MOFFETT PARK SPECIFIC PLAN NOISE AND VIBRATION CONSTRAINTS ANALYSIS

Sunnyvale, California

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Prepared for:

Kristy Weis
Principal Project Manager
David J. Powers & Associates, Inc.
1871 The Alameda, Suite 200
San José, CA 95123

Prepared by:

Carrie J. Janello and
Michael S. Thill

ILLINGWORTH & RODKIN, INC.
Acoustics • Air Quality
429 East Cotati Avenue
Cotati, CA 94931
(707) 794-0400

Project: 19-226

INTRODUCTION

The Moffett Park Specific Plan (MPSP) area consists of the northernmost developable portion of the City of Sunnyvale, located north of State Route 237 (SR 237) and east of the Moffett Federal Airfield. The MPSP is intended to support and encourage office/industrial and companion uses through the use of design guidelines, infrastructure improvements, development standards, and objectives for future development. Uses in the MPSP area include research and development, manufacturing, office, light and heavy industrial, and supporting uses, such as hotels and retail. The City Council of Sunnyvale approved a General Plan Amendment Initiation request for the MPSP in February 2018.

This report presents the results of the noise and vibration constraints analysis completed for the MPSP. The report includes two sections: 1) the Setting section provides a brief description of the fundamentals of environmental noise and groundborne vibration, summarizes applicable regulatory criteria, and discusses the results of the ambient noise monitoring survey completed for this project and a review of noise data collected for other recent project within the MPSP area; and 2) the Opportunities and Constraints Analysis section provides noise contour maps for existing noise conditions, identifies problematic areas for potential residential uses, and provides guidance towards the design and planning effort.

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 1.

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 2. 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* (L_{dn} or *DNL*) 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}/CNEL. Typically, the highest steady traffic noise level during the daytime is about equal to the L_{dn}/CNEL 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 12-17 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 57-62 dBA L_{dn}/CNEL with open windows and 65-70 dBA L_{dn}/CNEL if the windows are closed. Levels of 55-60 dBA are common along collector streets and secondary arterials, while 65-70 dBA is a typical value for a primary/major arterial. Levels of 75-80 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}/CNEL 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}/CNEL. At a L_{dn}/CNEL of about 60 dBA, approximately 12 percent of the population is highly annoyed. When the L_{dn}/CNEL increases to 70 dBA, the percentage of the population highly annoyed increases to about 25-30 percent of the population. There is, therefore, an increase of about 2 percent per dBA between a L_{dn}/CNEL of 60-70 dBA. Between a L_{dn}/CNEL of 70-80 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}/CNEL is 60 dBA, approximately 30-35 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.

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 3 displays the reactions of people and the effects on buildings that continuous vibration levels produce.

The annoyance levels shown in Table 3 should be interpreted with care since vibration may be found to be annoying at much 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.

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 induce structural 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. Studies have shown that the threshold of perception for average persons is in the range of 0.008 to 0.012 in/sec PPV. 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.

Damage caused by vibration can be classified as cosmetic or structural. Cosmetic damage includes minor cracking of building elements (exterior pavement, room surfaces, etc.). Structural damage includes threatening the integrity of the building. Damage resulting from construction related vibration is typically classified as cosmetic damage. Safe vibration limits that can be applied to assess the potential for damaging a structure vary by researcher and there is no general consensus as to what amount of vibration may pose a threat for structural damage to the building. 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.

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 has been correlated best with the velocity of the ground. The velocity of the ground is expressed on the decibel scale. The reference velocity is 1×10^{-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 4 illustrates some common sources of vibration and the association to human perception or the potential for structural damage.

TABLE 1 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 p.m. and 7:00 a.m.
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 p.m.to 10:00 p.m. and after addition of 10 decibels to sound levels measured in the night between 10:00 p.m. and 7:00 a.m.
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 2 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.

TABLE 3 Reactions 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	Virtually no risk of damage to normal buildings
0.3	Strongly perceptible to severe	Threshold at which there is a risk of damage to older residential dwellings such as plastered walls or ceilings
0.5	Severe - Vibrations considered unpleasant	Threshold at which there is a risk of damage to newer residential structures

Source: Transportation and Construction Vibration Guidance Manual, California Department of Transportation, September 2013.

TABLE 4 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

The State of California and the City of Sunnyvale have established regulatory criteria that are applicable in this assessment. The 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

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 DNL/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 DNL 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.

State CEQA Guidelines. 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; or

(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.

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.

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.

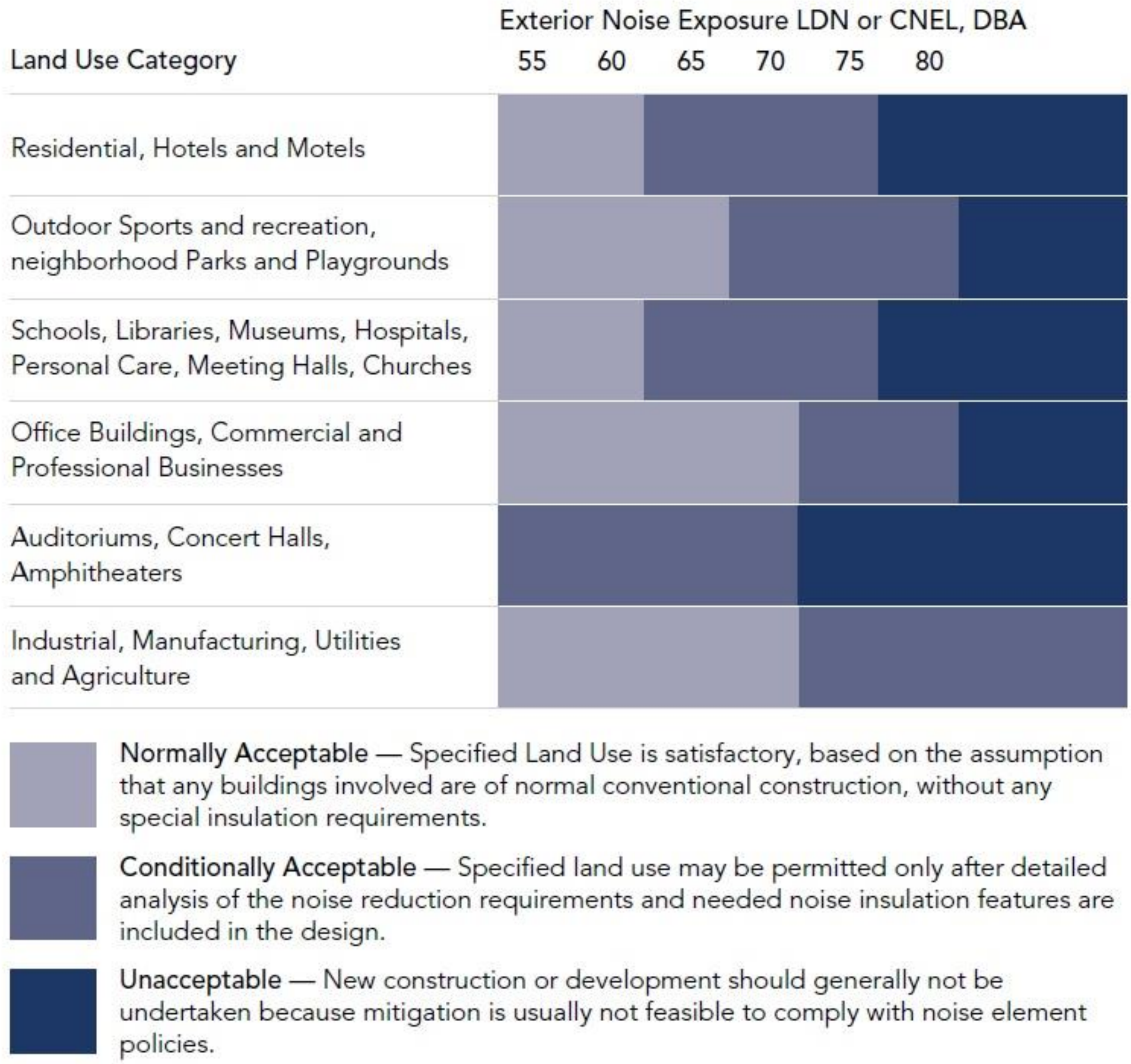
Goal SN-10. Maintained or Reduced Transportation Noise. Preserve and enhance the quality of neighborhoods by maintaining or reducing the levels of noise generated by transportation facilities.

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

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.

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

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

While the State of California and the City of Sunnyvale do not have specific vibration regulations, the U.S. Department of Transportation (DOT) Federal Transit Administration (FTA) has established vibration impact assessment criteria[1] for use in evaluating vibration impacts associated with developments in close proximity to rail lines. 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 5. 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).

TABLE 5 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.

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

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 6.

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 7. During the short-term noise measurements at ST-2, ST-3, and ST-4, construction noise was observed.

Previous Projects

<u>Innovation Hotel Project</u>
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.

<u>160 Persian Drive Project</u>
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 6) because of the presence of a 14- to 16-foot sound wall located along the eastbound shoulder of SR 237.

<u>Google Caribbean Project</u>
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 6 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 7 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 2020.

SoundPLAN Version 8.2, a three-dimensional ray-tracing computer program, was used to develop the traffic noise contours calculated for the existing traffic conditions specific to the Moffett Park Specific Plan project. Existing traffic noise levels were calculated 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, and the topography of the area. In order to provide a worst-case assessment of existing 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 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 to the model. 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. Figure 2 provides existing traffic noise contours for the plan area.

Table 8 summarizes the existing 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 runs east-west, parallel to Manila Drive/West Moffett Park Drive until North Mathilda Avenue where the lines turns 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 rights-of-way are also substantial sources of noise in some areas of the plan area. Passenger and commuter train schedules are fairly consistent on weekdays, with fewer pass-by events occurring on weekends. Measured noise levels at LT-1 and LT-2 would include noise from VTA trains, as well as the vehicular traffic noise. Railroad and light-rail train noise contours are not included on Figure 2.

