Appendix E

Noise and Vibration Assessment

Civic Center Family Housing Project
Initial Study

City of Santa Clara

CIVIC CENTER FAMILY HOUSING NOISE AND VIBRATION ASSESSMENT

Santa Clara, California

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INTRODUCTION

A five-story affordable residential building is proposed at 1601 Civic Center Drive in Santa Clara, California. The site is currently developed with an existing two-story office building that would be demolished as part of the proposed project. The proposed affordable housing project would include up to 110 residential units and two managers' units. The project would include a community room, offices that provide services to tenants, and surface and garage parking on the first floor.

This report evaluates the project's potential to result in significant noise and vibration 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 background, and describes the existing ambient noise environment at the project site; 2) the Plan Consistency Analysis Section discusses noise and land use compatibility utilizing applicable regulatory background; 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 measures, where necessary, to mitigate the impacts of the project on sensitive receptors in the vicinity.

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}. 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 12-17 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} with open windows and 65-70 dBA L_{dn} 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} 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 25-30 percent of the population. There is, therefore, an increase of about 2 percent per dBA between a L_{dn} of 60-70 dBA. Between a L_{dn} 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} 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 or frequent intermittent vibration levels produce. The guidelines in Table 3 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 3 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 3 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.

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 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.

Regulatory Background – Noise

The State of California and the City of Santa Clara have established noise criteria, and the California Department of Transportation (Caltrans) have established vibration criteria, that are applicable in this assessment. The State of California Environmental Quality Act (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.

Federal

2018 Federal Transit Administration's Transit Noise and Vibration Impact Assessment Manual. The Federal Transit Administration's (FDA) Transit Noise and Vibration Impact Assessment Manual includes general assessment criteria for construction noise. During daytime hours, the hourly average noise level limit is 90 dBA L_{eq} at residential land uses and 100 dBA L_{eq} at commercial and industrial land uses. Nighttime limits are 80 dBA L_{eq} at residential land uses and 100 dBA L_{eq} at commercial and industrial land uses.

State of California

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

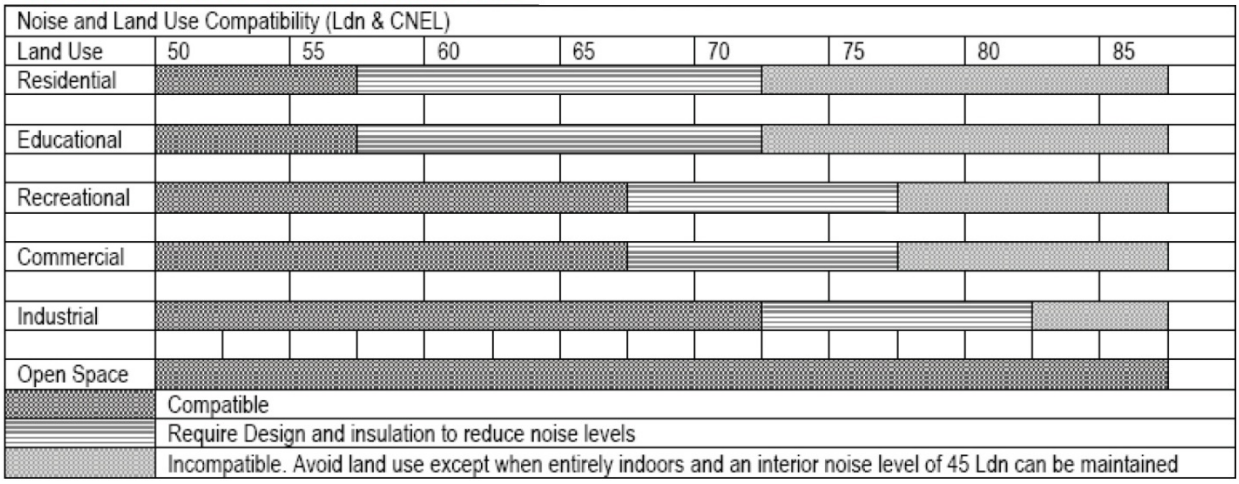
(c) For a project located within the vicinity of a private airstrip or an airport land use plan or where such a plan has not been adopted within two miles of a public airport or public use airport, if the project would expose people residing or working in the project area to excessive noise levels.

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

Local

City of Santa Clara General Plan. The City of Santa Clara's General Plan identifies noise and land use compatibility standards for various land uses and establishes policies to control noise within the community. Table 5.10-2 from the General Plan shows acceptable noise levels for various land uses. Commercial land uses are considered compatible in noise environments of 65 dBA L_{dn}/CNEL or less. The guidelines state that where the exterior noise levels are greater than 65 dBA L_{dn}/CNEL and less than 75 dBA L_{dn}/CNEL, the design of the project should include measures to reduce noise levels to acceptable levels. Noise levels exceeding 75 dBA L_{dn}/CNEL at commercial land uses are considered incompatible.

TABLE 5.10-2: GENERAL PLAN NOISE STANDARDS



Applicable goals and policies presented in the General Plan are as follows:

5.10.6-G1 Noise sources restricted to minimize impacts in the community.

5.10.6-G2 Sensitive uses protected from noise intrusion.

5.10.6-G3 Land use, development and design approvals that take noise levels into consideration.

5.10.6-P1 Review all land use and development proposals for consistency with the General Plan compatibility standards and acceptable noise exposure levels defined on Table 5.10-1.

5.10.6-P2 Incorporate noise attenuation measures for all projects that have noise exposure levels greater than General Plan "normally acceptable" levels, as defined on Table 5.10-1.

5.10.6-P3 New development should include noise control techniques to reduce noise to acceptable levels, including site layout (setbacks, separation and shielding), building treatments (mechanical ventilation system, sound-rated windows, solid core doors and baffling) and structural measures (earthen berms and sound walls).

5.10.6-P4 Encourage the control of noise at the source through site design, building design, landscaping, hours of operation and other techniques.

5.10.6-P5 Require noise-generating uses near residential neighborhoods to include solid walls and heavy landscaping along common property lines, and to place compressors and mechanical equipment in sound-proof enclosures.

5.10.6-P6 Discourage noise sensitive uses, such as residences, hospitals, schools, libraries and rest homes, from areas with high noise levels, and discourage high noise generating uses from areas adjacent to sensitive uses.

5.10.6-P7 Implement measures to reduce interior noise levels and restrict outdoor activities in areas subject to aircraft noise in order to make Office/Research and Development uses compatible with the Norman Y. Mineta International Airport land use restrictions.

City of Santa Clara Municipal Code. The City's Municipal Code establishes noise level performance standards for fixed sources of noise. Section 9.10.40 of the Municipal Code limits noise levels at commercial office buildings to 65 dBA during daytime hours (7:00 a.m. to 10:00 p.m.) and 60 dBA at night (10:00 p.m. to 7:00 a.m.). The noise limits are not applicable to emergency work, licensed outdoor events, City-owned electric, water, and sewer utility system facilities, construction activities occurring within allowable hours, permitted fireworks displays, or permitted heliports. Construction activities are not permitted within 300 feet of residentially zoned property except within the hours of 7:00 a.m. and 6:00 p.m. on weekdays and 9:00 a.m. and 6:00 p.m. on Saturdays. No construction is permitted on Sundays or holidays.

The City 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

California Department of Transportation. To avoid damage to buildings, Caltrans recommends that construction vibration levels are limited to 0.5 in/sec PPV for buildings structurally sound and designed to modern engineering standards, to 0.3 in/sec PPV for buildings that are found to be structurally sound but where structural damage is a major concern, and to 0.08 in/sec PPV for ancient buildings or buildings that are documented to be structurally weakened (see Table 3).

Existing Noise Environment

The project site is located northwest of the Civic Center Drive and Lincoln Street intersection in the City of Santa Clara. Currently, a small vacant office building occupies the site. The site is bound by Civic Center Drive to the south, Lincoln Street to the east, single-family residences to the west, and a church to the north. Existing commercial uses and a hotel are located to the south, opposite Civic Center Drive, and the Civic Center buildings are located to the east, opposite Lincoln Street.

The noise environment at the site and in the surrounding areas results primarily from vehicular traffic along Civic Center Drive and Lincoln Street. Nearby El Camino Real and aircraft associated with Mineta San José International Airport affects the noise environment also contribute to the noise environment.

A noise monitoring survey, which included one long-term and two short-term noise measurements, was performed at the site beginning on Wednesday September 29, 2021 and concluding on Friday October 1, 2021. Additionally, a second long-term measurement was made at the project site beginning on Friday November 19, 2021 and concluding on Wednesday November 24, 2021. All measurement locations are shown in Figure 1.

Long-term noise measurement LT-1 was made approximately 30 feet from the centerline of Civic Center Drive and approximately 255 feet from the centerline of Lincoln Street. Hourly average noise levels at LT-1 typically ranged from 51 to 58 dBA L_{eq} during the day and from 45 to 55 dBA L_{eq} at night. The average community noise equivalent level (CNEL) for 24-hour periods occurring between Wednesday September 29, 2021 and Friday October 1, 2021 was 58 dBA CNEL. The daily trends in noise levels at LT-1 are shown in Figures A1 through A3 in the Appendix of this report.

