structural damage.

Railroad and light rail operations are potential sources of substantial ground vibration depending on distance, the type and the speed of trains, and the type of railroad track. People’s response to ground vibration from rail vehicles has been correlated best with the average, root mean square

(RMS) velocity of the ground. The velocity of the ground is expressed on the decibel scale. The reference velocity is 1 x 10-6 in/sec RMS, which equals 0 VdB, and 1 in/sec equals 120 VdB. Although not a universally accepted notation, the abbreviation "VdB" is used in this document for vibration decibels to reduce the potential for confusion with sound decibels.

Typical background vibration levels in residential areas are usually 50 VdB or lower, well below the threshold of perception for most humans. Perceptible vibration levels inside residences are attributed to the operation of heating and air conditioning systems, door slams and foot traffic. Construction activities, train operations, and street traffic are some of the most common external sources of vibration that can be perceptible inside residences. Table 5 illustrates some common sources of vibration and the association to human perception or the potential for structural damage.

TABLE 4 Reaction of People and Damage to Buildings from Continuous or Frequent Intermittent Vibration Levels

Velocity Level, PPV (in/sec)	Human Reaction	Effect on Buildings
0.01	Barely perceptible	No effect
0.04	Distinctly perceptible	Vibration unlikely to cause damage of any type to any structure
0.08	Distinctly perceptible to strongly perceptible	Recommended upper level of the vibration to which ruins and ancient monuments should be subjected
0.1	Strongly perceptible	Threshold at which there is a risk of damage to fragile buildings with no risk of damage to most buildings
0.25	Strongly perceptible to severe	Threshold at which there is a risk of damage to historic and some old buildings.
0.3	Strongly perceptible to severe	Threshold at which there is a risk of damage to older residential structures
0.5	Severe - Vibrations considered unpleasant	Threshold at which there is a risk of damage to new residential and modern commercial/industrial structures

Source: Transportation and Construction Vibration Guidance Manual, California Department of Transportation, April 2020.

TABLE 5 Typical Levels of Groundborne Vibration

Human/Structural Response	Velocity Level, VdB	Typical Events (50-foot setback)
Threshold, minor cosmetic damage	100	Blasting, pile driving, vibratory compaction equipment
		Heavy tracked vehicles (Bulldozers, cranes, drill rigs)
Difficulty with tasks such as reading a video or computer screen	90	
		Commuter rail, upper range
Residential annoyance, infrequent events	80	Rapid transit, upper range
Residential annoyance, occasional events		Commuter rail, typical Bus or truck over bump or on rough roads
Residential annoyance, frequent events	70	Rapid transit, typical
Approximate human threshold of perception to vibration		Buses, trucks and heavy street traffic
	60	
		Background vibration in residential settings in the absence of activity
Lower limit for equipment ultra-sensitive to vibration	50	

Source: U.S. Department of Transportation, Federal Transit Administration, Transit Noise and Vibration Impact Assessment Manual, September 2018, FTA Report No. 0123.

Regulatory Background

This section describes the relevant guidelines, policies, and standards established by Federal Agencies, State Agencies, Santa Clara County, and the City of Sunnyvale. The State CEQA Guidelines, Appendix G, are used to assess the potential significance of impacts pursuant to local General Plan policies, Municipal Code standards, or the applicable standards of other agencies. A summary of the applicable regulatory criteria is provided below.

State of California

State CEQA Guidelines. The California Environmental Quality Act (CEQA) contains guidelines to evaluate the significance of effects of environmental noise attributable to a proposed project. Under CEQA, noise impacts would be considered significant if the project would result in:

a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;

b) Generation of excessive groundborne vibration or groundborne noise levels;

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

2019 California Building Code, Title 24, Part 2. The current version of the California Building Code (CBC) requires interior noise levels attributable to exterior environmental noise sources to be limited to a level not exceeding 45 dBA L_{dn}/CNEL in any habitable room.

2019 California Building Cal Green Code. The State of California established exterior sound transmission control standards for new non-residential buildings, as set forth in the 2010 California Green Building Standards Code (Section 5.507.4.1 and 5.507.4.2). These standards were not altered in the 2019 revisions. Section 5.507 states that either the prescriptive (Section 5.507.4.1) or the performance method (Section 5.507.4.2) shall be used to determine environmental control at indoor areas. The prescriptive method is very conservative and not practical in most cases; however, the performance method can be quantitatively verified using exterior-to-interior calculations. For the purposes of this report, the performance method is utilized to determine consistency with the Cal Green Code. Both of the sections that pertain to this project are as follows:

> **5.507.4.1 Exterior noise transmission, prescriptive method.** Wall and roof-ceiling assemblies exposed to the noise source making up the building or additional envelope or altered envelope shall meet a composite STC rating of at least 50 or a composite OITC rating of no less than 40, with exterior windows of a minimum STC of 40 or OITC of 30 within the 65 dBA CNEL or L_{dn} noise contour of a freeway or expressway, railroad, industrial source or fixed-guideway noise source, as determined by the Noise Element of the General Plan.
>
> **5.507.4.2 Performance method.** For buildings located, as defined by Section 5.507.4.1, wall and roof-ceiling assemblies exposed to the noise source making up the building envelope or addition envelope or altered envelope shall be constructed to provide an interior noise environment attributable to exterior sources that does not exceed an hourly equivalent noise level ($L_{eq(1\text{-}hr)}$) of 50 dBA in occupied areas during any hour of operation.

The performance method, which establishes the acceptable interior noise level, is the method typically used when applying these standards.

Santa Clara County

Santa Clara County Airport Land Use Commission Comprehensive Land Use Plan. The Comprehensive Land Use Plan (CLUP) adopted by the Santa Clara County Airport Land Use Commission contains standards for projects within the vicinity of San José International Airport which are relevant to this project;

4.3.2.1 Noise Compatibility Policies

N-1 The Community Noise Equivalent Level (CNEL) method of representing noise levels shall be used to determine if a specific land use is consistent with the CLUP.

N-2 In addition to the other policies herein, the Noise Compatibility Policies presented in Table 4-1 shall be used to determine if a specific land use is consistent with this CLUP.

N-3 Noise impacts shall be evaluated according to the Aircraft Noise Contours presented on Figure 5 (not shown in this report).

N-6 Noise level compatibility standards for other types of land uses shall be applied in the same manner as the above residential noise level criteria. Table 4-1 presents acceptable noise levels for other land uses in the vicinity of the Airport.

Table 4 - 1

NOISE COMPATIBILITY POLICIES

LAND USE CATEGORY	CNEL					
	55-60	60-65	65-70	70-75	75-80	80-85
Residential – low density Single-family, duplex, mobile homes	*	**	***	****	****	****
Residential – multi-family, condominiums, townhouses	*	**	***	****	****	****
Transient lodging - motels, hotels	*	*	**	****	****	****
Schools, libraries, indoor religious assemblies, hospitals, nursing homes	*	***	****	****	****	****
Auditoriums, concert halls, amphitheaters	*	***	***	****	****	****
Sports arena, outdoor spectator sports, parking	*	*	*	**	***	****
Playgrounds, neighborhood parks	*	*	***	****	****	****
Golf courses, riding stables, water recreation, cemeteries	*	*	*	**	***	****
Office buildings, business commercial and professional, retail	*	*	**	***	****	****
Industrial, manufacturing, utilities, agriculture	*	*	*	***	***	****
* Generally 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. Mobile homes may not be acceptable in these areas. Some outdoor activities might be adversely affected.					
** 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. Outdoor activities may be adversely affected. Residential: Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.					
*** Generally Unacceptable	New construction or development should 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. Outdoor activities are likely to be adversely affected.					
**** Unacceptable	New construction or development shall not be undertaken.					

Source: Based on General Plan Guidelines, Appendix C (2003), Figure 2 and Santa Clara County ALUC 1992 Land Use Plan, Table 1

Source: Comprehensive Land Use Plan Santa Clara County, Norman Y Mineta San José International Airport, May 25, 2011, Amended May 23, 2019.

City of Sunnyvale

City of Sunnyvale General Plan. Chapter 6 of the City of Sunnyvale's General Plan sets forth goals, policies, and standards for evaluating community noise in the City. The following are applicable to this proposed project:

Goal SN-8. Compatible Noise Environment. Maintain or achieve a compatible noise environment for all land uses in the community.

Policy SN-8.1: Enforce and supplement state laws regarding interior noise levels of residential units.

Policy SN-8.2: Apply Title 24 noise insulation requirements to all new single-family detached homes.

Policy SN-8.3: Attempt to achieve a maximum instantaneous noise level of 50 dBA in bedrooms and 55 dBA in other areas of residential units exposed to train or aircraft noise, where the exterior L_{dn} exceeds 55 dBA.

Policy SN-8.4: Prevent significant noise impacts from new development by applying state noise guidelines and Sunnyvale Municipal Code noise regulations in the evaluation of land use issues and proposals.

Policy SN-8.5: Comply with "State of California Noise Guidelines for Land Use Planning" (Figure 6-5 of the Safety-Noise Chapter) for the compatibility of land uses with their noise environments, except where the City determines that there are prevailing circumstances of a unique or special nature.

Policy SN-8.6: Use Figure 6-6 (of the Safety-Noise Chapter), "Significant Noise Impacts from New Development on Existing Land Use" to determine if proposed development results in a "significant noise impact" on existing development.

Policy SN-8.7: Supplement Figure 6-5, "State of California Noise Guidelines for Land Use Planning" for residential uses by attempting to achieve an outdoor L_{dn} of noise greater than 60 dBA for common recreational areas, backyards, patios, and medium and large-size balconies. These guidelines should not apply where the noise source is a railroad or an airport. If the noise source is a railroad, then an L_{dn} of no greater than 70 dBA should be achieved in common areas, backyards, patios, and medium and large-size balconies. If the noise source is from aircraft, then preventing new residential land uses within areas of high L_{dn} from aircraft noise is recommended.

Policy SN-8.8: Avoid construction of new residential uses where the outdoor L_{dn} is greater than 70 dBA as a result from train noise.

Policy SN-8.9: Consider techniques that block the path of noise and insulate people from noise.

SN-8.9a: *Use a combination of barriers, setbacks, site planning, and building design techniques to reduce noise impacts, keeping in mind their benefits and shortcomings.*

SN-8.9b: *Consider compiling and distributing information to residents of noise-impacted areas about what they can do to protect themselves from noise.*

SN-8.9c: *Proposed sound walls or other noise reduction barriers should be reviewed for design, location and material before installing the barrier. Sound readings should be taken before and after installing the noise reduction barrier in order to determine the efficacy of the noise reduction barrier. Measurement techniques shall be similar to procedures used by Caltrans to measure efficiency of sound walls.*

Goal SN-9. Acceptable Limits for Community Noise. Maintain or achieve acceptable limits for the levels of noise generated by land use operations and single-events.

Policy SN-9.1: Regulate land use operation noise.

Policy SN-9.2: Regulate select single-event noises and periodically monitor the effectiveness of the regulations.

Policy SN-9.3: Apply conditions to discretionary land use permits which limit hours of operation, hours of delivery and other factors which affect noise.

Goal SN-10. Maintained or Reduced Transportation Noise. Preserve and enhance the quality of neighborhoods by maintaining or reducing the levels of noise generated by transportation facilities.

Policy SN-10.1: Refrain from increasing or reduce the noise impacts of major roadways.

SN-10.1a: *Identify and mitigate roadway noise impacts as part of local land use plans and proposals.*

SN-10.1b: *Regulate the location, design and capacity of local roadway improvement projects to mitigate their noise impacts.*

SN-10.1c: *Use local traffic management techniques to reduce or protect noise levels.*

SN-10.1d: *Support state legislation to reduce vehicle noise levels.*

Policy SN-10.2: Support efforts to reduce or mitigate airport noise, including noise impacts of Moffett Federal Airfield, San José International Airport, and helicopters.

SN-10.2a: *Support the retention of the Airport Land Use Commission.*

SN-10.2b: *Support the right of private citizens to sue airports for noise impacts.*

SN-10.2c: *Encourage airport operation policies and procedures which reduce the level and frequency of noise as well as other policies and federal funding to alleviate the effects of aircraft noise.*

SN-10.2d: *Support federal legislation that requires military and federal aircraft to meet Stage 3 noise requirements similar to commercial aircraft.*

SN-10.2e: *Support state legislation to lower the noise levels of civilian aircraft and airports.*

Policy SN-10.3: Oppose any effort and/or expenditure of public funds to promote Moffett Federal Airfield for non-Federal purposes.

Policy SN-10.4: Mitigate and avoid the noise impacts from trains and light rail facilities.

SN-10.4a: *Monitor plans and projects which would increase the number of commuter or freight trains and evaluate their noise impacts and seek mitigation for any change that worsens local conditions.*

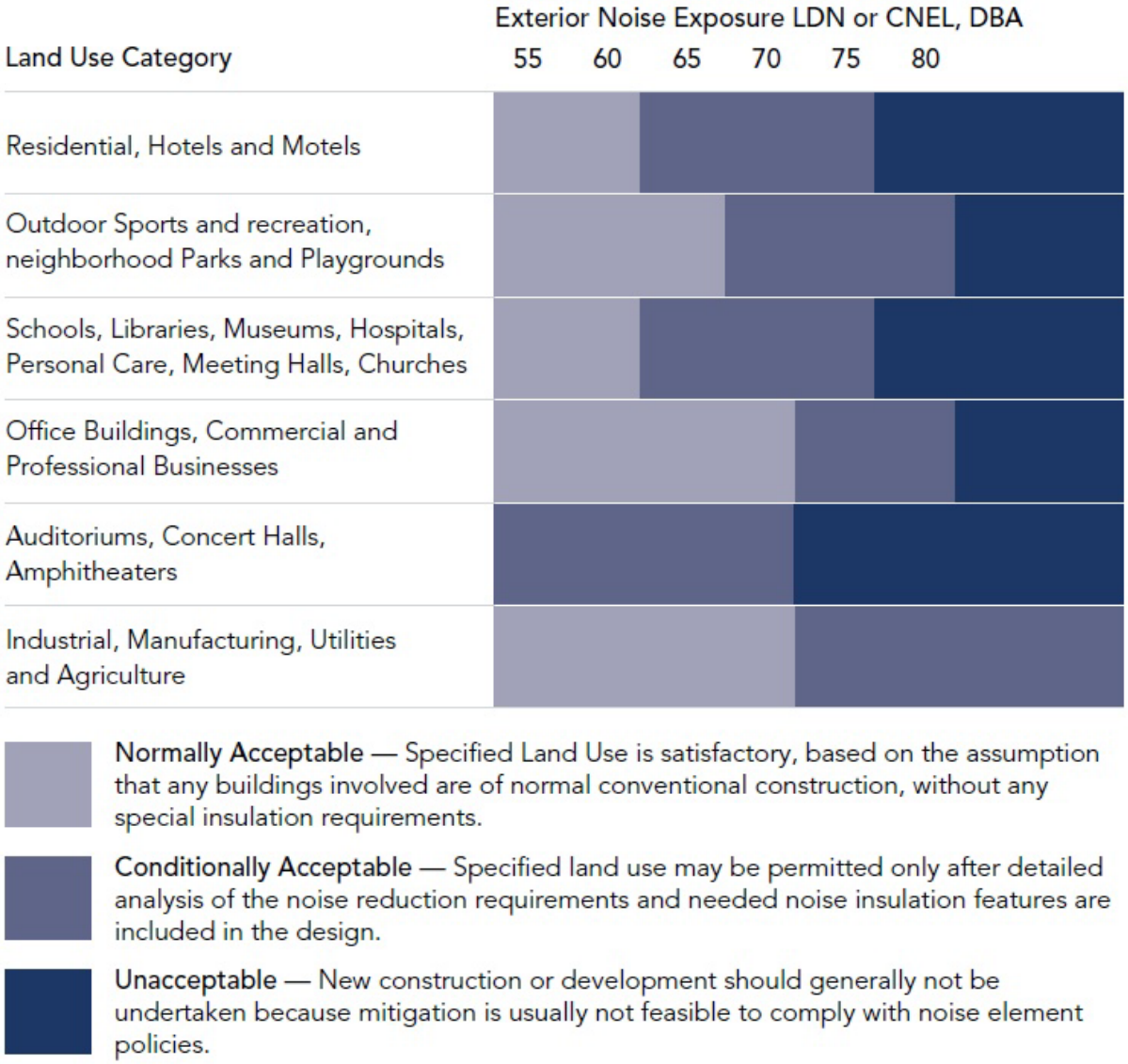
SN-10.4b: *Educate owners of older homes on ways to reduce noise levels from trains.*

SN-10.4c: *Support legislation to reduce the noise level of trains.*

SN-10.4d: *Seek the cooperation of train engineers to avoid unnecessary and prolonged use of air horns except for safety purposes.*

SN-10.4e: *Monitor regional plans for light rail facilities in Sunnyvale to ensure that noise impacts are identified and mitigated.*

Figure 6-5: State of California Noise Guidelines for Land Use Planning
Summary of Land Use Compatibility for Community Noise Environment



Source: City of Sunnyvale General Plan, July 2011.

Figure 6-6: Significant Noise Impacts from New Development on Existing Land Use

Ldn Category of Existing Development Per Figure 6-4	Noise Increase Considered "Significant" over Existing Noise Levels
Normally Acceptable	An increase of more than 3 dBA and the total Ldn exceeds the "normally acceptable" category
Normally Acceptable	An increase of more than 5 dBA
Conditionally Acceptable	An increase of more than 3 dBA
Unacceptable	An increase of more than 3 dBA

Source: City of Sunnyvale General Plan, July 2011.

City of Sunnyvale Municipal Code. The City's Municipal Code establishes construction noise regulations. According to Title 16, Chapter 16.08.030, construction activity shall be permitted between the hours of 7:00 a.m. and 6:00 p.m. daily Monday through Friday. Saturday hours of operation shall be between 8:00 a.m. and 5:00 p.m. There shall be no construction activity on Sunday or federal holidays when city offices are closed. No loud environmentally disruptive noises, such as air compressors without mufflers, continuously running motors or generators, loud playing musical instruments, radios, etc., will be allowed where such noises may be a nuisance to adjacent residential neighborhoods. The following exceptions are stated in Title 16, Chapter 16.08.030:

(a) Construction activity is permitted for detached single-family residential properties when the work is being performed by the owner of the property, provided no construction activity is conducted prior to 7:00 a.m. or after 7:00 p.m. Monday through Friday, prior to 8:00 a.m. or after 7:00 p.m. on Saturday and prior to 9:00 a.m. or after 6:00 p.m. on Sunday and national holidays when city offices are closed. It is permissible for up to two persons to assist the owner of the property so long as they are not hired by the owner to perform the work. For purposes of this section, "detached single-family residential property" refers only to housing that stands completely along with no adjoining roof, foundation or sides.