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).[2] Existing conditions are best represented by the 2022 noise exposure map that was adopted in 2016 and is shown in Figure 3. 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 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).

[2] 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.

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

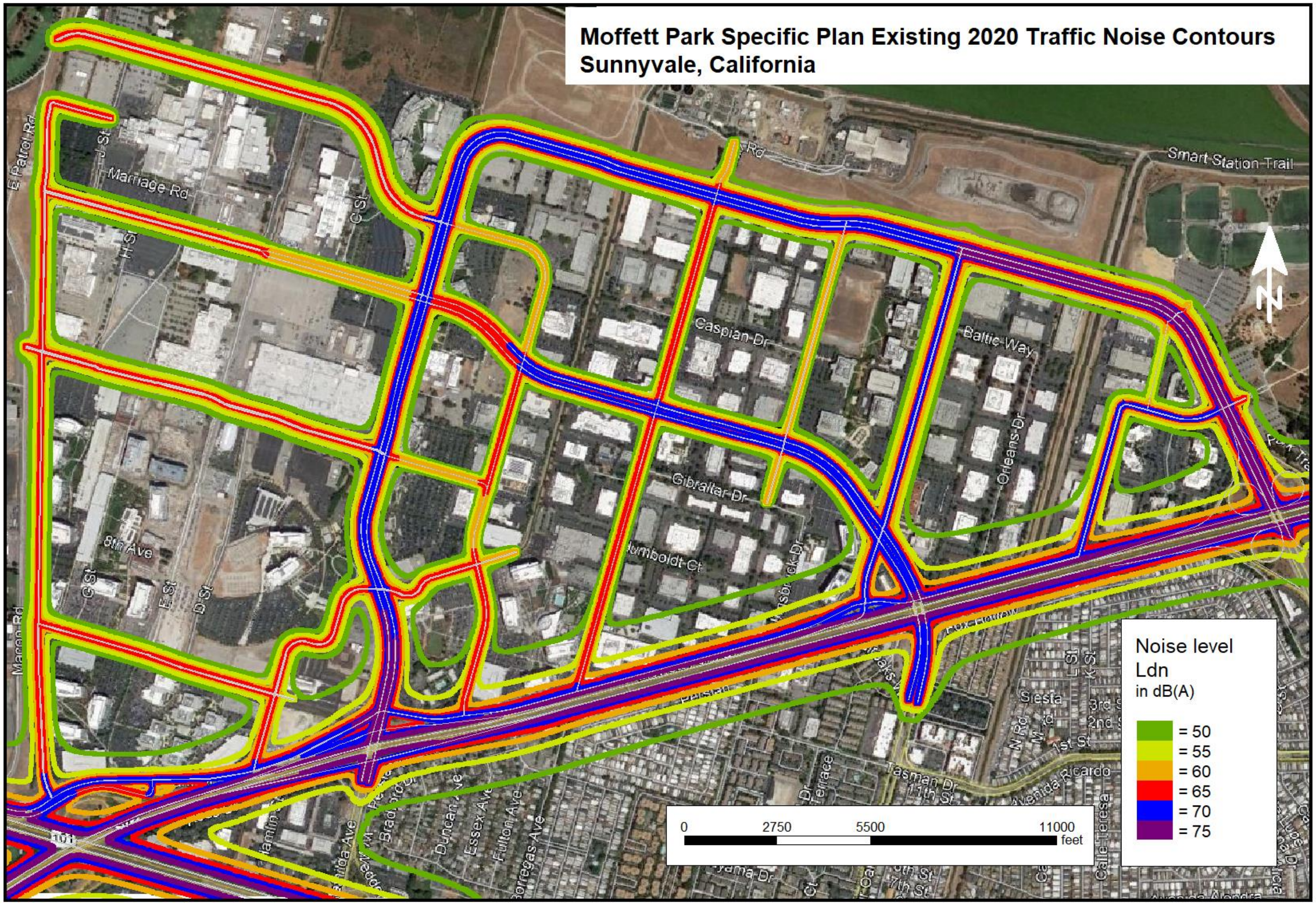


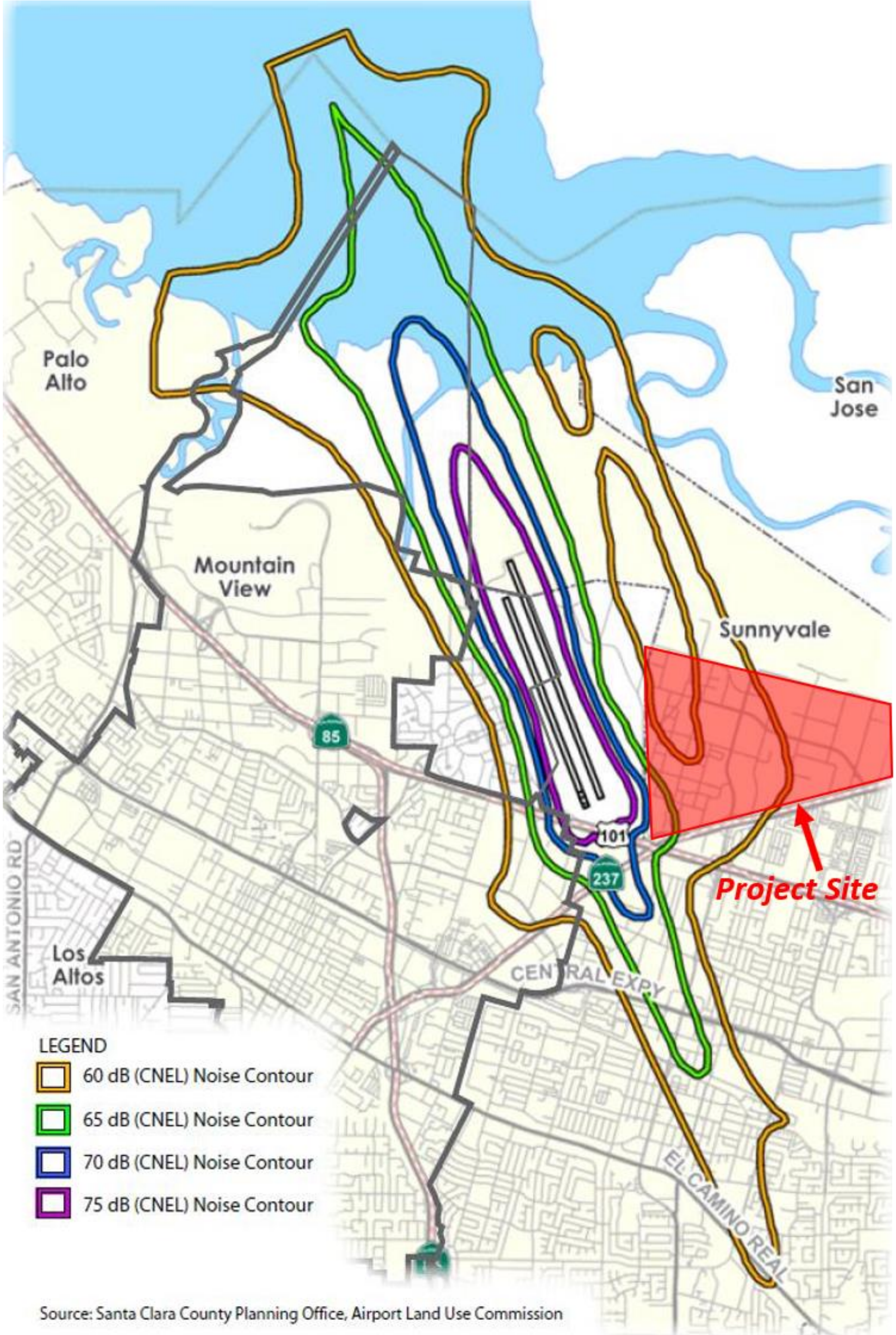
TABLE 8 Existing Modeled Noise Levels Along Surrounding Roadways

Roadway	Segment	Existing L_{dn} at 75 feet from the Roadway Centerline	Distance to 70 dBA L_{dn}	Distance to 60 dBA L_{dn}
1st Avenue	West of North Mathilda Avenue	62 dBA L_{dn}	<50 feet	110 feet
5th Avenue	West of North Mathilda Avenue	61 dBA L_{dn}	<50 feet	90 feet
	North Mathilda Avenue to Bordeaux Drive	57 dBA L_{dn}	<50 feet	<50 feet
11th Avenue	Enterprise Way to Innovation Way	61 dBA L_{dn}	<50 feet	80 feet
	East of Innovation Way	54 dBA L_{dn}	<50 feet	<50 feet
Bordeaux Drive	North Mathilda Avenue to Java Drive	54 dBA L_{dn}	<50 feet	<50 feet
	West Java Drive to 5th Avenue	58 dBA L_{dn}	<50 feet	<50 feet
	5th Avenue to Innovation Way	58 dBA L_{dn}	<50 feet	<50 feet
	Innovation Way to Moffett Park Drive	60 dBA L_{dn}	<50 feet	75 feet
Borregas Avenue	North of Caribbean Drive	56 dBA L_{dn}	<50 feet	<50 feet
	Caribbean Drive to Java Drive	61 dBA L_{dn}	<50 feet	85 feet
	Java Drive to Moffett Park Drive	60 dBA L_{dn}	<50 feet	75 feet
Caribbean Drive (W)	West of Borregas Avenue	66 dBA L_{dn}	<50 feet	200 feet
Caribbean Drive (E)	Borregas Avenue to Crossman Avenue	67 dBA L_{dn}	<50 feet	230 feet
	Crossman Avenue to Twin Creeks Driveway	68 dBA L_{dn}	<50 feet	250 feet
	Twin Creeks Driveway to Moffett Park Drive	68 dBA L_{dn}	<50 feet	255 feet
	East of Moffett Park Drive	69 dBA L_{dn}	55 feet	280 feet
Crossman Avenue	East Caribbean Drive to East Java Drive	64 dBA L_{dn}	<50 feet	150 feet
	East Java Drive to Moffett Park Drive	65 dBA L_{dn}	<50 feet	175 feet
Enterprise Way	North of 11th Avenue	59 dBA L_{dn}	<50 feet	50 feet
	11th Avenue to Manila Drive	62 dBA L_{dn}	<50 feet	110 feet
Geneva Drive	North of East Java Drive	53 dBA L_{dn}	<50 feet	<50 feet
	South of East Java Drive	55 dBA L_{dn}	<50 feet	<50 feet
Innovation Way	West Moffett Park Drive to 11th Avenue	62 dBA L_{dn}	<50 feet	100 feet
	11th Avenue to North Mathilda Avenue	60 dBA L_{dn}	<50 feet	75 feet
	North Mathilda Avenue to Bordeaux Drive	60 dBA L_{dn}	<50 feet	75 feet
	East of Bordeaux Drive	55 dBA L_{dn}	<50 feet	<50 feet

