THE HOME DEPOT
NOISE AND VIBRATION ASSESSMENT

Petaluma, California

October 18, 2021

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INTRODUCTION

The project proposes to build a single-story, 108,000-square-foot Home Depot store at 261 North McDowell Boulevard in Petaluma, California. The Home Depot store will occupy the general footprint of the previous Kmart store within the Plaza North Shopping Center.

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 DNL. Typically, the highest steady traffic noise level during the daytime is about equal to the DNL 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 DNL with open windows and 65-70 dBA DNL 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 DNL 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 DNL. At a DNL of about 60 dBA, approximately 12 percent of the population is highly annoyed. When the DNL 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 DNL of 60-70 dBA. Between a DNL 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 DNL 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

Federal, State, and local agencies have established noise and vibration criteria that are applicable in this assessment. These criteria are used to establish significance thresholds for the assessment the 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 Transit Administration. The Federal Transit Administration (FTA) includes construction noise limits in the *Transit Noise and Vibration Impact Assessment,* published in September 2018. One-hour L_{eq} noise limits are summarized in the table below:

Land Use	One-hour L_{eq} (dBA)	
	Day	Night
Residential	90	80
Commercial	100	100
Industrial	100	100

State CEQA Guidelines. The 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 Cal Green Code. The State of California established exterior sound transmission control standards for new non-residential buildings as set forth in the 2019 California Green Building Standards Code (Section 5.507.4.1 and 5.507.4.2). 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 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 when the building falls within the 65 dBA L_{dn} noise contour of a freeway or expressway, railroad, industrial source or fixed-guideway noise source, as determined by the local general plan noise element.
>
> **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 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.

City of Petaluma General Plan. Chapter 10 of the City of Petaluma's General Plan includes policies and programs to control the noise environment within the City. The applicable policies and programs are as follows:

10-P-3 Protect public health and welfare by eliminating or minimizing the effects of existing noise problems, and by minimizing the increase of noise levels in the future.

A. Continue efforts to incorporate noise considerations into land use planning decisions, and guide the location and design of transportation facilities to minimize the effects of noise on adjacent land uses.

C. Ensure that the City's Noise Ordinance and other regulations:

- Require that applicants for new noise-sensitive development in areas subject to noise levels greater than 65 dBA CNEL obtain the services of a professional acoustical engineer to provide a technical analysis and design of mitigation measures.

- Require placement of fixed equipment, such as air conditioning units and condensers, inside or in the walls of new buildings or on rooftops of central units in order to reduce noise impacts on any nearby sensitive receptors.

- Establish appropriate noise-emission standards to be used in connection with the purchase, use, and maintenance of City vehicles.

D. Continue to require control of noise or mitigation measures for any noise-emitting construction equipment or activity.

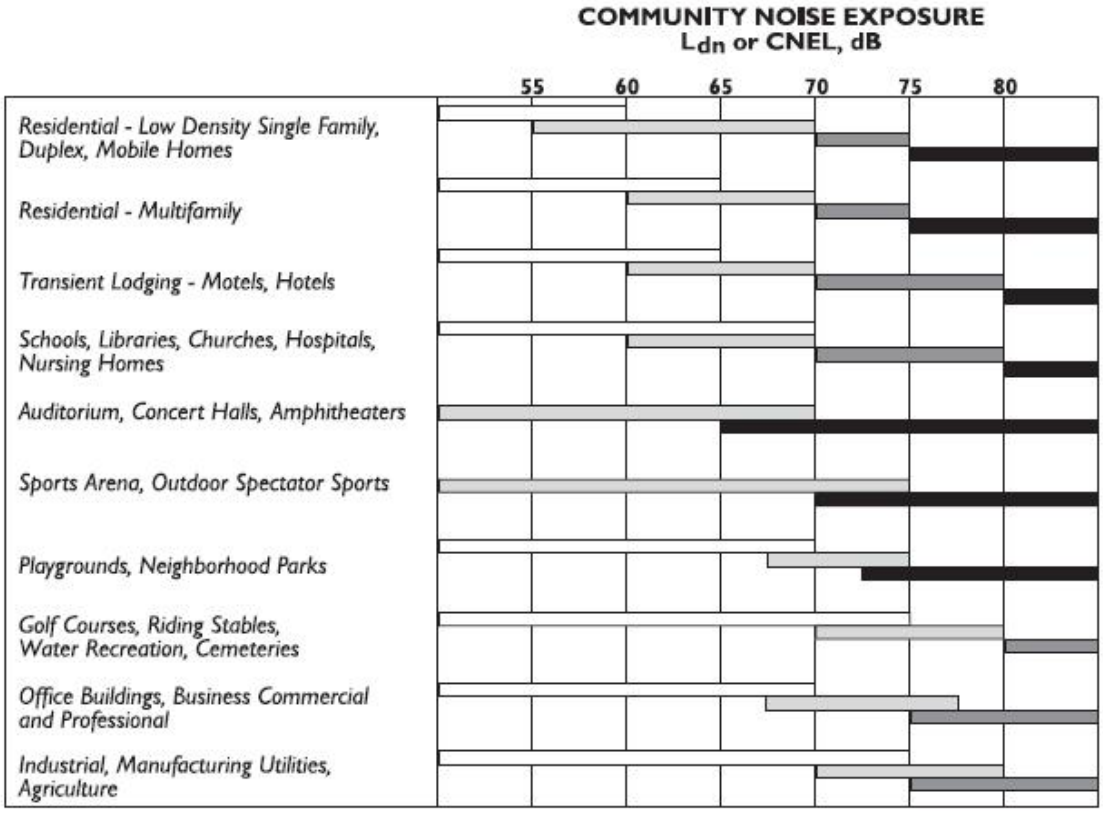
The City's Noise Ordinance establishes controls on construction-related noise.

E. As part of development review, use Figure 10-2: Land Use Compatibility Standards to determine acceptable uses and installation requirements in noise-impacted areas.

F. Discourage the use of sound walls anywhere except along Highway 101 and/or along the NWPRA corridor, without findings that such walls will not be detrimental to community character. When sound walls are deemed necessary, integrate them into the streetscape.

G. In making a determination of impact under the California Environmental Quality Act (CEQA), consider an increase of four or more dBA to be "significant" if the resulting noise level would exceed that described as normally acceptable for the affected land use in Figure 10-2: Land Use Compatibility Standards.

Figure 10-2: Land Use Compatibility Standards



INTERPRETATION:

NORMALLY ACCEPTABLE
Specified land use is satisfactory, based upon the assumption that any building involved is of normal conventional construction, without any special noise insulation requirements.

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

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

CLEARLY UNACCEPTABLE
New construction or development should generally not be undertaken.

SOURCE: California Governor's Office of Planning and Research, 1990.

City of Petaluma Zoning Ordinance. Chapter 21 of the City's Zoning Ordinance establishes performance standards intended to permit objective and precise measurement of the impact of nuisances; to establish permissible limits for each nuisance; to ensure that all industries will provide necessary control measures to protect the community from hazards and nuisances; and to protect any industry from arbitrary exclusion. The following sections apply to the proposed project.

21.030 – Nonresidential Uses Abutting Residential Uses: In order to address the potential impacts (noise, glare, odors, etc.) nonresidential uses may have on abutting residential uses, the following shall apply to any nonresidential that abuts a residential use located in a residential zone (RR, R1, R2, R3, R4, R5, or residential Planned Unit District):

A. Hours of operation are limited to Monday through Friday from 7:00 a.m. to 10:00 p.m. and Saturday, Sunday, and holidays recognized by the City from 9:00 a.m. to 10:00 p.m.

B. The hours of operation may be expanded beyond the hours permitted by Section 21.030(A) with approval of a conditional use permit, as prescribed by Section 24.030.

21.040 – Dangerous and Objectionable Elements

A. **Noise Regulations**

3. **Noise Regulations Generally**

a. The following specific acts, subject to the exemptions provided in Section 21.040(A)(5), are declared to be public nuisances and are prohibited:

1) The operation or use of any of the following before 7:00 a.m. or after 10:00 p.m. daily (except Saturday, Sunday and State, Federal or Local Holidays, when the prohibited time shall be before 9:00 a.m. and after 10:00 p.m.).

2) A hammer or any other device or implement used to repeatedly pound or strike an object.

3) An impact wrench, or other tool or equipment powered by compressed air.

4) Any tool or piece of equipment powered by an internal-combustion engine such as, but not limited to, chain saw, backpack blower, and lawn mower. Except as specifically included in this Ordinance, motor vehicles, powered by an internal-combustion engine and subject to the State of California vehicle code, are excluded from this prohibition.

5) Any electrically or battery powered tool or piece of equipment used for cutting, drilling, or shaping wood, plastic, metal, or other materials or objects, such as but not limited to a saw, drill, lathe or router.

6) Any of the following: the operation and/or loading or unloading of heavy equipment (such as but not limited to bulldozer, road grader, backhoe), ground drilling and boring equipment, hydraulic crane and boom equipment, portable power generator or pump, pavement equipment (such as but not limited to pneumatic hammer, pavement breaker, tamper, compacting equipment), pile driving equipment, vibrating roller, sand blaster, gunite machine, trencher, concrete truck, and hot kettle pump and the like.

7) Construction, demolition, excavation, erection, alteration or repair activity.

8) Operating or permitting the operation of powered model vehicles including but not limited to cars, aircraft and boats.

9) Using or operating for any purpose any loudspeaker, loudspeaker system or similar device in such a manner as to create a noise disturbance. Any permit issued pursuant to PMC Section 13.28.050 (amplified sound permit within a public park) is exempt from this section.

10) The use of truck/tractor trailer "Jake Brakes" on any public street under the jurisdiction of the City of Petaluma Police Department.