LT-2 was made approximately 40 feet from the centerline of Lincoln Street and approximately 75 feet from the centerline of Civic Center Drive. Hourly average noise levels at LT-2 typically ranged from 55 to 61 dBA L_{eq} during the day and from 48 to 59 dBA L_{eq} at night on weekdays. On weekends, typical hourly average noise levels ranged from 55 to 60 dBA L_{eq} during the day and from 47 to 58 dBA L_{eq} at night. The average CNEL was 62 dBA on weekdays and ranged from 60 to 61 dBA on weekends. The daily trends in noise levels at LT-2 are shown in Figures A4 through A9 in the Appendix of this report.

Both short-term noise measurements were made on Wednesday September 29, 2021 in 10-minute intervals between 11:40 a.m. and 11:50 a.m. ST-1 was made in the northwestern corner of the project site, approximately 245 feet north of the centerline of Civic Center Drive and approximately 285 feet west of the centerline of Lincoln Street. During this measurement, 14 passenger cars drove by along Lincoln Street, generating noise levels at ST-1 ranging from 45 to 50 dBA. Aircraft were observed to produce noise levels of 48 to 55 dBA, as well. Additionally, a nearby neighbor slammed their car door, generating noise levels up to 62 dBA. The 10-minute average noise level at ST-1 was 45 dBA $L_{eq(10\text{-}min)}$.

ST-2 was made along the sidewalk at the backyard equivalent location of 1690 Triton Court, approximately 20 feet from the centerline of Civic Center Drive. Vehicles along Civic Center Drive during this 10-minute period generated noise levels of 48 to 50 dBA, and a noisy scooter generated noise levels up to 61 dBA. The maximum noise level of 74 dBA was due to a barking dog. The 10-minute average noise level at ST-2 was 54 dBA $L_{eq(10\text{-}min)}$.

Table 4 summarizes the results of the 10-minute noise measurements made at ST-1 and ST-2.

TABLE 4 Summary of Short-Term Noise Measurement Data (dBA)

Noise Measurement Location (Date, Time)	**L_{max}**	**$L_{(1)}$**	**$L_{(10)}$**	**$L_{(50)}$**	**$L_{(90)}$**	**$L_{eq(10)}$**
ST-1: northwest corner of project site (9/29/2021, 11:40-11:50 a.m.)	62	54	47	43	42	45
ST-2: backyard equivalent of 1690 Triton Court, ~20 feet from the centerline of Civic Center Drive (9/29/2021, 11:40-11:50 a.m.)	74	67	55	43	40	54

FIGURE 1 Noise Measurement Locations



PLAN CONSISTENCY ANALYSIS

Noise and Land Use Compatibility

Noise levels in outdoor use areas that are affected by transportation noise are required to be maintained at or below 55 dBA CNEL to be considered normally acceptable for residential land uses, according to the City's General Plan. Additionally, residential interior noise levels are required to meet the performance standard of 45 dBA CNEL.

The future noise environment at the project site would continue to be dominated by traffic along Lincoln Street and other local roadways surrounding the site. A traffic study was not completed for the proposed project; however, peak trips were estimated to be 40 during the peak AM hour and 42 during the peak PM hour. Based on the low existing traffic volumes along Civic Center Drive and Lincoln Street, these peak hour trips would result in 1 dBA CNEL increase under project conditions. Additionally, a conservative 1% to 2% increase in traffic volumes each year for the next 20 years was assumed for standard traffic volume increase in a developed area. With the project trips, the total increase by the year 2040 would be about 2 dBA CNEL at the project site.

Future Exterior Noise Environment

The project's site plan shows two outdoor use areas intended for common use: 1) open space with seating located on the ground level adjacent to Lincoln Street; and 2) a level 2 podium courtyard located on the interior of the site.

The open space would have direct line-of-sight to traffic noise along Lincoln Street, and the center of this open space would be set back approximately 85 feet from the centerline of the roadway. Due to the angle of the proposed buildings, the center of the open space would be partially shielded by the building façades. The future exterior noise levels at the center of the open court would be 60 dBA CNEL, which would exceed the City's 55 dBA CNEL threshold for residential land uses by 5 dBA.

The podium courtyard located on level 2 would receive partial shielding from the north and south sections of the residential building, the upper-floor walkways connecting the two building sections, and the elevation of the courtyard above the ground. The center of the courtyard would be approximately 215 feet from the center of Lincoln Street. At this distance and assuming partial shielding, future exterior noise levels would be below 55 dBA CNEL.

While the common outdoor use area facing Lincoln Street would exceed the City's exterior noise limits for residential uses, the purpose of this outdoor area is to be an open seating area. The incorporation of a barrier fence or sound wall would obscure the view of this open area and diminish the aesthetic appeal. Further, the future exterior noise levels at the open space would fall within the City's conditionally acceptable threshold. Since the podium courtyard falls within the City's normally acceptable threshold and the open space falls within the conditionally acceptable threshold, no additional measures are recommended to reduce future exterior noise levels at the open space, assuming conditionally acceptable approval is obtained from the City of Santa Clara.

Future Interior Noise Environment

Standard residential construction provides approximately 15 dBA of exterior-to-interior noise reduction, assuming the windows are partially open for ventilation. Standard construction 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 CNEL, 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 CNEL, 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.

Residential units located along the eastern building façades would be set back approximately 60 to 105 feet from the centerline of Lincoln Street. At these distances, the units with direct line-of-sight to Lincoln Street would be exposed to future exterior noise levels up to 62 dBA CNEL. Assuming windows to be partially open, future interior noise levels in these units would be up to 47 dBA CNEL.

Units along the southern façade of the southern building would have direct line-of-sight to Civic Center Drive, with setbacks of approximately 50 feet from the centerline. At this distance, the units facing Civic Center Drive would be exposed to future exterior noise levels would of up to 57 dBA CNEL. Assuming windows to be partially open, future interior noise levels in these units would of 42 dBA CNEL.

To meet the interior noise requirements set forth by the State of California of 45 dBA CNEL, standard construction materials would be sufficient with the incorporation of forced-air mechanical ventilation, as determined by the local building official. This would allow occupants on the project site to keep windows closed to control interior noise and achieve the interior noise standards.

NOISE IMPACTS AND MITIGATION MEASURES

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.

- Hourly average noise levels during construction that would exceed 90 dBA L_{eq} at residential land uses or exceed 100 dBA L_{eq} at commercial land uses 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. A substantial increase would occur if: a) the noise level increase is 5 dBA CNEL or greater, with a future noise level of less than the "normally acceptable" standard, or b) the noise level increase is 3 dBA CNEL or greater, with a future noise level equal to or greater than 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. Groundborne vibration levels exceeding 0.3 in/sec PPV would have the potential to result in cosmetic damage to normal 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.

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.

The City's Municipal Code limits construction activities (including the loading and unloading of materials and truck movements) within 300 feet of residentially zoned property to the hours of 7:00 a.m. to 6:00 p.m. on weekdays and between the hours of 9:00 a.m. and 6:00 p.m. on Saturdays. No construction is permitted on Sundays or holidays.

While noise thresholds for temporary construction are not provided in the City's General Plan or Municipal Code, the Federal Transit Administration (FDA) includes daytime construction noise limits in the *Transit Noise and Vibration Impact Assessment Manual* from 2018.[1] During daytime

[1] Federal Transit Administration, *Transit Noise and Vibration Impact Assessment Manual*, FTA Report No. 0123, September 2018.

hours, an exterior threshold of 90 dBA L_{eq} shall be enforced at residential land uses and 100 dBA L_{eq} at commercial and industrial land uses. Therefore, the temporary construction noise impact would be considered significant if project construction activities produced noise levels exceeding 90 dBA L_{eq} at residential land uses or 100 dBA L_{eq} at commercial land uses surrounding the site.

Construction activities generate considerable amounts of noise, especially during earth-moving activities when heavy equipment is used. The typical range of maximum instantaneous noise levels for the proposed project would be 70 to 90 dBA L_{max} at a distance of 50 feet (see Table 5). Table 6 shows typical hourly average construction-generated noise levels 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.). As shown in Table 6, typical residential buildings generate construction noise levels ranging from 72 to 88 dBA L_{eq} at a distance of 50 feet from the center of the active site. Construction-generated noise levels drop off at a rate of about 6 dBA per doubling of the distance between the source and receptor. Shielding by buildings or terrain often result in lower construction noise levels at distant receptors; however, for purposes of assessing a worst-case scenario, construction noise levels in this report are estimated assuming no attenuation due to intervening buildings or structures.

Construction for the proposed project is expected to last for approximately 17 months. Construction activities for the proposed project would be completed in phases. During each phase of construction, there would be a different mix of equipment operating, and noise levels would vary by phase and vary within phases, based on the amount of equipment in operation and the location at which the equipment is operating. Equipment expected to be used in each construction phase are summarized in Table 7, along with the quantity of each piece of equipment, the duration of each phase, and the estimated noise levels projected from the center of the project site to the property lines of the surrounding land uses. For the purposes of assuming worst-case conditions, all pieces of equipment shown per phase are assumed to be operating simultaneously. The range of levels shown for various phases represents noise levels for that individual phase and noise levels during the overlapping periods with other phases.

