Appendix G: Noise and Vibration Assessment

3150 EL CAMINO REAL PROJECT NOISE AND VIBRATION ASSESSMENT

Palo Alto, California

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INTRODUCTION

The project proposes to demolish the three existing commercial buildings and redevelop the site with a seven-story, approximately 451,507-square-foot multi-family residential building at 3128, 3150, 3160, and 3170 El Camino Real in Palo Alto, California. The proposed residential building would include approximately 380 units and two levels of below-grade parking. The residential units would range from studio to three-bedroom units, and 10% of the proposed residential units would be below-market-rate (BMR) units provided at low-income thresholds.

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

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 the 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

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 pm and 7:00 am.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 pm to 10:00 pm and after addition of 10 decibels to sound levels measured in the night between 10:00 pm and 7:00 am.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

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

TABLE 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.

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

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

Effects of Noise

Sleep and Speech Interference

The thresholds for speech interference indoors are about 45 dBA if the noise is steady and above 55 dBA if the noise is fluctuating. Outdoors the thresholds are about 15 dBA higher. Steady noise 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.[1] 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.

1 Based on the U.S. Department of Transportation Federal Highway Administration document "Highway Traffic Noise: Analysis and Abatement Guidance" (2010) and data from Illingworth & Rodkin, Inc. noise monitoring projects.

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 55 dBA L_{dn}. At an L_{dn} of about 60 dBA, approximately 2 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 12 percent of the population. There is, therefore, an increase of about 1 percent per dBA between an L_{dn} of 60-70 dBA. Between an L_{dn} of 70-80 dBA, each decibel increase increases by about 2 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 10 percent of the population is believed to be highly annoyed. Each decibel increase to 70 dBA adds about 2 percentage points to the number of people highly annoyed. Above 70 dBA, each decibel increase results in about a 3 percent increase in the percentage of the population highly annoyed.[2]

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.

2 Kryter, Karl D. The Effects of Noise on Man. Menlo Park, Academic Press, Inc., 1985.

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.

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.

Regulatory Background – Noise

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

State of California

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

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

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

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

2022 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 DNL/CNEL in any habitable room.

Santa Clara County

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

4.3.2.1 Noise Compatibility Policies

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

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

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

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

Table 4 - 1

NOISE COMPATIBILITY POLICIES

LAND USE CATEGORY	CNEL					
	55-60	60-65	65-70	70-75	75-80	80-85
Residential – low density Single-family, duplex, mobile homes	*	**	***	****	****	****
Residential – multi-family, condominiums, townhouses	*	**	***	****	****	****
Transient lodging - motels, hotels	*	*	**	****	****	****
Schools, libraries, indoor religious assemblies, hospitals, nursing homes	*	***	****	****	****	****
Auditoriums, concert halls, amphitheaters	*	***	***	****	****	****
Sports arena, outdoor spectator sports, parking	*	*	*	**	***	****
Playgrounds, neighborhood parks	*	*	***	****	****	****
Golf courses, riding stables, water recreation, cemeteries	*	*	*	**	***	****
Office buildings, business commercial and professional, retail	*	*	**	***	****	****
Industrial, manufacturing, utilities, agriculture	*	*	*	***	***	****
* Generally Acceptable	Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements. Mobile homes may not be acceptable in these areas. Some outdoor activities might be adversely affected.					
** Conditionally Acceptable	New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Outdoor activities may be adversely affected. Residential: Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.					
*** Generally Unacceptable	New construction or development should be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design. Outdoor activities are likely to be adversely affected.					
**** Unacceptable	New construction or development shall not be undertaken.					

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

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

City of Palo Alto

City of Palo Alto Comprehensive Plan 2030. Chapter 4 of the 2030 Comprehensive Plan (Natural Environment) discusses noise. The following goals and policies apply to the proposed project:

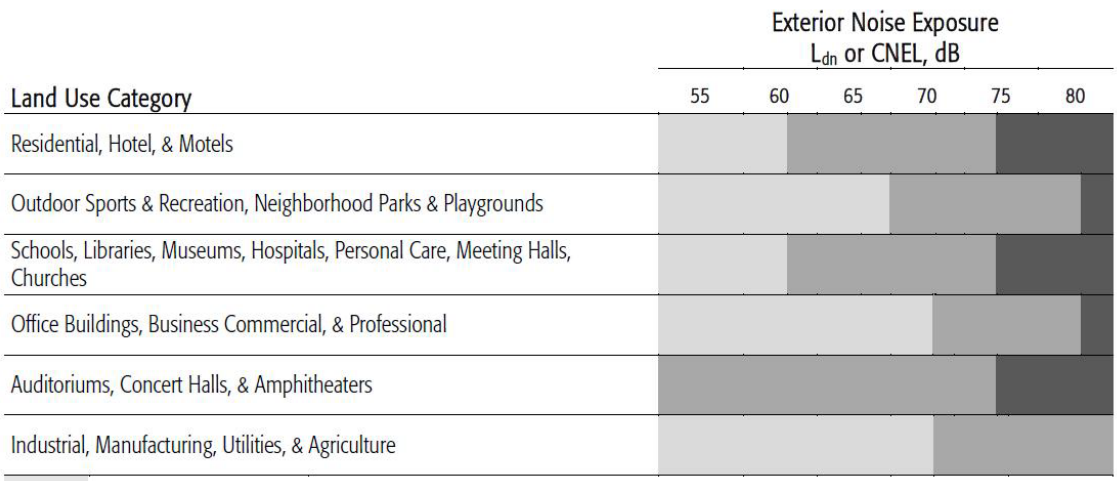
Goal N-6: An environment that minimizes the adverse impacts of noise.

Policy N-6.1 Encourage the location of land uses in areas with compatible noise environments. Use the guidelines in Table N-1 to evaluate the compatibility of proposed land uses with existing noise environments when preparing, revising, or reviewing development proposals. Acceptable exterior, interior and ways to discern noise exposure include:

- The guideline for maximum outdoor noise levels in residential areas is an L_{dn} of 60 dB. This level is a guideline for the design and location of future development and a goal for the reduction of noise in existing development. However, 60 L_{dn} is a guideline which cannot necessarily be reached in all residential areas within the constraints of economic or aesthetic feasibility. This guideline will be primarily applied where outdoor use is a major consideration (e.g., backyards in single-family housing developments, and recreational areas in multiple family housing projects). Where the City determines that providing an L_{dn} of 60 dB or lower outdoors is not feasible, the noise level in outdoor areas intended for recreational use should be reduced to as close to the standard as feasible through project design.

- Interior noise, per the requirements of the State of California Building Standards Code (Title 24) and Noise Insulation Standards (Title 25), must not exceed an L_{dn} of 45 dB in all habitable rooms of all new dwelling units.

TABLE N-1 LAND USE COMPATIBILITY FOR COMMUNITY NOISE ENVIRONMENT



	Normally Acceptable	Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal convention, construction, without any special insulation requirements.
	Conditionally Acceptable	Specified land use may be permitted only after detailed analysis of the noise reduction requirements and needed noise insulation features included in the design.
	Unacceptable	New construction or development should generally not be undertaken because mitigation is usually not feasible to comply with noise element policies.

Source: City of Palo Alto, 2017.

Policy N-6.3 Protect the overall community and especially sensitive noise receptors, including schools, hospitals, convalescent homes, senior and child care facilities and public conservation land from unacceptable noise levels from both existing and future noise sources, including construction noise.

Policy N-6.5 Protect residential and residentially-zoned properties from excessive and unnecessary noise from any sources on adjacent commercial or industrial properties.

Policy N-6.6 Apply site planning and architectural design techniques that reduce overall noise pollution and reduce noise impacts on proposed and existing projects within Palo Alto and surrounding communities.

Policy N-6.7 While a proposed project is in the development review process, the noise impact of the project on existing residential land uses, public open spaces and public conservation land should be evaluated in terms of the increase in existing noise levels for the potential for adverse community impact, regardless of existing background noise levels. If an area is below the applicable maximum noise guideline, an increase in noise up to the maximum should not necessarily be allowed.

Policy N-6.8 The City may require measures to reduce noise impacts of new development on adjacent properties through appropriate means including, but not limited to, the following:

- Orient buildings to shield noise sensitive outdoor spaces from sources of noise.
- Construct noise walls when other methods to reduce noise are not practical and when these walls will not shift similar noise impacts to another adjacent property.
- Screen and control noise sources such as parking lots, outdoor activities and mechanical equipment, including HVAC equipment.
- Increase setbacks to serve as a buffer between noise sources and adjacent dwellings.
- Whenever possible, retain fences, walls or landscaping that serve as noise buffers while considering design, safety and other impacts.
- Use soundproofing materials, noise reduction construction techniques, and/or acoustically-rated windows/doors.
- Include auxiliary power sources at loading docks to minimize truck engine idling.
- Control hours of operation, including deliveries and trash pickup, to minimize noise impacts.

Policy N-6.9 Continue to require applicants for new projects or new mechanical equipment in the Multifamily, Commercial, Manufacturing or Planned Community districts to submit an acoustical analysis demonstrating compliance with the Noise Ordinance prior to receiving a building permit.

Policy N-6.10 Continue to regulate noise from leaf blowers and residential power equipment.