4. **Noise Measurement:** Utilizing the "A" weighting scale of a sound level meter and the "slow" meter response (use "fast" response for impulsive type sounds), the ambient noise level shall first be measured at a position or positions at any point on the receiver's property which can include private and public property. In general, the microphone shall be located four to five feet above the ground; ten feet or more from the nearest reflective surface where possible. If possible, the ambient noise shall be measured with the alleged offending noise source inoperative. If for any reason the alleged offending noise source cannot be shut down, the ambient noise must be estimated by performing a measurement in the same general area of the source but at a sufficient distance such that the noise from the source is at least 10 dB below the ambient in order that only the ambient level be measured.

   a. If the measured ambient level is greater than 60 dB, the Maximum Noise Exposure standard shall be adjusted in 5 dB increments for each time period as appropriate to encompass or reflect the measured ambient noise level. In no case shall the maximum allowed threshold exceed 75 dB after adjustments are made.

   b. In the event the measured ambient noise level is 70 dB or greater, the maximum allowable noise level shall be increased to reflect the maximum ambient noise level. In this case, adjustments for loudness and time as contained in Table I shall not be permitted.

c. No person shall cause or allow to cause, any source of sound at any location within the incorporated City or allow the creation of any noise on property owned, leased, occupied or otherwise controlled by such person, which when measured on the property where the noise disturbance is being experienced within public or private open/outdoor spaces, exceeds the noise level of Table 21.1.

TABLE 21.1: Maximum Exterior Noise Exposure (Leq, dBA)

	Time: 10 p.m. to 7 a.m. M-F 10 p.m. to 8 a.m. S, S and Holidays	Time: 7 a.m. to 10 p.m. M-F 8 a.m. to 10 p.m. S, S and Holidays
General Plan Ambient	60	60
Cumulative period of 15 minutes or more in one hour	65	70
Cumulative period of 5 minutes or more in one hour	70	75
Cumulative period of 1 minute or more in one hour	75	80

5. **Exemptions**

d. The operation of garbage collection and other municipal or utility vehicles.

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 in the Plaza North Shopping Center at 261 North McDowell Boulevard in the City of Petaluma. Currently, the site is developed with an existing commercial building that was formerly occupied by Kmart. The site is bound by U.S. Highway 101 to the west and existing residential buildings to the north. Existing commercial buildings and shopping center parking lots are located to the east and to the south of the site. To the east, and opposite North McDowell Boulevard, is an existing park and single-family residences. To the west, and opposite U.S. Highway 101, are existing single-family residences.

The noise environment at the site and in the surrounding areas results primarily from vehicular traffic along U.S. Highway 101. Local traffic along North McDowell Boulevard also affects the noise environment at nearby land uses.

A noise monitoring survey was performed at the site beginning on Friday September 17, 2021 and concluding on Tuesday September 21, 2021. The monitoring survey included two long-term and

three short-term noise measurements along the north boundary of the site, which are shown in Figure 1.

Long-term noise measurement LT-1 was made along the northern boundary of the project site, shared with existing multi-family residences. LT-1 was approximately 150 feet from the centerline of the nearest through lane along U.S. Highway 101. Note, this measurement was made behind an existing sound wall that runs parallel to U.S. Highway 101. LT-1 represented the existing noise environment of the nearest noise-sensitive receptors to the north. Hourly average noise levels at LT-1 typically ranged from 55 to 64 dBA L_{eq} during the day and from 52 to 63 dBA L_{eq} at night. The average community noise equivalent level (CNEL) for 24-hour periods occurring between Friday September 17, 2021 and Tuesday September 21, 2021 ranged from 63 to 65 dBA CNEL. The daily trends in noise levels at LT-1 are shown in Figures A1 through A5 in the Appendix of this report.

LT-2 was made approximately 45 feet from the centerline of North McDowell Boulevard. Hourly average noise levels at LT-2 typically ranged from 66 to 78 dBA L_{eq} during the day and from 59 to 72 dBA L_{eq} at night. The average CNEL between Friday September 17, 2021 and Tuesday September 21, 2021 ranged from 72 to 74 dBA. The daily trends in noise levels at LT-2 are shown in Figures A6 through A10.

The three short-term noise measurements were made on Monday September 20, 2021 in 10-minute intervals between 1:20 p.m. and 1:50 p.m. Each of the short-term measurements were made along the property line between the existing shopping center and the residences to the north, noting different localized sources of noise.

ST-1 was the farthest receptor from North McDowell Boulevard, approximately 675 feet from the centerline. ST-1 was also about 355 feet from the centerline of the nearest through lane along U.S. Highway 101. The 10-minute average noise level at ST-1 was 56 dBA $L_{eq(10\text{-}min)}$.

ST-2 was made approximately 500 feet from the centerline of North McDowell Boulevard. This measurement was located near mechanical equipment associated with the existing commercial buildings at the shopping center. During this measurement, passenger vehicles on North McDowell Boulevard and U.S. Highway 101 generated noise levels of about 60 dBA. Two vehicles in the residential parking lot generated noise levels ranging from 60 dBA during normal activity to 79 dBA when driving over a metal plate. Mechanical equipment noise from the surrounding buildings generated noise levels of about 58 to 59 dBA. The 10-minute average noise level at ST-2 was 61 dBA $L_{eq(10\text{-}min)}$.

ST-3 was made approximately 255 feet from the centerline of North McDowell Boulevard. Typical vehicle pass-bys along North McDowell Boulevard generated noise levels ranging from 51 to 61 dBA at ST-3. Traffic noise from U.S. Highway 101 generated noise levels ranging from 49 to 51 dBA, and parking lot noise ranged from 60 to 61 dBA for passenger cars and up to 74 dBA for a heavy truck. An aircraft flew overhead during the ST-3 measurement, generating noise levels up to 58 dBA. The 10-minute average noise level at ST-3 was 57 dBA $L_{eq(10\text{-}min)}$.

Table 4 summarizes the results of the 10-minute noise measurements made at ST-1, ST-2, and ST-3.

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: ~675 feet from the North McDowell Boulevard centerline (9/20/2021, 1:20-1:30 p.m.)	67	61	57	55	54	56
ST-2: ~500 feet from the North McDowell Boulevard centerline (9/20/2021, 1:20-1:30 p.m.)	82	63	60	59	58	61
ST-3: ~255 feet from the North McDowell Boulevard centerline (9/20/2021, 1:40-1:50 p.m.)	74	69	58	53	49	57

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 70 dBA CNEL to be considered normally acceptable for commercial land uses, according to the City's General Plan. Additionally, nonresidential interiors are required to meet the Cal Green Code performance standard of 50 dBA $L_{eq(1\text{-}hr)}$ during daytime operational hours.

The future noise environment at the project site would continue to be dominated by traffic along U.S. Highway 101. While the traffic study completed for the proposed project did not include future traffic volumes for U.S. Highway 101, a typical 1% to 2% increase per year for the next 19 years was assumed, which would result in about a 2 dBA increase by the year 2040.

Future Exterior Noise Environment

The project's site plan does not show common use outdoor activity areas associated with the proposed building. Therefore, the future noise environment at the project site would not have an effect on the project.

Future Interior Noise Environment

The western façade of the proposed commercial building would be set back approximately 120 feet from the centerline of the nearest through lane along U.S. Highway 101. At the exterior façade, the highest hourly average noise levels would range from 65 to 73 dBA $L_{eq(1\text{-}hr)}$ during future daytime hours.

Standard construction materials and methods for commercial uses would provide about 25 to 30 dBA of noise reduction in interior spaces. Standard commercial construction materials and methods, assuming the implementation of forced-air mechanical ventilation, would reduce noise levels indoors to between 40 to 48 dBA, which would satisfy the interior threshold of 50 dBA $L_{eq(1\text{-}hr)}$ established by the Cal Green Code.

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 60 dBA L_{eq} at residential land uses or exceed 70 dBA L_{eq} at commercial land uses and exceed the ambient noise environment by at least 5 dBA L_{eq} for a period of more than one year would constitute a significant temporary noise increase in the project vicinity.

- A significant permanent noise level increase would occur if project-generated traffic generated by the project or project improvements/operations would substantially increase noise levels at sensitive receivers in the vicinity. 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 demolition and construction activities (including the loading and unloading of materials and truck movements) to the hours of 7:00 a.m. to 10:00 p.m. on weekdays and between the hours of 9:00 a.m. and 10:00 p.m. on weekends and holidays recognized by the City of Petaluma.

As discussed in the Fundamentals section of this report, thresholds for speech interference indoors is 45 dBA. Assuming a 15 dBA exterior-to-interior reduction for standard residential construction and a 25 dBA exterior-to-interior reduction for standard commercial construction, this would correlate to an exterior threshold of 60 dBA L_{eq} at residential land uses and 70 dBA L_{eq} at

commercial land uses. Additionally, temporary construction would be annoying to surrounding land uses if the ambient noise environment increased by at least 5 dBA L_{eq} for an extended period of time. Additionally, the Federal Transit Administration (FTA) has defined hourly average noise limits during construction activities to be 90 dBA at residential land uses and 100 dBA at commercial uses during daytime hours. Conservatively, the temporary construction noise impact would be considered significant if project construction activities exceeded 60 dBA L_{eq} at the nearby residences or exceeded 70 dBA L_{eq} at nearby commercial land uses and exceeded the ambient noise environment by 5 dBA L_{eq} or more for a period longer than one year.

Ambient noise levels at noise-sensitive receptors set back from North McDowell Boulevard range from 55 to 64 dBA L_{eq} during daytime hours, based on the existing noise measurements made at LT-1. For receptors along North McDowell Boulevard, ambient noise levels would be represented by LT-2, which range from 66 to 78 dBA L_{eq} during daytime hours.