FHWA's Roadway Construction Noise Model (RCNM) was used to calculate the hourly average noise levels for each phase of construction, assuming every piece of equipment would operate simultaneously, which would represent the worst-case scenario. Based on the hourly average noise levels calculated with RCNM, construction noise levels for each construction phase were propagated from the center of the project site, which represents the geometrical center of the active construction site, to the property lines of the receiving land uses surrounding the site.

TABLE 5 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.

TABLE 6 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 7 Estimated Construction Noise Levels at Nearby Land Uses

Phase	Phase Duration	Construction Equipment (Quantity)	Calculated Hourly Average L_{eq} at Noise-Sensitive Receptors, dBA			
			West Residences (130 feet)	North Church (110 feet)	South Hotel & Commercial (180 feet)	East Civic Buildings (230 feet)
Demolition	9/1/2023-10/1/2023	Concrete/Industrial Saw (1) Excavator (2) Rubber-Tired Dozer (1) Tractor/Loader/Backhoe (1)	78 dBA L_{eq}	80 dBA L_{eq}	75 dBA L_{eq}	73 dBA L_{eq}
Site Preparation	10/1/2023-11/1/2023	Grader (1) Rubber-Tired Dozer (1) Tractor/Loader/Backhoe (1)	76 dBA L_{eq}	78 dBA L_{eq}	73 dBA L_{eq}	71 dBA L_{eq}
Grading/ Excavation	11/1/2023-12/1/2023	Excavator (2) Grader (2) Rubber-Tired Dozer (1) Tractor/Loader/Backhoe (1)	79 dBA L_{eq}	80 dBA L_{eq}	76 dBA L_{eq}	74 dBA L_{eq}
Trenching/ Foundation	12/1/2023-1/1/2024	Tractor/Loader/Backhoe (1) Excavator (1)	73 dBA L_{eq}	75 dBA L_{eq}	71 dBA L_{eq}	68 dBA L_{eq}
Building Exterior	1/1/2024-8/1/2024	Crane (1) Forklift (2) Generator Set (1) Welder (1)	72 dBA L_{eq}	73 dBA L_{eq}	69 dBA L_{eq}	67 dBA L_{eq}
Building Interior/ Architectural Coating	8/11/2024-1/11/2025	Aerial Lift (2)	62 dBA L_{eq}	64 dBA L_{eq}	60 dBA L_{eq}	58 dBA L_{eq}
Paving	1/11/2025-2/1/2025	Paver (1) Paving Equipment (1) Roller (1)	75 dBA L_{eq}	77 dBA L_{eq}	72 dBA L_{eq}	70 dBA L_{eq}

The predicted construction noise levels in Table 7 indicate that project construction would not generate noise levels exceeding 90 dBA L_{eq} at the nearby residential uses or 100 dBA L_{eq} at the nearby commercial uses. Therefore, extended exposure to excessive construction noise at the nearest noise-sensitive receptors would be less-than-significant.

Reasonable regulation of the hours of construction, as well as regulation of the arrival and operation of heavy equipment and the delivery of construction material, are necessary to protect the health and safety of persons, promote the general welfare of the community, and maintain the quality of life. The construction crew shall adhere to the following construction best management practices to reduce construction noise levels emanating from the site and minimize disruption and annoyance at existing noise-sensitive receptors in the project vicinity. The incorporation of construction best management practices as project conditions of approval would result in a less-than-significant temporary noise impact.

Construction Best Management Practices

Develop a construction noise control plan, including, but not limited to, the following available controls:

- Ensure that excavating, grading and filling activities, and other construction activities (including the loading and unloading of materials and truck movements) within 300 feet of residentially zoned property, including hotel properties, are limited to the hours of 7:00 a.m. to 6:00 p.m. on weekdays and between the hours of 9:00 a.m. and 6:00 p.m. on Saturdays. No construction is permitted on Sundays or holidays.

- Construct temporary noise barriers, where feasible, to screen stationary noise-generating equipment. Temporary noise barrier fences would provide a 5 dBA noise reduction if the noise barrier interrupts the line-of-sight between the noise source and receptor and if the barrier is constructed in a manner that eliminates any cracks or gaps.

- Equip all internal combustion engine-driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment.

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

- Locate stationary noise-generating equipment, such as air compressors or portable power generators, as far as possible from sensitive receptors as feasible. If they must be located near receptors, adequate muffling (with enclosures where feasible and appropriate) shall be used to reduce noise levels at the adjacent sensitive receptors. Any enclosure openings or venting shall face away from sensitive receptors.

- Utilize "quiet" air compressors and other stationary noise sources where technology exists.

- 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.

- Route construction-related traffic along major roadways and as far as feasible from sensitive receptors.

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

- 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.

Implementation of the above measures would reduce construction noise levels emanating from the site, limit construction hours, and minimize disruption and annoyance. With the implementation of these measures as project conditions of approval and recognizing that noise generated by construction activities would occur over a temporary period, the temporary increase in ambient noise levels would result in a less-than-significant impact.

Mitigation Measure 1a: No further mitigation necessary.

Impact 1b: Permanent Noise Level Increase. The proposed project would not result in a substantial permanent noise level increase due to project-generated traffic at the existing noise-sensitive land uses in the project vicinity. **This is a less-than-significant impact.**

A significant impact would occur if the permanent noise level increase due to project-generated traffic was 3 dBA CNEL or greater for future ambient noise levels exceeding 60 dBA CNEL or was 5 dBA CNEL or greater for future ambient noise levels at or below 60 dBA CNEL. Existing ambient measurements made in the project site vicinity indicate that existing and future ambient noise levels at the noise-sensitive receptors in the project site vicinity would result in noise levels over 60 dBA CNEL. Therefore, a significant impact would occur if project-generated traffic increased levels by 3 dBA CNEL or more. For reference, a 3 dBA CNEL noise increase would be expected if the project would double existing traffic volumes along a roadway.

A traffic study was not required for the proposed project; however, peak hour trips were estimated to be 40 during the peak AM hour and 42 during the peak PM hour. Compared to the existing volumes along the surrounding roadways, these peak hour trips would result in a 1 dBA CNEL

increase under project conditions.[2] Therefore, the project-generated traffic would not cause a substantial permanent noise increase at the surrounding noise-sensitive receptors. This impact is a less-than-significant impact.

Mitigation Measure 1b: None required.

Impact 1c: Noise Levels in Excess of Standards. The proposed project is not expected to exceed the City's residential or commercial noise thresholds at the existing land uses surrounding the project site. **This is a less-than-significant impact.**

Under the City of Santa Clara Municipal Code, noise generated by fixed sources of noise would be restricted to 55 dBA during daytime hours (7:00 a.m. to 10:00 p.m.) and to 50 dBA during nighttime hours (10:00 p.m. to 7:00 a.m.) at residentially zoned land uses. At existing commercial land uses, noise would be restricted to 65 dBA during daytime hours and to 60 dBA during nighttime hours.

The roof plan for the proposed building shows solar thermal arrays and photovoltaic arrays, which would not generate measurable noise levels at the property lines of the project site. While the site plan also shows a heat room on the ground floor, which would likely house heating pumps for the building, heating, ventilation, and air conditioning systems (HVAC units) are not shown on the site plan. However, these types of units were recommended to reduce noise levels at residential interiors by closing the windows; therefore, these units are studied here as potential noise-generating equipment. Assuming worst-case conditions, the HVAC units are assumed to be located on the rooftop, a minimum of 10 feet from the roof's edge.

Typical noise levels produced by residential HVAC units would range from 53 to 63 dBA at 3 feet during operation. These types of units typically cycle on and off continuously during daytime and nighttime hours. Therefore, multiple units clustered in the same general vicinity are usually operating simultaneously at any given time. Assuming up to eight units would operate simultaneously at any given time, the estimated combined noise level at 3 feet would be up to 72 dBA.

The property line of the nearest single-family residences would be approximately 85 feet from the nearest rooftop equipment. At this distance, the worst-case combined noise levels would be up to 43 dBA. The property line of the church to the north would be approximately 35 feet from the nearest rooftop equipment, and at this distance, the worst-case combined noise levels would be up to 51 dBA. While this is a sensitive use, the church would not have occupants during nighttime hours; therefore, this would be considered a less-than-significant impact. All other uses would be 100 feet or more from the rooftop equipment and would not be subject to operational noise levels exceeding the City's Municipal Code noise standards. This is a less-than-significant impact.

Additionally, the site plan shows a transformer pad at the rear of the building on the ground level. Typically, transformers up to 1,000 kVA generate noise levels up to 64 dB, as measured at 1 meter (3.28 feet). This would represent the worst-case scenario for a building of this size. The nearest receiving residential property line would be approximately 60 feet to the west of the transformer pad.

[2] Illingworth & Rodkin, Inc., "Santa Clara Mixed-Use Project Environmental Noise Assessment," August 5, 2016.

At this distance, transformer noise levels would be up to 38 dBA, which would meet the City's thresholds during daytime and nighttime hours. The nearest commercial property line would be approximately 110 feet south of the transformer pad. At this distance, noise levels generated by the transformer would be up to 33 dBA, which would satisfy the City standards. This would be a less-than-significant impact.

Mitigation Measure 1c: None required.

Impact 2: Exposure to Excessive Groundborne Vibration due to Construction. Construction-related vibration levels resulting from activities at the project site would potentially exceed 0.3 in/sec PPV at the existing structures to the west and to the north the project site. **This is a potentially 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. According to the equipment list provided at the time of this study, impact or vibratory pile driving activities, which can cause excessive vibration, are not expected for the proposed project.