(b) As determined by the chief building official:

1) No loud environmentally disruptive noises, such as air compressors without mufflers, continuously running motors or generators, loud playing musical instruments, radios, etc., will be allowed where such noises may be a nuisance to adjacent properties.

2) Where emergency conditions exist, construction activity may be permitted at any hour or day of the week. Such emergencies shall be completed as rapidly as possible to prevent any disruption to other properties.

3) Where additional construction activity will not be a nuisance to surrounding properties, based on location and type of construction, a waiver may be granted to allow hours of construction other than as stated in this section. (Ord. 3006-13 § 2).

In the City's Municipal Code, operational noise standards enforced on residentially zoned property lines are also presented. Title 19, Chapter 19.42.030 states the following:

(a) Operational noise shall not exceed seventy-five dBA at any point on the property line of the premises upon which the noise or sound is generated or produced; provided, however, that the noise or sound level shall not exceed fifty dBA during nighttime or sixty dBA during daytime hours at any point on adjacent residentially zoned property. If the noise occurs during nighttime hours and the enforcing officer has determined that the noise involves a steady, audible tone such as a whine, screech or hum, or is a staccato or intermittent noise (e.g., hammering) or includes music or speech, the allowable noise or sound level shall not exceed forty-five dBA.

(b) Powered equipment used on a temporary, occasional, or infrequent basis which produces a noise greater than the applicable operational noise limit set forth in subsection (a) shall be used only during daytime hours when used adjacent to a property with a residential zoning district. Powered equipment used on other than a temporary, occasional or infrequent basis shall comply with the operational noise requirements. For the purpose of this section, powered equipment does not include leaf blowers. Construction activity regulated by Title 16 of this code shall not be governed by this section.

(c) It is unlawful for any person to make or allow to be made a nighttime delivery to a commercial or industrial establishment when the loading/unloading area of the establishment is adjacent to a property in a residential zoning district. Businesses legally operating at a specific location as of February 1, 1995, are exempt from this requirement.

(d) A "leaf blower" is a small, combustion engine-powered device used for property or landscape maintenance that can be hand-held or carried on the operator's back and which operates by propelling air under pressure through a cylindrical tube. It is unlawful for any person to operate a leaf blower on private property in or adjacent to a residential area except between the hours of 8:00 am and 8:00 pm. Effective January 1, 2000, all leaf blowers operated in or adjacent to a residential area shall operate at or below a noise level of sixty-five dBA at a distance of fifty feet, as determined by a test conducted by the American National Standards Institute or an equivalent. The dBA rating shall be prominently displayed on the leaf blower. (Ord. 2623-99 § 1 (part): prior zoning code § 19.24.020(b)--(d))

The City's Code does not define the acoustical time descriptor such as L_{eq} (the average noise level) or L_{max} (the maximum instantaneous noise level) that is associated with the above limits. A reasonable interpretation of the City Code would identify the ambient base noise level criteria as an average or median noise level (L_{eq}/L_{50}).

Regulatory Background – Vibration

Federal Government

Federal Transit Administration. The FTA has identified vibration impact criteria for sensitive buildings, residences, and institutional land uses near rail transit and railroads. These criteria are shown in Table 6. The thresholds for office buildings that operate primarily during daytime hours are 75 VdB for frequent events (more than 70 events of the same source per day), 78 VdB for occasional events (30 to 70 vibration events of the same source per day), and 83 VdB for infrequent events (less than 30 vibration events of the same source per day).

TABLE 6 Groundborne Vibration Impact Criteria

Land Use Category	Groundborne Vibration Impact Levels (VdB re 1 µinch/sec, RMS)		
	Frequent Events[1]	**Occasional Events[2]**	**Infrequent Events[3]**
Category 1 Buildings where vibration would interfere with interior operations.	65 VdB[4]	65 VdB[4]	65 VdB[4]
Category 2 Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB
Category 3 Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB

Notes:

1. "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
2. "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations.
3. "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.
4. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration sensitive manufacturing or research should always require detailed evaluation to define the acceptable vibration levels. Ensuring low vibration levels in a building requires special design of HVAC systems and stiffened floors.

Existing Noise Environment

The MPSP plan area is located north of SR 237, between the interchange with Highway 101 and interchange with East Caribbean Drive/Lawrence Expressway, in the City of Sunnyvale, California. Existing land uses located within the Specific Plan area are primarily commercial and light industrial land uses. A Radisson Hotel is located near the SR 237 interchange at East Caribbean Drive/Lawrence Expressway.

North of the plan area is the City of Sunnyvale Water Pollution Control Plant, a materials recycling facility, Stevens Creek Quarry, and the Twin Creeks sports fields. To the east of the plan area, there is the Baylands Park and Indian Grass Circle park area and an Animal Assisted Happiness non-profit organization. The Moffett Federal Airfield, National Aeronautics and Space Administration (NASA) buildings, and Kuiper Airborne Observatory are located west of the plan area. Single- and multi-family residential areas are located south of the plan area, opposite SR 237.

The noise environment at the plan area and in the surrounding areas results primarily from vehicular traffic along SR 237 and Highway 101. Traffic along North Mathilda Avenue, Caribbean Drive, and Java Drive also contribute to the ambient noise environment, as well as aircraft operations associated with Moffett Federal Airfield and light-rail trains along the Valley Transportation Authority (VTA) tracks, which run along the west side of North Mathilda Avenue and in the center of Java Drive.

A noise monitoring survey consisting of five long-term (LT-1 through LT-5) and five short-term (ST-1 through ST-5) noise measurements was conducted for the proposed project between Tuesday, February 25, 2020 and Tuesday, March 3, 2020. All measurement locations are shown in Figure 1. During the noise monitoring survey, on-going construction activities were observed at several locations in the plan area. While efforts were made to avoid construction noise contamination in the data, some construction noise would be included in the data. Three previous projects have been completed in the vicinity of the plan area, and the applicable data from these projects are also discussed in this section.

Long-term noise measurement LT-1 was made along North Mathilda Avenue, about halfway between 5th Avenue and West Java Drive. LT-1 was approximately 65 feet from the centerline of North Mathilda Avenue. Hourly average noise levels typically ranged from 59 to 68 dBA L_{eq} during daytime hours between 7:00 a.m. and 10:00 p.m. and from 55 to 66 dBA L_{eq} during nighttime hours between 10:00 p.m. and 7:00 a.m. The day-night average level on Wednesday, February 26, 2020 was 69 dBA L_{dn}. The daily trend in noise levels at LT-1 is shown in Figures A1 through A3 of the Appendix.

LT-2 was made in the northwestern corner of the parking lot at Ruckus Networks along West Java Drive. LT-2 was approximately 105 feet south of the centerline of the West Java Drive and the VTA tracks. Hourly average noise levels at LT-2 typically ranged from 58 to 68 dBA L_{eq} during daytime hours and from 57 to 61 dBA L_{eq} during nighttime hours. The day-night average level on Wednesday, February 26, 2020 was 65 dBA L_{dn}. The daily trend in noise levels at LT-2 is shown in Figures A4 through A6 of the Appendix.

LT-3 was made along East Caribbean Drive, just north of the Moffett Park Drive intersection. LT-3 was approximately 85 feet from the centerline of East Caribbean Drive. Hourly average noise levels typically ranged from 63 to 74 dBA L_{eq} during daytime hours and from 53 to 70 dBA L_{eq} during nighttime hours. The day-night average level on Wednesday, February 26, 2020 was 72 dBA L_{dn}. The daily trend in noise levels at LT-3 is shown in Figures A7 through A9 of the Appendix.

LT-4 was positioned along SR 237, just north of the Moffett Park Court driveway. LT-4 was approximately 100 feet north of the centerline of the nearest through lane along westbound SR 237. Hourly average noise levels at LT-4 typically ranged from 65 to 70 dBA L_{eq} during daytime hours and from 59 to 70 dBA L_{eq} during nighttime hours. The day-night average level on Wednesday, February 26, 2020 was 73 dBA L_{dn}. The daily trend in noise levels at LT-4 is shown in Figures A10 through A12 of the Appendix.

LT-5 was made between Enterprise Way and Macon Road, just east of Moffett Federal Airfield. LT-5 was approximately 50 feet west of the centerline of Enterprise Way. During installation and pickup of LT-5, a considerable amount of buses were observed along Macon Road, which contributed to the overall measured noise levels. Hourly average noise levels at LT-5 typically ranged from 48 to 72 dBA L_{eq} during daytime hours and from 44 to 63 dBA L_{eq} during nighttime hours. The day-night average level ranged from 64 to 65 dBA L_{dn} on weekdays and from 56 to 57 dBA L_{dn} on weekends. The daily trend in noise levels at LT-5 is shown in Figures A13 through A18 of the Appendix. All long-term data is summarized in Table 7.

Short-term noise measurements were made on Thursday, February 27, 2020 between 10:50 a.m. and 1:00 p.m. Each of the short-term measurements were made in 10-minute intervals, and the results of the measurements are summarized in Table 8. During the short-term noise measurements at ST-2, ST-3, and ST-4, construction noise was observed.

Previous Projects

Innovation Hotel Project

The Innovation Hotel development project site is located in the southwest corner of the North Mathilda Avenue/Innovation Way intersection. A noise monitoring survey, which included one long-term and two short-term noise measurements, was completed at this site in May 2016. The long-term noise measurement (I-1 in Figure 1) collected continuous noise data for a 24-hour period between May 3, 2016 and May 4, 2016. I-1 was positioned approximately 130 feet from the centerline of North Mathilda Avenue, and the day-night average noise level was calculated to be 73 dBA L_{dn} in this time period.

160 Persian Drive Project

This proposed residential development project site is located south of SR 237, along Persian Drive. Two long-term noise measurements were made in this noise monitoring survey: P-1 was located at the southeastern corner of Persian Drive and Plaza Drive, approximately 105 feet south of the centerline of the nearest through lane along eastbound SR 237; P-2 was located at the southeastern corner of Plaza Drive and Fulton Avenue. Both of these receptors are shown in Figure 1. Each of these measurements ran continuously from June 5, 2017 through June 7, 2017. The day-night average noise level at P-1 was 67 dBA L_{dn}, and the day-night average noise level at P-1 was 61 dBA L_{dn}. Noise levels produced by SR 237 are lower at this site as compared to the 2020 ambient measurements made at LT-4 (summarized in Table 7) because of the presence of a 14- to 16-foot sound wall located along the eastbound shoulder of SR 237.

Google Caribbean Project

On October 17, 2018, four short-term noise measurements were made in the portion of the area

plan bound by West Caribbean Drive to the north, West Java Drive to the south, North Mathilda Avenue to the west, and Borregas Avenue to the east. C-1 was made in front of 380-384 West Caribbean Drive, approximately 55 feet south of the centerline. The average noise level at C-1 was 67 dBA L_{eq}, with a maximum noise level of 81 dBA L_{max}. C-2 was made in the parking lot at the corner of Caribbean Drive and Borregas Avenue, approximately 65 feet from the centerline of Borregas Avenue. The average noise level at C-2 was 58 dBA L_{eq}, with a maximum noise level of 72 dBA L_{max}. C-3 was made at the end of Caspian Court, approximately 495 feet west of the centerline of Borregas Avenue. The average noise level at C-3 was 52 dBA L_{eq}, with a maximum noise level of 63 dBA L_{max}. C-4 was made at the corner of North Mathilda Avenue and Bordeaux Drive, approximately 135 feet from the centerline of North Mathilda Avenue. The average noise level at C-4 was 63 dBA L_{eq}, with a maximum noise level of 83 dBA L_{max}.

TABLE 7 Summary of Long-Term Noise Measurement Data (dBA)

Site	Predominant Noise Source	Hourly Average L_{eq}		L_{dn}
		Daytime Hours	Nighttime Hours	
LT-1	Traffic along North Mathilda Avenue	59-68	55-66	69
LT-2	Traffic along West Java Drive & VTA Tracks	58-68	57-61	65
LT-3	Traffic along East Caribbean Drive	63-74	53-70	72
LT-4	Traffic along SR 237	65-70	59-70	73
LT-5	Traffic along Enterprise Way and Macon Road	48-72	44-63	56-65

TABLE 8 Summary of Short-Term Noise Measurements (dBA)

Noise Measurement Location (Date, Time)	Predominant Noise Source	Measured Noise Level, dBA					
		L_{max}	$L_{(1)}$	$L_{(10)}$	$L_{(50)}$	$L_{(90)}$	$L_{eq(10\text{-}min)}$
ST-1: Near corner of Enterprise Way and 11th Avenue (2/27/2020, 10:50-11:00)	Traffic along Enterprise Way	73	71	68	61	52	64
ST-2: At corner of Gibraltar Drive and Innsbruck Drive (2/27/2020, 11:20-11:30)	Traffic along East Java Drive	69	67	56	52	48	55
ST-3: ~60 feet south of East Java Drive/VTA tracks centerline (2/27/2020, 12:10-12:20)	Traffic along East Java Drive	81	76	72	61	53	67
ST-4: At corner of Gibraltar Drive and Borregas Avenue (2/27/2020, 12:30-12:40)	Traffic along Borregas Avenue	92	84	67	53	47	70
ST-5: ~45 feet west of Crossman Avenue centerline (2/27/2020, 12:50-13:00)	Traffic along Crossman Avenue	82	76	68	55	49	64

FIGURE 1 Noise Measurement Locations

Source: Google Earth 2022.

Future Noise Environment

SoundPLAN Version 8.2, a three-dimensional ray-tracing computer program, was used to develop the traffic noise contours calculated for the existing (2020) and future (2040) traffic conditions specific to the Moffett Park Specific Plan project, along major roadways, expressways, and highways in the plan area. Calculations accounted for the source of noise (traffic), the frequency spectra of the noise source, traffic speeds, vehicle mix information and the topography of the area. In order to provide a credible worst-case assessment of existing and future traffic noise conditions throughout the plan area, the modeling did not incorporate existing buildings or barriers, including centerline K-rails on the expressway medians, into the calculations. The geometric data used to create the model were based on GIS information provided by the City of Sunnyvale. Existing and future (cumulative 2040 buildout plus project) peak hour traffic data provided by the traffic consultants and observed travel speeds were also input into the model for local roadways and expressway ramps. Since the plan area consists of light industrial uses, a truck mix of 3% to 5% was used along the local roadways and expressway ramps. For expressways, traffic volumes and truck mix data input into the model was based on information published by the California Department of Transportation (Caltrans). The predicted noise levels were then compared to measured noise levels for calibration purposes and adjustments were made as necessary. Contours presented in this report represent the primary traffic noise sources in the plan area. Localized sources of noise, such as industrial plants and other stationary equipment or operations, were not included in the model because these sources only affect limited areas. Figures 2, 3, and 4, provide existing (2020), cumulative 2040 buildout, and cumulative 2040 buildout plus project traffic noise contours for the plan area, respectively.

Table 9 summarizes the existing and future L_{dn} noise levels, as measured at a distance of 75 feet from the centerline of the roadway. For all receptors along SR 237, Java Drive, North Mathilda Avenue, and Caribbean Drive, roadways were modeled directionally. So, receptor distances were measured from the centerline of the nearest travel lanes.

VTA Light Rail train lines run east-west, parallel to Manila Drive/West Moffett Park Drive until North Mathilda Avenue where the lines turn north, running parallel to North Mathilda Avenue. The tracks turn east at Java Drive, running between the eastbound and westbound directions of the roadway. Rail operations along the VTA right-of-way are also substantial sources of noise in some areas of the plan area. Light-rail train schedules are fairly consistent on weekdays, with fewer pass-by events occurring on weekends. Measured noise levels at LT-1 and LT-2 include noise from VTA trains, as well as the vehicular traffic noise. Light-rail train noise contours are not included on Figures 2, 3, and 4.

Moffett Federal Airfield adjoins the plan area to the west, and noise exposure information is developed and reported in the Comprehensive Land Use Plan (CLUP).[1] Existing conditions are best represented by the 2022 noise exposure map that was adopted in 2016 and is shown in Figure 5. The portion of the plan area west of Borregas Avenue would fall within the 60 dBA CNEL noise contour, with the southwestern corner of the plan area (west of the U.S. Highway 101 on-ramp at

[1] Santa Clara County Airport Land Use Commission, "Comprehensive Land Use Plan Santa Clara County: Moffett Federal Airfield," November 2, 2012 and amended November 18, 2016.

West Moffett Park Drive) falling within the 65 dBA CNEL noise contour. The 70 dBA CNEL noise contour generally runs along the plan area's westernmost boundary (Enterprise Way).