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 commercial buildings generate construction noise levels ranging from 75 to 89 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			
			North Residences (350 feet)	East Commercial (375 feet)	South Commercial (330 feet)	West Residences (365 feet)
Demolition	8/16/2022-9/26/2022	Concrete/Industrial Saw (1) Excavator (3) Rubber-Tired Dozer (2)	70 dBA L_{eq}	69 dBA L_{eq}	70 dBA L_{eq}	69 dBA L_{eq}
Site Preparation	9/27/2022-11/7/2022	Rubber-Tired Dozer (3) Tractor/Loader/Backhoe (4)	71 dBA L_{eq}	70 dBA L_{eq}	71 dBA L_{eq}	70 dBA L_{eq}
Grading/ Excavation	11/8/2022-12/19/2022	Excavator (1) Grader (1) Rubber-Tired Dozer (1) Tractor/Loader/Backhoe (3)	70 dBA L_{eq}	70 dBA L_{eq}	71 dBA L_{eq}	70 dBA L_{eq}
Trenching/ Foundation	12/20/2022-1/16/2023	Tractor/Loader/Backhoe (1) Excavator (1)	65 dBA L_{eq}	64 dBA L_{eq}	65 dBA L_{eq}	64 dBA L_{eq}
Building Exterior	1/17/2023-12/4/2023	Crane (1) Forklift (3) Generator Set (1) Tractor/Loader/Backhoe (3) Welder (1)	69 dBA L_{eq}	69 dBA L_{eq}	70 dBA L_{eq}	69 dBA L_{eq}
Building Interior/ Architectural Coating	12/5/2023-12/28/2023	Air Compressor (1) Aerial Lift (1)	58 dBA L_{eq}	57 dBA L_{eq}	58 dBA L_{eq}	57 dBA L_{eq}
Paving	12/5/2023-12/28/2023	Cement and Mortar Mixer (2) Paver (1) Paving Equipment (2) Roller (2) Tractor/Loader/Backhoe (1)	71 dBA L_{eq}[a]	70 dBA L_{eq}[a]	71-72 dBA L_{eq}[a]	70-71 dBA L_{eq}[a]

[a] Range in estimated noise levels reflects the paving phase only and when in combination with the building interior/architectural coating phase.

While the FTA thresholds for construction would not be exceeded at the surrounding noise-sensitive land uses, the predicted construction noise levels in Table 7 indicate that project construction could potentially generate noise levels exceeding 60 dBA L_{eq} at the nearby sensitive uses and exceeding 70 dBA L_{eq} at the nearby commercial uses. At times, the existing ambient noise levels would potentially be exceeded by 5 dBA L_{eq} or more. Since project construction is expected to last for a period exceeding one year, this is conservatively considered a significant impact.

Mitigation Measure 1a:

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.

Construction Best Management Practices

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

- Ensure that all demolition and construction activities (including the loading and unloading of materials and truck movements) are limited to the hours of 7:00 a.m. to 10:00 p.m. on weekdays and between the hours of 9:00 a.m. and 10:00 p.m. on weekends and 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 and recognizing that noise generated by construction activities would occur over a temporary period, the temporary increase in ambient noise levels would be less-than-significant.

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.

The traffic study prepared for the proposed project included existing peak hour traffic volumes at each link of the East Washington Street/North McDowell Boulevard intersection. Comparing the existing plus project volumes to the existing volumes resulted in a less than 1 dBA CNEL noise level increase along all major roadway segments in the project vicinity. 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 could potentially generate noise levels exceeding the City's Municipal Code noise thresholds at the existing land uses surrounding the project site. **This is a potentially significant impact.**

Under the City of Petaluma Municipal Code, noise generated by operations at the proposed project site that would last for 30 minutes or more in any given hour would be restricted to noise levels of 60 dBA during daytime hours (7:00 a.m. to 10:00 p.m. on weekdays and 8:00 a.m. to 10:00 p.m. on weekends and holidays) and nighttime hours (10:00 p.m. to 7:00 a.m. on weekdays and 10:00 p.m. to 8:00 a.m. on weekends and holidays) at surrounding land uses, assuming the ambient noise environment is at or below 60 dBA. If the ambient noise environment exceeds 60 dBA, this threshold would be increased in 5 dBA increments until the ambient environment is reflected. For the existing residences to the north and to the west, both of which would be shielded from U.S. Highway 101 traffic by an existing sound wall, would be represented by LT-1 measurement data. Daytime ambient noise levels are up to 64 dBA L_{eq}, and nighttime ambient noise levels are up to 63 dBA L_{eq}. Therefore, for activities occurring for 30 minutes or more in any given hour, the threshold would be 65 dBA for both daytime and nighttime hours.

For activities occurring for 15 minutes or more in any given hour, the daytime threshold would be 75 dBA, and the nighttime threshold would be 70 dBA. For activities occurring for 5 minutes or more in any given hour, the daytime threshold would be 80 dBA, and the nighttime threshold would be 75 dBA. For activities occurring for 1 minute or more in any given hour, the daytime threshold would be 85 dBA, and the nighttime threshold would be 80 dBA.

Mechanical Equipment

Mechanical equipment associated with the proposed building would include heating pumps and air conditioning units, which are assumed to be located on the roof of the proposed building; however, the roof plan was not available at the time of this study to confirm. Therefore, information such as type and number of units, specific locations on the rooftop, potential screening proposed to shield the noise from surrounding land uses, and noise level information generated by the proposed equipment are also unavailable at this time. On the ground level along the western façade of the building, an emergency generator, a transformer, and a compactor are shown.

Typically, transformers up to 1,000 kVA generate noise levels up to 64 dB, as measured at 1 meter (3.28 feet). Note, the existing residences to the north and to the west, opposite U.S. Highway 101, would be partially shielded by an existing sound wall. To estimate worst-case conditions, no attenuation is assumed for this analysis. The residences to the north are approximately 390 feet from the transformer, and the residences to the west are approximately 230 feet from the transformer. At these distances, the noise levels would be below 30 dBA. The existing commercial property to the south would be approximately 370 feet from the transformer. At this distance, noise levels would be below 30 dBA, as well. Assuming the transformer runs continuously during daytime and nighttime hours, these levels would meet the 65 dBA daytime and nighttime thresholds. This would be a less-than-significant impact.

Typical heating pumps would generate noise ranging from 56 to 66 dBA at a distance of 3 feet. Assuming up to ten heating pumps would run simultaneously in any given hour, the total combined noise level at 3 feet would be up to 76 dBA. These units are typically located at least 10 feet from the edge of the building, which would make the nearest residential property lines approximately 75 feet north of the nearest rooftop mechanical equipment and 230 feet west of the nearest rooftop equipment. At these distances, the nearest residential receptors would be exposed to rooftop equipment noise of 48 dBA at the northern residences and below 40 dBA at the western residences. The existing commercial properties adjoining the project site would be approximately 50 feet to the south and approximately 180 feet east of the nearest potential location of rooftop equipment. At these distances, mechanical equipment noise would be up to 52 dBA at the southern commercial property and 40 dBA at the eastern commercial property. This equipment would run for a period of more than 30 minutes in a given hour. Therefore, the estimated mechanical equipment noise would meet the City's 65 dBA threshold during daytime and nighttime hours. This would be a less-than-significant impact.

The proposed emergency generator would have a capacity of 300 kW and use gasoline as fuel. At the time of this study, specific equipment and any noise-suppressing features such as enclosures, mufflers, etc., were not available. A 300 kW emergency generator would potentially generate noise levels up to 89 dBA with a weather enclosure at 23 feet and could be reduced to 84 dBA with a Level I sound enclosure or 71 dBA with a Level II sound enclosure, both measured at 23 feet. Emergency generators are typically tested for a period of one hour every month during daytime hours only and would run for more than 30 minutes during that hour of testing. The distance from the generator to the property lines of the northern residences would be 355 feet, to the western residences would be 230 feet, and to the southern commercial property would be 420 feet. Estimated noise levels generated by the emergency generator at the surrounding land uses are summarized in Table 8 for the weather enclosure, Level I sound enclosure, and Level 2 sound enclosure.

TABLE 8 Estimated Noise Levels for the Emergency Generator at Surrounding Land Uses

Receptor	Distance	Weather Enclosure	Level I Sound Enclosure	Level II Sound Enclosure
North Residences	355 feet	65 dBA	60 dBA	47 dBA
West Residences	230 feet	69 dBA	64 dBA	51 dBA
South Commercial Property	420 feet	64 dBA	59 dBA	46 dBA

As shown in Table 8, the emergency generator would potentially exceed the 65 dBA daytime threshold at the northern and western residences if a weather enclosure is used. However, the threshold would be met with the inclusion of a Level I or Level II sound enclosure. This is a potentially significant impact.

A compactor typically generates noise levels up to 76 dB at 50 feet. Due to the location of the compactor behind the garden center, the northern residences would be shielded from the noise-

generating equipment. However, the western residences and the southern commercial property would have direct line-of-sight. Both of these receptors are located approximately 250 feet from the compactor. At this distance, the surrounding receptors would be exposed to compactor noise levels up to 62 dBA, which would meet the 65 dBA threshold. This would be a less-than-significant impact.

Parking Lot

Parking lot noise is part of the ambient noise environment at the site since existing commercial uses currently occupy the site. Therefore, this is not considered a new noise source at the project site and would be included in the ambient measurements made at the surrounding land uses. No further analysis would be required. This would be a less-than-significant impact.

Truck Loading and Unloading

The site plan shows a lumber canopy in the northeastern corner of the proposed building and a lumber pad in the northwestern corner of the building, where it is assumed loading activities would occur. The loading canopy is where customers would load wood products on smaller pickup trucks and sports utility vehicles (SUVs), which would be considered light-duty passenger vehicles similar to the existing and future parking lot. Noise levels produced by lumber loading and off-loading activities area would be approximately 64 dBA L_{eq} at 50 feet. Such noise levels would be reduced by about 10 dBA at the north property line and would fall below the City 65 dBA threshold and ambient noise levels due to traffic.