Policy N-6.11 Continue to prioritize construction noise limits around sensitive receptors, including through limiting construction hours and individual and cumulative noise from construction equipment.

Policy N-6.12 Ensure compliance with the airport related land use compatibility standards for community noise environments, shown in Table N-1, by prohibiting incompatible land use development within the 60 dBA CNEL noise contours of the Palo Alto airport.

City of Palo Alto Municipal Code. The noise ordinance of the City of Palo Alto limits noise levels caused by stationary noise sources and construction on adjacent residential properties. The applicable portions of the noise code are as follows:

9.10.020 Definitions.

(d) *"Local ambient"* means the lowest sound level repeating itself during a six-minute period as measured with a precision sound level meter, using slow response and "A" weighting. The minimum sound level shall be determined with the noise source at issue silent, and in the same location as the measurement of the noise level of the source or sources at issue. However, for purposes of this chapter, in no case shall the local ambient be considered or determined to be less than: (1) Thirty (30) dBA for interior noise in Section 9.10.030(b); (2) Forty (40) dBA in all other sections. If a significant portion of the local ambient is produced by one or more individual identifiable sources which would otherwise be operating continuously during the six-minute measurement period and contributing significantly to the ambient sound level, determination of the local ambient shall be accomplished with these separate identifiable noise sources silent.

9.10.030 Residential property noise limits.

(a) No person shall produce, suffer or allow to be produced by any machine, animal, or device, or any combination of same, on residential property, a noise level more than six (6) dB above the local ambient at any point outside the property plane.

(c) Electrification Equipment shall be deemed to comply with this Section 9.10.030 if the equipment complies with the maximum equipment sound levels and is placed at the setbacks established in Table 1 – Setback Requirements (Table 4 in this report). As an Alternative to compliance with Table 1, a property owner may utilize the limits set forth in subsections (a) and (b) of this Section 9.10.030 if those provisions would be more permissive.

TABLE 4 Setback Requirements

Equipment Sound Level (dBA) West of Foothill Expressway	Equipment Sound Level (dBA) East of Foothill Expressway	Equipment Sound Level (dBA) West of Foothill Expressway for Inverter Pumps	Equipment Sound Level (dBA) East of Foothill Expressway for Inverter Pumps	Minimum Setback from Receiving Property Line (ft.)
43	53	45	55	3
44	54	46	56	4
45	55	47	57	4
46	56	48	58	5
47	57	49	59	5
48	58	50	60	6
49	59	51	61	7
50	60	52	62	7
51	61	53	63	8
52	62	54	64	9
53	63	55	65	10
54	64	56	66	12
55	65	57	67	13
56	66	58	68	15
57	67	59	69	17
58	68	60	70	19
59	69	61	71	21
60	70	62	72	24
61	71	63	73	27
62	72	64	74	30
63	73	65	75	34

9.10.060 Special Provisions. The special exceptions listed in this section shall apply, notwithstanding the provisions of Sections 9.10.030 through 9.10.050. Said exceptions shall apply only to the extent and during the hours specified in each of the following enumerated exceptions.

(a) General Daytime Exception. Any noise source which does not produce a noise level exceeding seventy (70) dBA at a distance of twenty-five feet under its most noisy condition of use shall be exempt from the provisions of Sections 9.10.030(a), 9.10.040 and 9.10.050(a) between the hours of eight a.m. and eight p.m. Monday through Friday, nine a.m. and eight p.m. on Saturday, except Sundays and holidays, when the exemption herein shall apply between ten a.m. and six p.m.

(b) Construction. Except for construction on residential property, construction, alteration and repair activities which are authorized by valid city building permit shall be prohibited on Sundays and holidays and shall be prohibited except between the hours of eight a.m. and six p.m. Monday through Friday, nine a.m. and six p.m. on Saturday provided that the construction, demolition or repair activities during those hours meet the following standards:

(1) No individual piece of equipment shall produce a noise level exceeding one hundred ten (110) dBA at a distance of twenty-five (25) feet. If the device is housed within a structure on the property, the measurement shall be made out-side the structure at a distance as close to twenty-five feet from the equipment as possible.

(2) The noise level at any point outside of the property plane of the project shall not exceed one hundred ten (110) dBA.

(3) The holder of a valid construction permit for a construction project in a non-residential zone shall post a sign at all entrances to the construction site upon commencement of construction, for the purpose of informing all contractors and subcontractors, their employees, agents, materialmen and all other persons at the construction site, of the basic requirements of this chapter.

(A) Said sign(s) shall be posted no less than three feet and no more than five feet above the ground level, shall be visible from the adjacent street, and shall be of a white background, with black lettering, which lettering shall be a minimum of one and one-half inches in height.

(B) Said sign shall read as follows:

CONSTRUCTION HOUSE FOR RESIDENTIAL PROPERTIES
MONDAY-FRIDAY 8:00 A.M. TO 6:00 P.M.
SATURDAY 9:00 A.M. TO 6:00 P.M.
SUNDAY/HOLIDAY CONSTRUCTION PROHIBITED

(j) Emergency. Emergencies are exempt from this chapter.

Regulatory Background – Vibration

California Department of Transportation. Caltrans identifies a vibration threshold 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 0.25 in/sec PPV for historic and some old buildings (see Table 3).

Existing Noise Environment

The project site is located at 3128, 3150, 3160, and 3170 El Camino Real in Palo Alto, California. Project north assumes that El Camino Real forms the site's northern border. A hotel is located to the east, a surface parking lot and office buildings are located to the south, and another surface parking and office buildings are located to the west.

The existing noise environment at the site results primarily from traffic along El Camino Real with traffic along Page Mill Road and other local roadways as secondary sources. Aircraft associated with operations from the Palo Alto Airport and Moffett Federal Airfield also affect the noise environment.

A noise monitoring survey was performed to document existing noise levels in the project vicinity beginning on Tuesday, October 10, 2023, and concluding on Thursday, October 12, 2023. The monitoring survey included two long-term (LT-1 and LT-2) noise measurements and two short-term (ST-1 and ST-2) noise measurements. All measurement locations are shown in Figure 1.

Long-term noise measurement LT-1 was made along El Camino Real, approximately 50 feet south of the centerline. Hourly average noise levels typically ranged from 68 to 73 dBA L_{eq} during the day (between 7:00 a.m. and 10:00 p.m.) and from 58 to 69 dBA L_{eq} at night (between 10:00 p.m. and 7:00 a.m.). The day-night average noise level on Wednesday, October 11, 2023, was 73 dBA L_{dn}. The daily trends in noise levels at LT-1 are shown in Figures A1 through A3 in the Appendix.

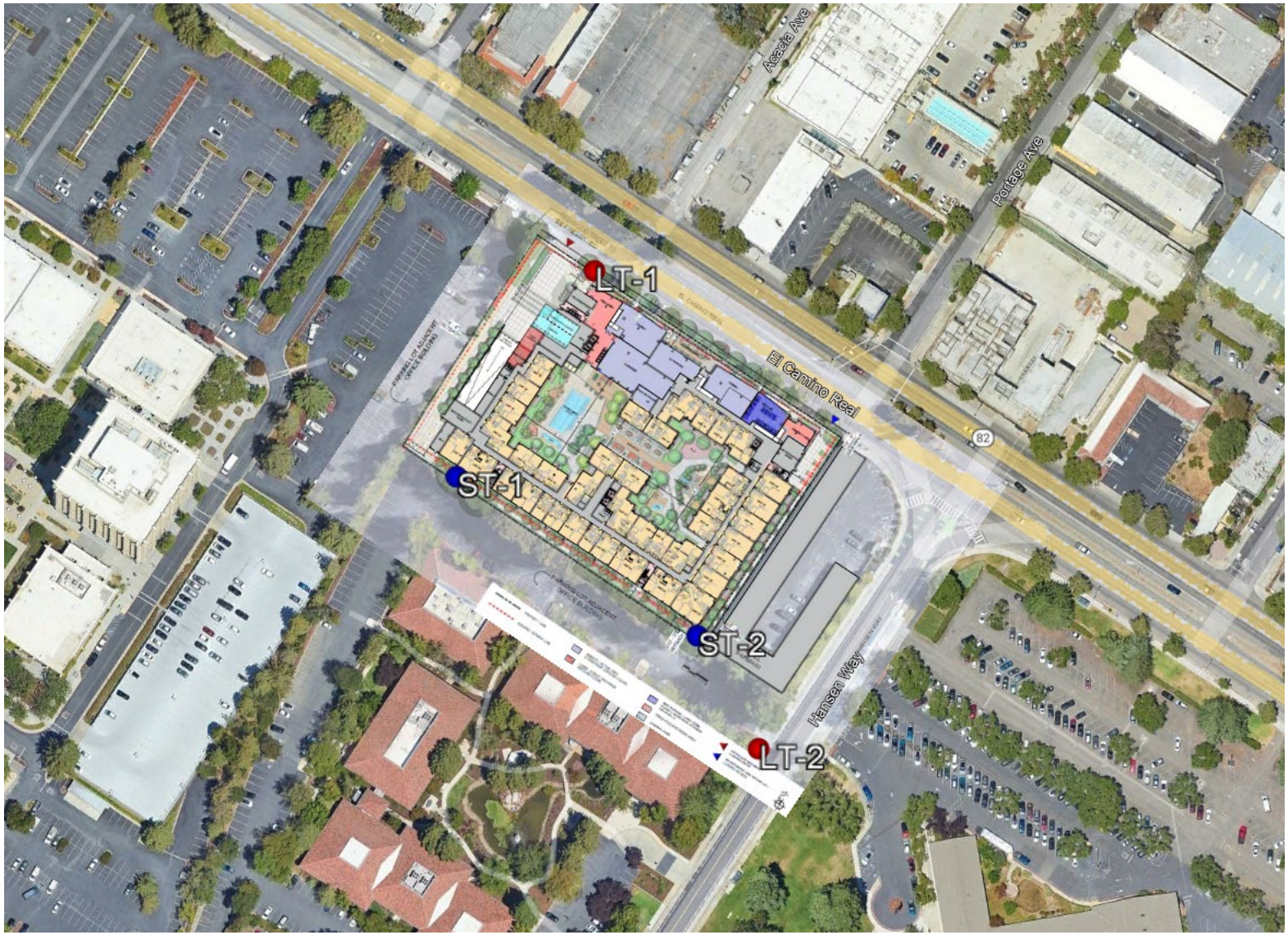
LT-2 was made in the southeastern corner of the project site, approximately 30 feet west of the centerline of Hansen Way. Hourly average noise levels typically ranged from 55 to 74 dBA L_{eq} during the day and from 49 to 61 dBA L_{eq} at night. The day-night average noise level on Wednesday, October 11, 2023, was 64 dBA L_{dn}. The daily trends in noise levels at LT-2 are shown in Figures A4 through A6 in the Appendix.