FIGURE 2 Moffett Park Specific Plan Area - Existing 2020 Traffic Noise Contours

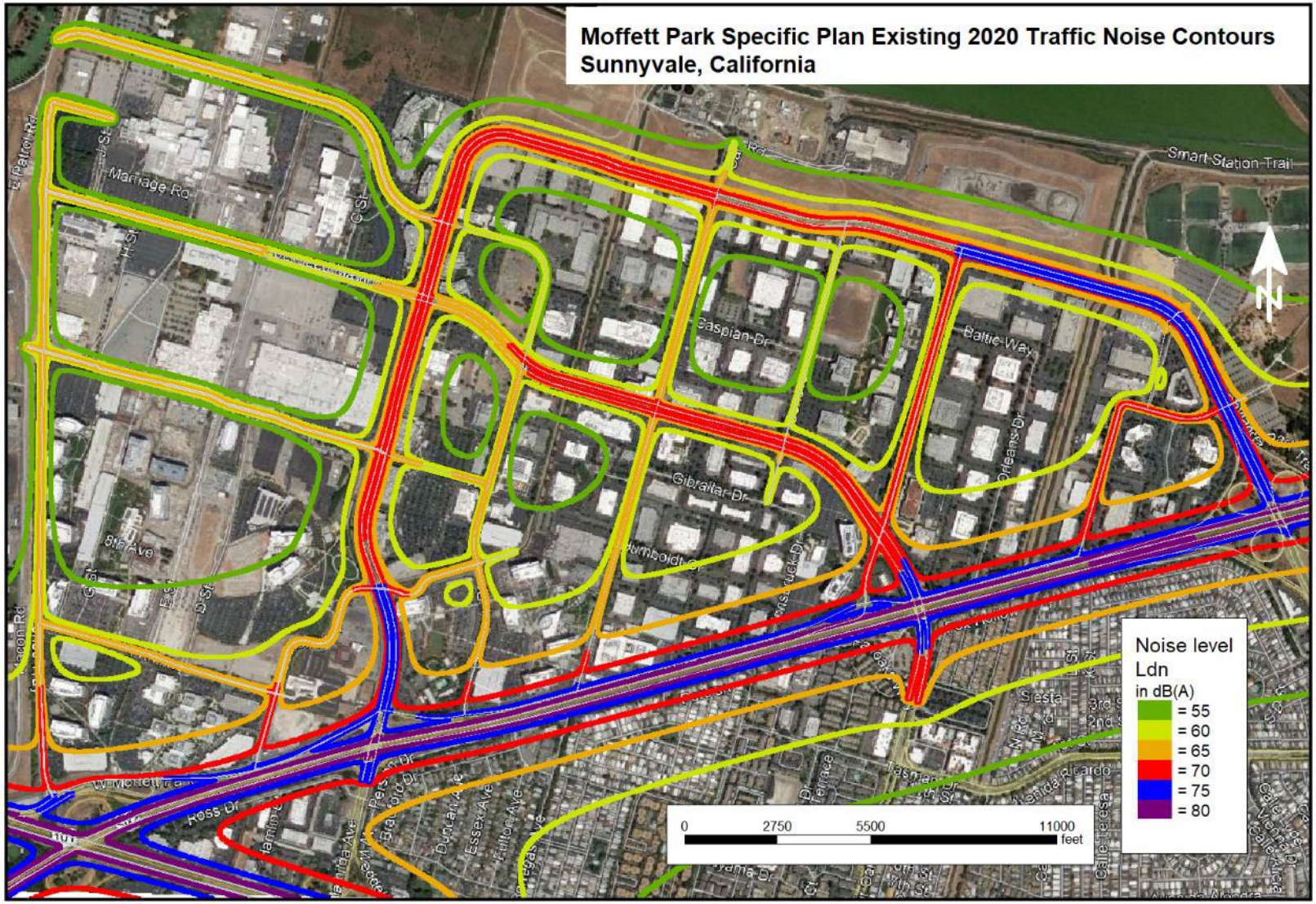


FIGURE 3 Moffett Park Specific Plan Area – Cumulative 2040 Traffic Noise Contours

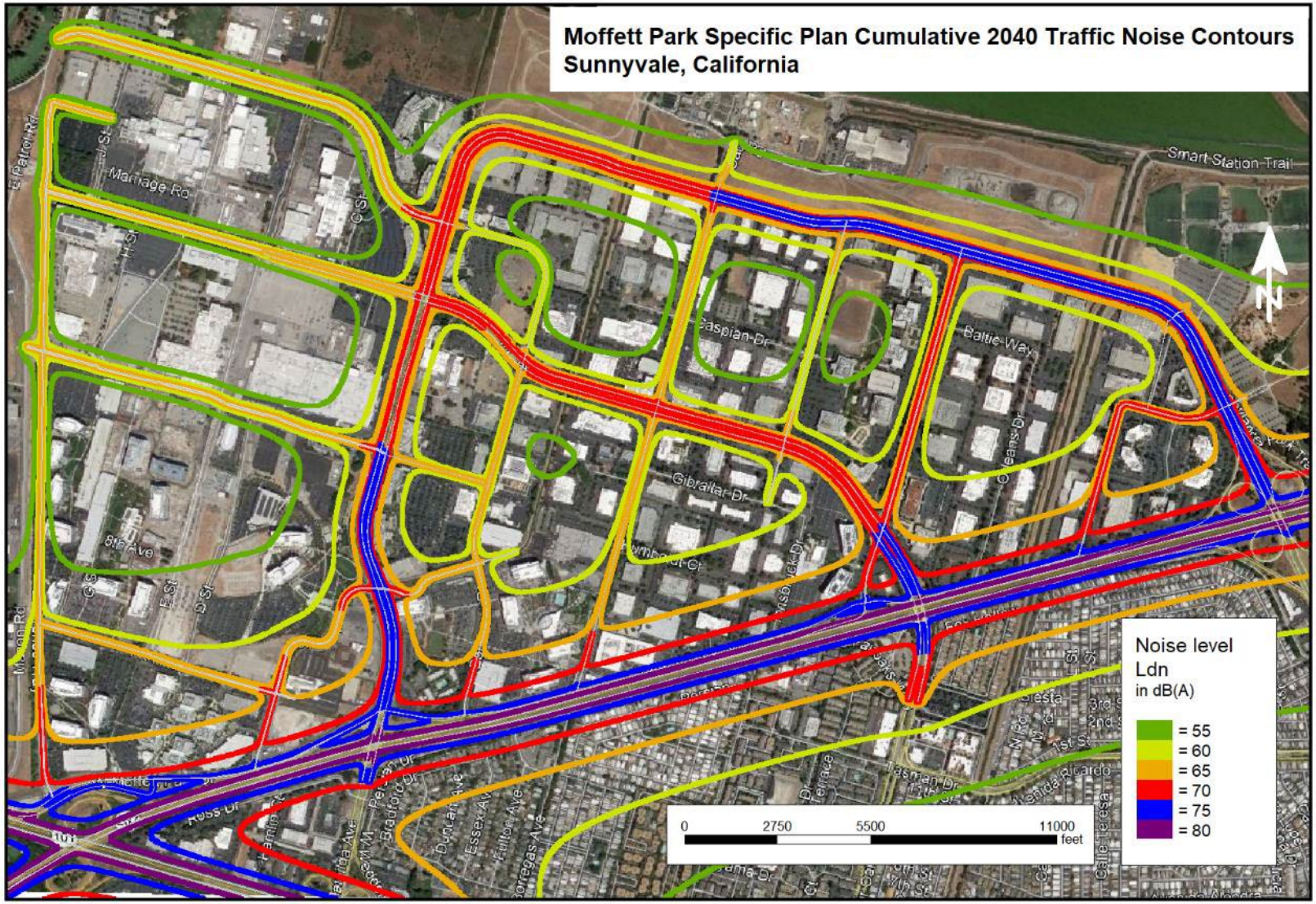


FIGURE 4 Moffett Park Specific Plan Area – Cumulative plus Project 2040 Traffic Noise Contours

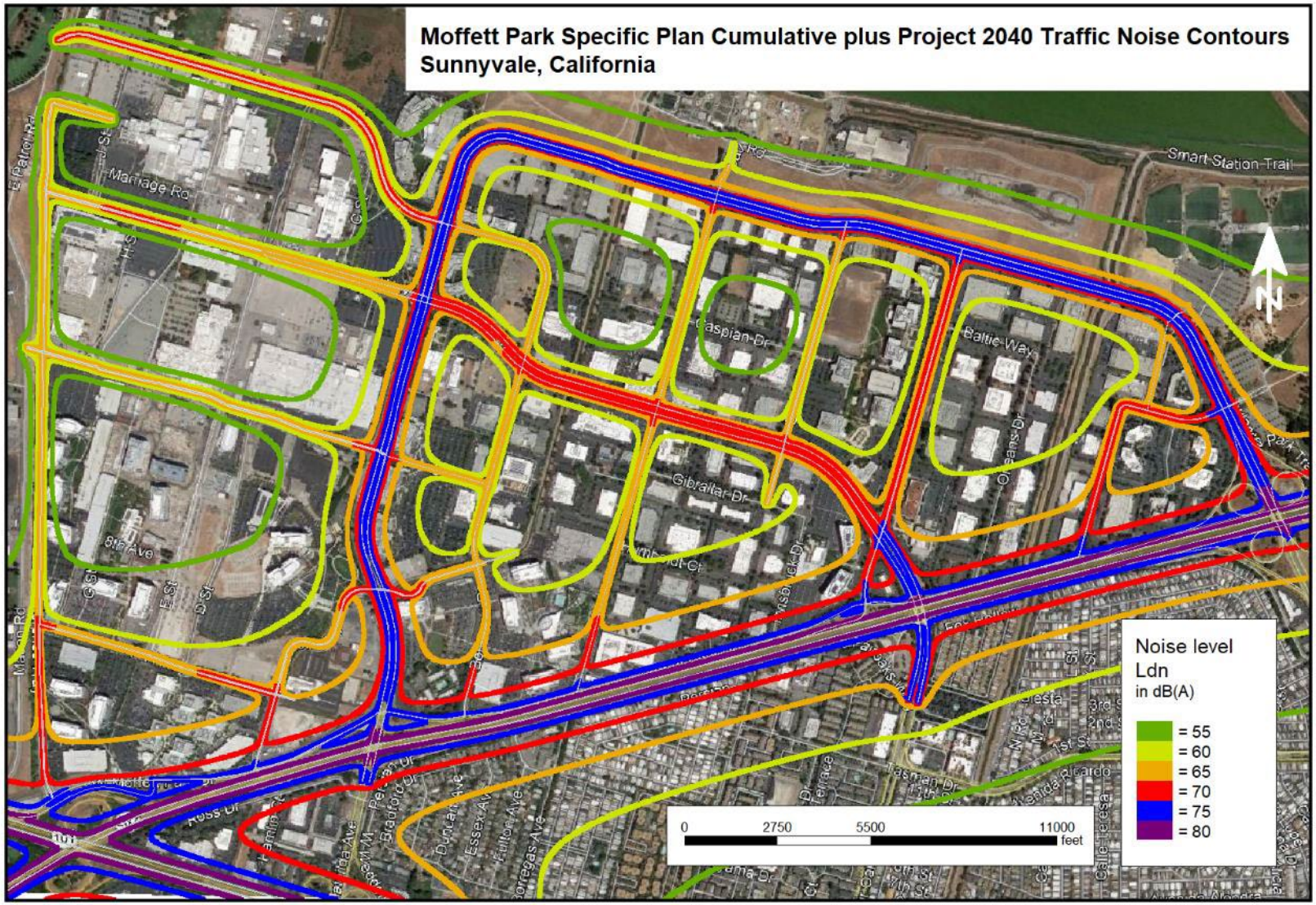


TABLE 9 Existing and Future Modeled Noise Levels Along Surrounding Roadways

Roadway	Segment	L_{dn} at 75 feet from the Roadway Centerline, dBA			Increase Over Existing, dBA		Increase of 2040 Plus Project Over 2040 No Project, dBA
		Existing	2040 No Project	2040 Project	2040 No Project	2040 Project	
1st Avenue	West of North Mathilda Ave.	62	63	64	1	2	1
5th Avenue	West of North Mathilda Ave.	61	62	62	1	1	0
	North Mathilda Ave. to Bordeaux Dr.	60	61	62	1	2	1
11th Avenue	Enterprise Way to Innovation Way	63	64	64	1	1	0
	East of Innovation Way	64	65	65	1	1	0
Bordeaux Drive	North Mathilda Ave. to Java Dr.	56	57	60	1	**4**	**3**
	West Java Dr. to 5th Ave.	60	60	61	0	1	1
	5th Ave. to Innovation Way	60	60	60	0	0	0
	Innovation Way to Moffett Park Dr.	64	65	65	1	1	0
Borregas Avenue	North of Caribbean Dr.	60	60	61	0	1	1
	Caribbean Dr. to Java Dr.	62	62	62	0	0	0
	Java Dr. to Moffett Park Dr.	63	63	63	0	0	0
Caribbean Drive (W)	West of Borregas Ave.	67	68	69	1	2	1
Caribbean Drive (E)	Borregas Ave. to Crossman Ave.	69	69	70	0	1	1
	Crossman Ave. to Twin Creeks Driveway	70	70	71	0	1	1

Roadway	Segment	L_{dn} at 75 feet from the Roadway Centerline, dBA			Increase Over Existing, dBA		Increase of 2040 Plus Project Over 2040 No Project, dBA
		Existing	2040 No Project	2040 Project	2040 No Project	2040 Project	
	Twin Creeks Driveway to Moffett Park Dr.	70	70	71	0	1	1
	East of Moffett Park Dr.	71	71	72	0	1	1
Crossman Avenue	East Caribbean Dr. to East Java Dr.	65	66	67	1	2	1
	East Java Dr. to Moffett Park Dr.	69	69	70	0	1	1
Enterprise Way	North of 11th Ave.	60	60	61	0	1	1
	11th Ave. to Manila Dr.	65	65	66	0	1	1
Geneva Drive	North of East Java Dr.	56	58	60	2	**4**	**2**
	South of East Java Dr.	60	60	61	0	1	1
Innovation Way	West Moffett Park Dr. to 11th Ave.	68	68	68	0	0	0
	11th Ave. to North Mathilda Ave.	64	65	65	1	1	0
	North Mathilda Ave. to Bordeaux Dr.	64	64	65	0	1	1
	East of Bordeaux Dr.	59	60	60	1	1	0
Java Drive (W)	North Mathilda Ave. to Bordeaux Dr.	62	64	65	2	3	1
	Bordeaux Dr. to Borregas Ave.	65	66	66	1	1	0
Java Drive (E)	Borregas Ave. to Geneva Dr.	66	66	66	0	0	0
	Geneva Dr. to Crossman Ave.	67	67	67	0	0	0
	East of Crossman Ave.	70	70	71	0	1	1
Lockheed Martin Way	West of North Mathilda Ave.	60	61	63	1	3	2

Roadway	Segment	L_{dn} at 75 feet from the Roadway Centerline, dBA			Increase Over Existing, dBA		Increase of 2040 Plus Project Over 2040 No Project, dBA
		Existing	2040 No Project	2040 Project	2040 No Project	2040 Project	
Manila Drive	West of Enterprise Way	76	77	77	1	1	0
Moffett Park Drive (W)	Enterprise Way to Highway 101 NB on-ramp	70	70	70	0	0	0
	Highway 101 NB on-ramp to Innovation Way	73	73	73	0	0	0
	Innovation Way to North Mathilda Ave.	73	74	74	1	1	0
	East of North Mathilda Ave.	72	72	73	0	1	1
Moffett Park Drive	West of Borregas Ave.	75	75	75	0	0	0
	Borregas Ave. to Crossman Ave.	75	76	76	1	1	0
	Crossman Ave. to Moffett Park Ct.	75	75	75	0	0	0
	Moffett Park Ct. to East Caribbean Dr.	66	66	67	0	1	1
	East of East Caribbean Dr.	66	66	67	0	1	1
North Mathilda Avenue	North of 1st Ave./Bordeaux Dr.	67	68	69	1	2	1
	1st Ave./Bordeaux Dr. to Lockheed Martin Way/West Java Dr.	67	68	69	1	2	1
	Lockheed Martin Way/West Java Dr. to 5th Ave.	67	68	70	1	3	2
	5th Ave. to Innovation Way	68	69	71	1	3	2

Roadway	Segment	L_{dn} at 75 feet from the Roadway Centerline, dBA			Increase Over Existing, dBA		Increase of 2040 Plus Project Over 2040 No Project, dBA
		Existing	2040 No Project	2040 Project	2040 No Project	2040 Project	
	Innovation Way to West Moffett Park Dr.	70	71	72	1	2	1
	West Moffett Park Dr. to SR 237 WB ramps	74	74	74	0	0	0
	South of SR 237 EB ramps	75	75	75	0	0	0
Twin Creeks Driveway	North of East Caribbean Dr.	64	65	66	1	2	1
	South of East Caribbean Dr.	60	61	62	1	2	1
SR 237 WB on-ramp	At West Moffett Park Dr./Crossman Ave. intersection	75	75	76	0	1	1
	At North Mathilda Ave.	73	73	73	0	0	0
SR 237 EB off-ramp	At North Mathilda Ave.	74	74	74	0	0	0
SR 237 EB on-ramp	At North Mathilda Ave.	75	75	75	0	0	0
SR 237	Highway 101 interchange to North Mathilda Ave.	80	80	80	0	0	0
	North Mathilda Ave. to East Java Dr.	80	80	80	0	0	0
	East Java Dr. to East Caribbean Dr.	80	80	80	0	0	0
	East of East Caribbean Dr.	81	82	82	1	1	0
U.S. 101 NB on-ramp	At West Moffett Park Dr.	71	72	72	1	1	0

FIGURE 5 2022 Noise Contours for Moffett Federal Airfield

Figure 5

PLAN CONSISTENCY ANALYSIS

This section summarizes the analysis of the land use compatibility of the proposed development within the Plan Area with respect to the future noise environment. Recommendations are made to ensure that future developments within the Plan Area are not exposed to excessive noise levels.

Noise and Land Use Compatibility

Chapter 6 of the City of Sunnyvale's General Plan sets forth policies with the goal of minimizing the impact of noise on people through noise reduction and suppression techniques and through appropriate land use policies in the City of Sunnyvale. The applicable General Plan policies were presented in detail in the Regulatory Background section and are summarized below for the proposed project:

- The City's acceptable exterior noise level standard is 60 dBA L_{dn} or less for the proposed residential, hotel, and school land uses. Policy SN-8.7 of the City's General Plan further states that for train noise sources, an L_{dn} of no greater than 70 dBA should be achieved at residential outdoor use areas, which would also apply to hotel and schools. New residential uses should not be located near airports.

- The City's acceptable exterior noise level standard is 70 dBA L_{dn} or less for the proposed office buildings, commercial land uses, industrial uses, and utilities.

- The City's acceptable interior noise level standard is 45 dBA L_{dn} or less for the proposed residential and hotel land uses. Additionally, a maximum instantaneous noise level of 50 dBA in bedrooms and 55 dBA in other areas of residential units are enforced for train or aircraft noise, where the exterior L_{dn} exceeds 55 dBA.

- The Cal Green Code standards specify an interior noise environment attributable to exterior sources not to exceed an hourly equivalent noise level ($L_{eq\ (1\text{-}hr)}$) of 50 dBA in occupied areas of nonresidential uses during any hour of operation.

Noise levels in the Plan Area were measured and calculated using SoundPLAN Version V8.2. The estimated noise level increases along each roadway segment are summarized in Table 9, and the cumulative plus project noise contours are shown in Figure 4.

Future Exterior Noise Environment

Specific locations for future development projects are unknown at this time. However, distances to the 60 dBA L_{dn} and 70 dBA L_{dn} thresholds for residential (including hotels and schools) and commercial and industrial uses, respectively, were estimated along each roadway segment based on the future exterior noise levels summarized in Table 10.