The site plan also shows a truck dock and loading pad to the west and south, respectively, of the garden center building. The truck dock is likely where shipments would be delivered to the store, which would involve heavy-duty trucks. The loading pad is likely where garden pickups would occur, which would typically be made by medium-duty vendor trucks or light-duty passenger vehicles similar to typical parking lot activity. Heavy-duty trucks typically generate maximum instantaneous noise levels of 70 to 75 dBA at a distance of 50 feet. Smaller medium-sized delivery trucks typically generate maximum noise levels of 60 to 65 dBA at the same distance. Low speed truck noise results from a combination of engine, exhaust, and tire noise, as well as the intermittent sounds of back-up alarms and releases of compressed air associated with truck/trailer air brakes. The noise levels produced by backup alarms can vary depending on the type and directivity of the sound, but maximum noise levels are typically between 65 to 75 dBA at a distance of 50 feet.

While both of these loading and unloading locations would be shielded from the residences to the north and west by intervening structures, they would be within direct line-of-sight to the existing commercial building to the south. The distance from the truck dock to the nearest unshielded receptors would be 250 feet. At 250 feet, heavy-duty truck loading and unloading activities would generate noise levels ranging from 56 to 61 dBA. The proposed project would include three daily truck trips, on average. Therefore, truck deliveries would typically occur for up to 15 minutes in any given hour. Assuming the proposed project would adhere to the City's loading and unloading allowable hours of 7:00 a.m. to 10:00 p.m. on weekdays and 9:00 a.m. to 10:00 p.m. on weekends and holidays, heavy truck deliveries occurring at the project site would meet the City's 75 dBA daytime threshold. The medium truck deliveries occurring at the loading pad would generate noise levels ranging from 42 to 47 dBA at the west residences and from 64 to 69 dBA at the southern

commercial property. Assuming daytime deliveries only, the City's 75 dBA threshold would be met. This would be a less-than-significant impact.

In addition to truck maneuvering and loading activities, truck pass-bys in the parking area would also generate noise levels at the surrounding land uses. Access to the truck dock and loading pad are shown from the south, between the proposed garden center and the existing commercial building; however, the exit route from the shopping center indicates that all trucks would travel along the northern boundary of the site, shared with the existing senior residential development. While this driveway currently exists, the number of truck trips would increase substantially under project conditions. Heavy truck pass-bys would generate noise levels of 68 to 70 dBA at a distance of 35 feet and would last for less than 5 minutes.

The distance from the centerline of the exit lane to the northern boundary shared with the existing residences is approximately 25 feet. At this distance, truck pass-bys would generate noise levels ranging from 70 to 72 dBA. This would be less than the City's 80 dBA threshold during daytime hours. Medium truck pass-bys would be about 5 dBA quieter. Therefore, 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 south of 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 9 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 9 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 9), 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 9, vibration levels could potentially exceed the conservative 0.3 in/sec PPV at the existing commercial building to the south of the project site.

A study completed by the US Bureau of Mines analyzed the effects of blast-induced vibration on buildings in USBM RI 8507.[1] The findings of this study have been applied to buildings affected by construction-generated vibrations.[2] As reported in USBM RI 8507[1] and reproduced by Dowding,[2] Figure 2 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 2, maximum vibration levels of 0.4 in/sec PPV would result in a less than 5% chance of threshold damage or cosmetic damage, while no minor or major damage would be expected.

Typical construction equipment, as shown in Table 9, would have the potential to produce vibration levels of 0.3 in/sec PPV or more at the nearest building 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.

[1] 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.
[2] Dowding, C.H., Construction Vibrations, Prentice Hall, Upper Saddle River, 1996.

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.
- 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.

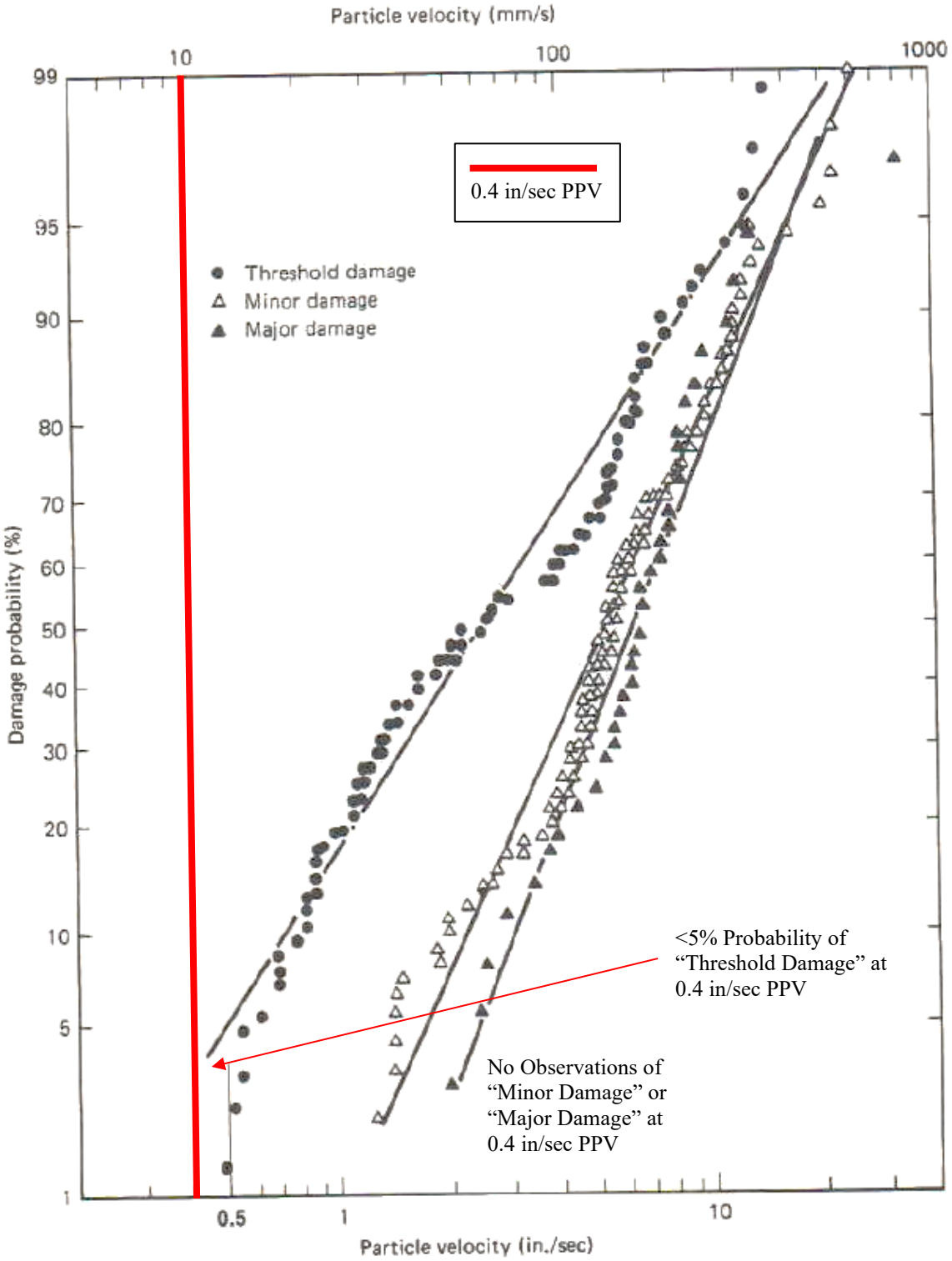
The implementation of these measures would reduce the impact to a less-than-significant level.

TABLE 9 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			
			North Residences (80 feet)	West Residences (185 feet)	South Commercial (15 feet)	East Commercial (40 feet)
Clam shovel drop		0.202	0.056	0.022	**0.354**	0.120
Hydromill (slurry wall)	in soil	0.008	0.002	0.001	0.014	0.005
	in rock	0.017	0.005	0.002	0.030	0.010
Vibratory Roller		0.210	0.058	0.023	**0.368**	0.053
Hoe Ram		0.089	0.025	0.010	0.156	0.053
Large bulldozer		0.089	0. 025	0.010	0.156	0.053
Caisson drilling		0.089	0.025	0.010	0.156	0.053
Loaded trucks		0.076	0.021	0.008	0.133	0.045
Jackhammer		0.035	0.010	0.004	0.061	0.021
Small bulldozer		0.003	0.001	0.0003	0.005	0.002

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., September 2021.

FIGURE 2 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 2019.