Roadway	Segment	Existing L_{dn} at 75 feet from the Roadway Centerline	Distance to 70 dBA L_{dn}	Distance to 60 dBA L_{dn}
Java Drive (W)	North Mathilda Avenue to Bordeaux Drive	61 dBA L_{dn}	<50 feet	80 feet
	Bordeaux Drive to Borregas Avenue	63 dBA L_{dn}	<50 feet	130 feet
Java Drive (E)	Borregas Avenue to Geneva Drive	64 dBA L_{dn}	<50 feet	150 feet
	Geneva Drive to Crossman Avenue	65 dBA L_{dn}	<50 feet	160 feet
	East of Crossman Avenue	67 dBA L_{dn}	<50 feet	215 feet
Lockheed Martin Way	West of North Mathilda Avenue	60 dBA L_{dn}	<50 feet	75 feet
Manila Drive	West of Enterprise Way	71 dBA L_{dn}	85 feet	350 feet
Moffett Park Drive (W)	Enterprise Way to Highway 101 northbound on-ramp	65 dBA L_{dn}	<50 feet	165 feet
	Highway 101 northbound on-ramp to Innovation Way	66 dBA L_{dn}	<50 feet	190 feet
	Innovation Way to North Mathilda Avenue	68 dBA L_{dn}	<50 feet	240 feet
	East of North Mathilda Avenue	65 dBA L_{dn}	<50 feet	155 feet
Moffett Park Drive	West of Borregas Avenue	68 dBA L_{dn}	<50 feet	255 feet
	Borregas Avenue to Crossman Avenue	69 dBA L_{dn}	60 feet	290 feet
	Crossman Avenue to Moffett Park Court	69 dBA L_{dn}	50 feet	270 feet
	Moffett Park Court to East Caribbean Drive	63 dBA L_{dn}	<50 feet	125 feet
	East of East Caribbean Drive	60 dBA L_{dn}	<50 feet	75 feet
North Mathilda Avenue	North of 1st Avenue/Bordeaux Drive	66 dBA L_{dn}	<50 feet	195 feet
	1st Avenue/Bordeaux Drive to Lockheed Martin Way/West Java Drive	65 dBA L_{dn}	<50 feet	175 feet
	Lockheed Martin Way/West Java Drive to 5th Avenue	66 dBA L_{dn}	<50 feet	190 feet
	5th Avenue to Innovation Way	65 dBA L_{dn}	<50 feet	175 feet
	Innovation Way to West Moffett Park Drive	68 dBA L_{dn}	<50 feet	250 feet
	West Moffett Park Drive to SR 237 westbound ramps	69 dBA L_{dn}	60 feet	285 feet
	South of SR 237 eastbound ramps	70 dBA L_{dn}	65 feet	300 feet

Roadway	Segment	Existing L_{dn} at 75 feet from the Roadway Centerline	Distance to 70 dBA L_{dn}	Distance to 60 dBA L_{dn}
Twin Creeks Driveway	North of East Caribbean Drive	59 dBA L_{dn}	<50 feet	50 feet
	South of East Caribbean Drive	52 dBA L_{dn}	<50 feet	<50 feet
SR 237 westbound on-ramp	At West Moffett Park Drive/Crossman Avenue intersection	68 dBA L_{dn}	<50 feet	260 feet
	At North Mathilda Avenue	66 dBA L_{dn}	<50 feet	200 feet
SR 237 eastbound off-ramp	At North Mathilda Avenue	67 dBA L_{dn}	<50 feet	215 feet
SR 237 eastbound on-ramp	At North Mathilda Avenue	68 dBA L_{dn}	<50 feet	245 feet
SR 237	Highway 101 interchange to North Mathilda Avenue	77 dBA L_{dn}	240 feet	735 feet
	North Mathilda Avenue to East Java Drive	77 dBA L_{dn}	240 feet	735 feet
	East Java Drive to East Caribbean Drive	77 dBA L_{dn}	240 feet	735 feet
	East of East Caribbean Drive	77 dBA L_{dn}	240 feet	735 feet
U.S. 101 northbound on-ramp	At West Moffett Park Drive	60 dBA L_{dn}	<50 feet	75 feet

FIGURE 3 2022 Noise Contours for Moffett Federal Airfield



OPPORTUNITES AND CONSTRAINTS ANALYSIS

The most common noise issue that is likely to be faced as part of the Moffett Park Specific Plan would be the evaluation of land use proposals in this noisy, light industrial area and the incorporation of noise control treatments into these projects to achieve acceptable levels. In addition to existing traffic noise levels, Table 8 also includes distances to the City's commercial use threshold of 70 dBA L_{dn} and to the City's residential threshold of 60 dBA L_{dn} based on the existing unattenuated traffic noise levels. Under future traffic conditions, it would be expected that the noise levels and distances to the thresholds would increase.

A review of the noise contour data calculated for existing conditions shows that potential residential land uses could be developed without any noise mitigation within portions of the plan area where the noise contour is at or below 60 dBA L_{dn}, which would be considered a normally acceptable noise environment for residences. Where noise levels are 70 dBA L_{dn} or less in the plan area, residential development would require shielding from surrounding buildings or noise barriers to reduce exterior noise levels at private or common outdoor use areas to 60 dBA L_{dn} and sound-rated construction methods with forced-air mechanical ventilation systems to reduce interior noise levels to 45 dBA L_{dn} or less, in accordance with the City's General Plan. In a conditionally acceptable noise environment, the development of residential land uses requires that noise reduction requirements are analyzed and included in the design of the project. Based on the existing noise data, mitigation to achieve the City of Sunnyvale's exterior and interior noise level goals would be feasible.

Noise from aircraft activities related to operations at Moffett Federal Airfield, which is shown in Figure 3, would range between 60 and 65 dBA CNEL for the majority of the plan area. The Santa Clara County ALUC has jurisdiction over new land uses in the vicinity of airports and establishes 65 dBA CNEL as the maximum allowable noise level considered compatible with residential uses. The southwestern portion of the plan area is located within the 65 dBA CNEL contour line for aircraft activities at Moffett Federal Airfield. Residential land uses would not be recommended within this area because residential land uses would not be considered compatible with the exterior noise environment, and interior noise levels resulting from aircraft would be greater than 45 dBA CNEL without the incorporation of noise insulation features designed into each project. Commercial and industrial land uses would be considered compatible in areas where noise levels exceed 65 dBA CNEL, and the interior noise thresholds for these less noise-sensitive land uses could be met with standard construction methods.

Commercial and industrial operations are the primary stationary noise sources that make a significant local contribution to community noise levels within the plan area. Such uses can generate noise due to the regular operation of equipment, including fans, blowers, chillers, compressors, boilers, pumps, and air conditioning systems that may run continuously. Other intermittent sources of noise include emergency generators, horns, buzzers, and loading activities. The possibility of sensitive development encroaching on some of these stationary noise sources could result in some land use conflicts, requiring careful consideration during the planning process.

Groundborne vibration produced by VTA light-rail trains could also pose constraints on sensitive land use proposals near the tracks. Since the tracks run between the eastbound and westbound directions of Java Drive, vibration impacts at sensitive uses along this roadway would be minimal; however, the tracks run parallel to West Moffett Park Drive to the north and parallel to North Mathilda Avenue to the west. Sensitive land uses north of West Moffett Park Drive and west of North Mathilda Avenue may be exposed to excessive groundborne vibration levels associated with the VTA tracks when proposed near the tracks.

The FTA recommends that groundborne vibration levels from frequent events (more than 70 events per day) be maintained at or below 72 VdB, occasional events (between 30 and 70 events per day) be maintained at or below 75 VdB, and infrequent events (few than 30 events per day) be maintained at or below 80 VdB. Based on vibration data from previous projects, there would be the potential for residential land uses located within 50 feet of the VTA tracks to exceed the 72 VdB threshold. Such setbacks would be sufficient to ensure that groundborne vibration levels from VTA trains would be below the 72 VdB threshold established by FTA.