Short-term noise measurements were made over 10-minute periods, concurrent with the long-term noise data, on Tuesday, October 10, 2023, between 12:30 p.m. and 1:00 p.m. in order to complete the noise survey. All short-term measurement results are summarized in Table 5.

ST-1 was made in the southwestern corner of the project site, approximately 320 feet south of the centerline of El Camino Real. The dominant noise source at ST-1 was traffic from El Camino Real, which produced noise levels that ranged from 50 to 59 dBA. Parking lot activity generated noise levels of 57 to 66 dBA at ST-1. A jet flyover generated noise levels of 52 dBA, and other general aviation generated noise levels of 53 to 57 dBA. The 10-minute L_{eq} at ST-1 was 54 dBA.

ST-2 was made along the southern boundary of the site, approximately 155 feet west of the centerline of Hansen Way. The dominant noise source at ST-2 was traffic from El Camino Real, which produced noise levels that ranged from 49 to 61 dBA. Local vehicular traffic along Hansen Way generated noise levels of 48 to 51 dBA at ST-2. The 10-minute L_{eq} at ST-2 was 53 dBA.

FIGURE 1 Aerial Image of the Project Site and Surrounding Area with Long- and Short-Term Measurement Locations Identified



Source: Google Earth, 2024.

TABLE 5 Summary of Short-Term Noise Measurements (dBA)

Noise Measurement Location (Date, Time)	L_{max}	$L_{(1)}$	$L_{(10)}$	$L_{(50)}$	$L_{(90)}$	L_{eq}
ST-1: Southwest corner of project site (10/10/2023, 12:30-12:40 p.m.)	66	59	56	54	52	54
ST-2: Southern boundary of project site (10/10/2023, 12:50-1:00 p.m.)	61	59	56	52	49	53

PLAN CONSISTENCY ANALYSIS

Noise and Land Use Compatibility

Table N-1 of the City of Palo Alto General Plan includes land use compatibility criteria for various noise environments. The applicable General Plan criteria and other policies were presented in detail in the Regulatory Background section and are summarized below for the proposed project:

- The City's acceptable exterior noise level standard is 60 dBA L_{dn} or less for the proposed multi-family residential land uses.

- The State of California's acceptable interior noise level standard is 45 dBA L_{dn} or less for the proposed residential land uses.

The future noise environment at the site would continue to result primarily from vehicular traffic along El Camino Real. The traffic study completed for the project included cumulative plus project traffic volumes, which resulted in a future noise level increase of 1 dBA L_{dn} along El Camino Real over existing volumes. This noise level increase is assumed throughout the project site.

Future Exterior Noise Environment

The site plan shows two ground-level courtyards located on the interior of the building. Two roof decks are also shown on level 6 along the northern and southern façades. The site plan also shows a level 7 roof deck located to the south of the interior courtyard nearest to Hansen Way.

The ground level courtyards would be completely surrounded by the proposed building and therefore well shielded from the surrounding traffic noise. Future exterior noise levels at the center of each ground-level courtyard would be below 60 dBA $L_{dn,}$ meeting the City's normally acceptable threshold for multi-family residential uses.

The south roof deck would be located at the rear of the building and would be well shielded from traffic noise along El Camino Real and mostly shielded from Hansen Way, with the center set back more than 400 feet from the centerline. Future exterior noise levels at the center of the south roof deck would be below 60 dBA L_{dn}. The north roof deck stretch the length of the northern façade, with the center being set back approximately 60 to 85 feet from the centerline of El Camino Real. The elevation of about 55 feet above the ground would provide a minimum attenuation of 14 dBA

at the center of the north roof deck. Assuming a minimum 14 dBA attenuation, future exterior noise levels at the center of the north roof deck on level 6 would be at or below 60 dBA L_{dn}.

The level 7 roof deck would be located on the interior of the building, overlooking the courtyard nearest to Hansen Way. This roof deck would be well shielded from the surrounding traffic noise. Future exterior noise levels at the center of the level 7 roof deck would be below 60 dBA $L_{dn,}$ meeting the City's normally acceptable threshold for multi-family residential uses.

The proposed project would be compatible with the future exterior noise environment at the project site.

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 L_{dn}, the inclusion of adequate forced-air mechanical ventilation is often the method selected to reduce interior noise levels to acceptable levels by closing the windows to control noise. Where noise levels exceed 65 dBA L_{dn}, forced-air mechanical ventilation systems and sound-rated construction methods are normally required. Such methods or materials may include a combination of smaller window and door sizes as a percentage of the total building façade facing the noise source, sound-rated windows and doors, sound rated exterior wall assemblies, and mechanical ventilation so windows may be kept closed at the occupant's discretion.

The northern façade of the proposed building would face El Camino Real, with a setback of approximately 60 feet from the centerline. At this distance, the units facing El Camino Real would be exposed to future exterior noise levels up to 73 dBA L_{dn}. Assuming windows to be partially open, future interior noise levels in these units would be up to 58 dBA L_{dn}.

The units along the western and eastern façades would also have some direct exposure to traffic noise from El Camino Real, with setbacks ranging from 60 to 315 feet from the centerline; however, units along the eastern façade would be partially shielded by the existing hotel adjoining the site. With setbacks ranging from 60 to 315 feet, the units along the western and eastern building façades would be exposed to future exterior noise levels ranging from 63 to 73 dBA L_{dn}, assuming no attenuation. Assuming windows to be partially open, future interior noise levels in these units would range from 48 to 58 dBA L_{dn}.

Units along the southern façade and surrounding the interior courtyards would be shielded from traffic noise along El Camino Real. These units would be exposed to future exterior noise levels at or below 60 dBA L_{dn}. Assuming windows to be partially open, future interior noise levels in these units would be up to 45 dBA L_{dn}.

To meet the interior noise requirements set forth by the State of California of 45 dBA L_{dn}, implementation of noise insulation features would be required.

Recommended Noise Insulation Features to Reduce Future Interior Noise Levels

The following noise insulation features shall be incorporated into the proposed project to reduce interior noise levels to 45 dBA L_{dn} or less at residential interiors:

- Provide a suitable form of forced-air mechanical ventilation, as determined by the local building official, for all residential units on the project site, so that windows can be kept closed at the occupant's discretion to control interior noise and achieve the interior noise standards.

- Preliminary calculations indicate that residential units located along the northern façades of the proposed building would require windows and doors with a minimum rating of 35 STC with adequate forced-air mechanical ventilation to meet the interior noise threshold of 45 dBA L_{dn}.

- Preliminary calculations indicate that residential units located along the western and eastern façades would require windows and doors with a minimum rating of 28 to 35 STC with adequate forced-air mechanical ventilation to meet the interior noise threshold of 45 dBA L_{dn}.

- Units located along the southern façade and surrounding the interior courtyards would require standard construction materials with the incorporation of a suitable form of forced-air mechanical ventilation to meet the 45 dBA L_{dn} threshold.

The implementation of these noise insulation features would reduce interior noise levels to 45 dBA L_{dn} or less at residential uses.

Conditions of Approval

Interior Noise Standard for Residential Development. The project applicant shall prepare final design plans that incorporate building design and acoustical treatments to ensure compliance with State Building Codes and City noise standards. A project-specific acoustical analysis shall be prepared to ensure that the design incorporates controls to reduce interior noise levels to 45 dBA L_{dn} or lower within the residential unit. The project applicant shall conform with any special building construction techniques requested by the City's Building Department, which may include sound-rated windows and doors, sound-rated wall constructions, and acoustical caulking.