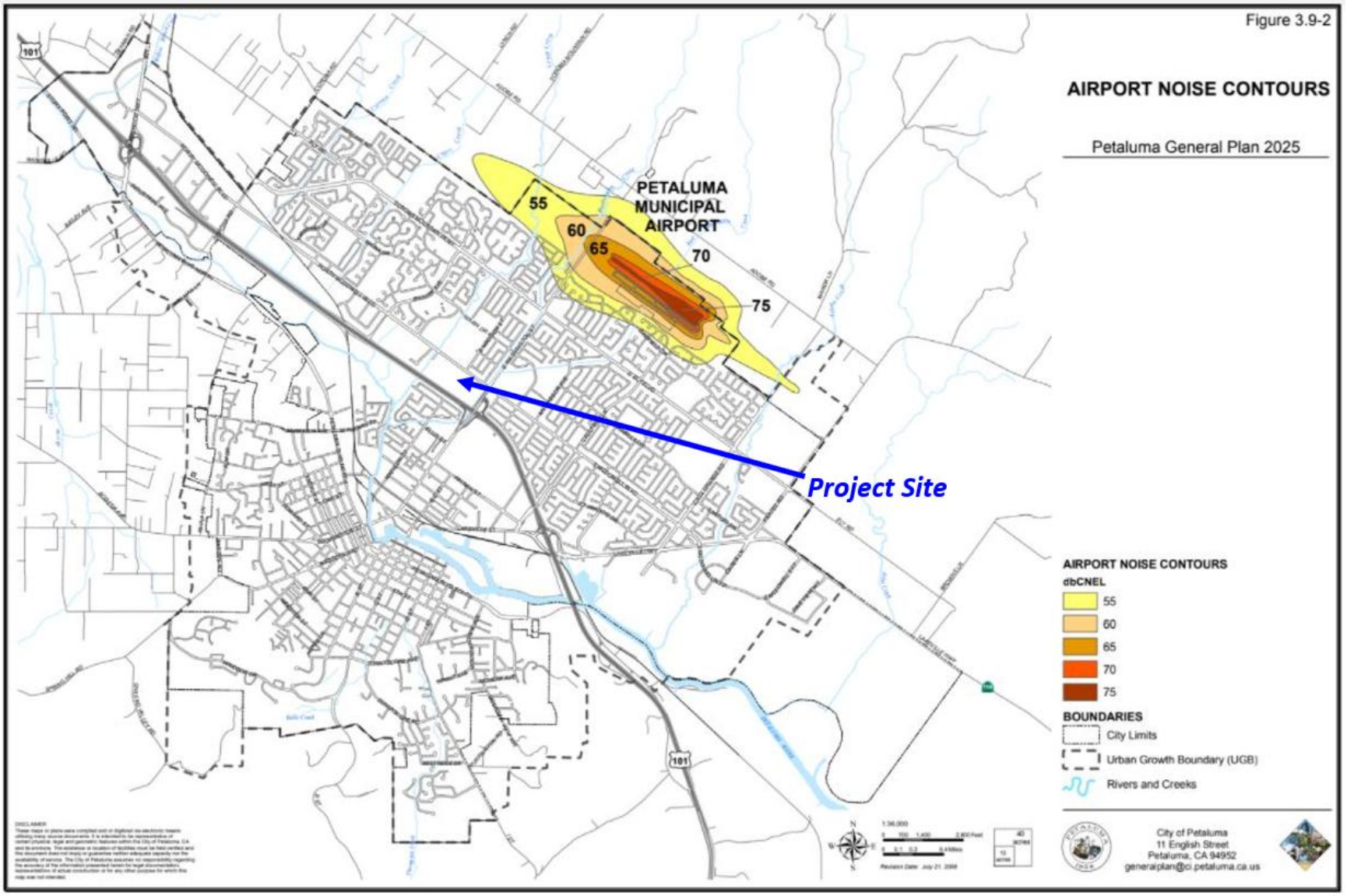
Impact 3: **Excessive Aircraft Noise.** The project site is located more than one mile from a public airport or public use airport, and the proposed project would not expose people working in the area to excessive aircraft noise levels. **This is a less-than-significant impact.**

The Petaluma Municipal Airport is a public-use airport located approximately 1.2 miles east of the project site. The project site lies well outside the 55 dBA CNEL contour line (see Figure 3). Aircraft noise would result in exterior noise levels below the City's requirements for commercial land uses. Therefore, the proposed project would be compatible with the City's exterior noise standards for aircraft noise.

Additionally, the Charles M. Schulz Sonoma County Airport is approximately 19.7 miles northwest of the project site, which lies well outside the 55 dBA CNEL noise contours for 2030. The proposed project would be compatible with the City's exterior noise standards for aircraft noise. This is a less-than-significant impact.

Mitigation Measure 3: **None required.**

FIGURE 3 2025 CNEL Noise Contours for the Petaluma Municipal Airport Relative to Project Site



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.

The traffic study included cumulative plus project traffic volumes. When compared to the existing traffic volumes, a noise level increase of 1 dBA CNEL or less was calculated along all four roadway segments at the East Washington Street/North McDowell Boulevard intersection. Therefore, the project would not result in a cumulatively considerable contribution along any roadway segments in the project vicinity. Therefore, the project would not result in a cumulative noise increase due to traffic.

There are no known approved projects surrounding the project site that would be constructed during the same timeframe as the proposed project. Therefore, the noise-sensitive receptors surrounding the project site would not be subject to cumulative construction impacts.