APPENDIX

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

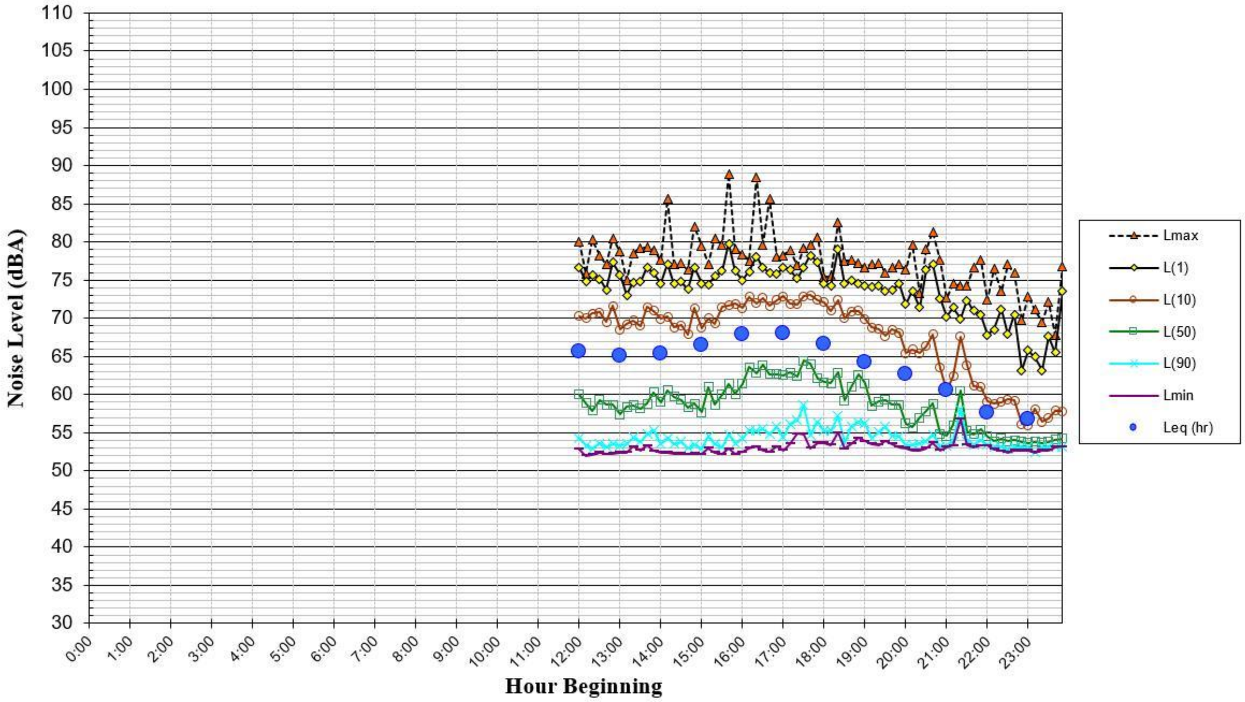


FIGURE A2 Daily Trend in Noise Levels at LT-1, Wednesday, February 26, 2020

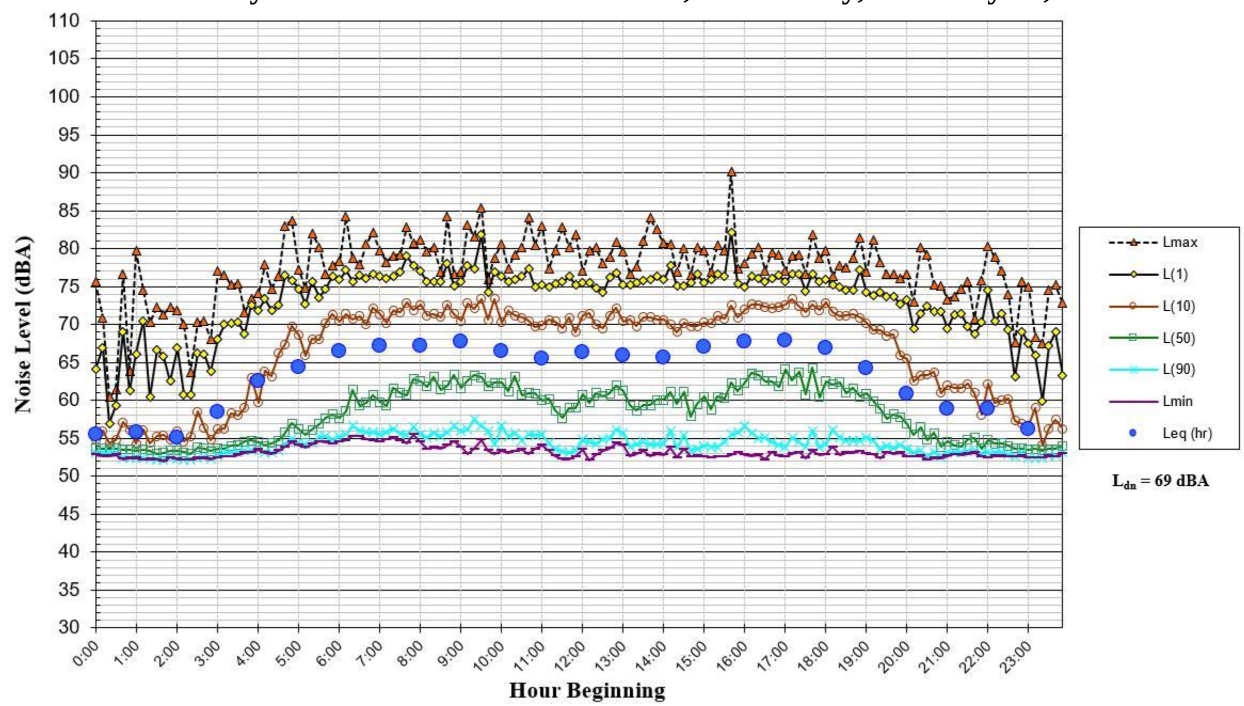


FIGURE A3 Daily Trend in Noise Levels at LT-1, Thursday, February 27, 2020

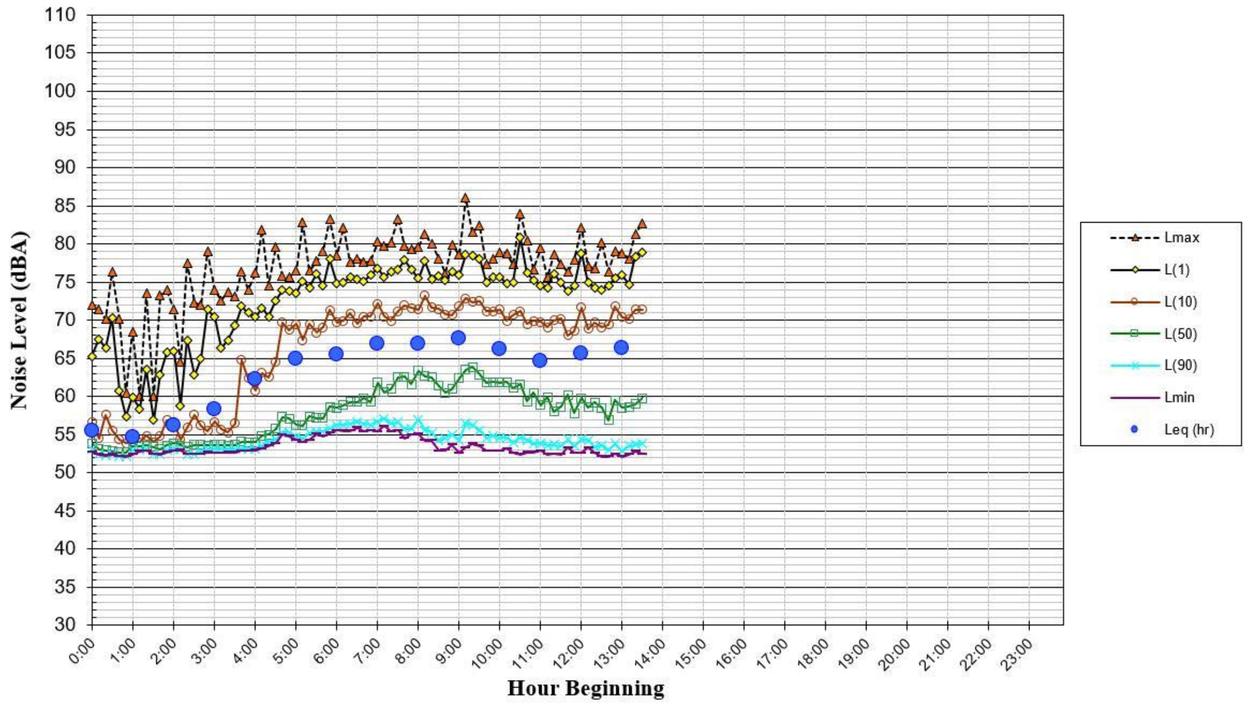


FIGURE A4 Daily Trend in Noise Levels at LT-2, Tuesday, February 25, 2020