For structural damage, 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, 0.3 in/sec PPV for buildings that are found to be structurally sound but where structural damage is a major concern, and a conservative limit of 0.08 in/sec PPV for ancient buildings or buildings that are documented to be structurally weakened. No known ancient buildings or buildings that are documented to be structurally weakened adjoin the project area. Therefore, conservatively, groundborne vibration levels exceeding 0.3 in/sec PPV would have the potential to result in a significant vibration impact.

Table 8 presents typical vibration levels that could be expected from construction equipment, as measured at a distance of 25 feet. 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.

Table 8 also summarizes the estimated vibration levels at the nearest existing buildings surrounding the project site. Construction vibration levels would depend on the specific location of individual pieces of equipment. That is, equipment scattered throughout the site would not generate a collective vibration level, but a vibratory roller, for instance, operating near the project site boundary would generate the worst-case vibration levels for the receptor sharing that property line. Further, construction vibration impacts are assessed based on the potential for damage to buildings on receiving land uses, not at receptors at the nearest property lines. Therefore, the distances used to propagate construction vibration levels (as shown in Table 8), which are different than the distances used to propagate construction noise levels (as shown in Table 7), were

estimated under the assumption that each piece of equipment was operating along the nearest boundary of the project site, which would represent the worst-case scenario.

As shown in Table 8, vibration levels could potentially exceed the conservative 0.3 in/sec PPV at the residences to the west of the site and at the nearest church building to the north of the site.

A study completed by the US Bureau of Mines analyzed the effects of blast-induced vibration on buildings in USBM RI 8507.[3] The findings of this study have been applied to buildings affected by construction-generated vibrations.[4] As reported in USBM RI 8507[3] and reproduced by Dowding,[4] Figure 3 presents the damage probability, in terms of "threshold damage," "minor damage," and "major damage," at varying vibration levels. Threshold damage, which is described as cosmetic damage in this report, would entail hairline cracking in plaster, the opening of old cracks, the loosening of paint or the dislodging of loose objects. Minor damage would include hairline cracking in masonry or the loosening of plaster, and major structural damage would include wide cracking or shifting of foundation or bearing walls. As shown in Figure 3, maximum vibration levels of 0.6 in/sec PPV would result in a less than 8% chance of threshold damage or cosmetic damage, while no minor or major damage would be expected.

Typical construction equipment, as shown in Table 8, would have the potential to produce vibration levels of 0.3 in/sec PPV or more at the nearest buildings adjoining the site. While no minor or major damage would occur at these conventional buildings, there is the potential to generate threshold or cosmetic damage at the surrounding buildings. This is a significant impact.

At these locations, and in other surrounding areas within 200 feet, vibration levels would potentially be perceptible. 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 during hours with the least potential to affect nearby businesses, perceptible vibration can be kept to a minimum.

Mitigation Measure 2:

The following measures are recommended to reduce vibration impacts from construction activities to a less-than-significant level:

- Limit vibration-inducing equipment to the extent feasible.
- Where possible, use of the heavy vibration-generating construction equipment shall be prohibited within 20 feet of the adjacent building to the east and to the north.
- Use a smaller vibratory roller, such as the Caterpillar model CP433E vibratory compactor, when compacting materials within 20 feet of adjacent structures.

[3] Siskind, D.E., M.S. Stagg, J.W. Kopp, and C.H. Dowding, Structure Response and Damage Produced by Ground Vibration form Surface Mine Blasting, RI 8507, Bureau of Mines Report of Investigations, U.S. Department of the Interior Bureau of Mines, Washington, D.C., 1980.
[4] Dowding, C.H., Construction Vibrations, Prentice Hall, Upper Saddle River, 1996.

- Modify/design or identify alternative construction methods to reduce vibration levels below the limits.

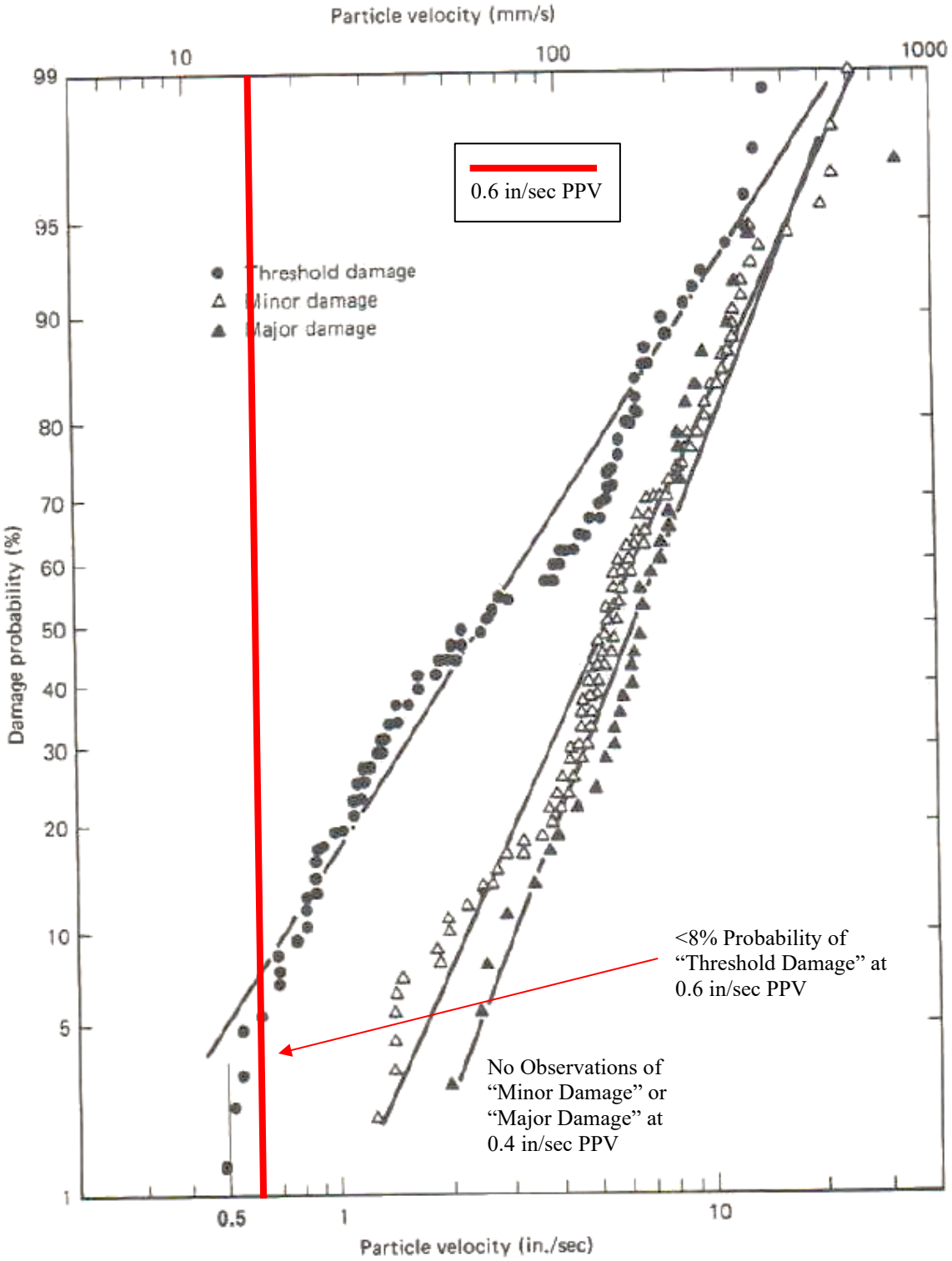
- Alternative methods for breaking up existing pavement, such as a pavement grinder, shall be used instead of dropping heavy objects, within 20 feet of adjacent buildings.

TABLE 8 Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 ft. (in/sec)	Estimated Vibration Levels at Structures Surrounding the Project Site, in/sec PPV				
			East Residences (10 feet)	North Church (10 feet)	South Commercial (80 feet)	South Hotel (65 feet)	East Civic Buildings (125 feet)
Clam shovel drop		0.202	**0.553**	**0.553**	0.056	0.071	0.034
Hydromill (slurry wall)	in soil	0.008	0.022	0.022	0.002	0.003	0.001
	in rock	0.017	0.047	0.047	0.005	0.006	0.003
Vibratory Roller		0.210	**0.575**	**0.575**	0.058	0.073	0.036
Hoe Ram		0.089	0.244	0.244	0.025	0.031	0.015
Large bulldozer		0.089	0.244	0.244	0. 025	0.031	0.015
Caisson drilling		0.089	0.244	0.244	0.025	0.031	0.015
Loaded trucks		0.076	0.208	0.208	0.021	0.027	0.013
Jackhammer		0.035	0.096	0.096	0.010	0.012	0.006
Small bulldozer		0.003	0.008	0.008	0.001	0.001	0.001

Source: Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, September 2018, as modified by Illingworth & Rodkin, Inc., November 2021.

FIGURE 3 Probability of Cracking and Fatigue from Repetitive Loading



Source: Dowding, C.H., Construction Vibrations, Prentice Hall, Upper Saddle River, 1996, as modified by Illingworth & Rodkin, Inc., November 2021.