Noise produced by vehicular traffic along roadways in the vicinity of Plan Area could potentially expose the proposed land uses to levels exceeding the exterior compatibility thresholds. Future exterior noise levels at a distance of 75 feet from the centerline of the primary roadways within

the Plan Area would typically range from 57 dBA L_{dn} along Bordeaux Drive between North Mathilda Avenue to Java Drive to 77 dBA L_{dn} along Manila Avenue. Future exterior noise levels within 75 feet of the nearest through lane of SR-237 would range from 80 to 82 dBA L_{dn}. Table 10 summarizes the distances to the 60 and 70 dBA L_{dn} noise contours along the roadways within the Plan Area.

Since all train tracks run parallel to roadways within the Plan Area, the noise sources are combinations of train and traffic noise, with the dominant source coming from the vehicular traffic. Hence, the exterior noise threshold for new residential in the Plan Area would be 60 dBA L_{dn}.

TABLE 10 2040 General Plan Buildout Plus Proposed Project Traffic Noise Contour Distances within the Plan Area

Roadway	Segment	Distance from Centerline to Traffic Noise Contour, feet		
		70 dBA L_{dn}	65 dBA L_{dn}	60 dBA L_{dn}
1st Ave.	West of North Mathilda Ave.	<50 feet	55 feet	130 feet
5th Ave.	West of North Mathilda Ave.	<50 feet	<50 feet	100 feet
	North Mathilda Ave. to Bordeaux Dr.	<50 feet	<50 feet	95 feet
11th Ave.	Enterprise Way to Innovation Way	<50 feet	60 feet	140 feet
	East of Innovation Way	<50 feet	70 feet	150 feet
Bordeaux Dr.	North Mathilda Ave. to Java Dr.	<50 feet	<50 feet	65 feet
	West of Java Dr. to 5th Ave.	<50 feet	<50 feet	100 feet
	5th Ave. to Innovation Way	<50 feet	<50 feet	80 feet
	Innovation Way to Moffett Park Dr.	<50 feet	70 feet	155 feet
Borregas Ave.	North of Caribbean Dr.	<50 feet	<50 feet	90 feet
	Caribbean Dr. to Java Dr.	<50 feet	<50 feet	105 feet
	Java Dr. to Moffett Park Dr.	<50 feet	50 feet	125 feet
Caribbean Dr. (W)	West of Borregas Ave.	55 feet	135 feet	205 feet
Caribbean Dr. (E)	Borregas Ave. to Crossman Ave.	75 feet	165 feet	240 feet
	Crossman Ave. to Twin Creeks Driveway	90 feet	180 feet	255 feet
	Twin Creeks Driveway to Moffett Park Dr.	90 feet	185 feet	260 feet
	East of Moffett Park Dr.	105 feet	175 feet	310 feet
Crossman Ave.	East Caribbean Dr. to East Java Dr.	<50 feet	100 feet	165 feet
	East Java Dr. to Moffett Park Dr.	70 feet	155 feet	230 feet
Enterprise Way	North of 11th Ave.	<50 feet	<50 feet	85 feet
	11th Ave. to Manila Dr.	<50 feet	85 feet	175 feet

Roadway	Segment	Distance from Centerline to Traffic Noise Contour, feet		
		70 dBA L_{dn}	65 dBA L_{dn}	60 dBA L_{dn}
Geneva Dr.	North of East Java Dr.	<50 feet	<50 feet	70 feet
	South of East Java Dr.	<50 feet	<50 feet	95 feet
Innovation Way	West Moffett Park Dr. to 11th Ave.	50 feet	125 feet	195 feet
	11th Ave to North Mathilda Ave.	<50 feet	65 feet	150 feet
	North Mathilda Ave. to Bordeaux Dr.	<50 feet	65 feet	150 feet
	East of Bordeaux Dr.	<50 feet	<50 feet	75 feet
Java Dr. (W)	North Mathilda Ave. to Bordeaux Dr.	<50 feet	65 feet	150 feet
	Bordeaux Dr. to Borregas Ave.	<50 feet	90 feet	195 feet
Java Dr. (E)	Borregas Ave. to Geneva Dr.	<50 feet	90 feet	190 feet
	Geneva Dr. to Crossman Ave.	<50 feet	110 feet	175 feet
	East of Crossman Ave.	90 feet	185 feet	260 feet
Lockheed Martin Way	West of North Mathilda Ave.	<50 feet	<50 feet	110 feet
Manila Dr.	West of Enterprise Way	160 feet	290 feet	510 feet
Moffett Park Dr. (W)	Enterprise Way to Highway 101 NB on-ramp	80 feet	170 feet	250 feet
	Highway 101 NB on-ramp to Innovation Way	125 feet	200 feet	350 feet
	Innovation Way to North Mathilda Ave.	135 feet	205 feet	365 feet
	East of North Mathilda Ave.	115 feet	180 feet	325 feet
Moffett Park Dr.	West of Borregas Ave.	165 feet	240 feet	430 feet
	Borregas Ave. to Crossman Ave.	175 feet	255 feet	450 feet
	Crossman Ave. to Moffett Park Ct.	165 feet	245 feet	430 feet
	Moffett Park Ct. to East Caribbean Dr.	<50 feet	105 feet	170 feet
	East of East Caribbean Dr.	<50 feet	100 feet	160 feet
North Mathilda Ave.	North of 1st Ave./Bordeaux Dr.	60 feet	140 feet	210 feet
	1st Ave./Bordeaux Dr. to Lockheed Martin Way/West Java Dr.	55 feet	130 feet	200 feet
	Lockheed Martin Way/West Java Dr.to 5th Ave.	75 feet	165 feet	240 feet
	5th Ave. to Innovation Way	90 feet	185 feet	260 feet

Roadway	Segment	Distance from Centerline to Traffic Noise Contour, feet		
		70 dBA L_{dn}	65 dBA L_{dn}	60 dBA L_{dn}
	Innovation Way to West Moffett Park Dr.	100 feet	170 feet	300 feet
	West Moffett Park Dr. to SR 237 WB ramps	140 feet	210 feet	375 feet
	South of SR 237 EB ramps	170 feet	245 feet	430 feet
Twin Creeks Driveway	North of East Caribbean Dr.	<50 feet	85 feet	175 feet
	South of East Caribbean Dr.	<50 feet	<50 feet	100 feet
SR 237 WB on-ramp	At West Moffett Park Dr./ Crossman Ave. intersection	175 feet	250 feet	445 feet
	At North Mathilda Ave.	120 feet	190 feet	335 feet
SR 237 EB off-ramp	At North Mathilda Ave.	140 feet	210 feet	375 feet
SR 237 EB on-ramp	At North Mathilda Ave.	160 feet	235 feet	420 feet
SR 237	Highway 101 interchange to North Mathilda Ave.	240 feet	425 feet	760 feet
	North Mathilda Ave. to East Java Dr.	240 feet	420 feet	750 feet
	East Java Dr. to East Caribbean Dr.	230 feet	410 feet	730 feet
	East of East Caribbean Dr.	280 feet	500 feet	890 feet
U.S. 101 NB on-ramp	At West Moffett Park Dr.	100 feet	170 feet	300 feet

Future Interior Noise Environment

Residential Uses

Standard residential and school construction provides approximately 15 dBA of exterior-to-interior noise reduction, assuming the windows are partially open for ventilation. Standard construction for hotels and for residences and schools with the windows closed provides approximately 20 to 25 dBA of noise reduction in interior spaces. Where exterior noise levels range from 60 to 65 dBA L_{dn}, the inclusion of adequate forced-air mechanical ventilation is often the method selected to reduce interior noise levels to acceptable levels by closing the windows to control noise. Where noise levels exceed 65 dBA L_{dn}, forced-air mechanical ventilation systems and sound-rated construction methods are normally required. Such methods or materials may include a combination of smaller window and door sizes as a percentage of the total building façade facing the noise source, sound-rated windows and doors, sound-rated exterior wall assemblies, and mechanical ventilation so windows may be kept closed at the occupant's discretion.

The setback distances in Table 10 to meet the exterior noise limit of 60 dBA L_{dn} would also meet the interior noise limit of 45 dBA L_{dn}, assuming standard residential, hotel, and school construction materials. Buildings within the setback distances to the 65 dBA L_{dn} contour would require adequate forced-air mechanical ventilation with standard construction materials to meet 45 dBA L_{dn} within

residential units. At or within the 70 dBA L_{dn} contour distance, sound-rated construction materials would be required to meet the 45 dBA L_{dn} limit.

Additionally, VTA light-rail tracks run along Manila Drive/West Moffett Park Drive, North Mathilda Avenue, and Java Drive. The City requires maximum instantaneous noise levels within bedrooms to be at or below 50 dBA L_{max} and within all other rooms to be at or below 55 dBA L_{max}. To meet these standards, sound-rated construction materials would be required.

Commercial, Office, and Industrial Uses

Standard construction materials for commercial, office, and industrial uses would provide about 25 dBA of noise reduction in interior spaces. The inclusion of adequate forced-air mechanical ventilation systems is normally required so that windows may be kept closed at the occupant's discretion and would provide an additional 5 dBA reduction. The standard construction materials in combination with forced-air mechanical ventilation would satisfy the daytime threshold of 50 dBA $L_{eq(1\text{-}hr)}$ at most commercial uses.

Spaces where lower noise levels would be desired, such as private offices and conference rooms, may benefit from additional noise control in order to meet a lower, more desirable interior noise level. Additional noise control could be accomplished by selecting higher sound-rated windows (STC 34 or greater along exterior façades).

Recommendations to Reduce Future Exterior and Interior Noise Levels

When project-level development information, such as site plans, building elevations, floor plans, and the position of buildings and outdoor use areas within the Plan Area are known, site-specific project-level noise studies should be conducted to confirm the recommendations for exterior and interior noise reduction methods for both residential and nonresidential uses. An acoustical study shall be conducted when an application is received for a development project that could be exposed to noise greater than that deemed acceptable by the maximum noise levels specified in Figure 6-5 of the City of Sunnyvale's General Plan for any given land use proposed on the site. The study shall determine compliance with the noise and land use compatibility standards, identify potential noise impacts, and propose site-specific measures to reduce exposure to exterior and interior noise levels that exceed maximum permissible levels.

Policy SN-8.9 of the City's General Plan provides techniques to block the path of noise and insulate people from noise sources. Implementation of SN-8.9a would require a combination of barriers, setbacks, site planning, and building design techniques to reduce exterior noise levels.

A project-specific acoustical analysis shall be prepared, in compliance with State Building Codes and City noise standards, to ensure that the design incorporates controls to reduce interior noise levels to 45 dBA L_{dn} or lower within the residential units and to 50 dBA $L_{eq(1\text{-}hr)}$ or lower within nonresidential interiors. Additionally for residential units located adjacent to the VTA light-rail tracks, maximum instantaneous noise levels shall be at or below 50 dBA L_{max} within bedrooms and at or below 55 dBA L_{max} within all other residential rooms. The project applicant shall conform with any special building construction techniques requested by the City's Building Department,

which may include sound-rated windows and doors, sound-rated wall constructions, and acoustical caulking.

The following general recommendations shall be considered to reduce exterior noise levels to meet the normally acceptable thresholds of 60 dBA L_{dn} at residential uses or 70 dBA L_{dn} at commercial retail and offices uses:

- When developing project site plans, locate noise-sensitive outdoor use areas away from major roadways or other significant sources of noise. Shield noise-sensitive spaces with buildings or noise barriers to reduce exterior noise levels. The final detailed design of the heights and limits of proposed noise barriers shall be completed at the time that the final site and grading plans are submitted.

If the 45 dBA L_{dn} or 50 dBA $L_{eq(1\text{-}hr)}$ threshold would not be met, other site-specific measures, such as increasing setbacks of the buildings from the adjacent roadways, using shielding by other buildings or noise barriers to reduce noise levels, implementing additional sound treatments to the building design, etc. shall be considered to reduce interior noise levels to meet the State and City thresholds.

Train Vibration and Land Use Compatibility

The U.S. Department of Transportation, Federal Transit Administration's (FTA) vibration impact assessment criteria[2] are used by the City of Sunnyvale to evaluate the compatibility of proposed projects with vibration levels produced by heavy-rail and light-rail trains. The FTA vibration impact criteria are based on maximum overall levels for a single event. The impact criteria for groundborne vibration are shown in Table 6. Note that there are criteria for frequent events (more than 70 events of the same source per day), occasional events (30 to 70 vibration events of the same source per day), and infrequent events (less than 30 vibration events of the same source per day).

Future Vibration Environment

For purposes of this study, it is assumed that occasional events (between 30 and 70 daily trips) would occur along the VTA light rail train lines through the Plan Area under future conditions. This would require vibration levels due to train pass-bys to be below 75 VdB for residential buildings and below 78 VdB for commercial, office, and institutional buildings.

While vibration measurements were not made within the Plan Area, vibration levels due to train pass-bys were estimated based on typical vibration levels by light rail trains included in the FTA manual. VTA trains traveling in developed areas, such as the Plan Area, typically travel at slower speeds ranging from 30 to 45 mph. Along roadways where the train tracks are located between travel lanes, such as along Java Drive, trains reach speeds up to 55 mph. According to the FTA manual, light rail train systems with speeds of 50 mph generate 72 VdB at 60 feet. With the

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

recommended FTA propagation rate of $20Log\left(speed/speed_{ref}\right)$, vibration levels at the typical travel speeds within the Plan Area were estimated. At speeds of 30 to 45 mph, vibration levels would range from 68 to 71 VdB at 60 feet. At a speed of 55 mph, vibration levels would be 73 VdB at 60 feet. From these base vibration levels, minimum setback distances for residential and nonresidential buildings within the Plan Area are summarized in Table 11.

TABLE 11 Minimum Distances to the Vibration Thresholds for Proposed Buildings within the Plan Area

Roadway Segment	Distance from Edge of Nearest Tracks, feet	
	Residential (75 VdB)	Nonresidential (78 VdB)
Manila Dr./West Moffett Park Dr. (30 to 45 mph)	10 to 24	5 to 12
North Mathilda Ave. (30 to 45 mph)	10 to 24	5 to 12
Java Dr. (55 mph)	35	18

Based on the setback distances presented in Table 11, project-specific vibration analyses shall be prepared for residential developments within 35 feet of the VTA light rail lines within the Plan Area and within 20 feet of the VTA light rail lines for commercial, office or institutional developments. This study should include vibration measurements at the project site and a comparison of the measurements to the established FTA standards in order to verify vibration and land use compatibility.

NOISE IMPACTS AND MITIGATION MEASURES

The following section summarizes the analysis of the noise and vibration impacts resulting from the project upon existing land uses. Both temporary impacts, such as construction noise, and permanent impacts, such as increased traffic noise, resulting from the proposed project are considered. This section describes the significance criteria used to evaluate project impacts at off-site receptor locations, provides a discussion of each project impact, and presents mitigation measures, where necessary, to provide a compatible project in relation to adjacent land uses.

Significance Criteria

The following criteria were used to evaluate the significance of environmental noise resulting from the project:

- A significant noise impact would be identified if the project would generate a substantial temporary or permanent noise level increase over ambient noise levels at existing noise-sensitive receptors surrounding the project site and that would exceed applicable noise standards presented in the General Plan or Municipal Code at existing noise-sensitive receptors surrounding the project site.

    - Consistent with the LUTE, hourly average noise levels during construction that would exceed 60 dBA L_{eq} at residential land uses or exceed 70 dBA L_{eq} at

commercial land uses and exceed the ambient noise environment by at least 5 dBA L_{eq} for a period of more than one year would constitute a significant temporary noise increase in the project vicinity.

- A significant permanent noise level increase would occur if project-generated traffic generated by the project or project improvements/operations would substantially increase noise levels at sensitive receivers in the vicinity. According to Figure 6-6 of the City's General Plan, a substantial increase would occur if: a) the noise level increase is more than 5 dBA L_{dn}, with a future noise level of less than the "normally acceptable" standard; or b) the noise level increase is more than 3 dBA L_{dn} , with a future noise level exceeding the "normally acceptable" standard.

- A significant noise impact would be identified if the project would expose persons to or generate noise levels that would exceed applicable noise standards presented in the General Plan or Municipal Code.

- A significant impact would be identified if the construction of the project would generate excessive vibration levels surrounding receptors. Consistent with the LUTE, groundborne vibration levels exceeding 0.25 in/sec PPV would have the potential to result in cosmetic damage to older buildings.

- A significant noise impact would be identified if the project would expose people residing or working in the project area to excessive aircraft noise levels.

Impact 1a: **Temporary Construction Noise.** Existing noise-sensitive land uses would be exposed to a temporary increase in ambient noise levels due to project construction activities. The incorporation of construction best management practices as project conditions of approval would result in a **less-than-significant** temporary noise impact.

Construction activities for the proposed project would occur intermittently at different sites within in the City of Sunnyvale until full build-out. Although the related noise impacts at any one location would be temporary, construction of individual projects could cause adverse localized effects on the ambient noise environment.

Noise impacts resulting from construction depend upon the noise generated by various pieces of construction equipment, the timing and duration of noise-generating activities, and the distance between construction noise sources and noise-sensitive areas. Construction noise impacts primarily result when construction activities occur during noise-sensitive times of the day (e.g., early morning, evening, or nighttime hours), the construction occurs in areas immediately adjoining noise-sensitive land uses, or when construction lasts over extended periods of time.

Title 16 of the City's Municipal Code defines the allowable construction hours between 7:00 a.m. and 6:00 p.m. on weekdays and between 8:00 a.m. and 5:00 p.m. on Saturdays. Construction activity is not permitted on Sundays or federal holidays when the City offices are closed. This Title also states that no loud environmentally disruptive noises, such as air compressors without

mufflers, continuously running motors or generators, loud playing music and radios, etc. shall be allowed where noises may be a nuisance to adjacent residential neighborhoods. Title 19 provides operational noise thresholds during daytime and nighttime hours; however, Title 19(b) states that construction noise would be exempt from these thresholds during the allowable construction hours stated in Title 16. The Municipal Code does not provide quantitative noise limits for construction activities.

The noise level threshold for speech interference indoors is 45 dBA. Assuming a 15 dBA exterior-to-interior reduction for standard residential construction, this would correlate to an exterior threshold of 60 dBA L_{eq} at residential land uses. Additionally, temporary construction would be annoying to surrounding land uses if the ambient noise environment increased by at least 5 dBA L_{eq} for an extended period of time. Therefore, the temporary construction noise impact would be considered significant if project construction activities exceeded 60 dBA L_{eq} at nearby residences and exceeded the ambient noise environment by 5 dBA L_{eq} or more for a period longer than one year.