APPENDIX

FIGURE A1 Daily Trend in Noise Levels at LT-1, Friday, September 17, 2021

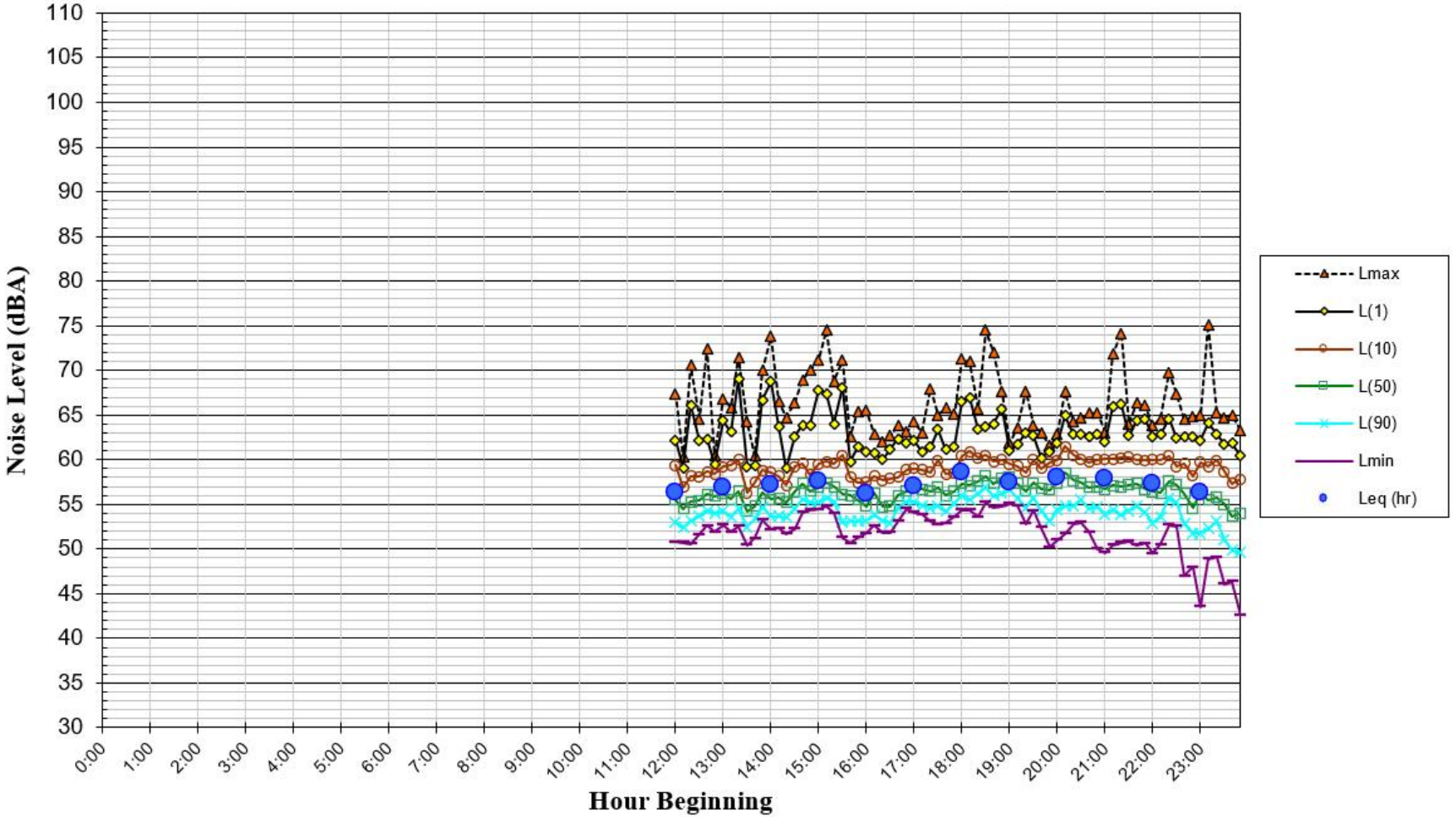


FIGURE A2 Daily Trend in Noise Levels at LT-1, Saturday, September 18, 2021

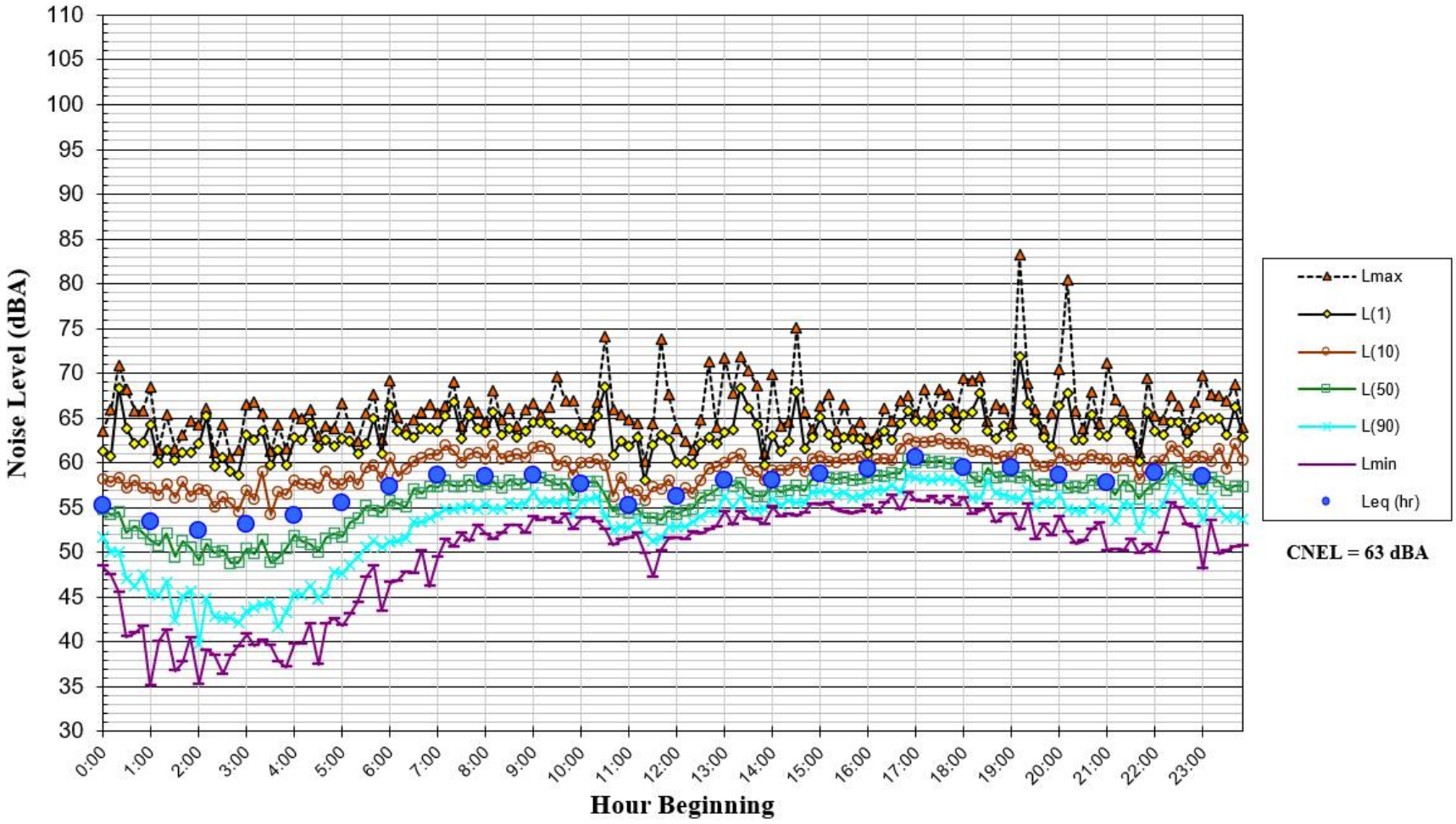


FIGURE A3 Daily Trend in Noise Levels at LT-1, Sunday, September 19, 2021

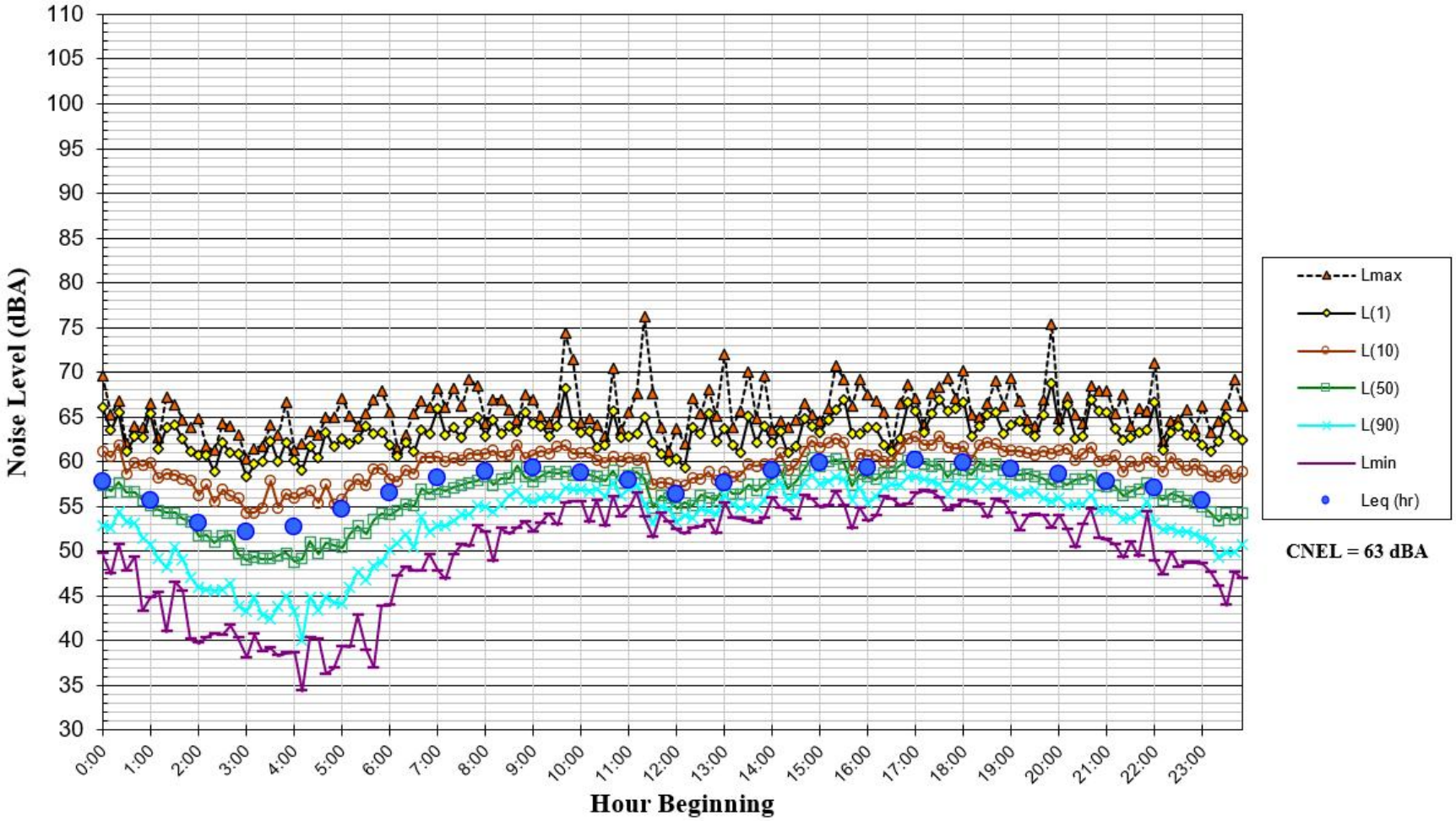