Impact 3: **Excessive Aircraft Noise.** The project site is located more than two miles from a public airport or public use airport, and the proposed project would not expose people residing or working in the area to excessive aircraft noise levels. **This is a less-than-significant impact.**

Norman Y. Mineta San José International Airport is a public-use airport located approximately 1.3 miles northeast of the project site. According to the new Airport Master Plan Environmental Impact Report,[5] the project site lies well outside the 60 dBA CNEL contour line (see Figure 4). Aircraft noise would result in exterior noise levels below the City's requirements for residential land uses. Therefore, the proposed project would be compatible with the City's exterior noise standards for aircraft noise.

Mitigation Measure 3: **None required.**

[5] David J. Powers & Associates, Inc., Integrated Final Environmental Impact Report, Amendment to Norman Y. Mineta San Jose International Airport Master Plan, April 2020.

FIGURE 4 2037 CNEL Noise Contours for SJIA Relative to Project Site

Figure 5
Scenario 2: With Project 2037 Noise Contour Map

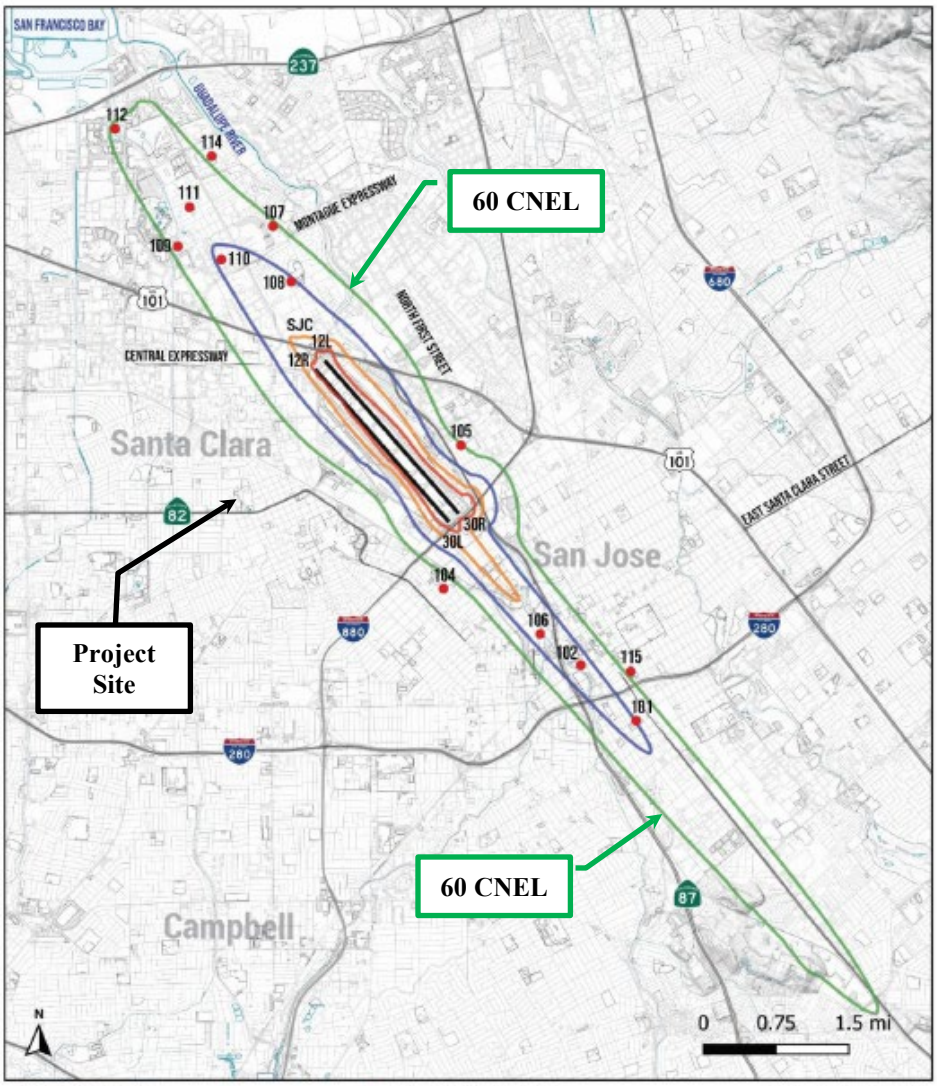


Figure 5 Scenario 2: With Project 2037 Noise Contour Map

Source: BridgeNet International 2019

Cumulative Impacts

Cumulative noise impacts would include either cumulative traffic noise increases under future conditions or temporary construction noise from cumulative construction projects.

A significant cumulative traffic noise increase would occur if two criteria are met: 1) if the cumulative traffic noise level increase was 3 dBA CNEL or greater for future levels exceeding 60 dBA CNEL or was 5 dBA CNEL or greater for future levels at or below 60 dBA CNEL; and 2) if the project would make a "cumulatively considerable" contribution to the overall traffic noise increase. A "cumulatively considerable" contribution would be defined as an increase of 1 dBA CNEL or more attributable solely to the proposed project.

A traffic study was not required for this project; therefore, the project would not be expected to result in a cumulatively considerable contribution along any roadway segments with noise-sensitive receptors. Therefore, the project would not result in a cumulative noise increase due to traffic.