Major noise-generating construction activities associated with Area Plan would typically include removal of existing structures, site grading and excavation, installation of utilities, the construction of building foundations, cores, and shells, paving, and landscaping. Construction activities generate considerable amounts of noise, especially during earth-moving activities when heavy equipment is used. While specific project information is unknown at this time, the construction of building foundations for high-rise building may require impact or vibratory pile driving activities to support the structure, which would generate high noise levels. Site grading, excavation activities, the operation of heavy construction equipment, and the arrival/departure of heavy-duty trucks would also generate high noise levels, as these phases often require the simultaneous use of multiple pieces of heavy equipment such as dozers, excavators, scrapers, and loaders.

Typical hourly average construction generated noise levels are about 81 to 88 dBA L_{eq}, measured at a distance of 50 feet from the center of the site during busy construction periods (e.g., earth moving equipment, impact tools, etc.). Construction-generated noise levels drop off at a rate of about 6 dBA per doubling of distance between the source and receptor. Shielding by buildings or terrain often result in lower construction noise levels at distant receptors. Lower noise levels result from building construction activities when these activities move indoors, and less heavy equipment is required to complete the tasks. Typical construction noise levels at a distance of 50 feet are shown in Tables 12 and 13. Table 12 shows the average noise level ranges, by construction phase, and Table 13 shows the maximum noise level ranges for different construction equipment.

TABLE 12 Typical Ranges of Construction Noise Levels at 50 Feet, L_{eq} (dBA)

	Domestic Housing		Office Building, Hotel, Hospital, School, Public Works		Industrial Parking Garage, Religious Amusement & Recreations, Store, Service Station		Public Works Roads & Highways, Sewers, and Trenches	
	I	**II**	**I**	**II**	**I**	**II**	**I**	**II**
Ground Clearing	83	83	84	84	84	83	84	84
Excavation	88	75	89	79	89	71	88	78
Foundations	81	81	78	78	77	77	88	88
Erection	81	65	87	75	84	72	79	78
Finishing	88	72	89	75	89	74	84	84

I - All pertinent equipment present at site.
II - Minimum required equipment present at site.

Source: U.S.E.P.A., Legal Compilation on Noise, Vol. 1, p. 2-104, 1973.

TABLE 13 Construction Equipment 50-foot Noise Emission Limits

Equipment Category	L_{max} Level (dBA)[1,2]	Impact/Continuous
Arc Welder	73	Continuous
Auger Drill Rig	85	Continuous
Backhoe	80	Continuous
Bar Bender	80	Continuous
Boring Jack Power Unit	80	Continuous
Chain Saw	85	Continuous
Compressor[3]	70	Continuous
Compressor (other)	80	Continuous
Concrete Mixer	85	Continuous
Concrete Pump	82	Continuous
Concrete Saw	90	Continuous
Concrete Vibrator	80	Continuous
Crane	85	Continuous
Dozer	85	Continuous
Excavator	85	Continuous
Front End Loader	80	Continuous
Generator	82	Continuous
Generator (25 KVA or less)	70	Continuous
Gradall	85	Continuous
Grader	85	Continuous
Grinder Saw	85	Continuous
Horizontal Boring Hydro Jack	80	Continuous
Hydra Break Ram	90	Impact
Impact Pile Driver	105	Impact
Insitu Soil Sampling Rig	84	Continuous
Jackhammer	85	Impact
Mounted Impact Hammer (hoe ram)	90	Impact
Paver	85	Continuous
Pneumatic Tools	85	Continuous
Pumps	77	Continuous
Rock Drill	85	Continuous
Scraper	85	Continuous
Slurry Trenching Machine	82	Continuous
Soil Mix Drill Rig	80	Continuous
Street Sweeper	80	Continuous
Tractor	84	Continuous
Truck (dump, delivery)	84	Continuous
Vacuum Excavator Truck (vac-truck)	85	Continuous
Vibratory Compactor	80	Continuous
Vibratory Pile Driver	95	Continuous
All other equipment with engines larger than 5 HP	85	Continuous

Notes:

[1] Measured at 50 feet from the construction equipment, with a "slow" (1 sec.) time constant.

[2] Noise limits apply to total noise emitted from equipment and associated components operating at full power while engaged in its intended operation.

[3]Portable Air Compressor rated at 75 cfm or greater and that operates at greater than 50 psi.

Temporary construction noises are disturbances that are necessary for the construction or repair of buildings and structures in urban and rural areas. Reasonable regulation of the hours of construction, as well as regulation of the arrival and operation of heavy equipment and the delivery of construction materials, are necessary to protect the health and safety of persons, promote the general welfare of the community, and maintain the quality of life. Limiting the hours when construction can occur to daytime hours is often a simple method to reduce the potential for noise impacts. In areas immediately adjacent to construction, controls such as constructing temporary noise barriers and utilizing "quiet" construction equipment can also reduce the potential for noise impacts.

Construction activities within the Plan Area will be conducted in accordance with the provisions of the City's Municipal Code, which limits temporary construction work to between 7:00 a.m. and 6:00 p.m. on weekdays and between 8:00 a.m. and 5:00 p.m. on Saturdays. Construction activity is not permitted on Sundays or federal holidays when the City offices are closed. The City of Sunnyvale Land Use and Transportation Element (LUTE) Update EIR[3] provides mitigation measure **MM 3.6.3** to reduce construction noise levels:

MM 3.6.3: New development and public projects shall employ site-specific noise attenuation measures during construction to reduce the generation of construction noise and vibration. These measures shall be included in a Noise Control Plan that shall be submitted for review and approval by the City. Measures specified in the Noise Control Plan and implemented during construction shall include, at a minimum, the following noise control strategies:

- Equipment and trucks used for construction shall use the best available noise control techniques (e.g., improved mufflers, equipment redesign, use of intake silencers, ducts, engine enclosures, and acoustically attenuating shields or shrouds);

- Impact tools (e.g., jackhammers, pavement breakers, and rock drills) used for construction shall be hydraulically or electrically powered wherever possible to avoid noise associated with compressed air exhaust from pneumatically powered tools; and

- Stationary noise sources shall be located as far from adjacent receptors as possible, and they shall be muffled and enclosed within temporary sheds, incorporate insulation barriers, or include other similar measures.

- Noise and vibration reducing pile-driving techniques shall be employed during construction and will be monitored to ensure no damage to nearby structures occurs (i.e., vibrations above peak particle velocity (PPVs) of 0.25 inches per second at nearby structures). These techniques shall include:

    - Installing intake and exhaust mufflers on pile-driving equipment;

    - Vibrating piles into place when feasible, and installing shrouds around the pile- driving hammer where feasible;

[3] Michael Baker International, "City of Sunnyvale Land Use and Transportation Element: Draft Environmental Impact Report," SCH No. 2012032003, August 2016.

- Implementing "quiet" pile-driving technology (such as pre-drilling of piles and the use of more than one pile driver to shorten the total pile driving duration), where feasible, in consideration of geotechnical and structural requirements and conditions;

- Using cushion blocks to dampen impact noise, if feasible based on soil conditions. Cushion blocks are blocks of material that are used with impact hammer pile drivers. They consist of blocks of material placed atop a piling during installation to minimize noise generated when driving the pile. Materials typically used for cushion blocks include wood, nylon and micarta (a composite material); and

- At least 48 hours prior to pile-driving activities, notifying building owners and occupants within 600 feet of the project area of the dates, hours, and expected duration of such activities.

LUTE EIR **MM 3.6.3** requires that the Project implement *at the minimum* the above-listed noise control strategies. In compliance with LUTE EIR **MM 3.6.3**, the following additional construction best management practices are recommended to further reduce construction noise levels emanating from the site and minimize disruption and annoyance at existing noise-sensitive receptors in the project vicinity. With the incorporation of the following construction best management practices into the project's Noise Control Plan pursuant to LUTE EIR **MM 3.6.3**, which will be implemented as a condition of approval, this would be a less-than-significant impact.

Construction Best Management Practices

Include the following controls in the Noise Control Plan:

- Unnecessary idling of internal combustion engines should be strictly prohibited.

- Construction staging areas shall be established at locations that will create the greatest distance between the construction-related noise sources and noise-sensitive receptors nearest the project site during all project construction. Locate material stockpiles, as well as maintenance/equipment staging and parking areas, as far as feasible from residential receptors.

- Control noise from construction workers' radios to a point where they are not audible at existing residences bordering the project site.

- Where feasible, temporary power service from local utility companies should be used instead of portable generators.

- Locate cranes as far from adjoining noise-sensitive receptors as possible.

- During final grading, substitute graders for bulldozers, where feasible. Wheeled heavy equipment are quieter than track equipment and should be used where feasible.

- Maintain smooth vehicle pathways for trucks and equipment accessing the site, and avoid local residential neighborhoods as much as possible.

- During interior construction, the exterior windows facing noise-sensitive receptors should be closed.

- During interior construction, locate noise-generating equipment within the building to break the line-of-sight to the adjoining receptors.

- The contractor shall prepare a detailed construction schedule for major noise-generating construction activities. The construction plan shall identify a procedure for coordination with adjacent residential land uses so that construction activities can be scheduled to minimize noise disturbance.

- Designate a "disturbance coordinator" who would be responsible for responding to any complaints about construction noise. The disturbance coordinator will determine the cause of the noise complaint (e.g., bad muffler, etc.) and will require that reasonable measures be implemented to correct the problem. Conspicuously post a telephone number for the disturbance coordinator at the construction site and include in it the notice sent to neighbors regarding the construction schedule.

The implementation of the reasonable and feasible controls outlined above would reduce construction noise levels emanating from the site, minimizing disruption and annoyance. With the implementation of these controls, as well as the Municipal Code limits on allowable construction hours, and considering that construction is temporary, the impact would be reduced to a less-than-significant level.

Mitigation Measure 1a: No additional measures are required.

Impact 1b: Permanent Noise Level Increase/Exceed Applicable Standards. The proposed project would generate traffic that results in a substantial permanent noise level increase. Since there are no noise-sensitive residential land uses located along roadways within the vicinity of the plan area, this is a **less-than-significant impact.**

For a substantial permanent cumulative noise increase to occur, two qualifications must be met: 1) if the 2040 cumulative plus project traffic volumes result in a noise level increase at sensitive receptors of more than 5 dBA L_{dn}, with a future noise level of less than 60 dBA L_{dn}, or of more than 3 dBA L_{dn}, with a future noise level of 60 dBA L_{dn} or greater, compared to existing traffic volumes; and 2) if the 2040 cumulative plus project traffic volumes result in a 1 dBA L_{dn} or more noise level increase compared to 2040 cumulative (no project) conditions, which would be considered a cumulatively considerable contribution to the overall traffic noise increase.

Title 19 of the City's Municipal Code states that operational noise shall not exceed 75 dBA at any point along the property line of the premises where the noise was generated, provided that the noise level shall not exceed 60 dBA during daytime hours (7:00 a.m. to 10:00 p.m.) or 50 dBA during nighttime hours (10:00 p.m. to 7:00 a.m.) at any point on adjacent residential properties. If the nighttime noise is determined to be a steady, audible tone or includes music or speech, the allowable nighttime threshold shall be 45 dBA.

Project Traffic

SoundPLAN Version V8.2 was used to calculate the traffic noise increase expected for the 2040 cumulative (no project) scenario and for the 2040 cumulative plus project scenario using the traffic data supplied by Fehr and Peers.[2] All of the predicted noise levels and increases are summarized in Table 9. As indicated in Table 9 and discussed above, noise levels on two roadway segments in the Plan Area would increase by more than 3 dBA L_{dn} with the 2040 cumulative plus project scenario, when compared to the existing traffic conditions: Bordeaux Drive and Geneva Drive. These increases are bolded in the second column to the right of Table 9 to denote their significance with respect to the City's General Plan requirements. Increased traffic on each of these segments result in a future noise level of 60 dBA L_{dn} or greater under the 2040 cumulative plus project conditions. Additionally, the permanent noise level increases would be more than 1 dBA L_{dn} higher than the increases calculated for the 2040 cumulative (no project) scenario. Therefore, both of these segments would result in a cumulatively considerable contribution to the overall traffic noise at the existing noise-sensitive receptors along these roadways. Although there is a significant increase in noise levels predicted as a result of development in the area, no existing noise-sensitive receptors are located along these roadways that would be affected by the increased noise levels. This is a less-than-significant impact.

Implementation Policy SN 10.1 the City's General Plan would require that the roadway improvements proposed by the project be reviewed for potential noise impacts upon sensitive receptors. Table 10, above, summarizes the noise contour distances to the 60, 65, and 70 dBA L_{dn} contours along each roadway segment within the Plan Area. This table can be used as a guide when refining the alignment of new roadways in order to avoid impacting existing sensitive receptors.

Operational Noise

Various mechanical equipment for heating, ventilation, and cooling purposes, exhaust fans, emergency generators, and other similar equipment could produce noise levels exceeding the maximum noise limits when located near existing or proposed residential land uses. Additionally, potential noise-generating sources, such as truck deliveries or other project-specific noise sources, may also be proposed at the project-level. The number of variables inherent in the mechanical equipment needs of an individual project (number and types of units, locations, size, housing, specs, etc.), as well as details pertaining to project-specific noise sources, are unavailable at this time. The impacts of operational noise sources on nearby noise-sensitive uses should be assessed during the final design stage of individual projects.

Impact 3.6.1 of the LUTE states that new developments would be required to comply with City noise standards set forth in the General Plan and Municipal Code. To ensure compliance with the noise levels required by the LUTE and Municipal Code (Title 19, Chapter 19.42.030), a qualified acoustical consultant will be retained to review mechanical equipment systems during final design of the proposed project consistent with standards City practice. The consultant shall review selected equipment and determine specific noise reduction measures necessary to reduce noise to comply with the City's noise level requirements. Noise reduction measures could include, but are not limited to, selection of equipment that emits low noise levels and/or installation of noise barriers, such as enclosures and parapet walls, to block the line-of-sight between the noise source

and the nearest receptors. Additionally, enclosures and interior wall treatments shall be considered to reduce noise exposure within the on-site units. Alternate measures may include locating equipment in less noise-sensitive areas, where feasible. The measures recommended by the acoustical consultant to ensure compliance with the City's requirements would be implemented as project conditions of approval, and therefore, this would be a less-than-significant impact.

Summary of Project-Generated Noise

The City of Sunnyvale General Plan provides goals and policies to reduce operational and transportation noise at sensitive receptors. Goal SN-9 and associated Policies SN-9.1, SN-9.2, and SN-9.3 regulate all operational noise, single-event noises, and hours of operation to that address complaints and concerns for certain activities and powered equipment that are noise-producing. When combined with mitigation for Impact 3.6.1 of the LUTE, operational noise generated by the proposed Specific Plan would be less-than-significant.

Goal SN-10 and Policy SN-10.1 helps maintain or reduce transportation noise along major roadways. Actionable items provided under this policy help to identify and mitigate roadway noise impacts; regulate the location, design and capacity of local roadway improvement projects; encourage the use of local traffic management techniques to reduce or protect noise levels; and support state legislation to reduce vehicle noise levels. In accordance with the General Plan goal and policy, project-specific mitigation may be required along roadway segments in the Plan Area that would result in a 3 dBA increase over existing conditions and may result in a cumulatively considerable contribution to the overall noise environment. Since there are no existing noise-sensitive receptors located along the roadways identified with a substantial noise level increase, this is a less-than-significant impact.

Mitigation Measure 1b: No additional measures are required.

Impact 2: Exposure to Excessive Groundborne Vibration due to Construction. Construction-related vibration caused by some types of construction activity could be in excess of 0.25 in/sec PPV at the existing residences located adjacent to the project site. The incorporation of construction vibration controls as a condition of approval would result in a **less-than-significant impact.**

The construction of the project may generate vibration when heavy equipment or impact tools (e.g., jackhammers, hoe rams) are used. Construction activities would include grading, foundation work, paving, and new building framing and finishing. Detailed information regarding construction equipment and phasing are not available at this time. Therefore, impact or vibratory pile driving activities, which can cause excessive vibration, may be required for the projects within the Plan Area.

The California Department of Transportation recommends a vibration limit of 0.5 in/sec PPV for buildings structurally sound and designed to modern engineering standards, which typically consist of buildings constructed since the 1990s. Conservative vibration limits of 0.25 to 0.3 in/sec PPV has been used for buildings that are found to be structurally sound but where structural damage is a major concern (see Table 3 above for further explanation). For historical buildings or

buildings that are documented to be structurally weakened, a cautious limit of 0.08 in/sec PPV is often used to provide the highest level of protection. No historical buildings or buildings that are documented to be structurally weakened adjoin the project site. For the purposes of this study, groundborne vibration levels exceeding the conservative 0.08 in/sec PPV at historical buildings and 0.25 in/sec PPV limit, which was used in the LUTE, at nonhistorical buildings in the project vicinity would have the potential to result in a significant vibration impact.

Table 14 presents typical vibration levels that could be expected from construction equipment at a distance of 25 feet, as well as distances to the 0.08 in/sec PPV threshold for historical buildings and to the 0.25 in/sec PPV threshold for nonhistorical buildings. Project construction activities, such as drilling, the use of jackhammers, rock drills and other high-power or vibratory tools, and rolling stock equipment (tracked vehicles, compactors, etc.), may generate substantial vibration in the immediate vicinity. Jackhammers typically generate vibration levels of 0.035 in/sec PPV, and drilling typically generates vibration levels of 0.09 in/sec PPV at a distance of 25 feet. Vibration levels would vary depending on soil conditions, construction methods, and equipment used.

Pile driving has the potential of generating the highest ground vibration levels and is of primary concern to architectural damage, particularly when it occurs within 100 to 200 feet of structures. Vibration levels generated by pile driving activities would vary depending on project conditions, such as soil conditions, construction methods, and equipment used, but could exceed the recommended PPV thresholds to avoid architectural damage. Other project construction activities, such as caisson drilling, the use of jackhammers, rock drills and other high-power or vibratory tools, and rolling stock equipment (tracked vehicles, compactors, etc.), may also potentially generate substantial vibration in the immediate vicinity.