NOISE IMPACTS AND MITIGATION MEASURES

This section describes the significance criteria used to evaluate project impacts under CEQA, provides a discussion of each project impact, and presents mitigation measures, where necessary, to reduce project impacts to less-than-significant levels.

Significance Criteria

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

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

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

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

Impact 1a: **Temporary Construction Noise.** Existing receptors are not expected to be exposed to temporary construction noise levels exceeding the City's threshold. The incorporation of construction best management practices as project conditions of approval would result in a **less-than-significant** temporary noise impact.

Construction of the proposed project would occur on weekdays between 7:00 a.m. and 5:00 p.m. The construction schedule assumed that the earliest possible start date would be early January 2025, and expected completion would be early November 2026 (total construction time of about 34 months). Construction phases would include demolition, site preparation, grading, trenching, building construction, architectural coating, and paving. 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.

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.

Section 9.10.060(b) of the City of Palo Alto Municipal Code states that construction activities are permitted between the hours of 8:00 a.m. and 6:00 p.m. Monday through Friday and between 9:00 a.m. and 6:00 p.m. on Saturdays provided that no individual piece of equipment produces a noise level exceeding 110 dBA at a distance of 25 feet or noise levels of 110 dBA are exceeded anywhere outside the property plane. If the equipment is housed in a structure, the 110 dBA would be enforced at a distance of 25 feet from the structure. All construction activities are prohibited on Sundays and holidays. The applicant proposes construction outside the City's allowable hours, and therefore would require a special provision from the City to work prior to 8:00 a.m.

Construction activities generate considerable amounts of noise, especially during earth-moving activities when heavy equipment is used. The hauling of excavated materials and construction materials would generate truck trips on local roadways, as well. For the proposed project, pile driving, which generates excessive noise levels, is not expected. 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 6) from the equipment. Table 7 shows the hourly average noise level ranges, by

construction phase, typical for various types of projects. Hourly average noise levels generated by construction are about 72 to 88 dBA L_{eq} for residential dwellings, measured at a distance of 50 feet from the center of a busy construction 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 results in lower construction noise levels at distant receptors.

Equipment expected to be used in each construction stage are summarized in Table 8, along with the quantity of each type of equipment and the reference noise level at 25 and 10 feet, assuming the operation of the two loudest pieces of construction equipment for each construction phase.

Federal Highway Administration's (FHWA's) Roadway Construction Noise Model (RCNM) was used to calculate the hourly average noise levels for each phase of construction, assuming the two loudest pieces of equipment would operate simultaneously, as recommended by the FTA for construction noise evaluations. This construction noise model includes representative sound levels for the most common types of construction equipment and the approximate usage factors of such equipment that were developed based on an extensive database of information gathered during the construction of the Central Artery/Tunnel Project in Boston, Massachusetts (CA/T Project or "Big Dig"). The usage factors represent the percentage of time that the equipment would be operating at full power. Table 8 also summarizes the construction noise levels for the two loudest pieces of equipment propagated to the surrounding receiving land uses.

To assess construction noise impacts at the receiving property lines of existing noise-sensitive receptors, the worst-case hourly average noise level, which is calculated by combining all pieces of equipment per phase, was propagated from the geometrical center of the project site to the nearest property lines of the surrounding land uses. These noise level estimates are shown in Table 9. Noise levels in Table 9 do not assume reductions due to intervening buildings or existing barriers.

TABLE 6 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 7 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 8 Estimated Construction Noise Levels for the Proposed Project Building at a Distance of 25 and 10 feet

Phase of Construction	Total Workdays	Construction Equipment (Quantity)	Estimated Construction Noise Level, dBA L_{eq}	
			At 25 feet	At 10 feet
Demolition	20	Concrete/Industrial Saw (1)[a] Excavator (3) Tractor/Loader/Backhoe (1)[a] Water Truck (1) Sweeper (1)	91	99
Site Preparation	3	Grader (1)[a] Scraper (1)[a] Rubber-Tired Dozer (1) Water Truck (1) Compactor (1)	89	97
Grading/Excavation (On-Site)	57	Excavator (1) Grader (1)[a] Rubber-Tired Dozer (1) Tractor/Loader/Backhoe (1)[a] Sweeper (1) Water Truck (1)	90	98
Grading/Excavation (Off-Site)	6	Excavator (1)[a] Sweeper (1) Water Truck (1)[a]	84	92

Phase of Construction	Total Workdays	Construction Equipment (Quantity)	Estimated Construction Noise Level, dBA L_{eq}	
			At 25 feet	At 10 feet
Trenching/Foundation	6	Tractor/Loader/Backhoe (1)[a] Excavator (1)[a]	88	96
Building – Exterior	300	Crane (1) Forklift (2) Generator Set (1)[a] Tractor/Loader/Backhoe (1)[a] Welder (3)	88	96
Building – Interior/ Architectural Coating	90	Air Compressor (1)[a]	80	88
Paving (On-Site & Off-Site)	10	Cement & Mortar Mixer (1) Paver (1) Paving Equipment (1)[a] Roller (2) Tractor/Loader/Backhoe (1)[a] Sweeper (1)	91	98
Basement Pad Finish	4	Excavator (1) Grader (1)[a] Rubber-Tired Dozer (1) Tractor/Loader/Backhoe (1)[a] Roller (1) Water Truck (1)	90	98
Finish Grade On-Site	4	Tractor/Loader/Backhoe (1)[a] Roller (1)[a] Water Truck (1)	87	95

[a] Denotes two loudest pieces of construction equipment per phase.

TABLE 9 Estimated Construction Noise Levels at Nearby Land Uses

Phase of Construction	Calculated Hourly Average Noise Levels, L_{eq} (dBA)			
	East Hotel & West Office (200ft)	South Office (145ft)	North Future Res. & Comm. (240ft)	Nearest Res. (500ft)
Demolition	75	77	73	67
Site Preparation	73	76	72	65
Grading/Excavation (On-Site)	74	76	72	66
Grading/Excavation (Off-Site)	67	70	65	59
Trenching/Foundation	70	72	68	62
Building – Exterior	71	74	70	63

Phase of Construction	Calculated Hourly Average Noise Levels, L_{eq} (dBA)			
	East Hotel & West Office (200ft)	South Office (145ft)	North Future Res. & Comm. (240ft)	Nearest Res. (500ft)
Building – Interior/ Architectural Coating	62	65	60	54
Paving (On-Site & Off-Site)	74	77	72	66
Basement Pad Finish	74	76	72	66
Finish Grade On-Site	69	72	68	61

As shown in Table 8, construction noise levels are anticipated to comply with the City of Palo Alto's threshold of 110 dBA at 25 feet during daytime hours on typical construction days. Additionally, assuming the two loudest pieces of equipment would operate 10 feet from the property lines, construction noise levels would be up to 99 dBA outside the property plane. The City's 110 dBA threshold would not be exceeded.

For existing and future residential uses and the existing hotel to the east, construction noise levels would range from 54 to 75 dBA L_{eq} when construction activities are centered at the project site. For existing and future office and commercial uses, construction noise levels would range from 60 to 77 dBA L_{eq} when construction activities are centered at the project site.

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. With the incorporation of construction best management practices as a project condition of approval, construction noise exposure at sensitive receptors would be reduced as much as possible. Therefore, this would be a less-than-significant impact.

Construction Best Management Practices

Implementation of the following construction best management practices would reduce the construction noise levels at sensitive receptors as much as possible:

- Construction will be limited to the hours of 7:00 a.m. to 6:00 p.m. Monday through Friday and between 9:00 a.m. and 6:00 p.m. on Saturdays for any on-site or off-site work within 300 feet of any residential unit.

- The contractor shall use "new technology" power construction equipment with state-of-the-art noise shielding and muffling devices. All internal combustion engines used on the project site shall be equipped with adequate mufflers and shall be in good mechanical condition to minimize noise created by faulty or poorly maintained engines or other components.

- The unnecessary idling of internal combustion engines shall be prohibited.

- Staging areas and stationary noise-generating equipment shall be located as far as possible from noise-sensitive receptors such as residential uses (a minimum of 200 feet).

- The surrounding neighborhood shall be notified early and frequently of the construction activities.

- A "noise disturbance coordinator" shall be designated to respond to any local complaints about construction noise. The disturbance coordinator would determine the cause of the noise complaints (e.g., beginning work too early, bad muffler, etc.) and institute reasonable measures warranted to correct the problem. A telephone number for the disturbance coordinator would be conspicuously posted at the construction site.

- Utilize 'quiet' models of air compressors and other stationary noise sources where technology exists.

- Equip all internal combustion engine-driven equipment with mufflers, which are in good condition and appropriate for the equipment.

- Construct temporary noise barriers, where feasible, to screen stationary noise-generating equipment when located within 200 feet of adjoining sensitive land uses. 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.

- If stationary noise-generating equipment must be located near receptors, adequate muffling (with enclosures where feasible and appropriate) shall be used. Any enclosure openings or venting shall face away from sensitive receptors.

- Ensure that generators, compressors, and pumps are housed in acoustical enclosures.

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

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

- Substitute nail guns for manual hammering, where feasible.

- Substitute electrically powered tools for noisier pneumatic tools, where feasible.

- The contractor shall prepare a detailed construction plan identifying the 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.