APPENDIX

FIGURE A1 Daily Trend in Noise Levels at LT-1, Wednesday, September 29, 2021

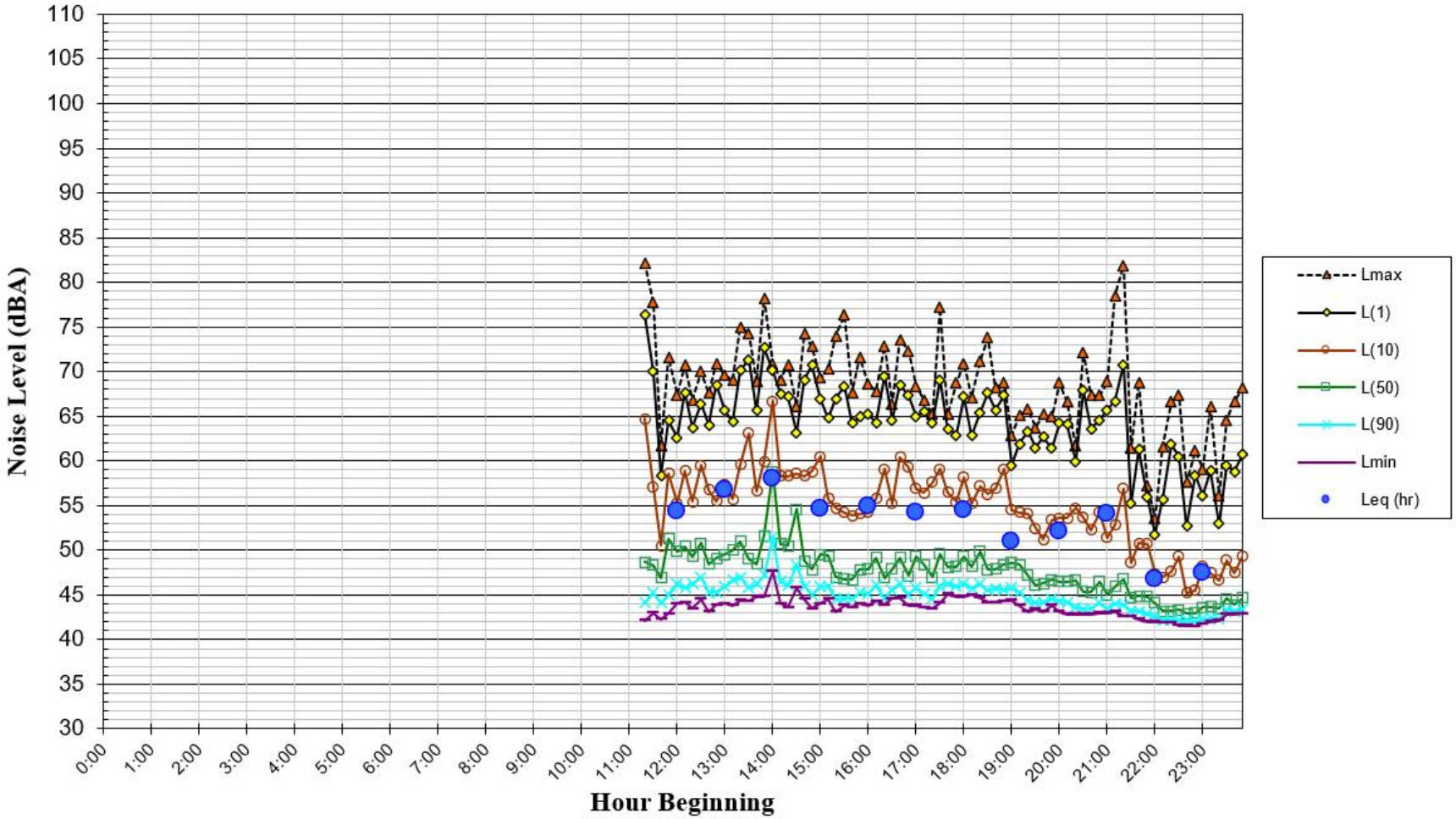


FIGURE A2 Daily Trend in Noise Levels at LT-1, Thursday, September 30, 2021

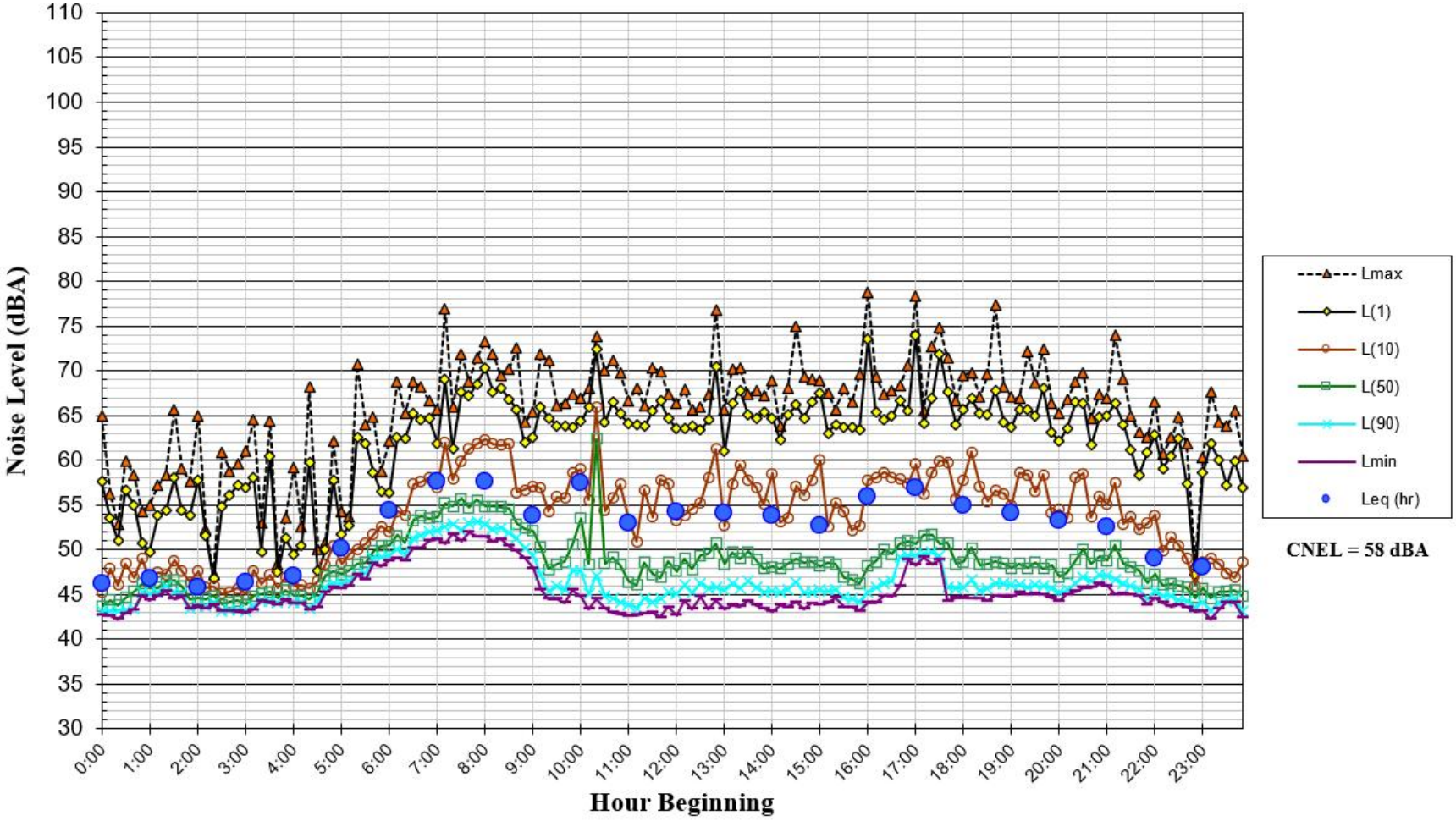


FIGURE A3 Daily Trend in Noise Levels at LT-1, Friday, October 1, 2021