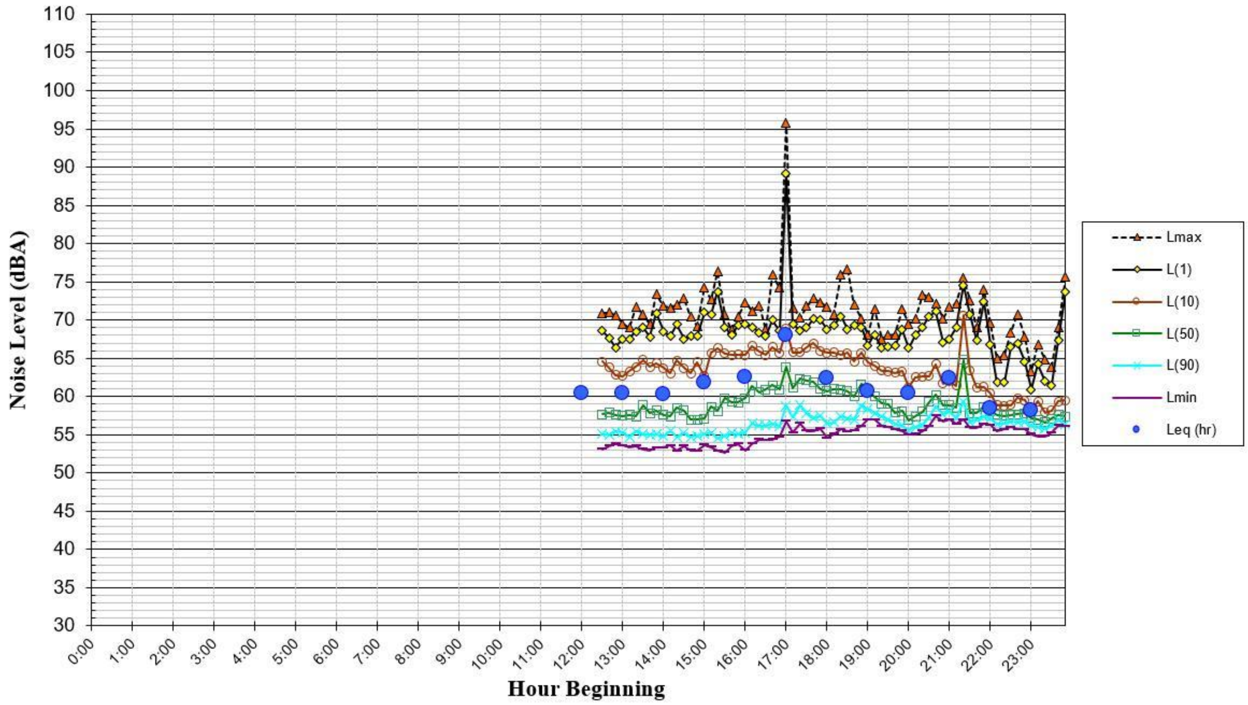


FIGURE A5 Daily Trend in Noise Levels at LT-2, Wednesday, February 26, 2020

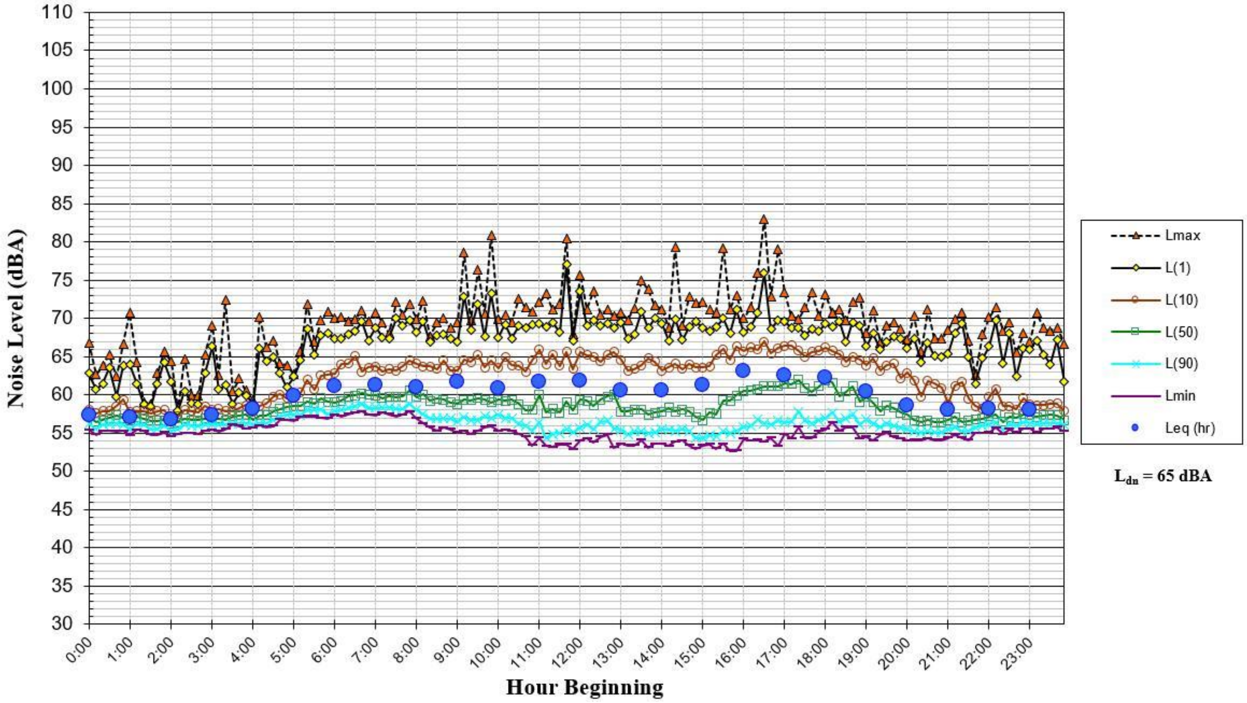


FIGURE A6 Daily Trend in Noise Levels at LT-2, Thursday, February 27, 2020

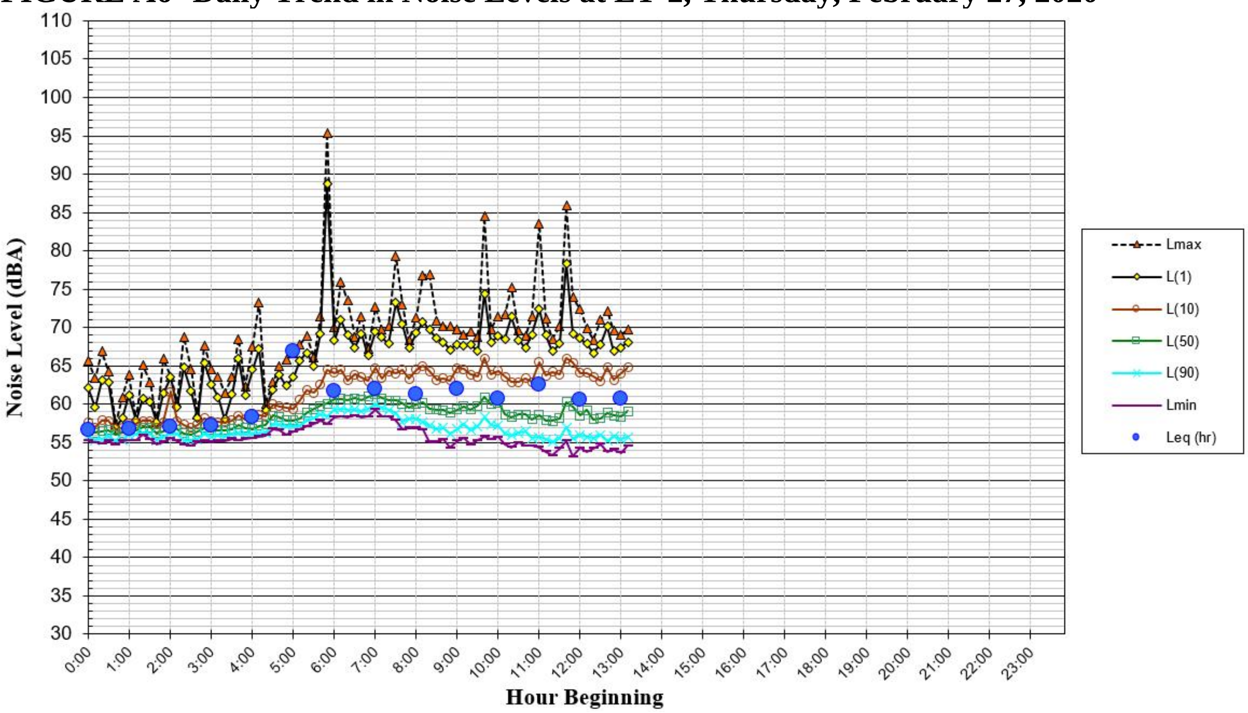


FIGURE A7 Daily Trend in Noise Levels at LT-3, Tuesday, February 25, 2020

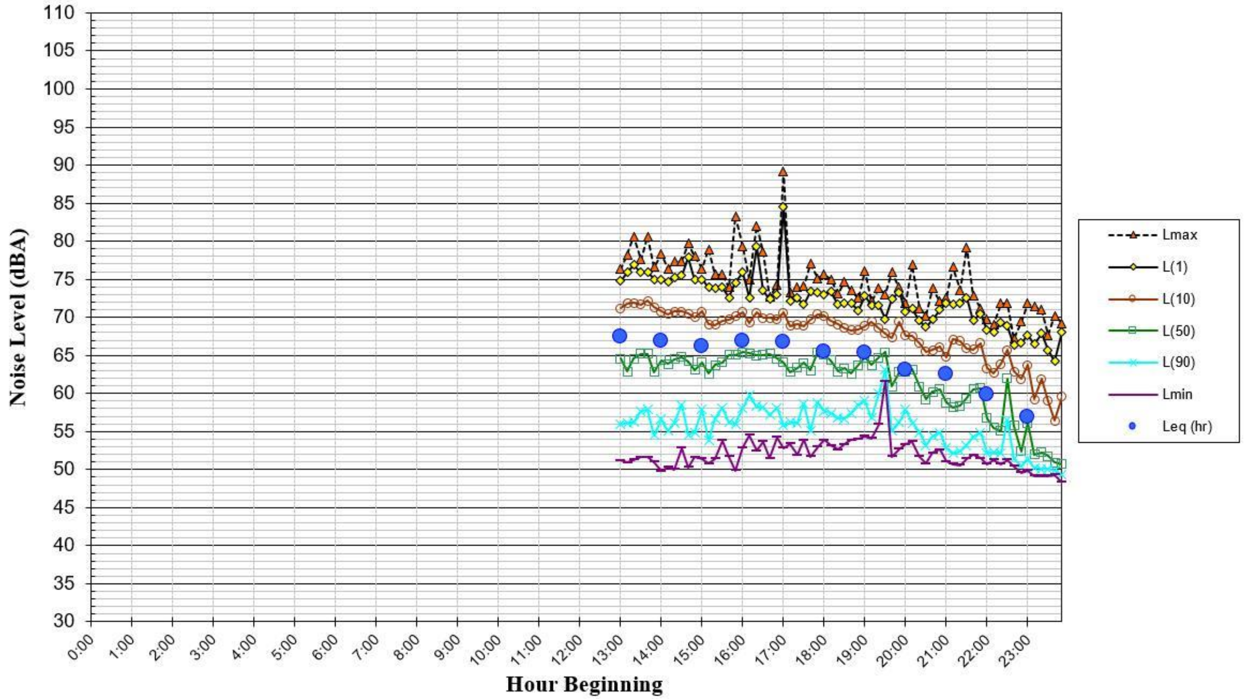