The implementation of these measures would reduce construction noise levels emanating from the site, minimizing disruption and annoyance. With the implementation of these controls, as well as

the Municipal Code limits on allowable construction hours, and considering that construction is temporary, the impact would be reduced to a less-than-significant level.

Mitigation Measure 1a: No further mitigation required.

Impact 1b: Permanent Noise Level Increase/Exceed Applicable Standards. The proposed project would not result in a substantial permanent noise level increase at residential uses. Further, the project would not generate operational noise levels exceeding the City's ambient noise levels by 6 dBA or more at residential receptors or by 8 dBA or more at commercial and office receptors. **This is a less-than-significant impact.**

A significant impact would result if the proposed project would result in a substantial permanent increase in noise levels at sensitive receptors in the vicinity. A substantial increase would occur if: a) the noise level increase is 5 dBA L_{dn} or greater, with a future noise level of less than 60 dBA L_{dn}; or b) the noise level increase is 3 dBA L_{dn} or greater, with a future noise level of 60 dBA L_{dn} or greater. Noise-sensitive receptors surrounding the project site are exposed to existing noise levels greater than 60 dBA L_{dn}, according to existing noise contours shown in Figure 7.5 of the City's General Plan;[3] therefore, a significant noise increase would occur if project-generated operations would permanently increase noise levels by 3 dBA L_{dn}.

Section 9.10.040 of the Municipal Code states that any noise generated at the project site shall not exceed ambient levels by 6 dBA. Receptors along El Camino Real, which include the east hotel, the west office, and the north future residential and commercial uses, would have existing ambient noise levels represented by LT-1, with daytime noise levels ranging from 68 to 73 dBA L_{eq} (average of 72 dBA L_{eq}) and nighttime noise levels ranging from 58 to 69 dBA L_{eq} (average of 64 dBA L_{eq}). The south office receptors would be represented by noise levels measured at LT-2, which include daytime noise levels of 55 to 64 dBA L_{eq} (average of 61 dBA L_{eq}) and nighttime noise levels of 49 to 61 dBA L_{eq} (average of 54 dBA L_{eq}). Conservatively, daytime and nighttime thresholds applied at the property lines of the surrounding receptors are summarized in Table 10.

TABLE 10 Summary of Operational Noise Thresholds Applied at Each Receiving Property Line

Receptor	Daytime L_{eq}, dBA	Nighttime L_{eq}, dBA
East Hotel	78	70
South Office	67	60
West Office	78	70
North Future Residential & Commercial	78	70

Project Traffic Increase

The traffic study completed for the proposed project included existing and existing plus project traffic turning movements for six intersections in the project vicinity. By comparing the existing plus project traffic volumes to the existing volumes, the project's contribution was estimated to be

[3] *City of Palo Alto Comprehensive Plan 2030*, adopted by the Palo Alto City Council November 13,2017.

at or below 1 dBA L_{dn} along all segments in the project vicinity. The project would not result in a permanent noise increase of 3 dBA L_{dn} or more at noise-sensitive receptors in the project vicinity.

Mechanical Equipment

The site plan shows pump rooms, equipment rooms, and fan rooms on the basement levels. Equipment located in these below-grade levels would be well shielded from existing off-site receptors surrounding the site. The site plan shows additional ground-level electrical and utility equipment rooms, which would adequately shield mechanical equipment noise from the surrounding receptors.

The roof plan of the proposed building shows proposed PV areas, which would potentially include solar panels. Solar panels would not generate noise levels audible at the project site boundaries and would therefore not exceed City noise limits. Additionally, the roof plan shows heat pumps located along the centerline of the roof, approximately 30 feet from the building edges. Noise levels produced by a typical residential heat pump would range from 53 to 63 dBA at 3 feet during operation. These types of units cycle on and off continuously. Assuming up to 10 units to be operating simultaneously at any given time in the same general area of the roof, hourly average noise levels would range from 63 to 73 dBA L_{eq} at 3 feet during worst-hour daytime and nighttime hours. The day-night average noise levels would be up to 79 dBA L_{dn} at 3 feet.

The site plan also shows a parapet wall ranging from 5 to 8.5 feet tall surrounding the rooftop. Due to the height and location of the surrounding receptors, a minimum attenuation of 5 dBA would be provided by the parapet wall for the elevated office sources to the west and for the future elevated residential uses to the north. A minimum attenuation of 10 dBA would be provided by the parapet wall and elevation of ground-level and level 2 receptors to the east and south. Table 11 shows the estimated mechanical equipment noise propagated to the property lines of the surrounding land uses, assuming minimum attenuation from the parapet wall and elevation of the rooftop sources.

TABLE 11 Estimated Operational Noise Levels for Residential Heat Pumps

Receptor	Distance from Nearest Heat Pumps, feet	Hourly L_{eq}, dBA	L_{dn}, dBA	Noise Level Increase, dBA L_{dn}
East Hotel	55	28 to 38[a]	44[a]	0
South Office	50	29 to 39[a]	45[a]	0
West Office	60	32 to 42[b]	48[b]	0
North Future Residential & Commercial	130	25 to 35[b]	42[b]	N/A[c]

[a] Minimum attenuation of 10 dBA applied to ground-level and second-floor receptors due to parapet wall and elevation of the rooftop equipment.
[b] Minimum attenuation of 5 dBA applied to elevated receptors due to parapet wall.
[c] Future receptors would not be subject to the existing noise environment and therefore would not be subject to a noise level increase.

Additionally, the nearest residences would be about 400 feet from the nearest heat pumps, and mechanical equipment would generate hourly average noise levels up to 21 dBA L_{eq}, and day-night average noise levels up to 27 dBA L_{dn}.

Based on the estimated noise levels in Table 11, mechanical equipment noise levels are not expected to exceed the City's daytime or nighttime thresholds summarized in Table 10. For all existing receptors, the noise level increase due to rooftop equipment would not be measurable or detectable (0 dBA L_{dn} increase). This would be a less-than-significant impact.

Truck Loading and Unloading

The site plan shows a loading area on the ground level along the western building façade. Due to the orientation of the building, the receptors to the east and south would be shielded from the loading area.

Truck maneuvering, which typically lasts for a period of more than five minutes but less than 15 minutes in a given hour per delivery. Noise generated by truck maneuvering would include 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. For multi-family residential buildings, medium-sized delivery trucks would be expected at the proposed building. Medium-sized delivery trucks typically generate maximum noise levels of 60 to 65 dBA at 50 feet. The noise level of backup alarms can vary depending on the type and directivity of the sound, but maximum noise levels are typically in the range of 65 to 75 dBA at a distance of 50 feet. Assuming one delivery in a given hour, the hourly average noise level due to truck loading and unloading activities would be 59 dBA L_{eq}. All deliveries are assumed to occur during daytime hours between 7:00 a.m. and 10:00 p.m.

It is assumed that up to two deliveries would occur weekly and only one delivery would occur in a given hour. Assuming no attenuation for the west and north receptors, Table 12 summarizes expected noise levels generated by typical truck deliveries at the receptors with exposure to the loading areas.

TABLE 12 Estimated Operational Noise Levels from Truck Loading and Unloading Activities

Receptor	Distance from Center of Loading Area, feet	Noise Levels from Truck Deliveries, dBA L_{eq}	L_{dn}, dBA	Noise Level Increase, dBA L_{dn}
West Office	75	56	42	0
North Future Residential & Commercial	175	48	34	N/A[a]

[a] Future receptors would not be subject to the existing noise environment and therefore would not be subject to a noise level increase.

The nearest existing residential land uses would be shielded by intervening buildings and would not have direct exposure to truck loading and unloading. Noise levels would not exceed the City's thresholds.

Based on the estimated noise levels in Table 12, truck loading and unloading activities would not exceed the City's daytime thresholds, which are summarized in Table 10, at the receptors with direct line-of-sight to the loading areas. For all existing receptors, the noise level increase due to truck loading and unloading activities would not be measurable or detectable (0 dBA L_{dn} increase). This would be a less-than-significant impact.

Total Combined Project-Generated Noise

The operational noise levels produced by the proposed project combined (i.e., traffic, mechanical equipment, truck loading and unloading activities) would not result in an increase of 3 dBA L_{dn} or more at existing noise-sensitive receptors in the project vicinity. Operational noise levels due to mechanical equipment and truck loading and unloading activities at the proposed residential development would not exceed the City's thresholds at the receiving property lines. This is a less-than-significant impact.

Mitigation Measure 1b: None required.

Impact 2: Exposure to Excessive Groundborne Vibration. Construction-related vibration levels would potentially exceed applicable vibration thresholds at the adjoining sensitive land use to the east. **This is a potentially significant impact.**

The construction of the project may generate perceptible vibration when heavy equipment or impact tools (e.g., jackhammers, hoe rams) are used. Construction activities would include demolition, site preparation work, foundation work, and new building framing and finishing. Pile driving equipment, which can cause excessive vibration, is not expected to occur during construction of the proposed project.

The City of Palo Alto does not specify a construction vibration limit. For structural damage, the California Department of Transportation recommends a vibration limit of 0.5 in/sec PPV for new residential and modern commercial/industrial structures, 0.3 in/sec PPV for older residential structures, and a limit of 0.25 in/sec PPV for historic and some old buildings (see Table 3). The 0.3 in/sec PPV vibration limit would be applicable to properties in the immediate vicinity of the project site and the 0.25 in/sec PPV vibration limit would be applicable to the nearest historic property.