FIGURE A4 Daily Trend in Noise Levels at LT-1, Monday, September 20, 2021

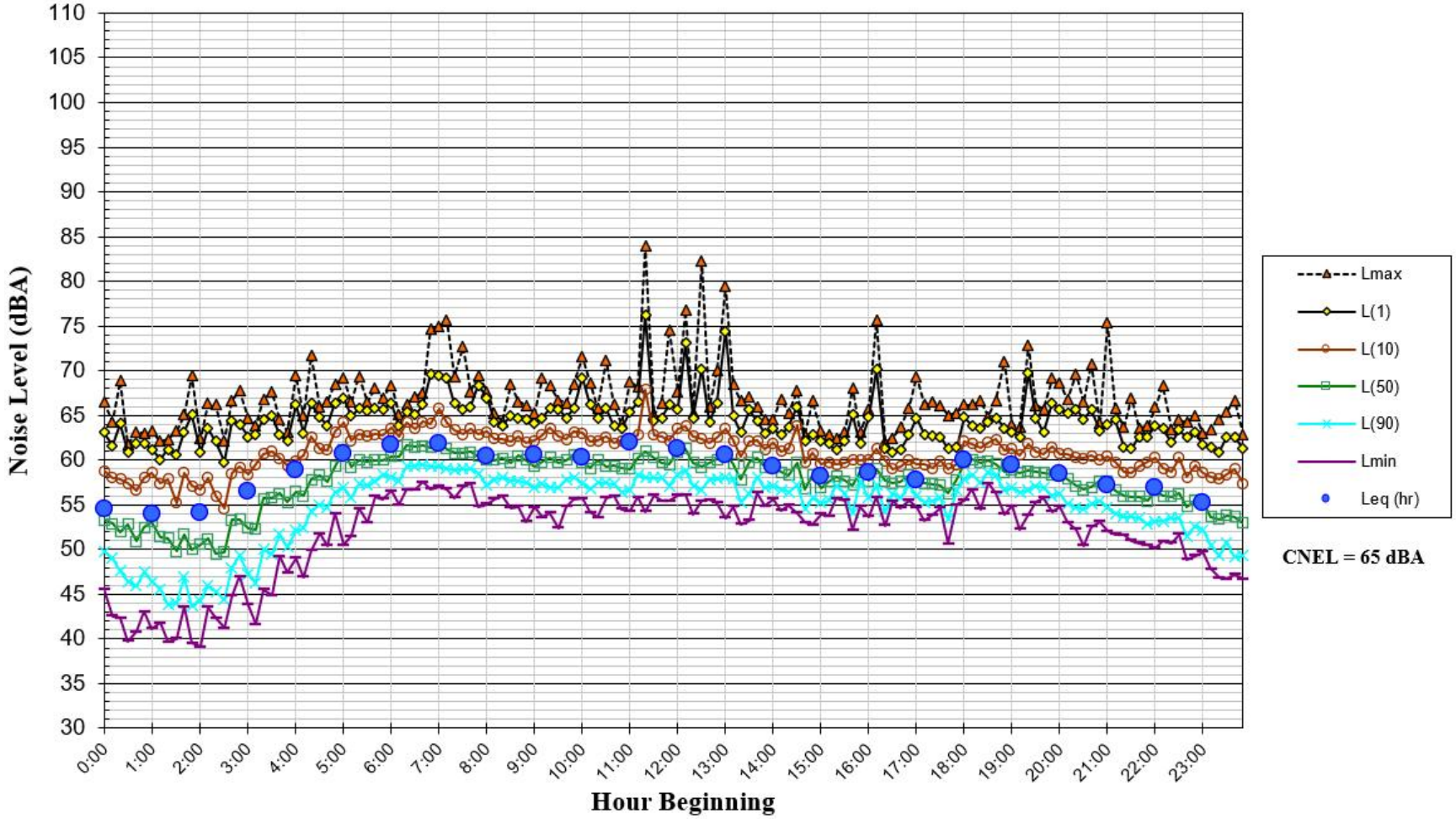


FIGURE A5 Daily Trend in Noise Levels at LT-1, Tuesday, September 21, 2021

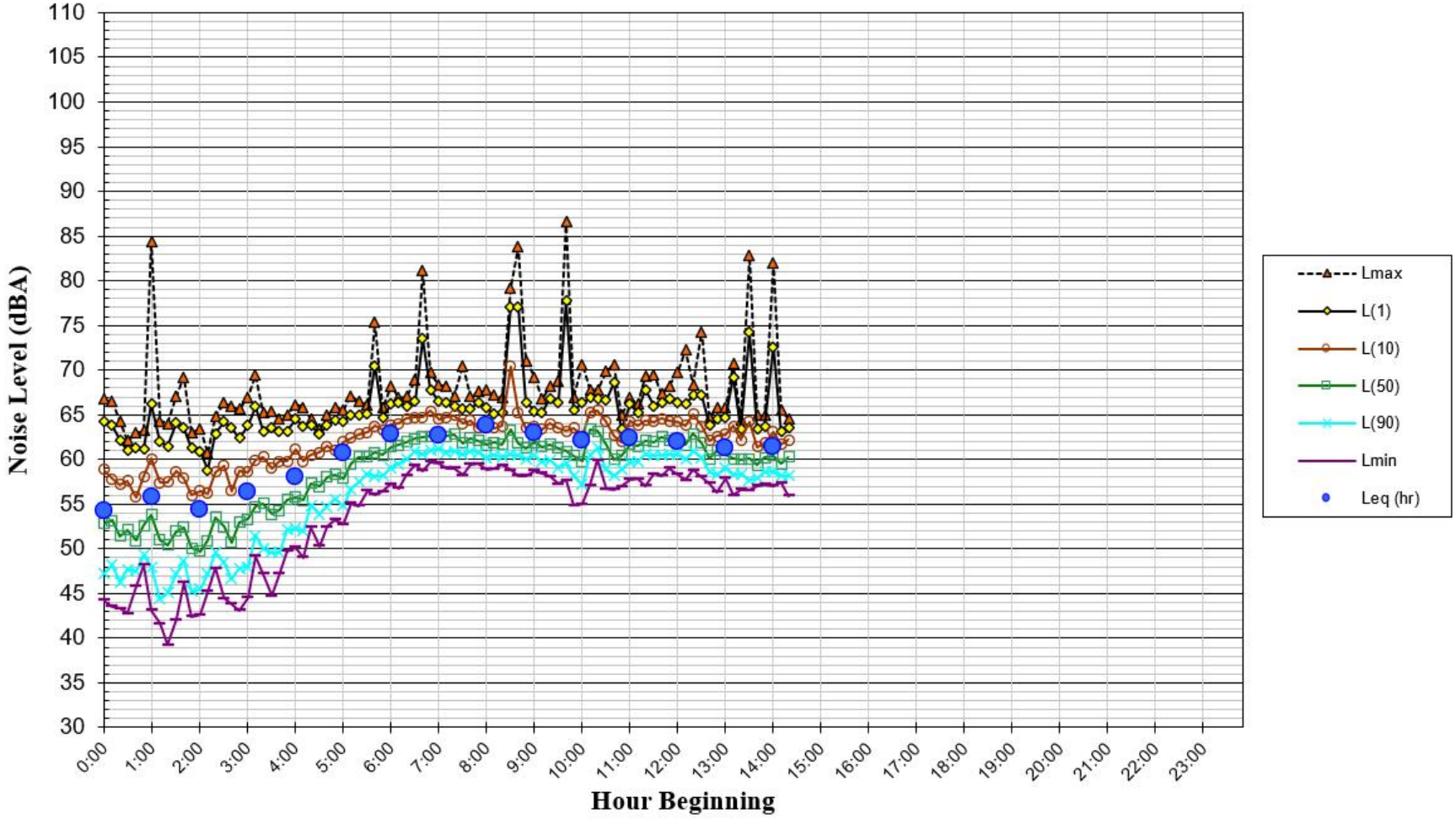


FIGURE A6 Daily Trend in Noise Levels at LT-2, Friday, September 17, 2021

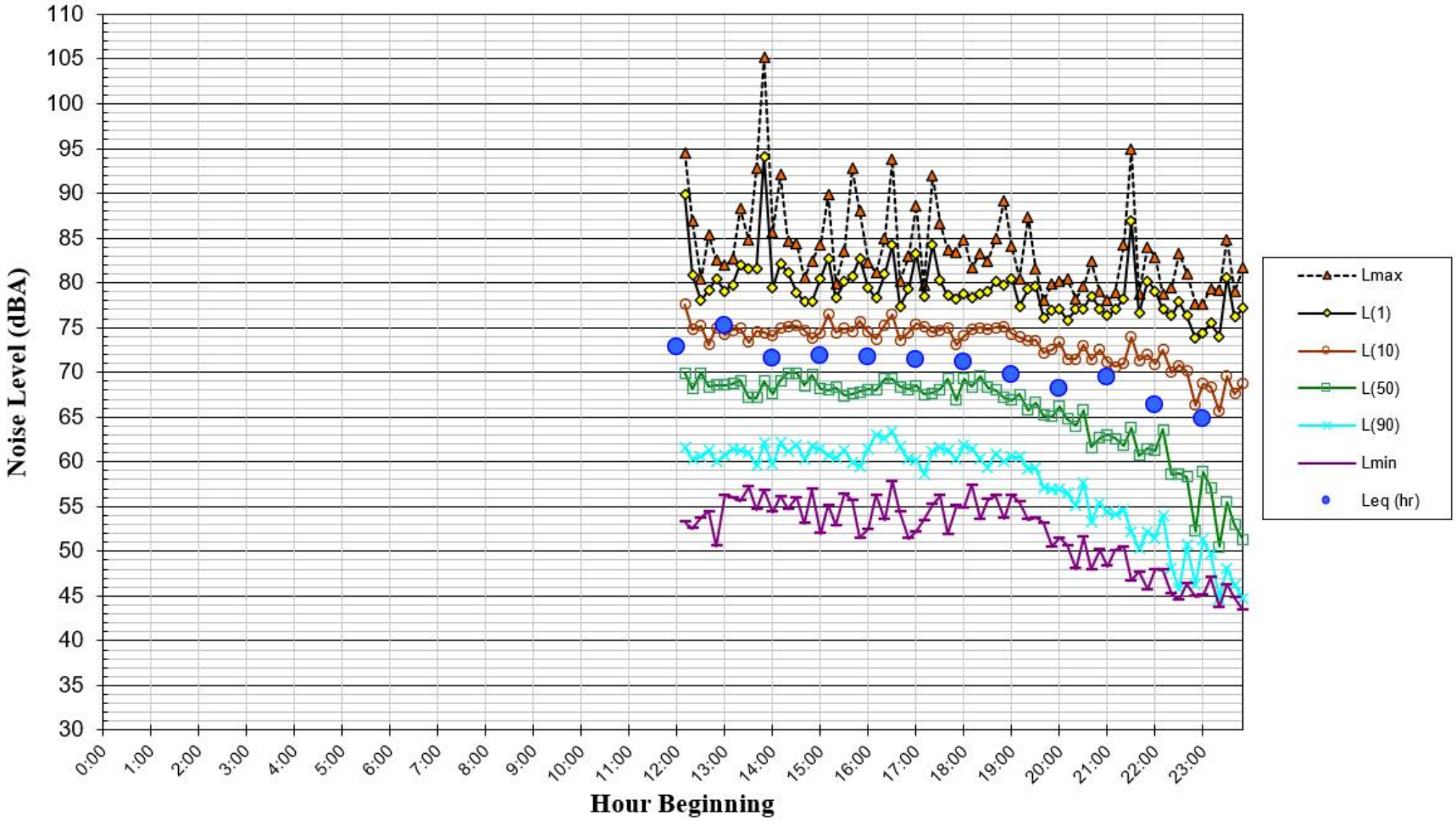


FIGURE A7 Daily Trend in Noise Levels at LT-2, Saturday, September 18, 2021