FIGURE A8 Daily Trend in Noise Levels at LT-3, Wednesday, February 26, 2020

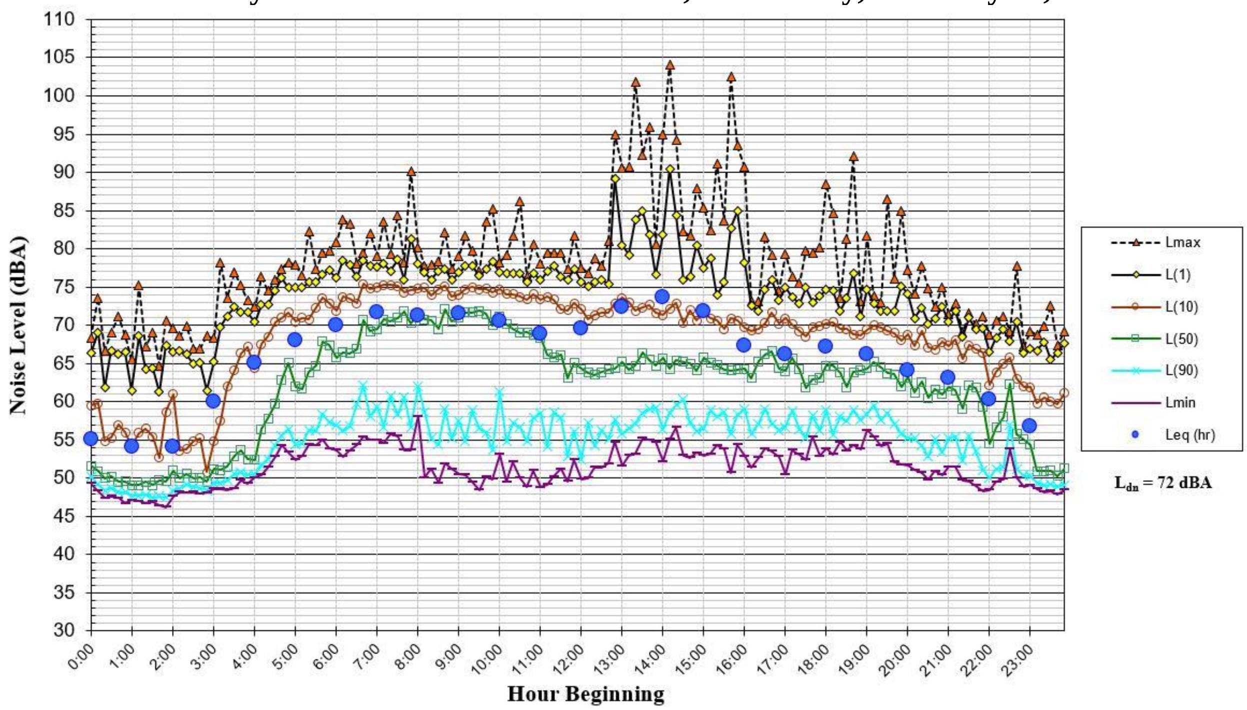


FIGURE A9 Daily Trend in Noise Levels at LT-3, Thursday, February 27, 2020

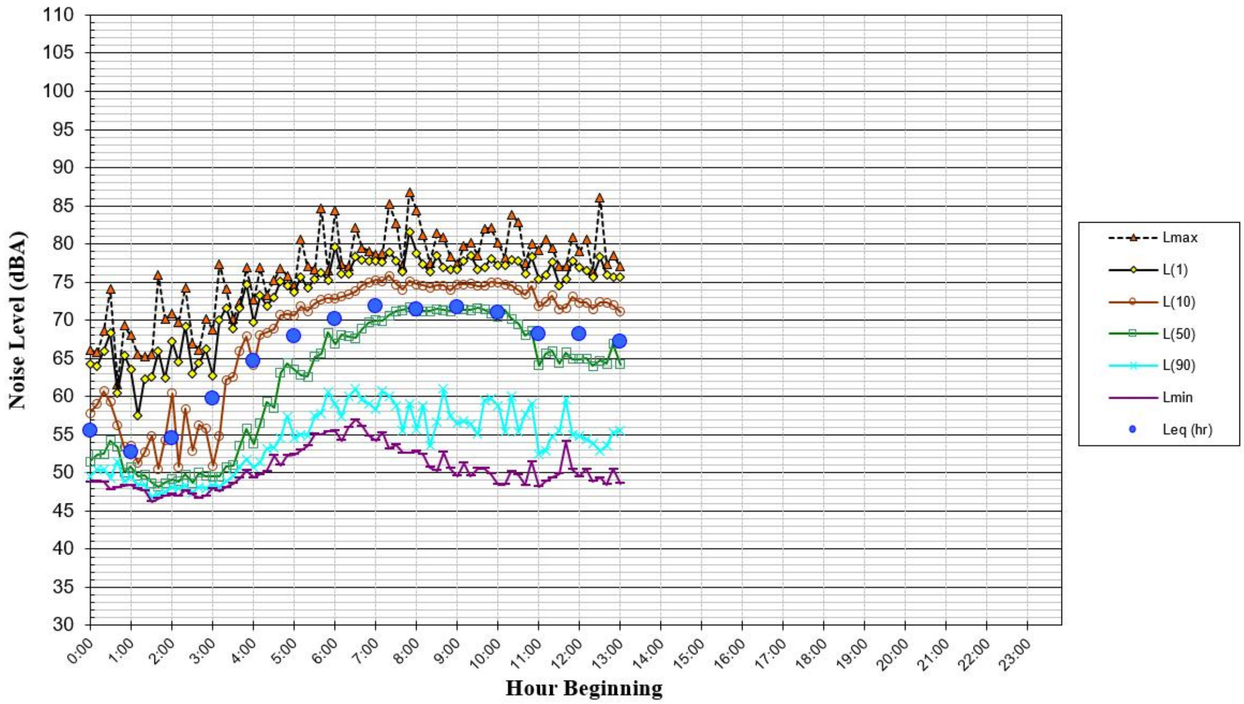


FIGURE A10 Daily Trend in Noise Levels at LT-4, Tuesday, February 25, 2020

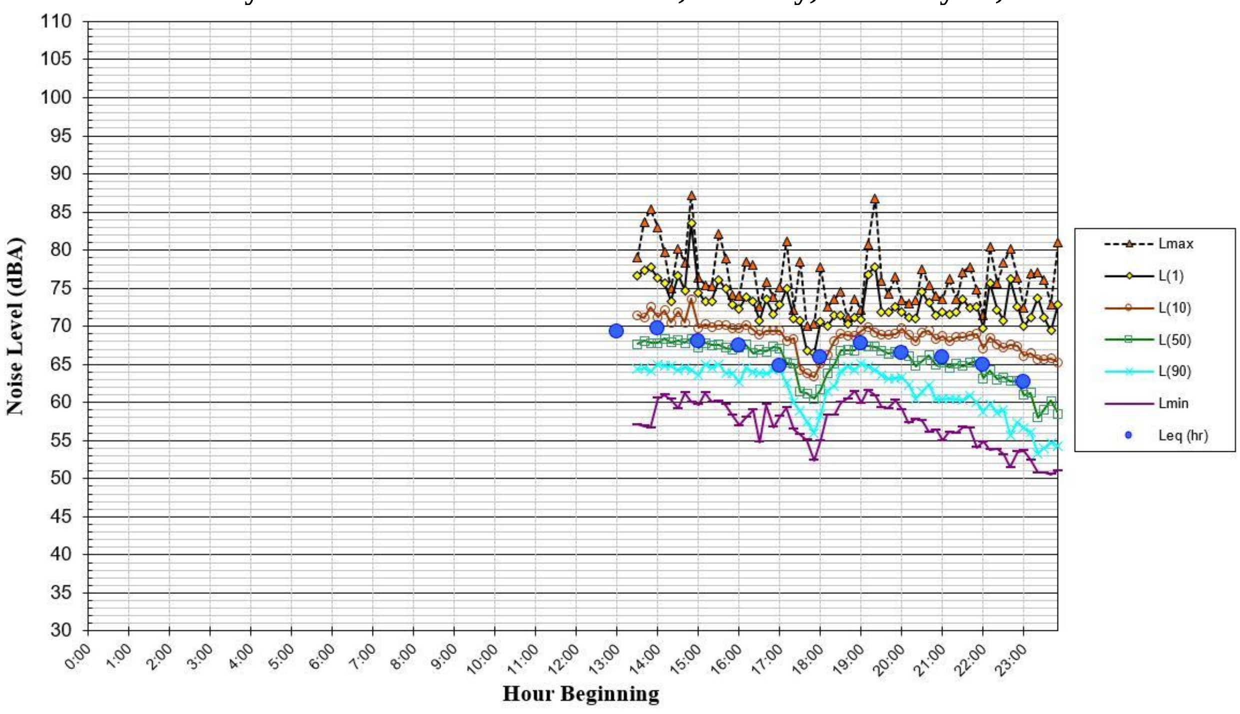


FIGURE A11 Daily Trend in Noise Levels at LT-4, Wednesday, February 26, 2020