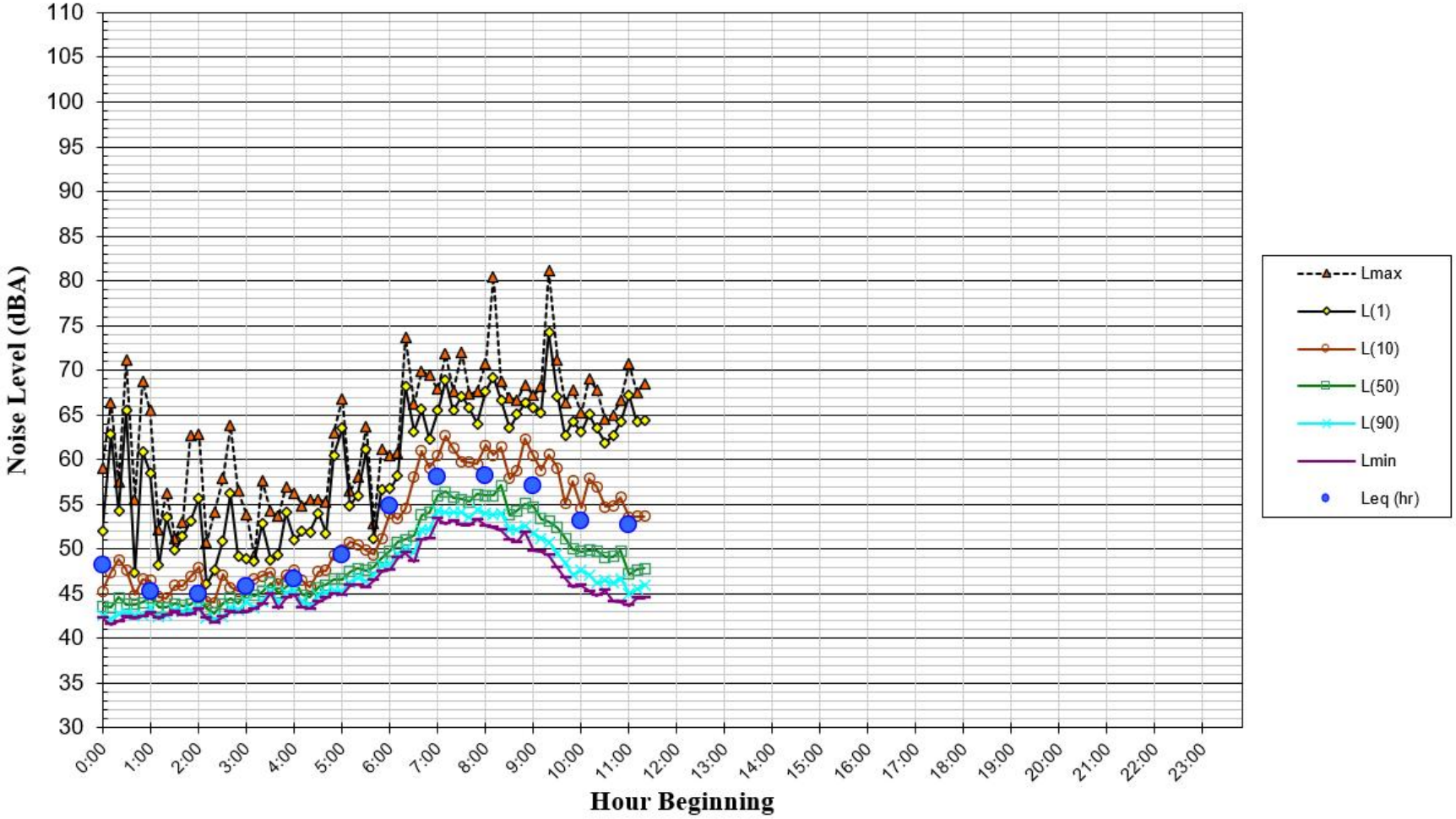


FIGURE A4 Daily Trend in Noise Levels at LT-2, Friday, November 19, 2021

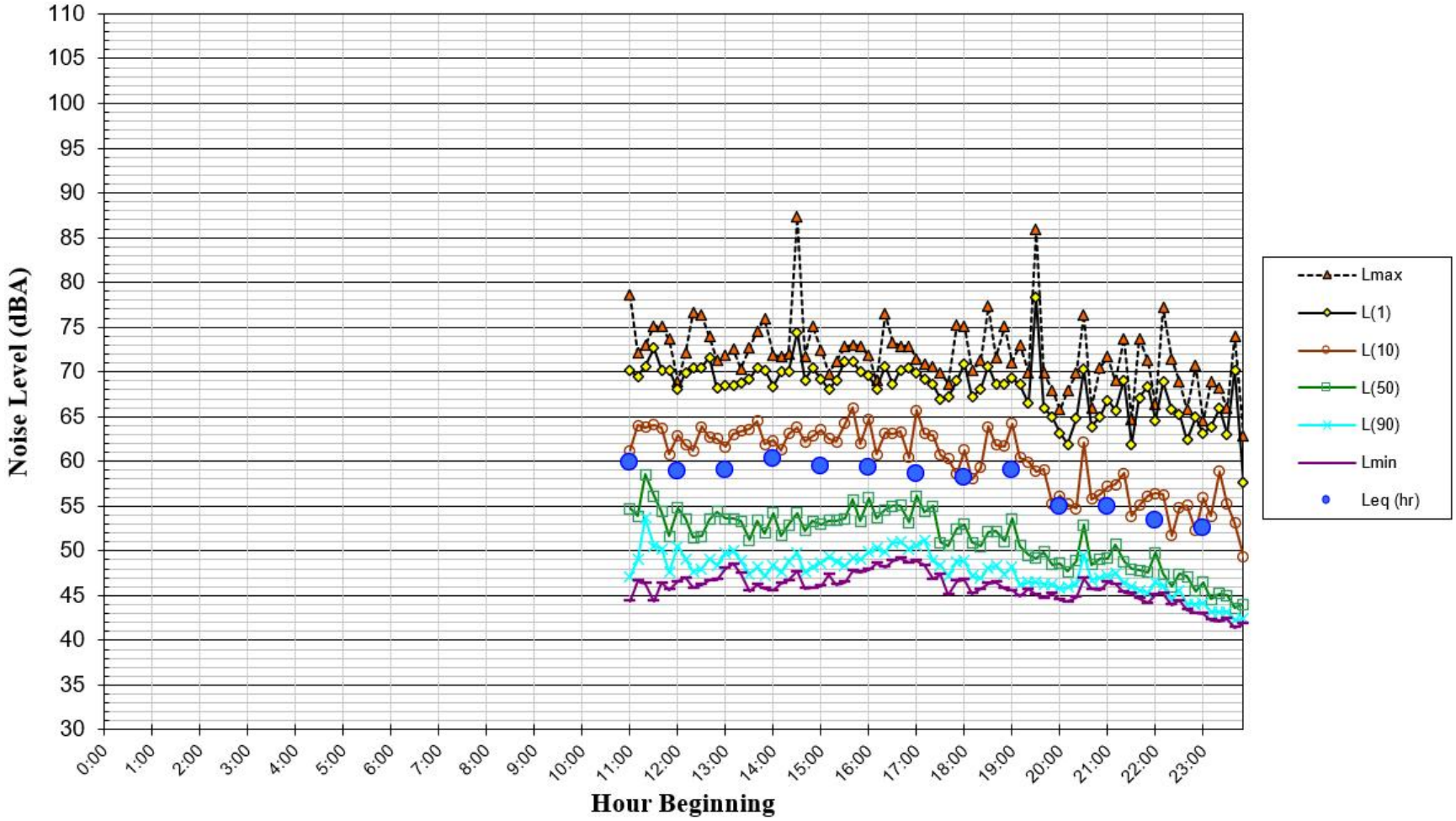


FIGURE A5 Daily Trend in Noise Levels at LT-2, Saturday, November 20, 2021

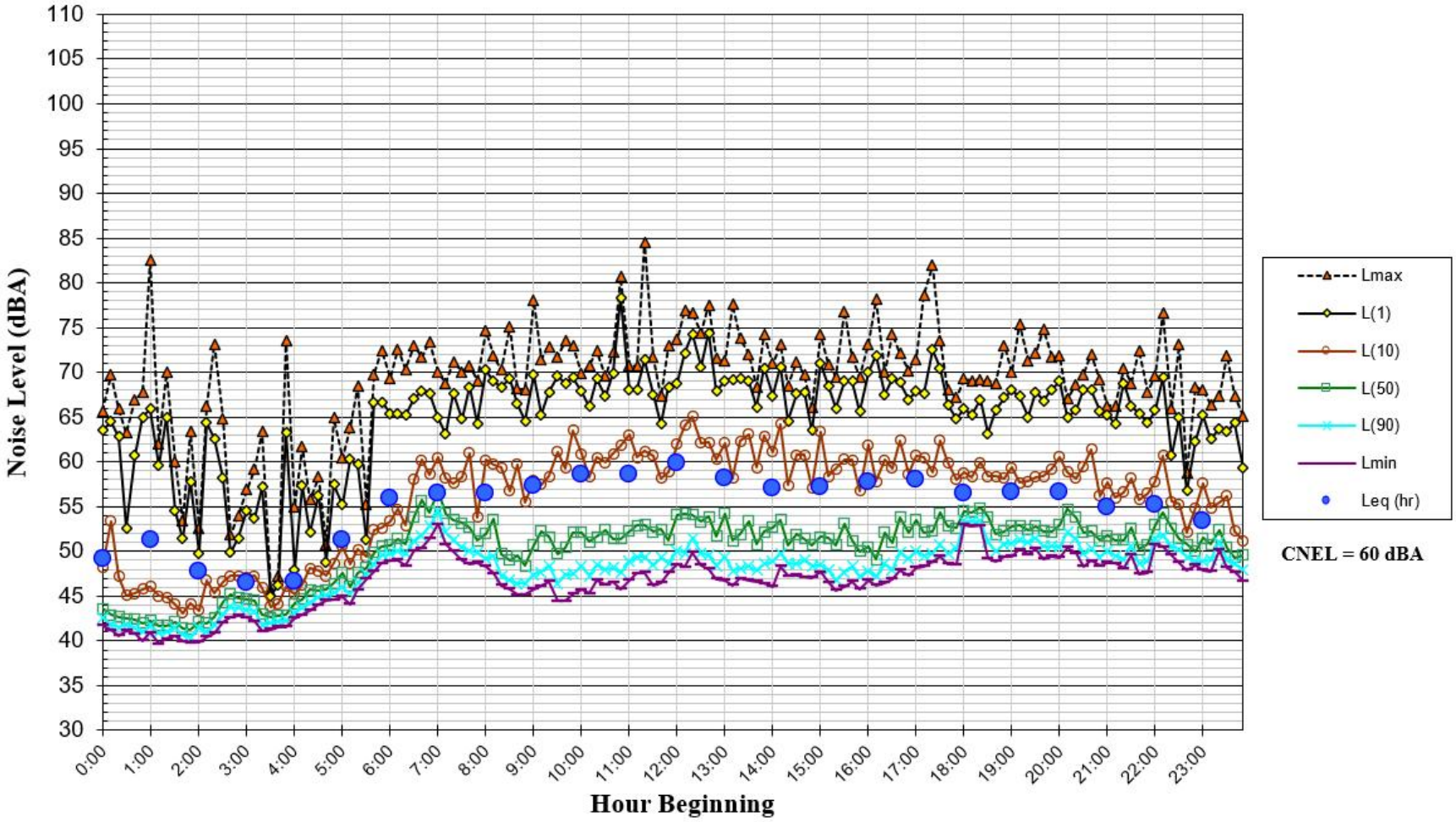


FIGURE A6 Daily Trend in Noise Levels at LT-2, Sunday, November 21, 2021