According to the historical inventory for the City of Palo Alto,[4] there are no historical buildings located within 200 feet of the proposed project site. At this distance, construction vibration levels would be well under the State's thresholds. Historical buildings are not discussed further in this report.

Table 13 presents typical construction equipment 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.

[4] https://www.cityofpaloalto.org/files/assets/public/v/1/planning-amp-development-services/historic-preservation/historic-inventory/city-historic-inventory-list.pdf

Vibration levels would vary depending on soil conditions, construction methods, and equipment used. Table 13 summarizes the vibration levels at each of the surrounding buildings in the project vicinity. Vibration levels are highest close to the source and then attenuate with increasing distance at the rate $\left({}^{D_{ref}}/_{D}\right)^{1.1}$, where D is the distance from the source in feet and D_{ref} is the reference distance of 25 feet. While construction noise levels increase based on the cumulative equipment in use simultaneously, construction vibration levels would be dependent on the 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 damage to buildings on receiving land uses, not receptors at the nearest property lines. Therefore, the distances used to propagate construction vibration levels (as shown in Table 13), which are different than the distances used to propagate construction noise levels (as shown in Table 9), were estimated under the assumption that each piece of equipment from Table 13 was operating along the nearest boundary of the project site, which would represent the worst-case scenario.

As shown in Table 13, the nearest building constructed of conventional materials would be the existing hotel to the east (about 5 feet from the shared boundary), and construction vibration levels at the nearest building façade would be at or below 1.2 in/sec PPV when vibratory rollers are used near the boundary line. A study completed by the US Bureau of Mines analyzed the effects of blast-induced vibration on buildings in USBM RI 8507.[5] The findings of this study have been applied to buildings affected by construction-generated vibrations.[6] As reported in USBM RI 8507[3] and reproduced by Dowding,[4] Figure 2 presents the damage probability, in terms of "threshold damage" (described above as cosmetic damage), "minor damage," and "major damage," at varying vibration levels. As shown in Figure 2, maximum vibration levels of 0.3 in/sec PPV or lower would result in virtually no measurable damage, while maximum vibration levels of 1.2 in/sec PPV would result in about 20% chance of cosmetic damage. No minor or major damage would be expected at the buildings immediately adjoining the project site.

Neither cosmetic, minor, or major damage would occur at conventional buildings surrounding the project site. At these locations, and in other surrounding areas where vibration would not be expected to cause cosmetic damage, vibration levels may still be perceptible. However, as with any type of construction, this would be anticipated and would not be considered significant, given the intermittent and short duration of the phases that have the highest potential of producing vibration (use of jackhammers and other high-power tools). 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.

[5] 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.

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

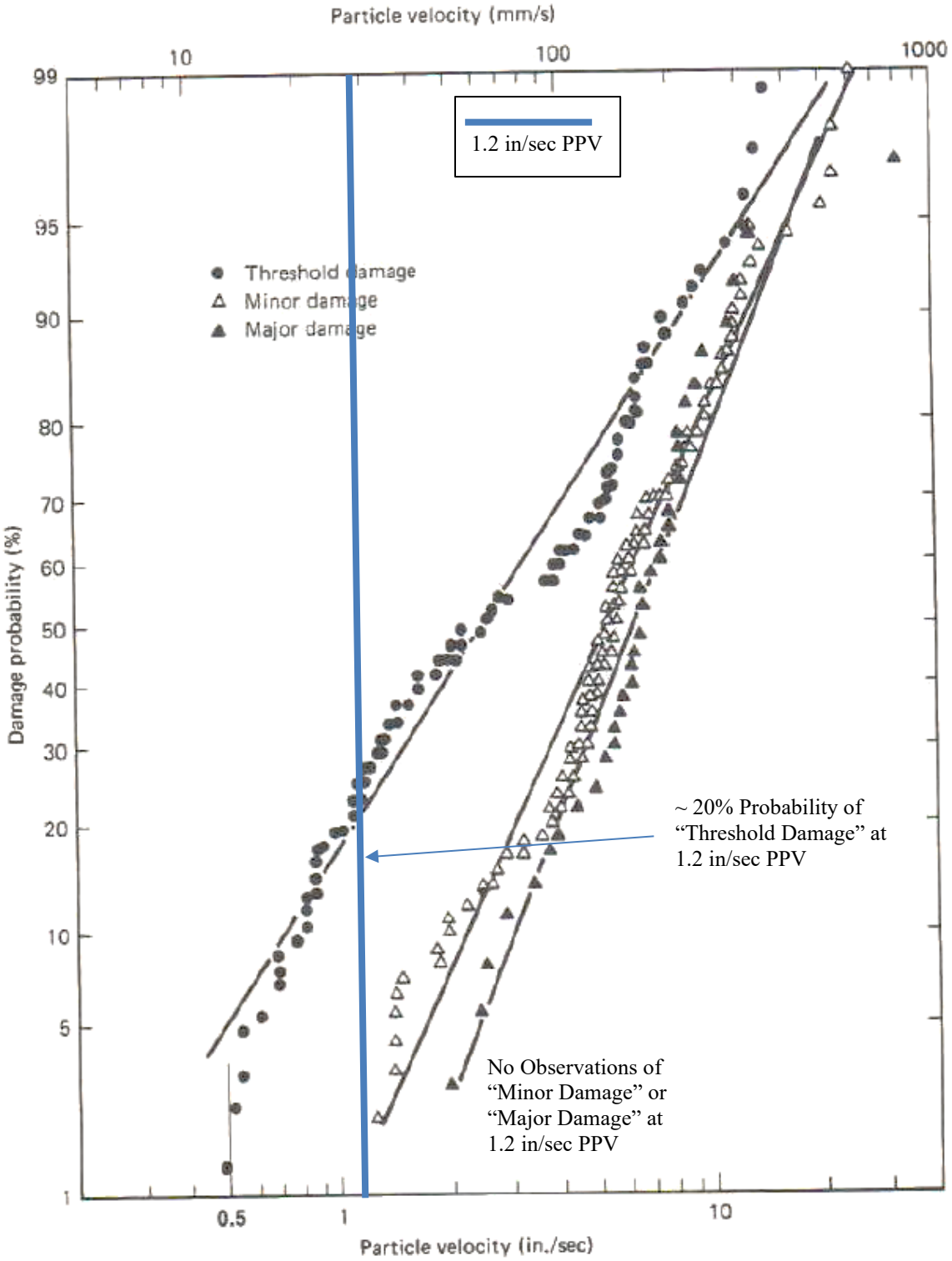
In summary, the construction of the project would not generate vibration levels exceeding 0.08 in/sec PPV at the nearest historical properties but would exceed 0.3 in/sec PPV at the surrounding buildings of conventional materials. This would be a potentially significant impact.

TABLE 13 Vibration Levels for Construction Equipment at a Source Distance of 25 feet and at the Nearest Surrounding Buildings.

Equipment		PPV at 25 ft. (in/sec)	Estimated Vibration Levels at Nearest Building Façades Surrounding the Project Site, in/sec PPV			
			East Hotel (5ft)	South Office (65ft)	West Office (235ft)	North Future Res. & Comm. (125ft)
Clam shovel drop		0.202	**1.186**	0.071	0.017	0.034
Hydromill (slurry wall)	in soil	0.008	0.047	0.003	0.001	0.001
	in rock	0.017	0.100	0.006	0.001	0.003
Vibratory Roller		0.210	**1.233**	0.073	0.018	0.036
Hoe Ram		0.089	**0.523**	0.031	0.008	0.015
Large bulldozer		0.089	**0.523**	0.031	0.008	0.015
Caisson drilling		0.089	**0.523**	0.031	0.008	0.015
Loaded trucks		0.076	**0.446**	0.027	0.006	0.013
Jackhammer		0.035	0.206	0.012	0.003	0.006
Small bulldozer		0.003	0.018	0.001	0.000	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., January 2024.

FIGURE 2 Probability of Cracking and Fatigue from Repetitive Loading



Source: Dowding, C.H., Construction Vibrations, Prentice Hall, Upper Saddle River, 1996.

Mitigation Measure 2:

The following measures shall be incorporated into the proposed project to reduce vibration impacts from construction activities to a less-than-significant level:

- Prior to issuance of a demolition permit, a list of all heavy construction equipment to be used for this project known to produce high vibration levels (e.g., tracked vehicles, vibratory compaction, jackhammers, hoe rams, clam shovel drop, and vibratory roller, etc.) shall be submitted to the City by the contractor. This list shall be used to identify equipment and activities that would potentially generate substantial vibration and to define the level of effort for reducing vibration levels below the thresholds.

- Smaller equipment (less than 18,000 pounds) shall be used near the property lines adjacent to sensitive buildings to minimize vibration levels to 0.3 in/sec PPV or less. For example, a smaller vibratory roller similar to a Caterpillar model CP433E vibratory compactor could be used when compacting materials within 20 feet of the adjacent conventional building. The smaller equipment intended to implement this requirement shall be individually identified among the list of equipment required under the above condition as the subset of equipment allowed for use at the property lines.