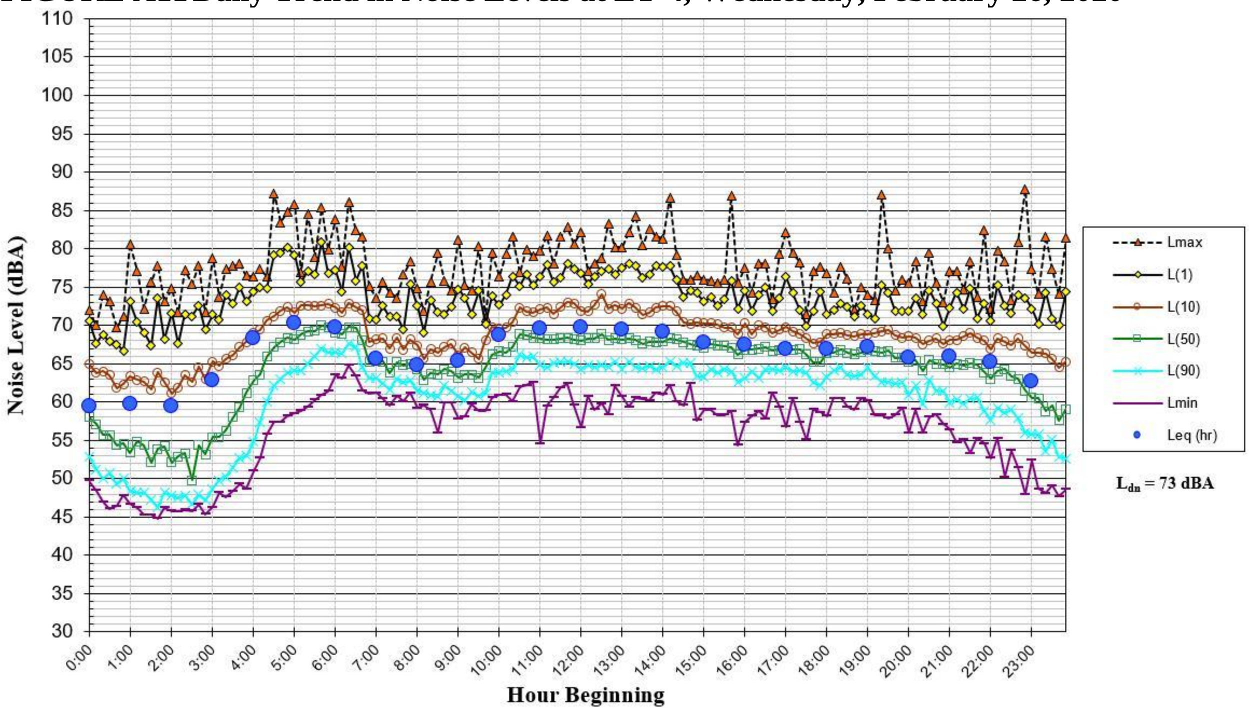


FIGURE A12 Daily Trend in Noise Levels at LT-4, Thursday, February 27, 2020

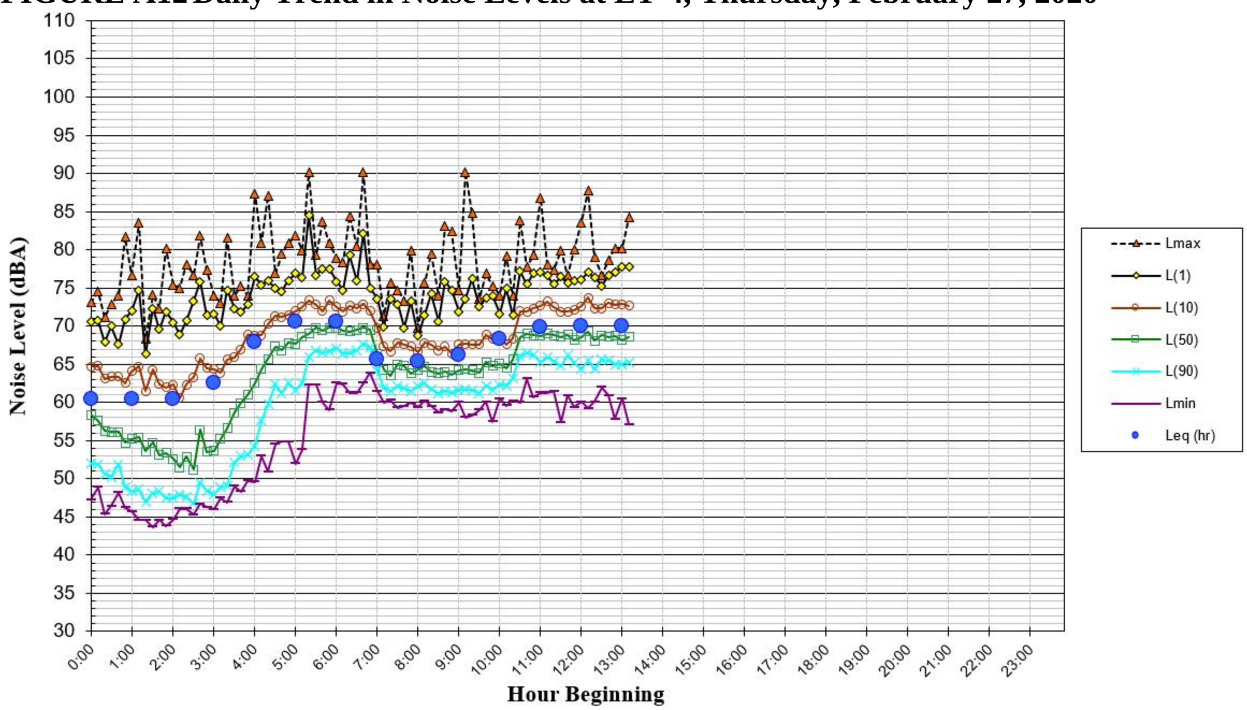


FIGURE A13 Daily Trend in Noise Levels at LT-5, Thursday, February 27, 2020

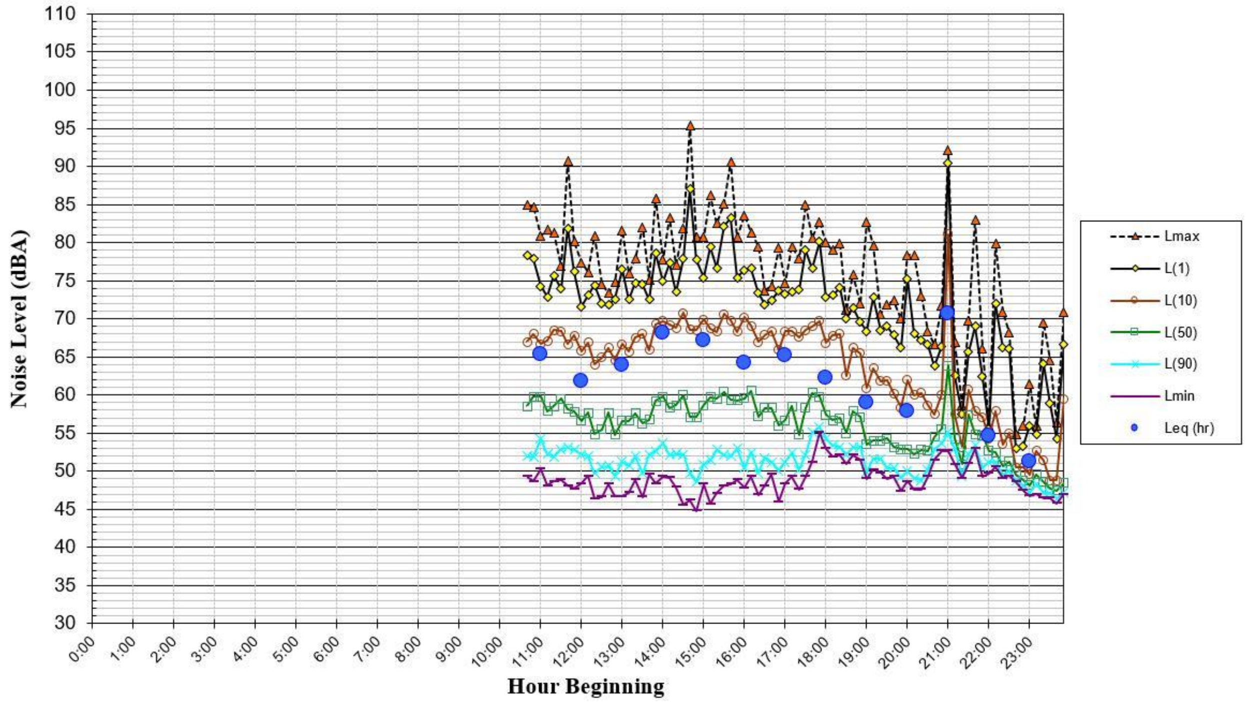


FIGURE A14 Daily Trend in Noise Levels at LT-5, Friday, February 28, 2020

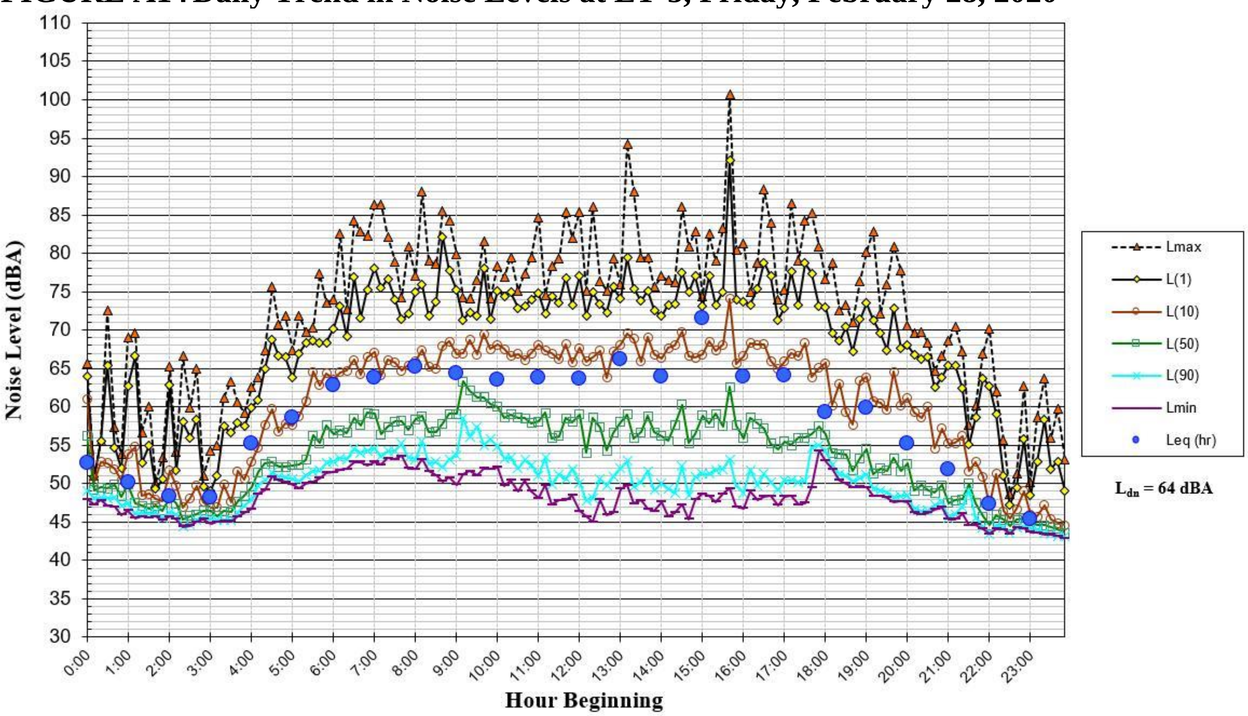