Depending on the proximity of existing structures to each construction site, the structural soundness of the existing buildings, and the methods of construction used, vibration levels may be high enough to damage existing structures. Given the scope of the proposed project and the location of Area Plan with respect to existing structures in the immediate vicinity (i.e., within 200 feet), groundborne vibration impacts would be potentially significant.

As with any type of construction, vibration levels may at times be perceptible. However, construction phases that have the highest potential of producing vibration (pile driving and use of jackhammers and other high-power tools) would be intermittent and would only occur for short periods of time for any individual project site. The City of Sunnyvale General Plan and Municipal Code do not address construction vibration. By use of administrative controls, such as notifying neighbors of scheduled construction activities and scheduling construction activities with the highest potential to produce perceptible vibration to hours with least potential to affect nearby businesses, perceptible vibration can be kept to a minimum and as such would not result in a significant impact with respect to perception.

TABLE 14 Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 ft. (in/sec)	Minimum Distance to Meet 0.08 in/sec PPV (feet)	Minimum Distance to Meet 0.25 in/sec PPV (feet)
Pile Driver (Impact)	upper range	1.158	271	100
	typical	0.644	160	59
Pile Driver (Sonic)	upper range	0.734	180	66
	typical	0.170	48	18
Clam shovel drop		0.202	56	21
Hydromill (slurry wall)	in soil	0.008	3	2
	in rock	0.017	6	3
Vibratory Roller		0.210	58	21
Hoe Ram		0.089	27	10
Large bulldozer		0.089	27	10
Caisson drilling		0.089	27	10
Loaded trucks		0.076	23	9
Jackhammer		0.035	12	5
Small bulldozer		0.003	2	1

Source: Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, September 2018, modified by Illingworth & Rodkin, Inc. July 2022.

To address potential impacts related to vibration, the project will implement, as part of its Noise Control Plan required by LUTE EIR mitigation measure **MM 3.6.3**, the following additional vibration controls:

- Comply with the construction noise ordinance to limit hours of exposure. The City's Municipal Code allows construction activities between the hours 7:00 a.m. and 6:00 p.m. on weekdays and between 8:00 a.m. and 5:00 p.m. on Saturdays. Construction activity is not permitted on Sundays or federal holidays when the City offices are closed.

- Prohibit the use of heavy vibration-generating construction equipment within 25 feet of residences. Use a smaller vibratory roller, such as the Caterpillar model CP433E vibratory compactor, when compacting materials within 25 feet of residences adjoining the site.

- Avoid dropping heavy equipment within 25 feet of residences. Use alternative methods for breaking up existing pavement, such as a pavement grinder, instead of dropping heavy objects within 25 feet of residences adjoining the site.

- The contractor shall alert heavy equipment operators to the close proximity of the adjacent structures so they can exercise extra care.

- For projects requiring impact or vibratory pile driving, a Construction Vibration Monitoring, Treatment, and Reporting Plan shall be implemented to document conditions prior to, during, and after vibration-generating construction activities. All plan tasks shall be undertaken under

the direction of a licensed Professional Structural Engineer in the State of California and be in accordance with industry-accepted standard methods. The construction vibration monitoring plan shall include, but not be limited to, the following measures:

- Document conditions at all structures located within 100 feet of pile driving activities and at historic structures located within 275 feet of pile driving activities prior to, during, and after vibration-generating construction activities. All plan tasks shall be undertaken under the direction of a licensed Professional Structural Engineer in the State of California and be in accordance with industry-accepted standard methods. Specifically:

    - Vibration limits shall be applied to vibration-sensitive structures located within 100 feet of any high impact construction activities, such as pile driving, and 275 feet of historic buildings.

    - Performance of a photo survey, elevation survey, and crack monitoring survey for each structure of normal construction within 100 feet of any high impact construction activities and each historic structure within 275 feet of pile driving activities. Surveys shall be performed prior to any construction activity, in regular intervals during construction, and after project completion, and shall include internal and external crack monitoring in structures, settlement, and distress, and shall document the condition of foundations, walls and other structural elements in the interior and exterior of said structures.

- Develop a vibration monitoring and construction contingency plan to identify structures where monitoring would be conducted, set up a vibration monitoring schedule, define structure-specific vibration limits, and address the need to conduct photo, elevation, and crack surveys to document before and after construction conditions. Construction contingencies shall be identified for when vibration levels approached the limits.

- At a minimum, vibration monitoring shall be conducted during all pile driving activities.

- If vibration levels approach limits, suspend construction and implement contingency measures to either lower vibration levels or secure the affected structures.

- Designate a person responsible for registering and investigating claims of excessive vibration. The contact information of such person shall be clearly posted on the construction site.

- Conduct a post-construction survey on structures where either monitoring has indicated high vibration levels or complaints of damage has been made. Make appropriate repairs or compensation where damage has occurred as a result of construction activities.

The Noise Control Plan, including the above-listed measures will be implemented as a project condition of approval, consistent with the City's standard practice. The implementation of the

Noise Control Plan with these construction vibration controls would reduce the impact to a less-than-significant level.