- Avoid using vibratory rollers and clam shovel drops within 20 feet of the adjacent conventional buildings.

- Select demolition methods that do not involve large impact tools such as hoe-rams within 20 feet of the adjacent conventional building. Portable jackhammers, saws, or grinders shall be used to minimize impacts to the ground.

- Avoid dropping heavy equipment and use alternative methods for breaking up existing pavement, such as a pavement grinder, instead of dropping heavy objects, within 20 feet of the adjacent conventional building.

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

The implementation of these measures as project conditions of approval would reduce a potential impact to a less-than-significant level.

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

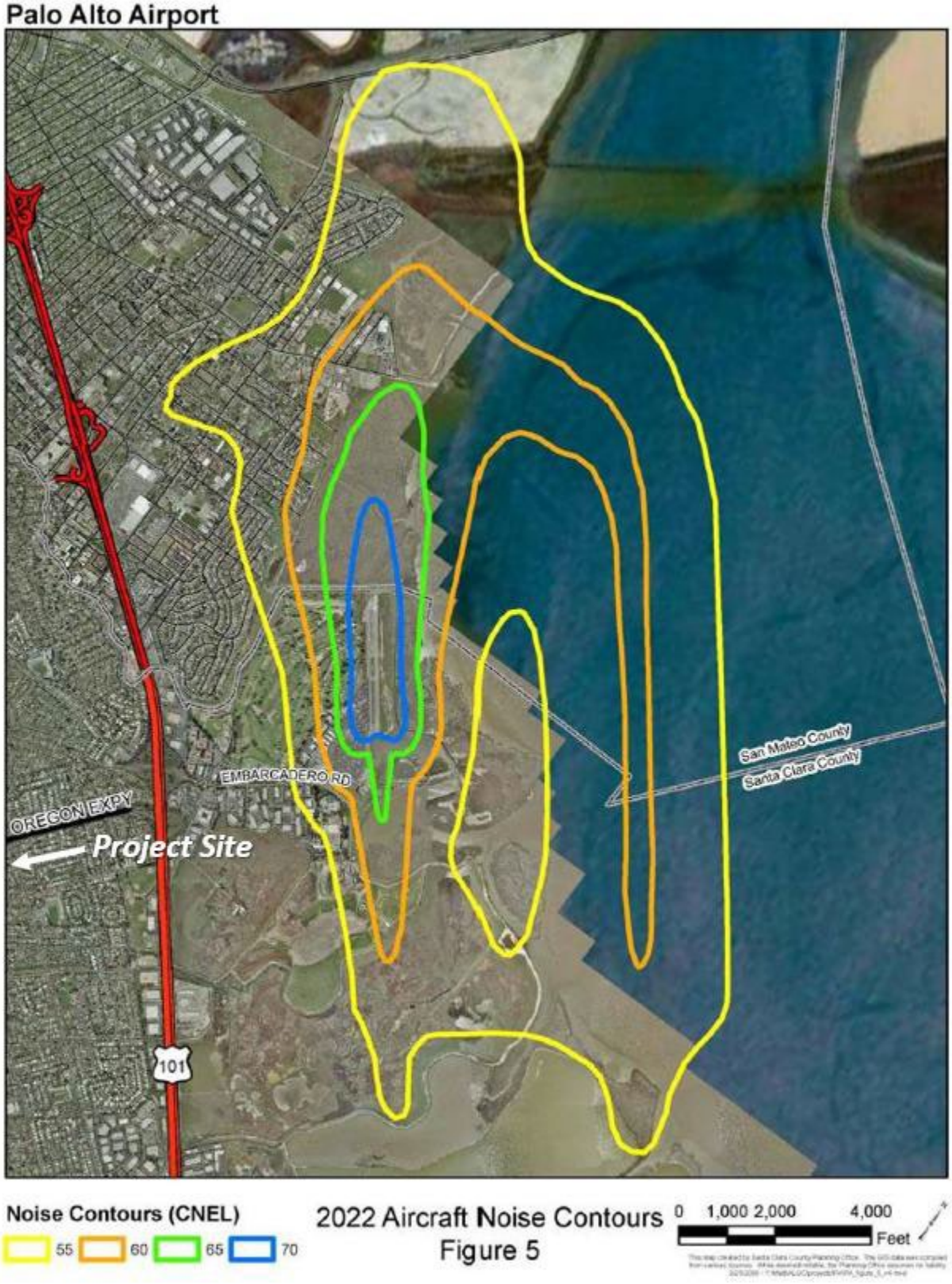
The Palo Alto Airport is a general aviation airport located approximately 2.8 miles northeast of the project site. The project site lies well-outside the 55 dBA CNEL 2022 noise contour for the

airport, according to the Palo Alto Airport Comprehensive Land Use Plan[7] amended in November 2016 (see Figure 3). This means that future exterior noise levels due to aircraft from Palo Alto Airport would be below 55 dBA CNEL/L_{dn} at the project site. Further, the project site is about 4.5 miles from Moffett Federal Airfield and more than 11 miles from San José Mineta International Airport. The project site is located well outside the 60 dBA CNEL noise contours for each of these airports. Therefore, the proposed project would be compatible with the City's exterior noise standards for aircraft noise. This would be a less-than-significant impact.

Mitigation Measure 3: **None required.**

7 Santa Clara County Airport Land Use Commission, "Palo Alto Airport Comprehensive Land Use Plan Santa Clara County," prepared by Walter B. Windus, PE, amended November 16, 2016.

FIGURE 3 2022 CNEL Noise Contours for Palo Alto Airport Relative to Project Site



Cumulative Impacts

Cumulative noise impacts would result from substantially increased construction noise levels from cumulative construction projects or cumulative traffic noise level increases. A significant cumulative traffic noise impact would occur if two criteria are met: 1) if the cumulative traffic noise level increase was 3 dBA L_{dn} or greater for future levels exceeding the normally acceptable threshold; 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 L_{dn} or more attributable solely to the proposed project.

Cumulative (no project) and cumulative plus project peak hour traffic volumes were included in the traffic study. When cumulative (no project) and cumulative plus project traffic volumes were compared to the existing peak hour volumes, all roadway segments resulted in an increase of 2 dBA L_{dn} or less. Therefore, the first criterion of resulting in an increase of 3 dBA L_{dn} or more was not achieved. The proposed project would not result in cumulatively considerable contribution to the overall traffic noise increase. This would be a less-than-significant cumulative impact.

The City of Palo Alto's website[8] shows the following list of project sites located within 500 feet of the proposed 3150 El Camino Real project site:

- **2951 El Camino Real** – this project is approximately 300 feet northwest of the project site, opposite El Camino Real. This project is currently in the planning review phase and would consist of mixed-use development with approximately 119 residential units, 5,000 square feet of office space, and 1,000 square feet of retail space. Construction dates for this project have not been confirmed. Due to the noisy environment caused by El Camino Real and the location of the two sites, this project site would not share receptors with direct line-of-sight to the proposed project site. Therefore, this would not result in a cumulative construction impact.

- **3001/3017 El Camino Real** – this project is approximately 120 feet north of the project site, opposite El Camino Real. This project would consist of demolishing two existing retail buildings and the construction of a 129-unit, 100% affordable, five-story, multi-family residential development. This project has been approved, but construction has not started. It is likely that this project would be completed prior to the start of the proposed project. This would not result in a cumulative construction impact.

- **420 Acacia Avenue** – this project is located north of El Camino Real from the project site and was considered a future sensitive receptor in this study. The 420 Acacia Avenue project consists of 16 multi-family residential townhomes and is currently in the planning review phase of development. Construction dates for this project have not been confirmed but due to the close proximity of the project site and the noise-sensitive receptors shared by both project sites, a significant cumulative construction impact would potentially occur, exposing the nearby sensitive receptors to construction activities at both sites simultaneously or consecutively.

[8] https://www.cityofpaloalto.org/Departments/Planning-Development-Services/Current-Planning/Projects

- **3225 El Camino Real** – this project is approximately 120 feet northeast of the project site, opposite El Camino Real. This project would consist of a new 29,249-square-foot mixed-use project that would include eight residential units and 11,984 square feet of commercial space. This project has been approved, but construction has not started. It is likely that this project would be completed prior to the start of the proposed project. This would not result in a cumulative construction impact.

- **3265 El Camino Real** – this project is approximately 390 feet northeast of the project site, opposite El Camino Real. This project has been approved and would consist of a five-story 100% affordable housing development with approximately 44 residential units. Construction dates for this project have not been confirmed but would likely be completed prior to construction of the proposed project. This project site would not share receptors with direct line-of-sight to the proposed project site. Therefore, this would not result in a cumulative construction impact.

- **3300 El Camino Real** – this project is approximately 180 feet east of the project site. This project is currently in the planning review phase and would consist of a new two-story, 50,355-square-foot office/research and development project. Construction dates for this project have not been confirmed and could occur simultaneously or consecutively with the proposed project. The existing hotel to the east of 3150 El Camino Real would be a shared receptor with direct line-of-sight to both project sites. This would potentially result in a significant cumulative construction impact.