FIGURE A15 Daily Trend in Noise Levels at LT-5, Saturday, February 29, 2020

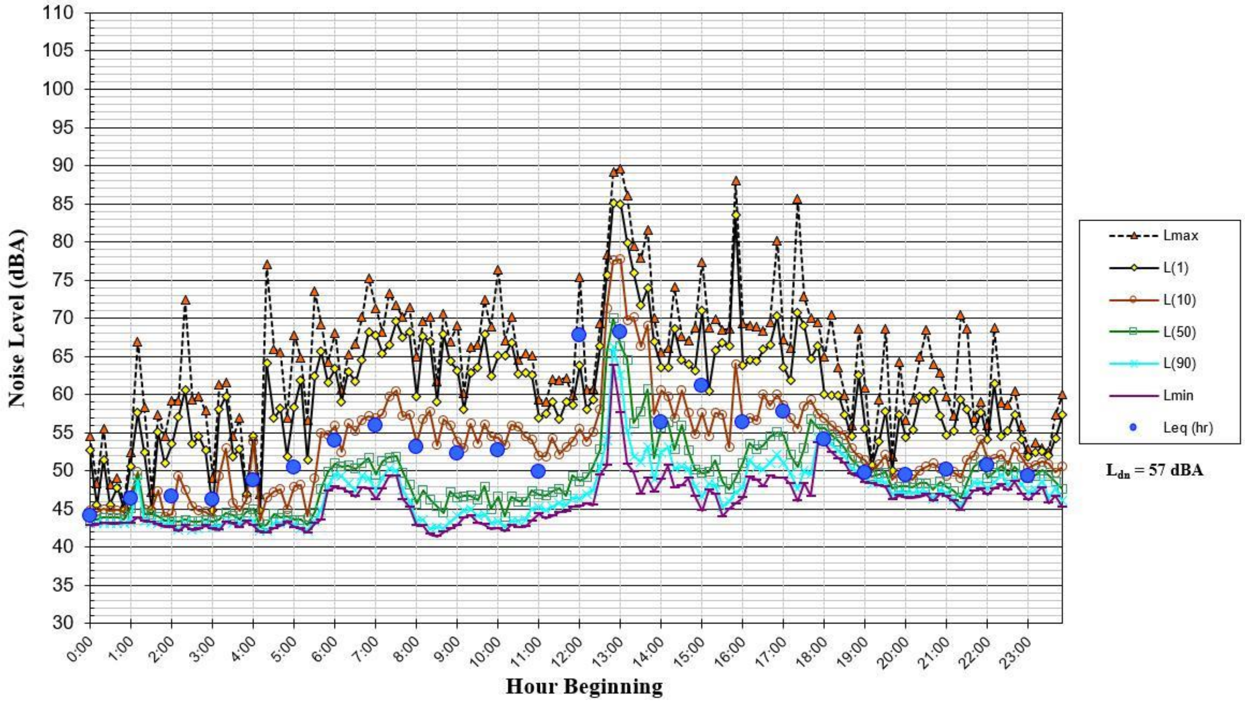


FIGURE A16 Daily Trend in Noise Levels at LT-5, Sunday, March 1, 2020

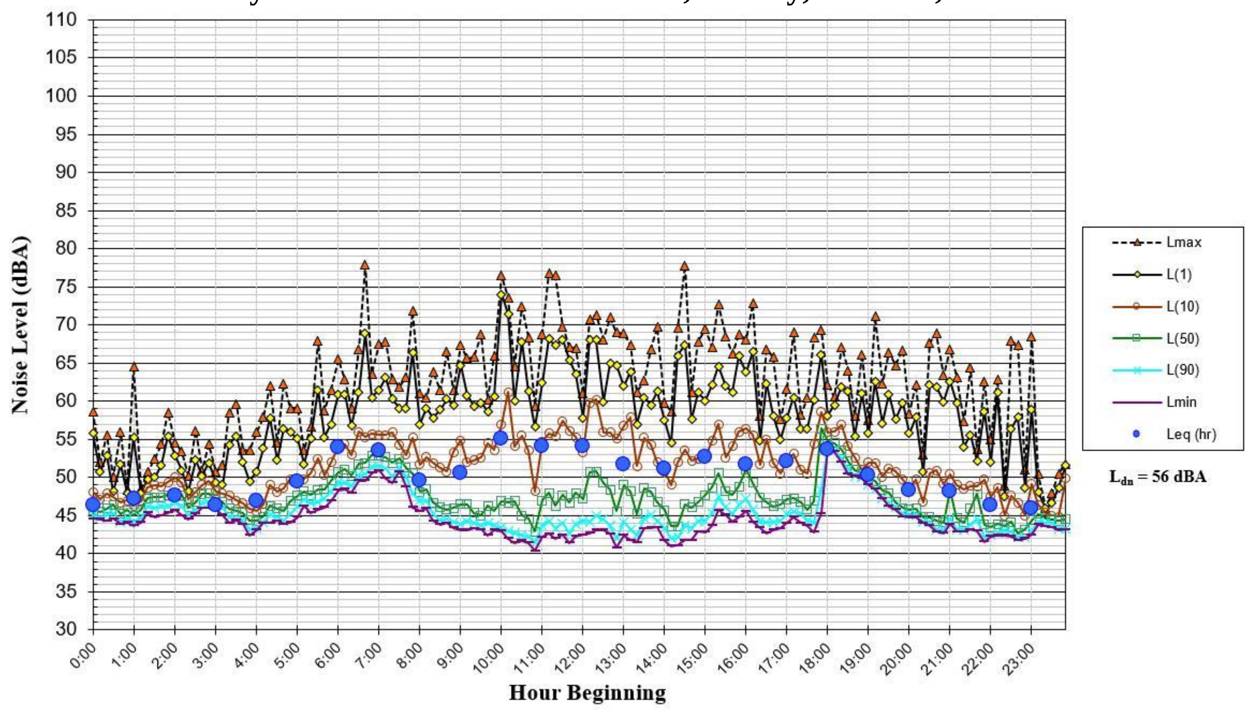


FIGURE A17 Daily Trend in Noise Levels at LT-5, Monday, March 2, 2020

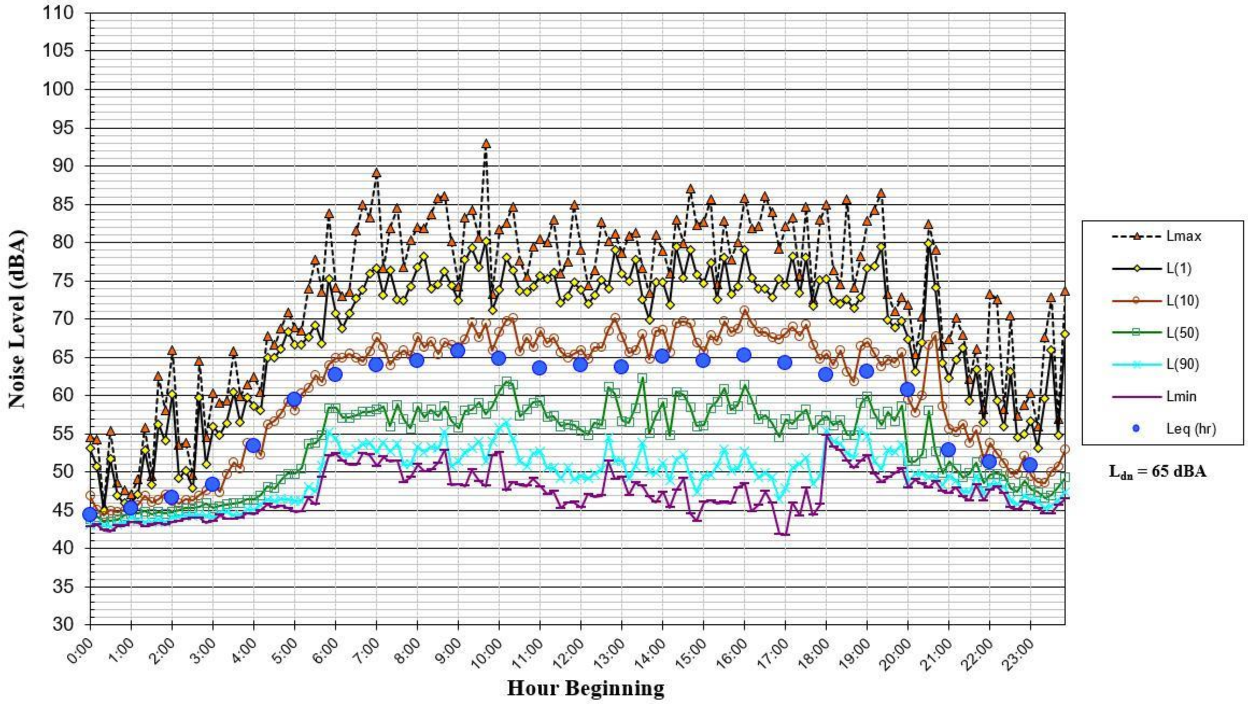


FIGURE A18 Daily Trend in Noise Levels at LT-5, Tuesday, March 3, 2020