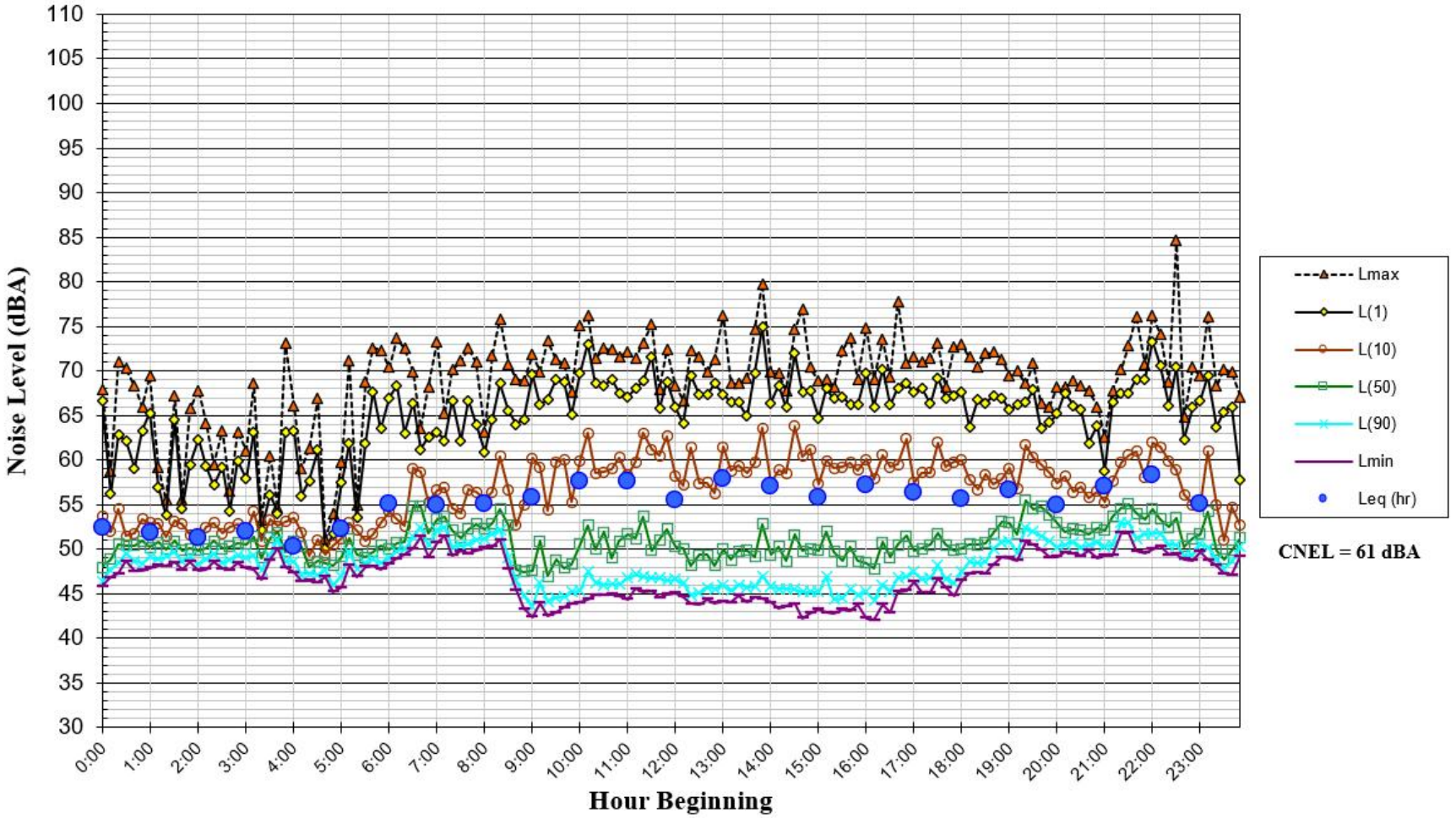


FIGURE A7 Daily Trend in Noise Levels at LT-2, Monday, November 22, 2021

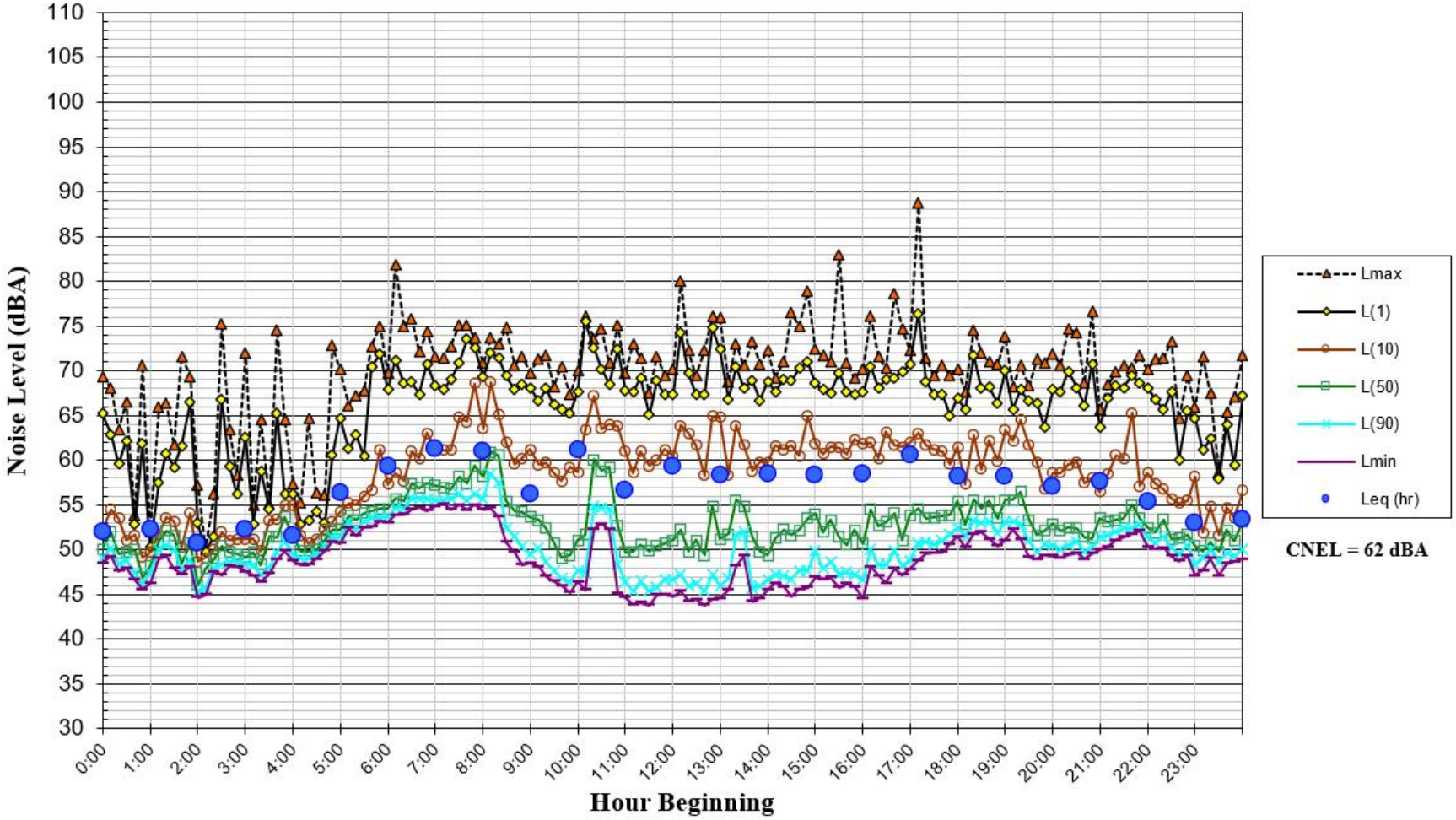


FIGURE A8 Daily Trend in Noise Levels at LT-2, Tuesday, November 23, 2021

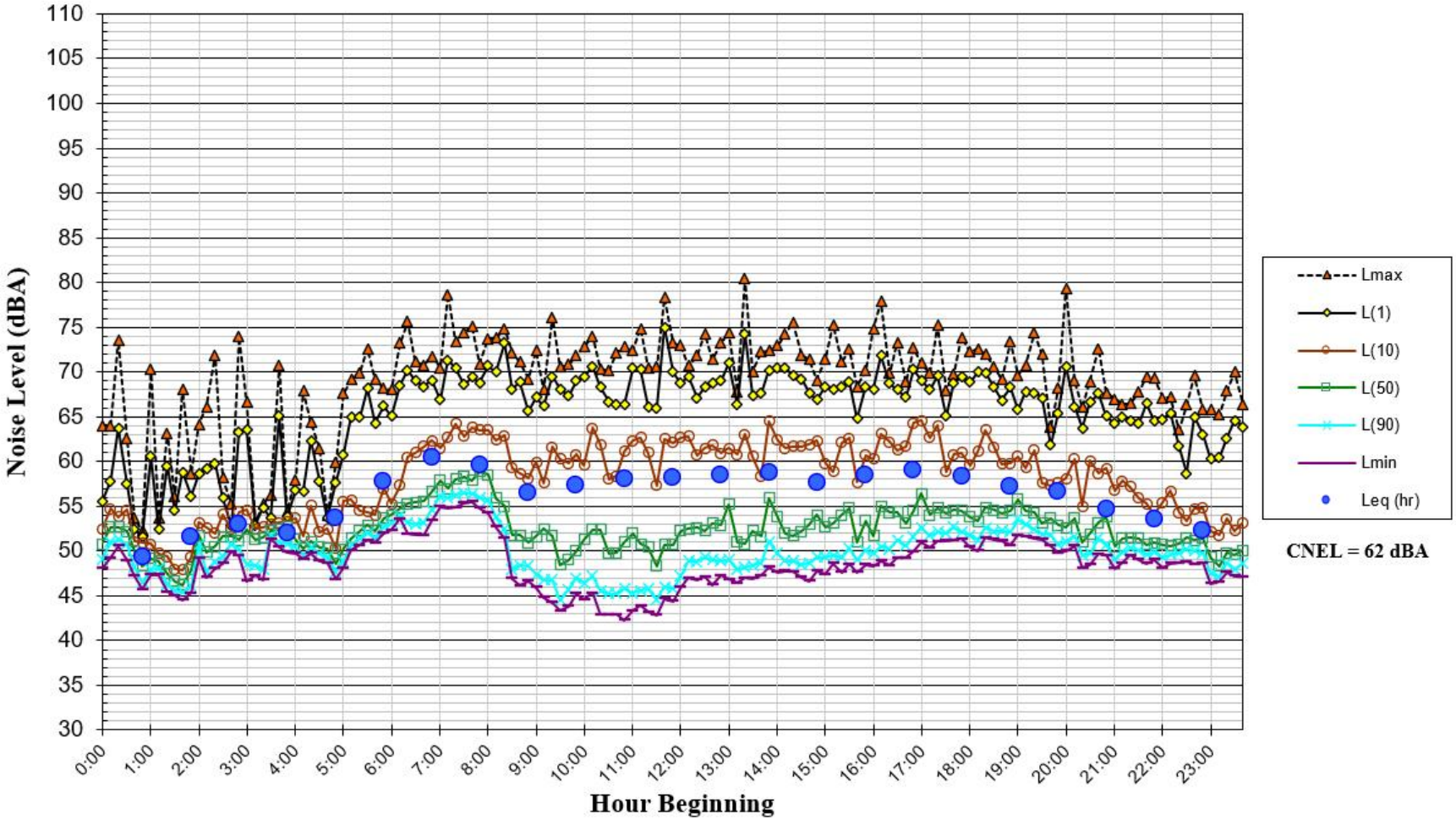


FIGURE A9 Daily Trend in Noise Levels at LT-2, Wednesday, November 24, 2021