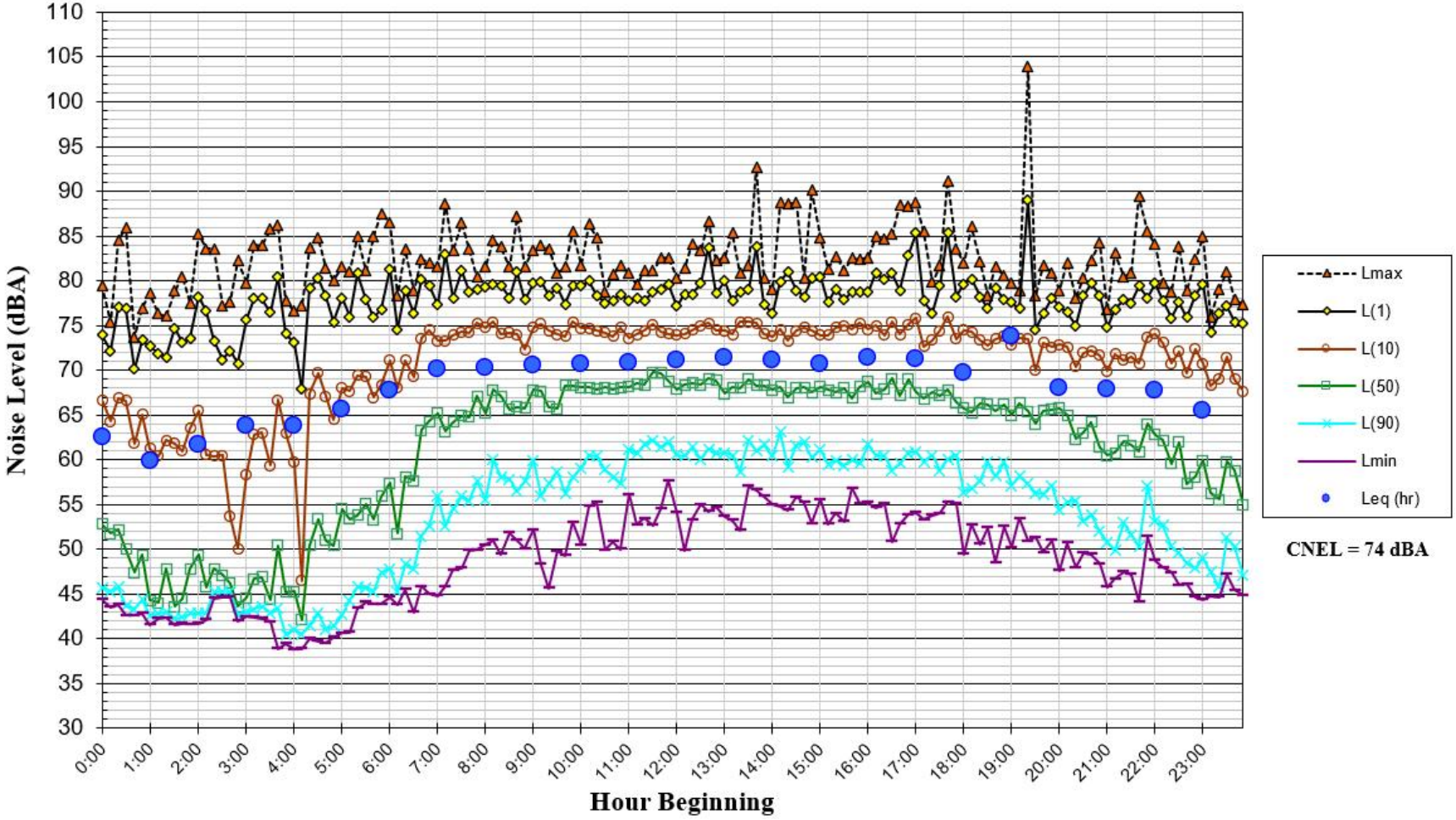


FIGURE A8 Daily Trend in Noise Levels at LT-2, Sunday, September 19, 2021

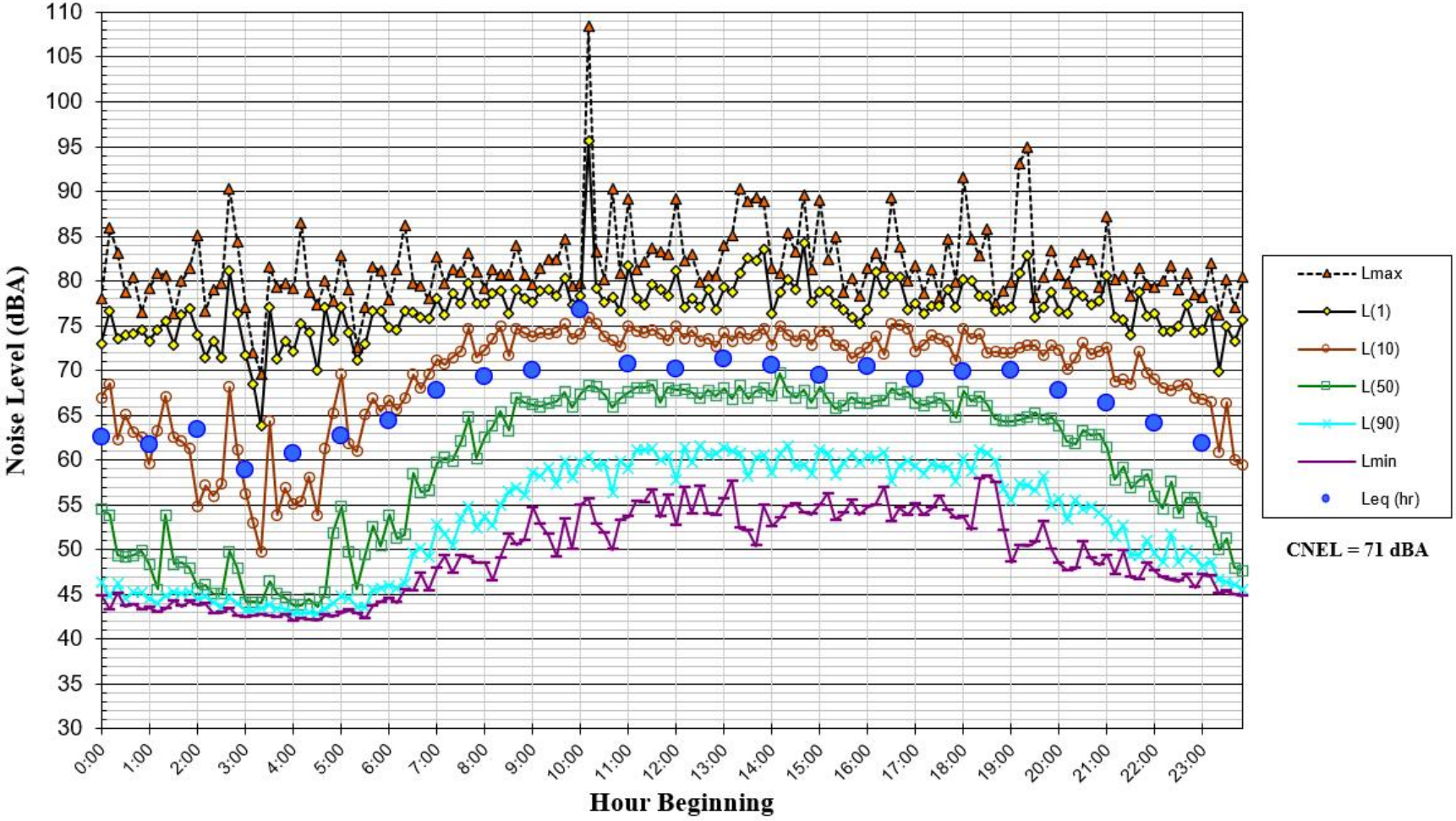


FIGURE A9 Daily Trend in Noise Levels at LT-2, Monday, September 20, 2021

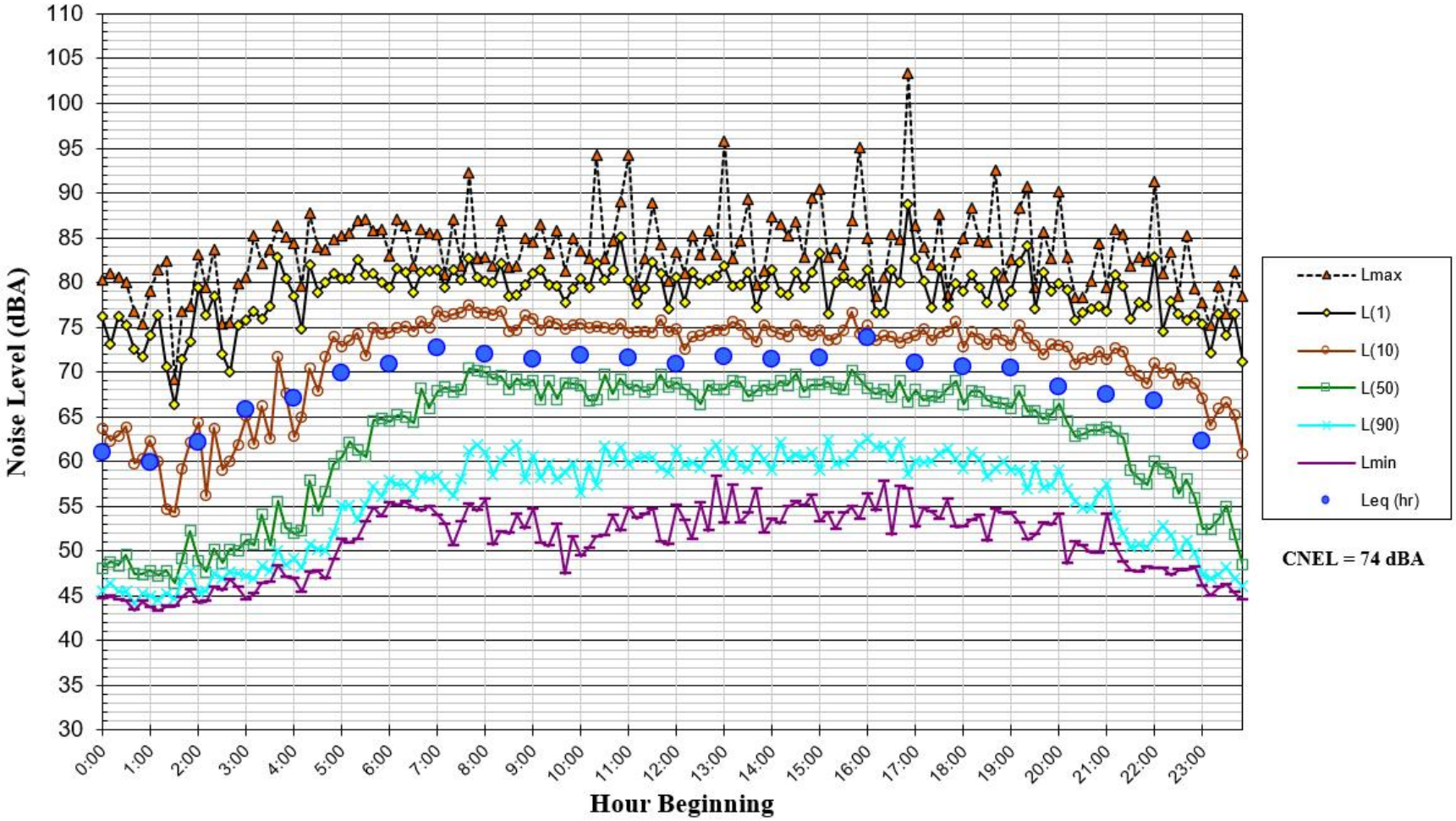


FIGURE A10 Daily Trend in Noise Levels at LT-2, Tuesday, September 21, 2021