Mitigation Measure 2: **No further mitigation required.**

APPENDIX

FIGURE A1 Daily Trend in Noise Levels at LT-1, Tuesday, February 25, 2020

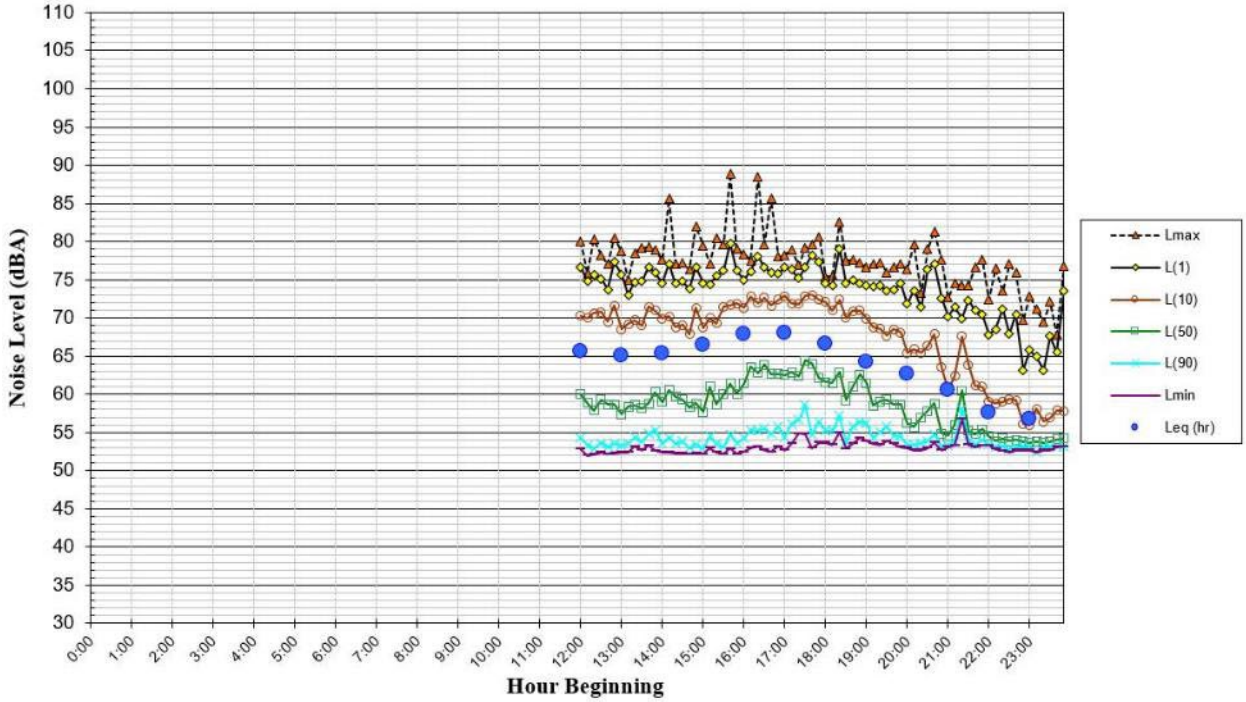


FIGURE A2 Daily Trend in Noise Levels at LT-1, Wednesday, February 26, 2020

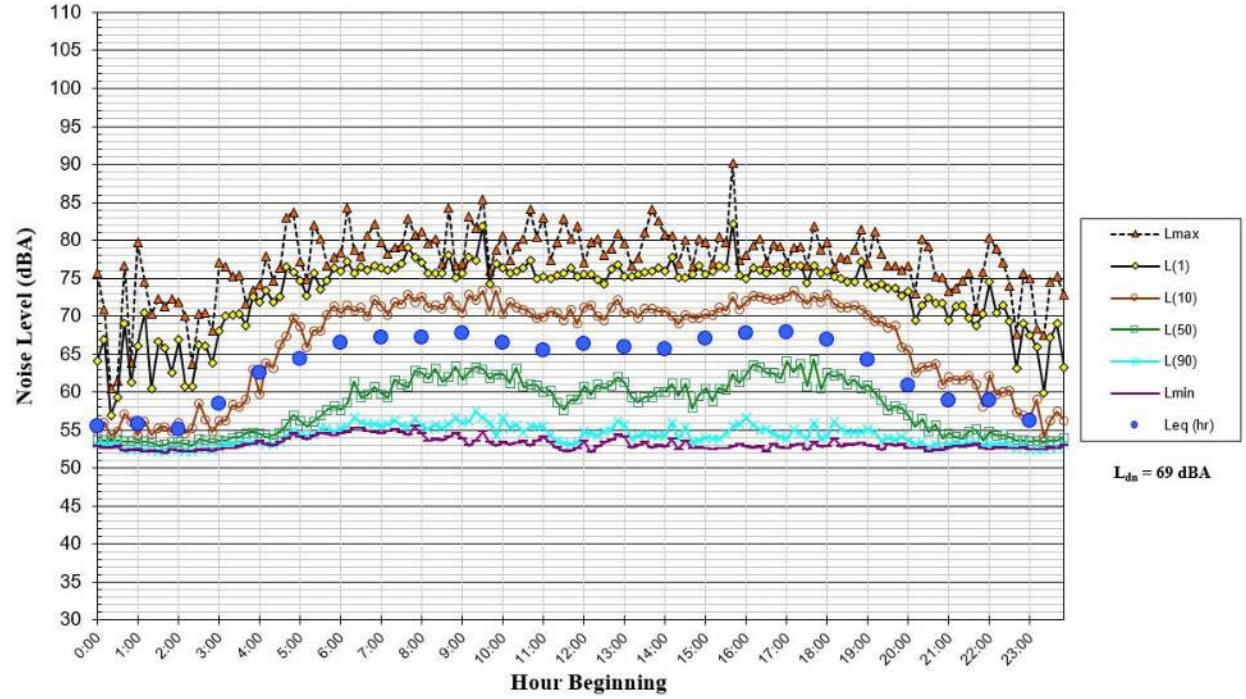


FIGURE A3 Daily Trend in Noise Levels at LT-1, Thursday, February 27, 2020

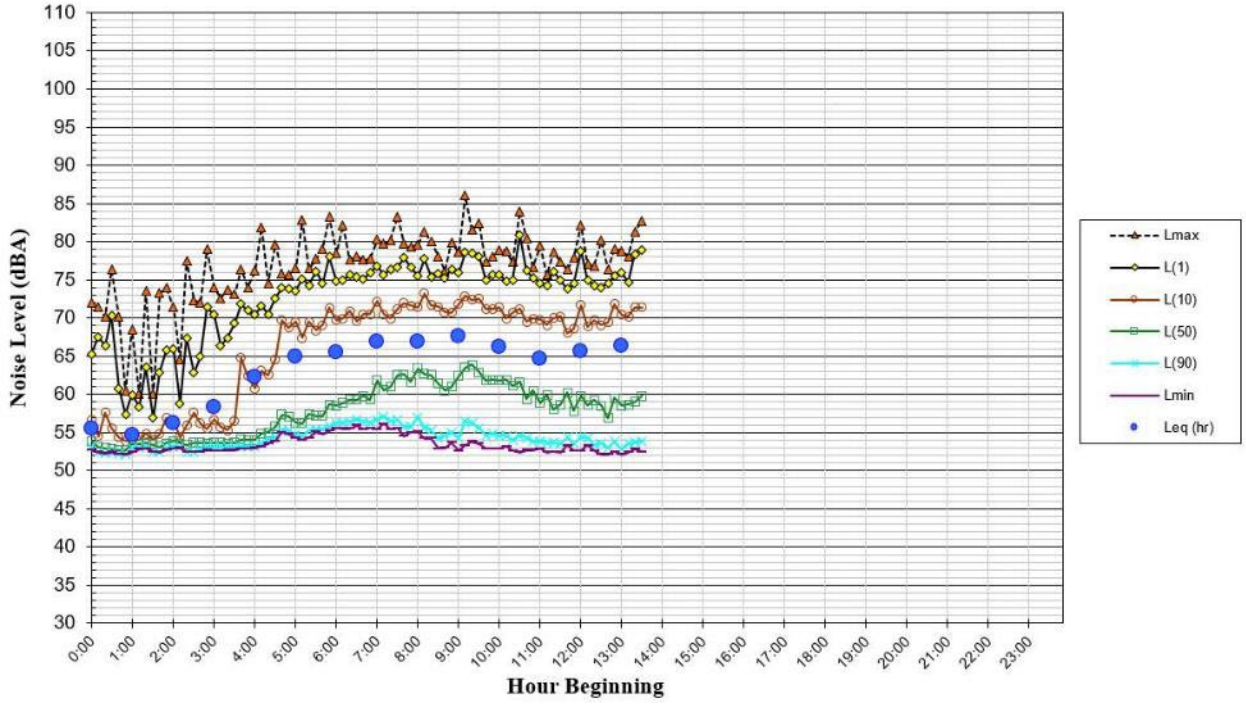


FIGURE A4 Daily Trend in Noise Levels at LT-2, Tuesday, February 25, 2020

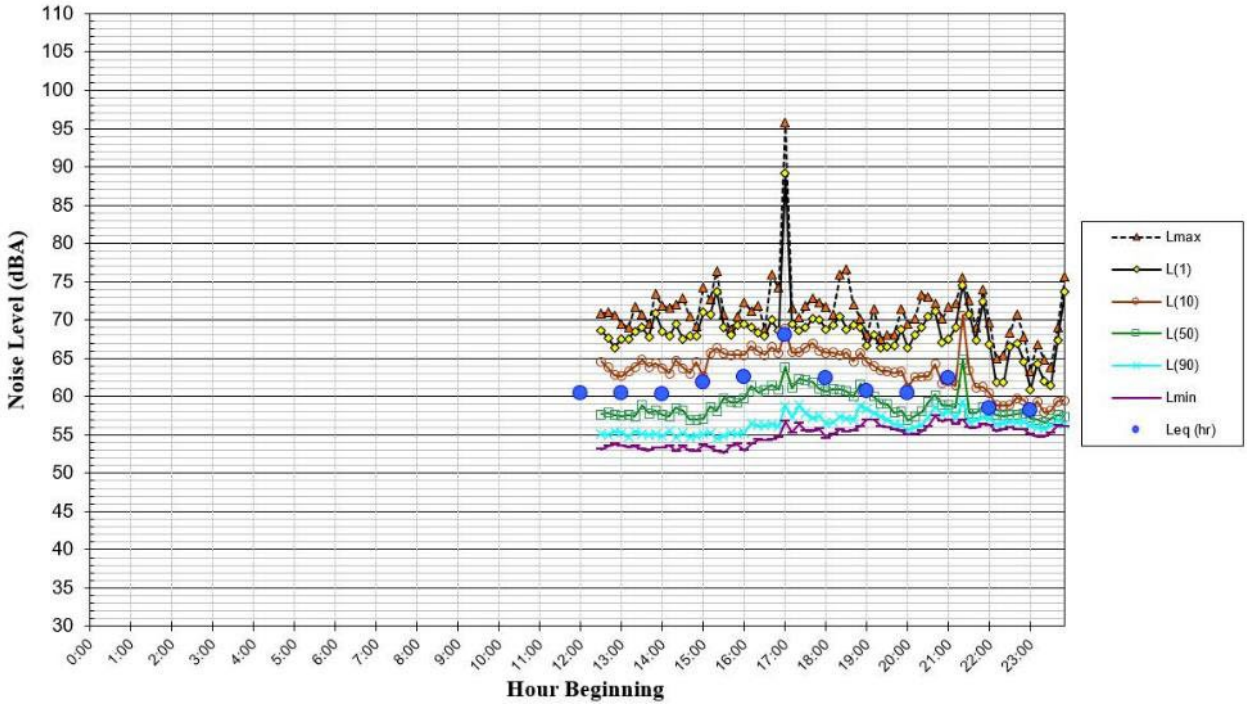


FIGURE A5 Daily Trend in Noise Levels at LT-2, Wednesday, February 26, 2020

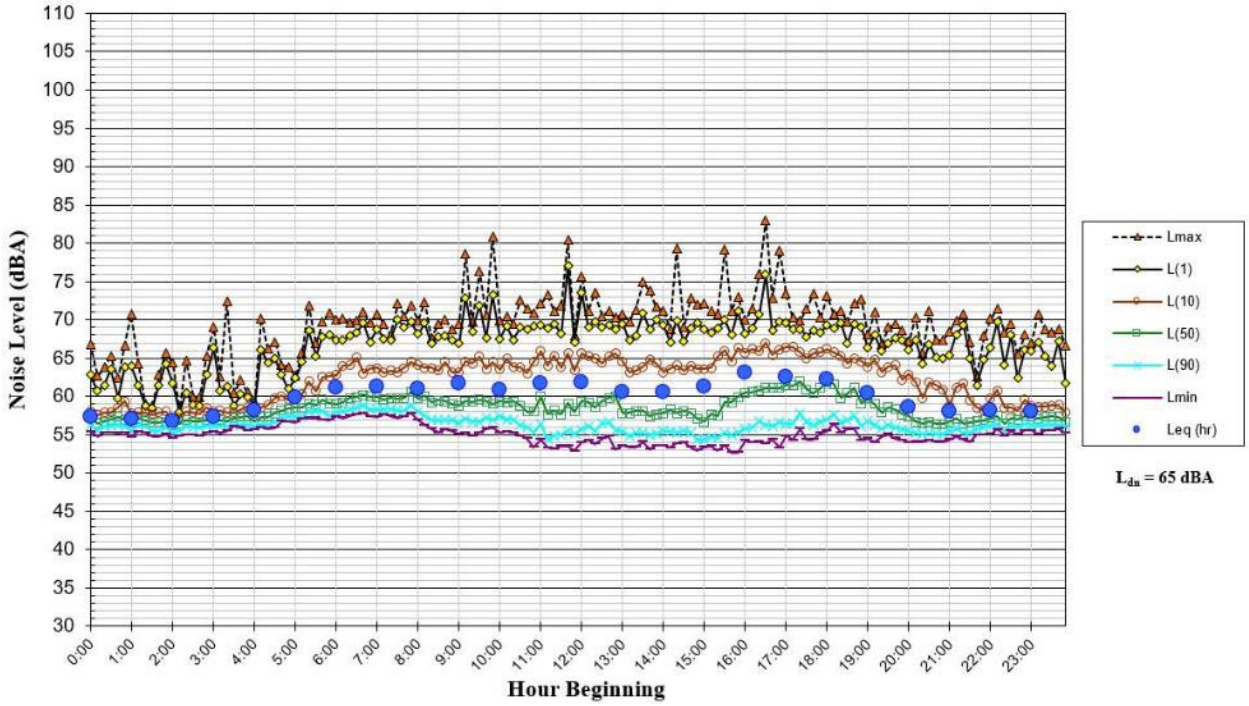


FIGURE A6 Daily Trend in Noise Levels at LT-2, Thursday, February 27, 2020

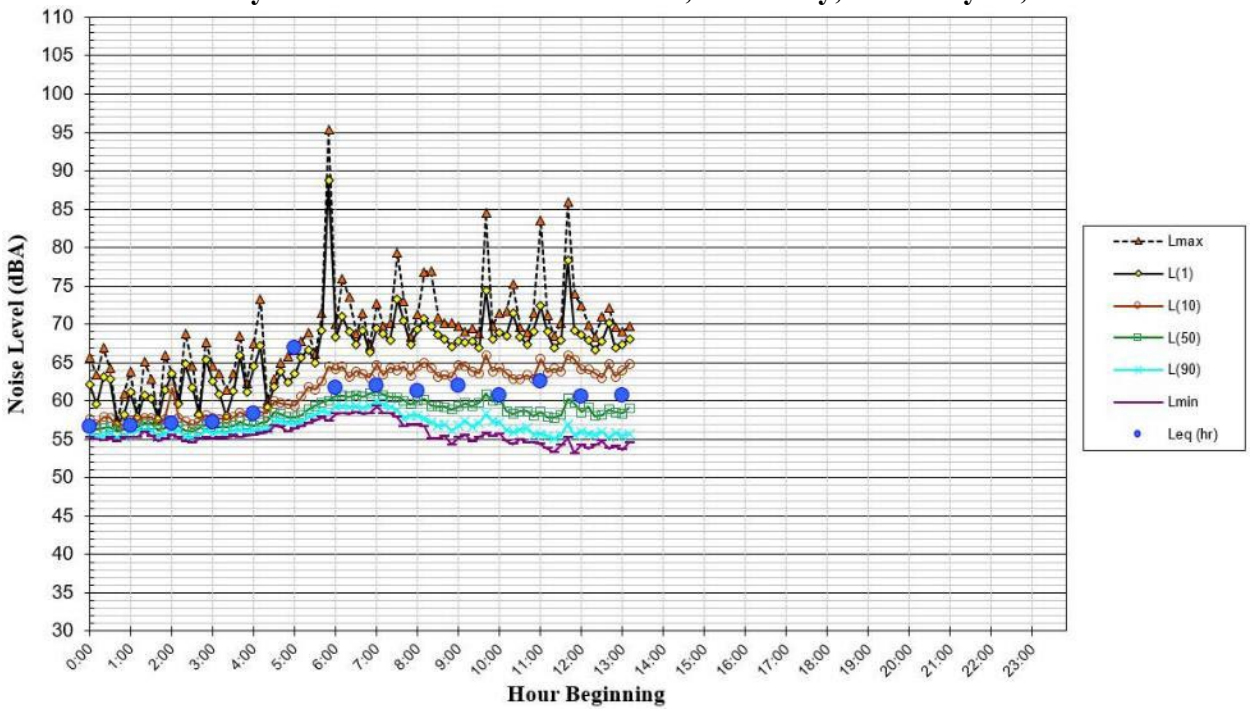


FIGURE A7 Daily Trend in Noise Levels at LT-3, Tuesday, February 25, 2020

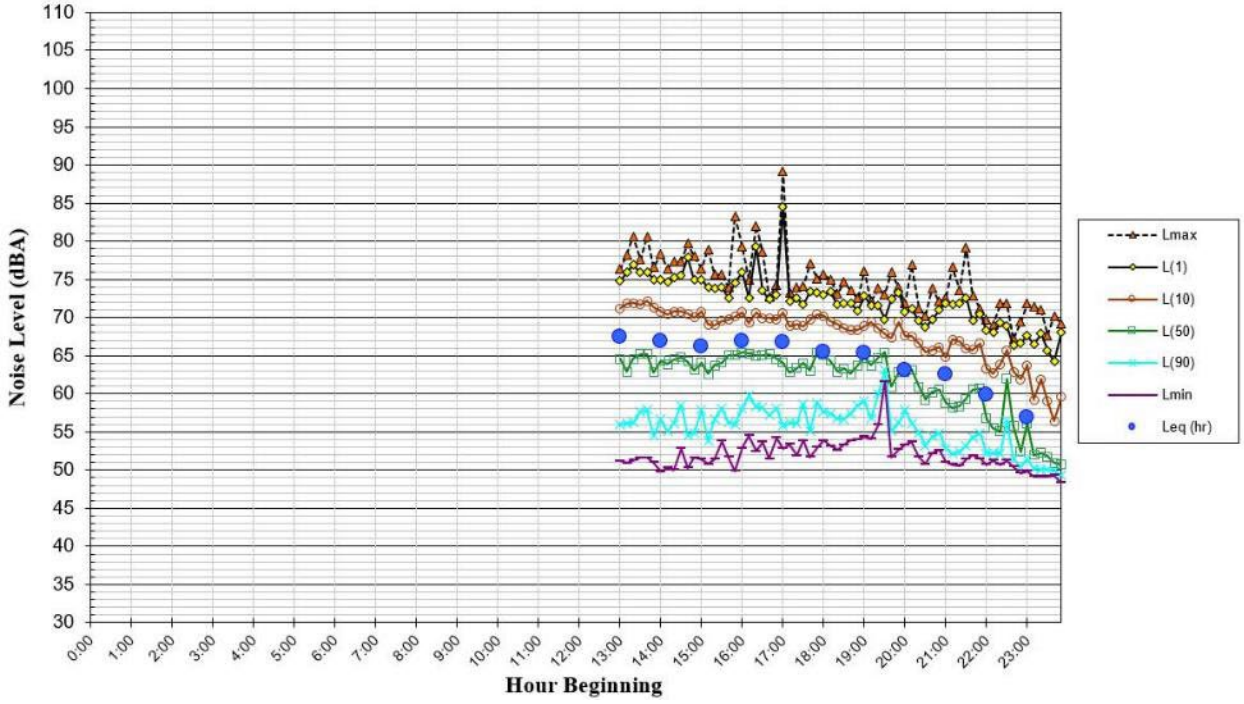


FIGURE A8 Daily Trend in Noise Levels at LT-3, Wednesday, February 26, 2020

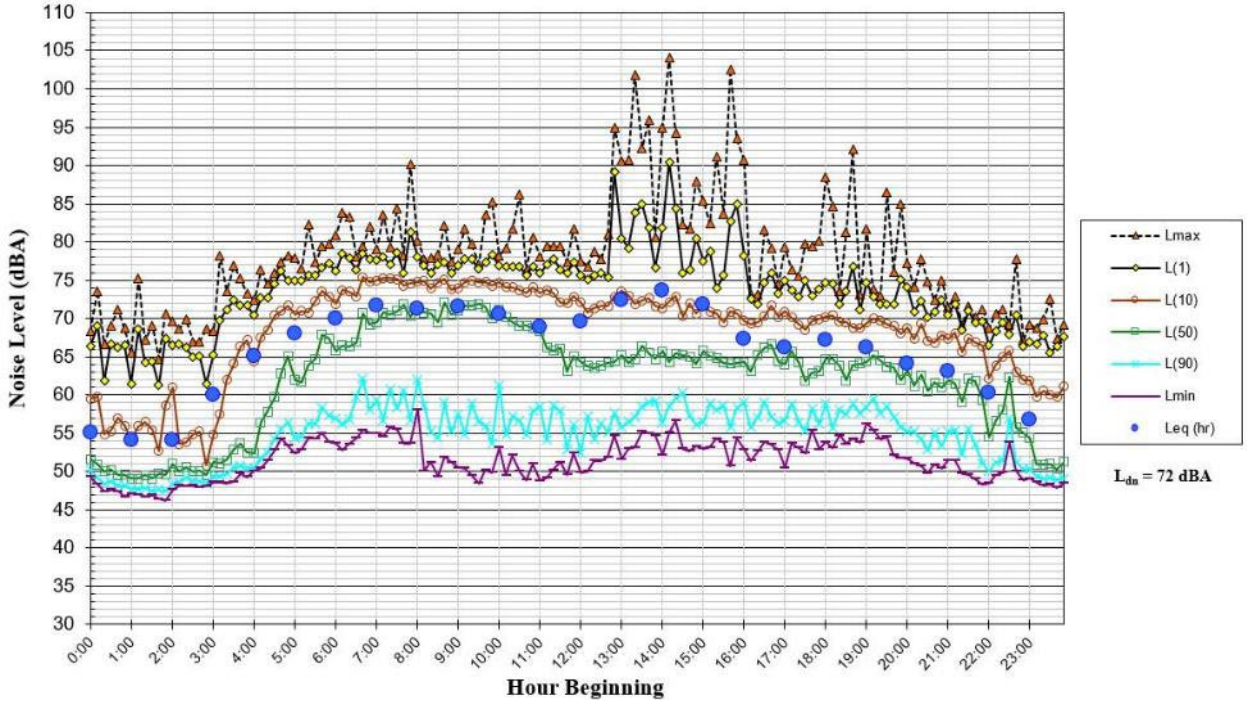


FIGURE A9 Daily Trend in Noise Levels at LT-3, Thursday, February 27, 2020

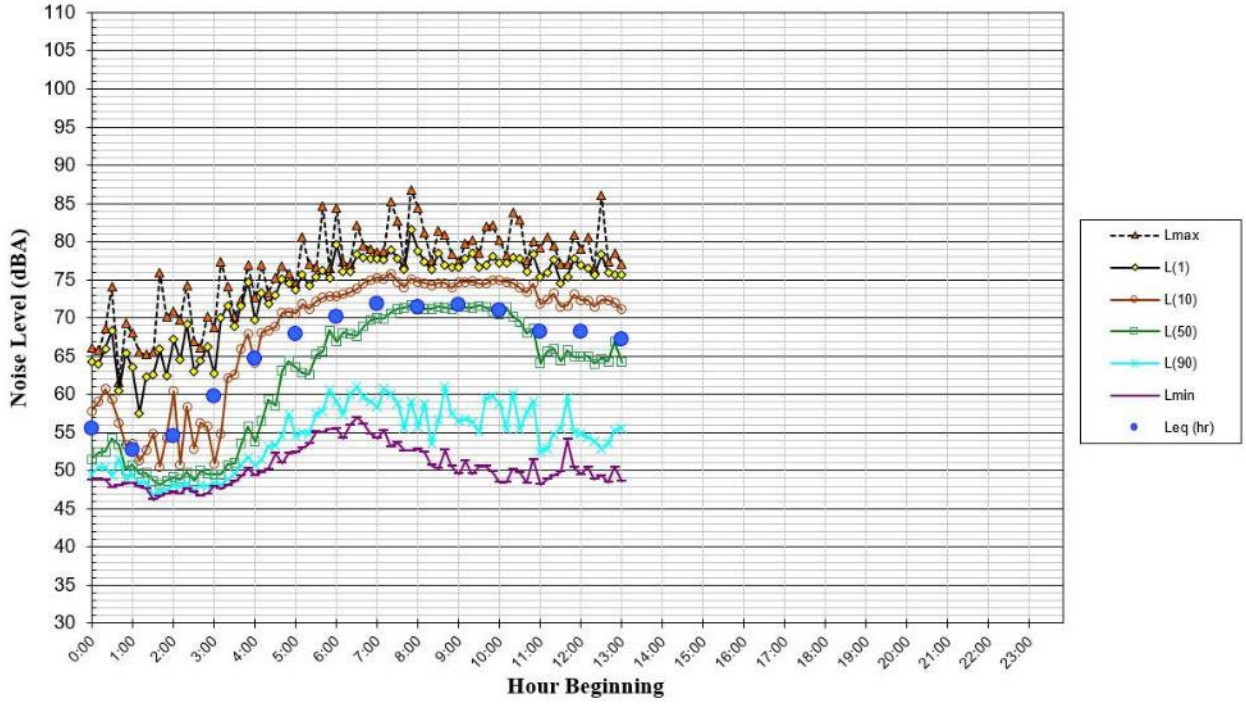


FIGURE A10 Daily Trend in Noise Levels at LT-4, Tuesday, February 25, 2020

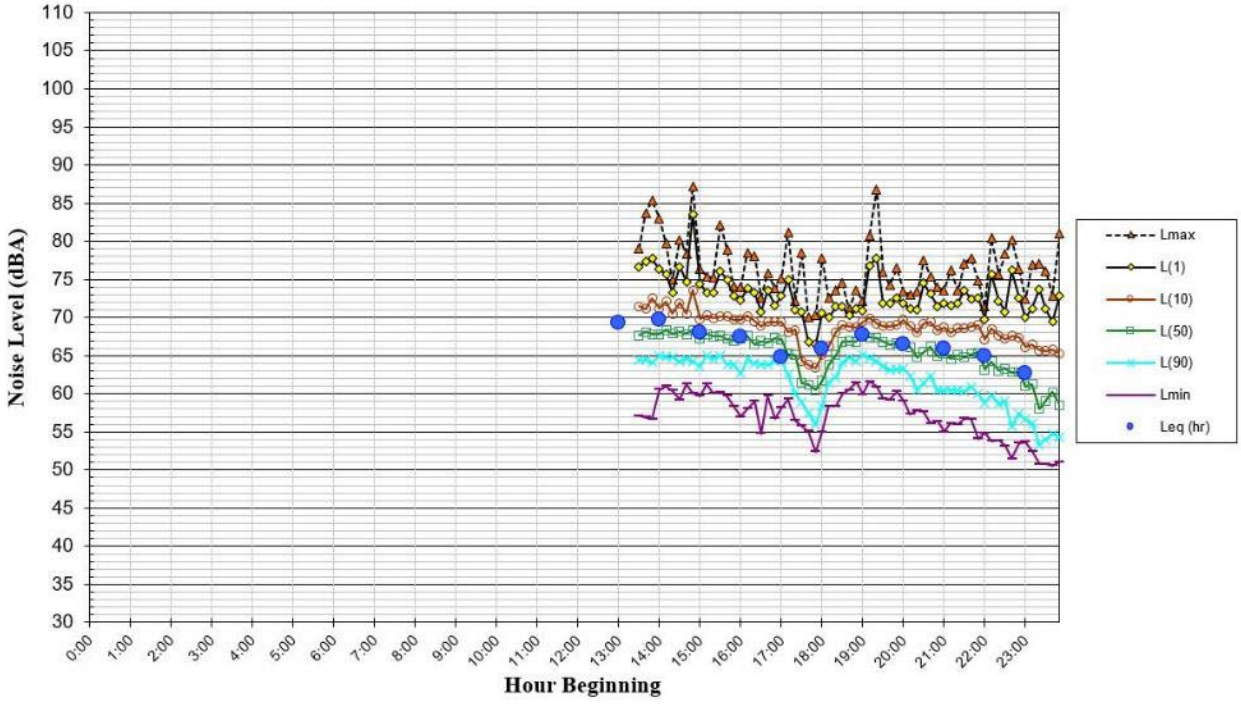


FIGURE A11 Daily Trend in Noise Levels at LT-4, Wednesday, February 26, 2020

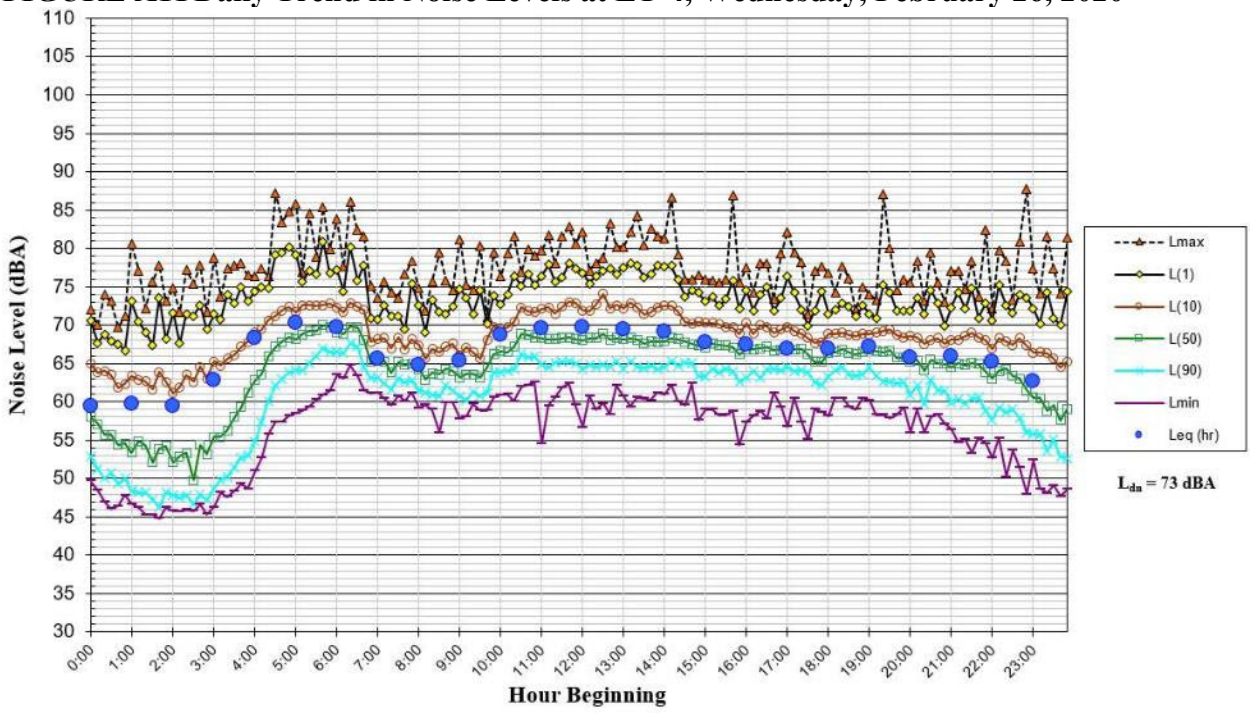


FIGURE A12 Daily Trend in Noise Levels at LT-4, Thursday, February 27, 2020

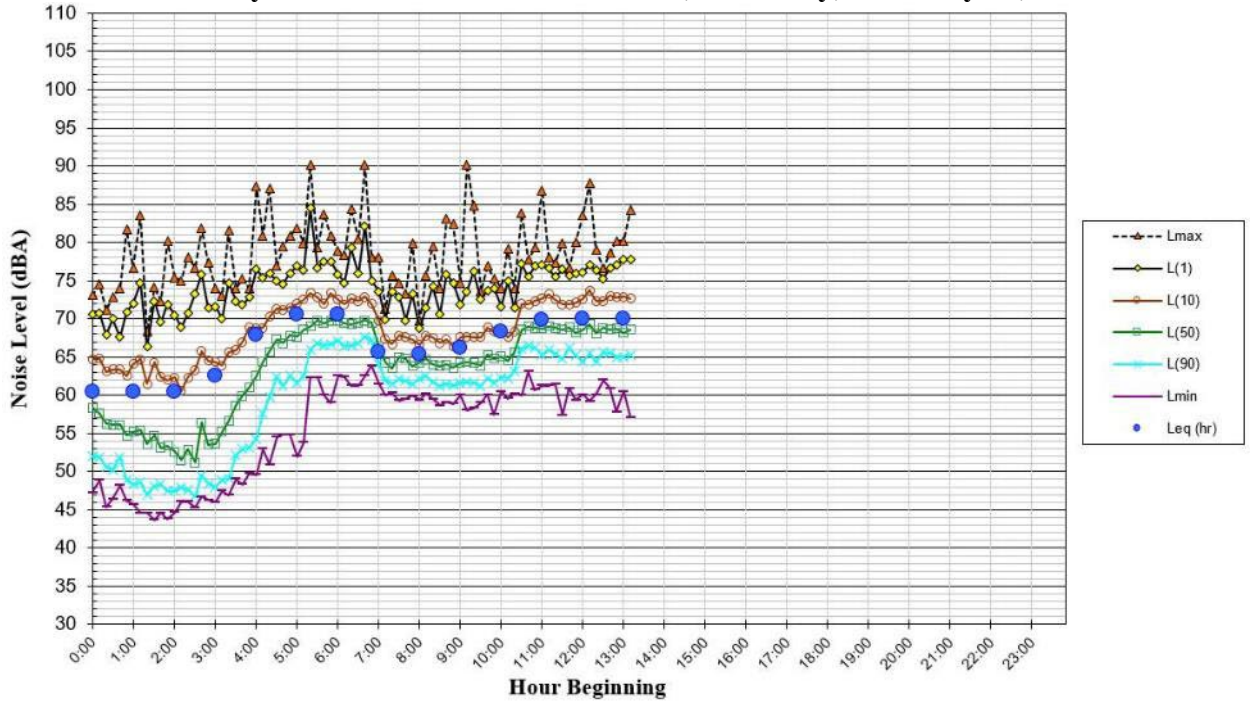


FIGURE A13 Daily Trend in Noise Levels at LT-5, Thursday, February 27, 2020

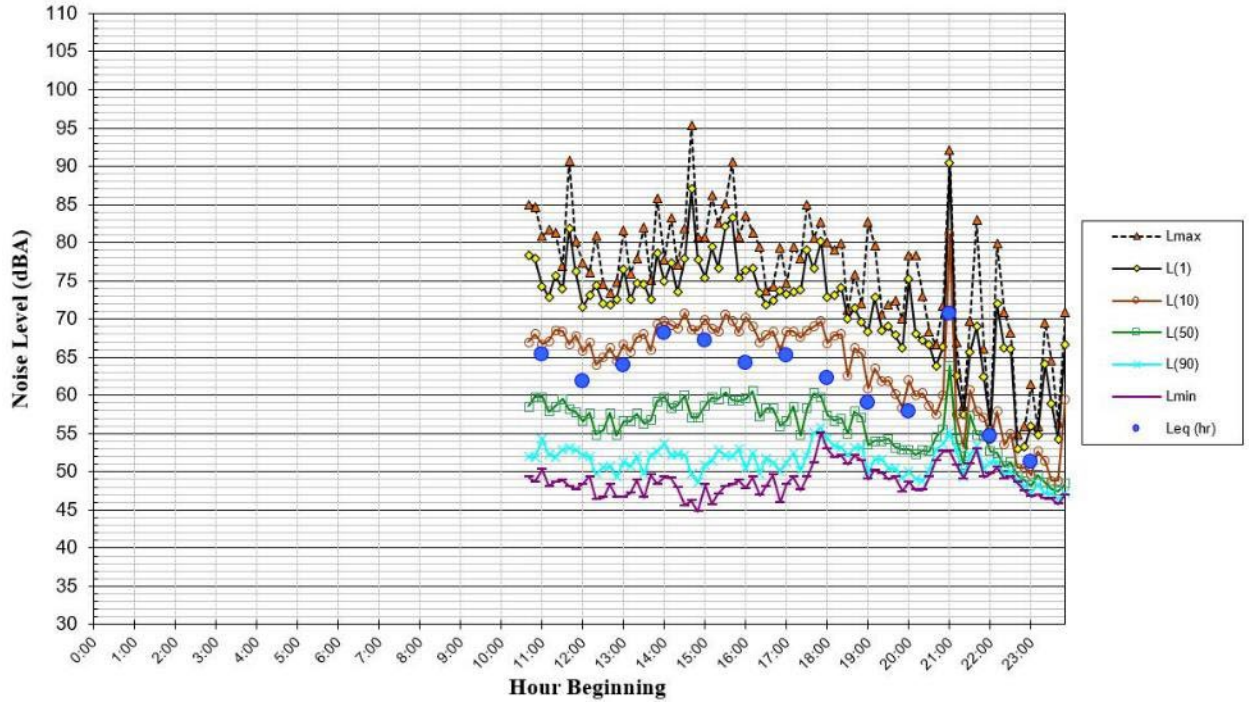


FIGURE A14 Daily Trend in Noise Levels at LT-5, Friday, February 28, 2020

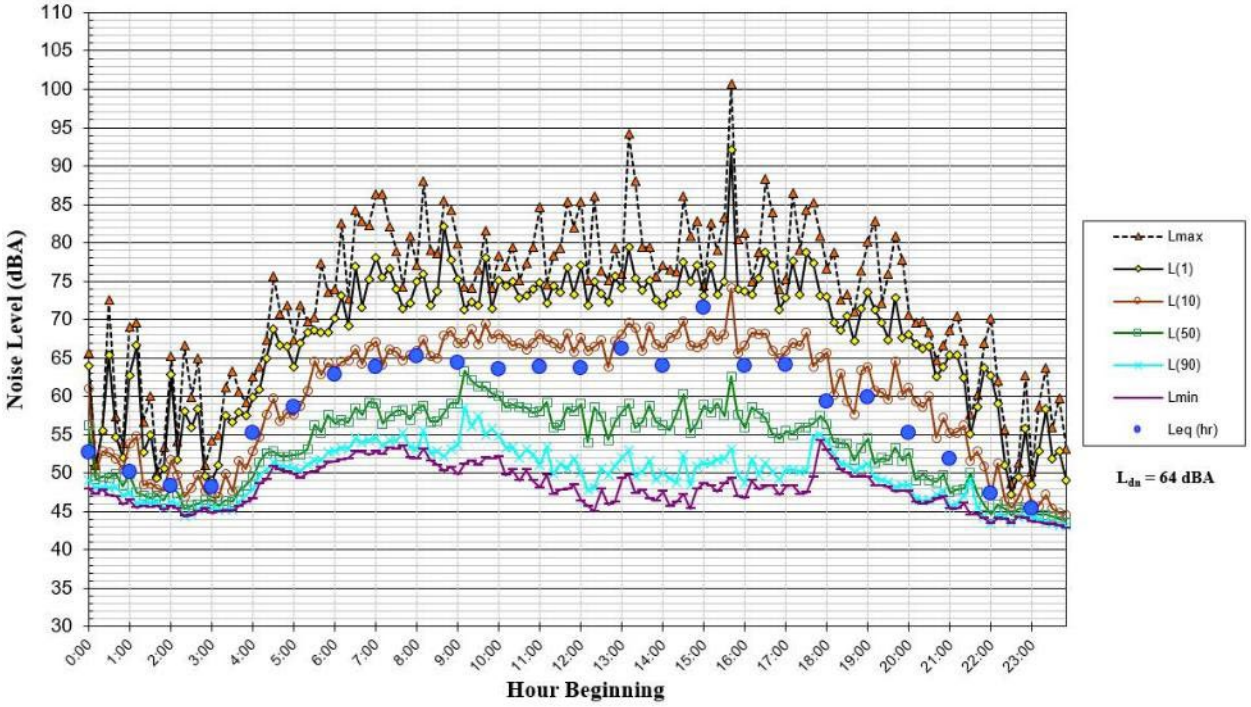


FIGURE A15 Daily Trend in Noise Levels at LT-5, Saturday, February 29, 2020

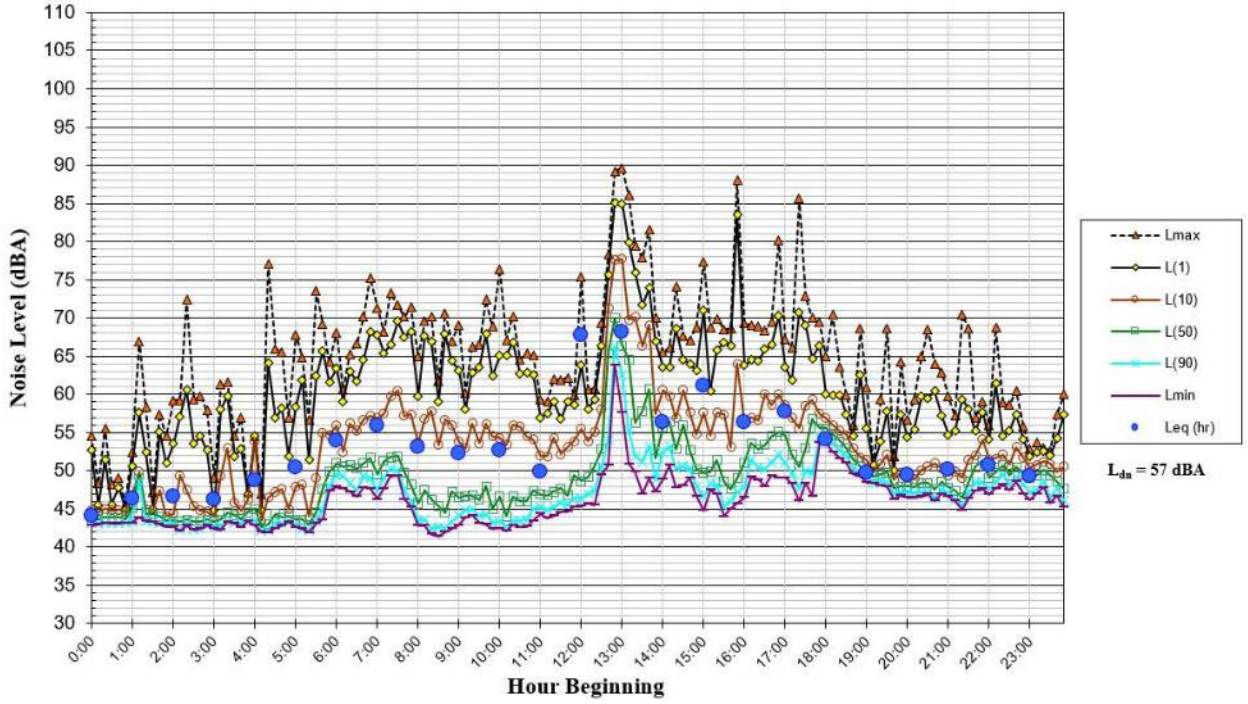


FIGURE A16 Daily Trend in Noise Levels at LT-5, Sunday, March 1, 2020

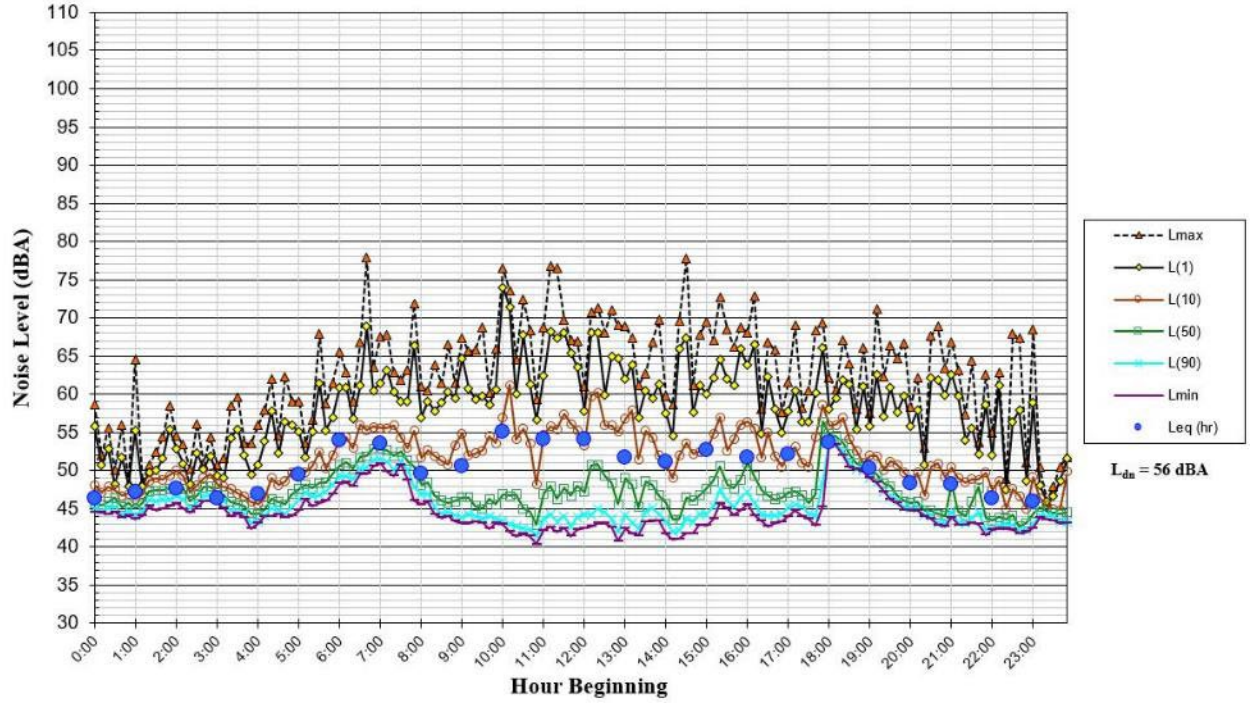


FIGURE A17 Daily Trend in Noise Levels at LT-5, Monday, March 2, 2020

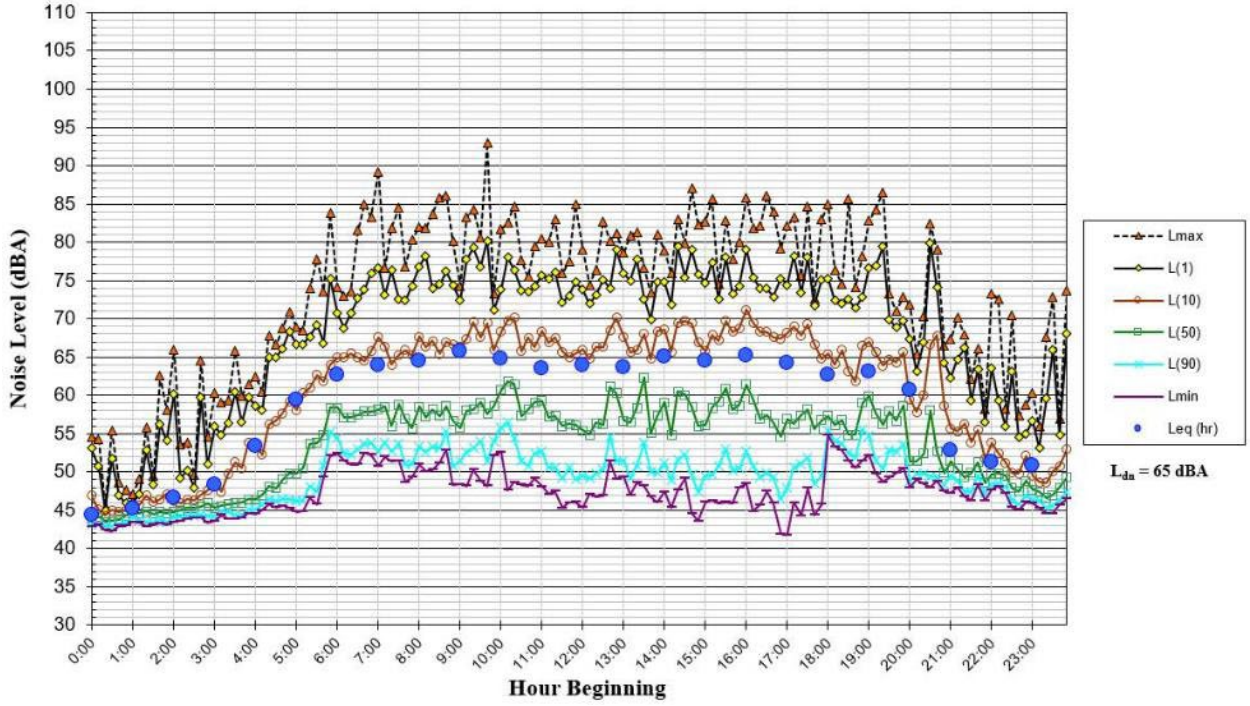


FIGURE A18 Daily Trend in Noise Levels at LT-5, Tuesday, March 3, 2020