The existing receptors to the east of the project site and the future and existing receptors adjoining the 420 Acacia Avenue site would be considered sensitive receptors during construction activities at both project sites. However, due to the size of 420 Acacia Avenue construction project and the likely construction time duration significantly less than the proposed project, the construction noise levels emanating from the 420 Acacia Avenue site would not substantially increase the construction noise levels from the 3150 El Camino Real site. With the implementation of construction noise best management practices and vibration mitigation measures included in the individual projects, construction noise and vibration levels would be reduced as much as possible at all surrounding sensitive receptors during construction of each individual project. Therefore, the potential cumulative construction impact would be less-than-significant.

While the east hotel would have direct line-of-sight to both the proposed project site and the 3300 El Camino Real site, construction activities from the proposed project site would be the dominant construction noise environment at the shared receptor due to the close proximity of the receptor to the construction activities. Due to the size of the project at 3300 El Camino Real and the location opposite Hansen Way from the east hotel receptor, construction noise levels would not substantially increase if construction of both projects occurred simultaneously. With the implementation of construction noise best management practices and vibration mitigation measures included in the individual projects, construction noise and vibration levels would be reduced as much as possible at all surrounding sensitive receptors during construction of each individual project. Therefore, the potential cumulative construction impact would be less-than-significant.

APPENDIX A

FIGURE A1 Daily Trend in Noise Levels at LT-1, Tuesday, October 10, 2023

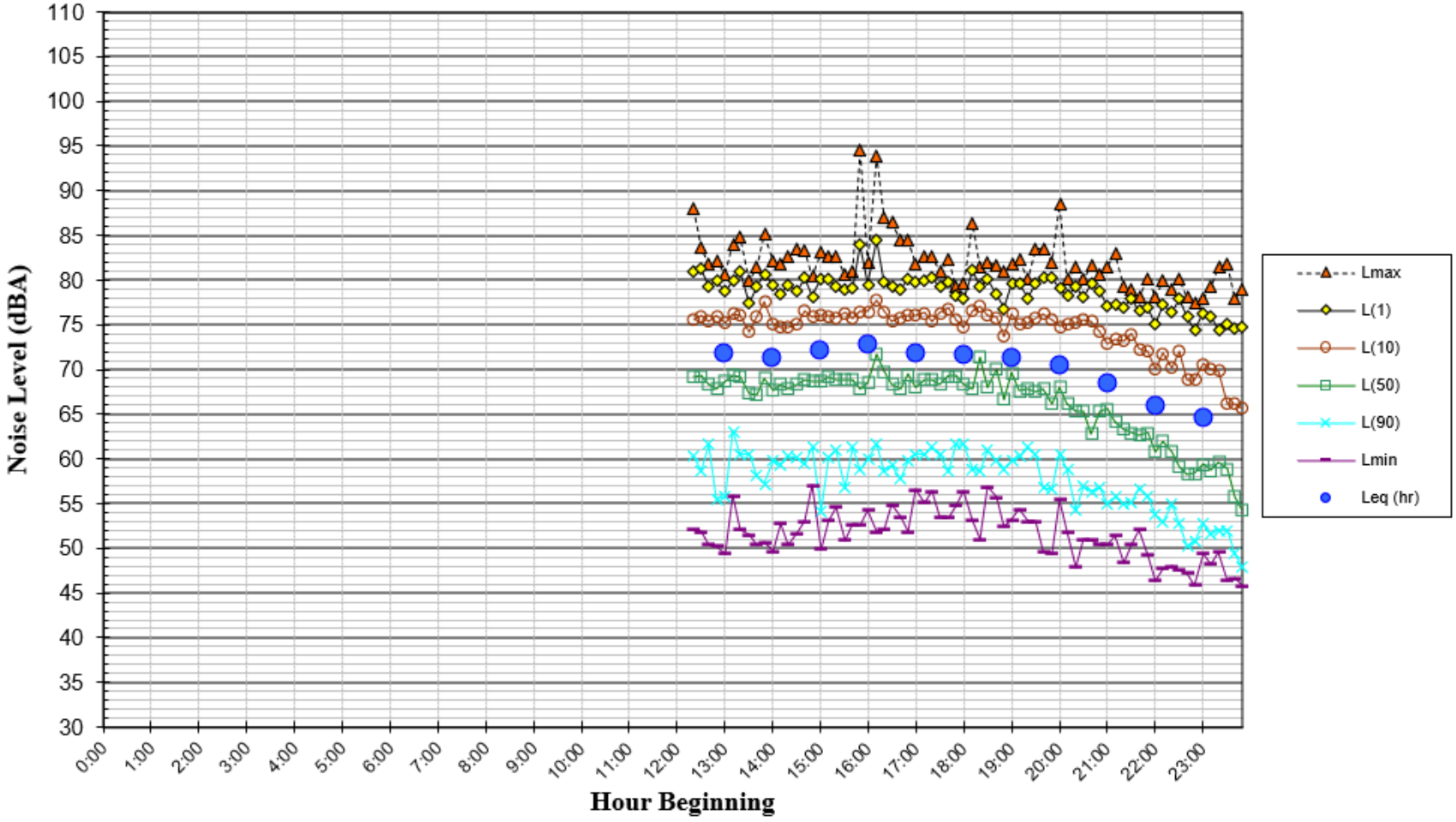


FIGURE A2 Daily Trend in Noise Levels at LT-1, Wednesday, October 11, 2023

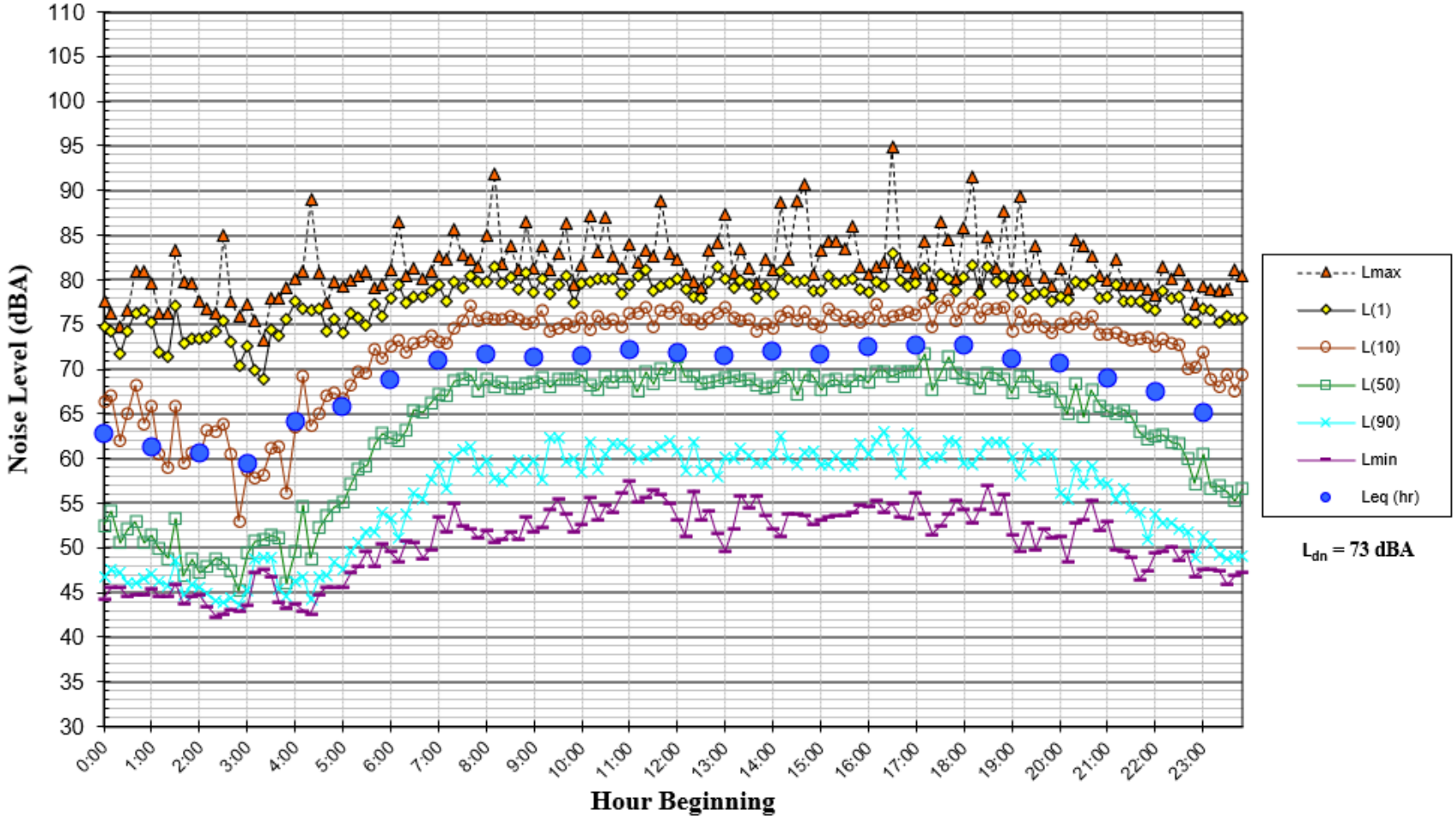


FIGURE A3 Daily Trend in Noise Levels at LT-1, Thursday, October 12, 2023

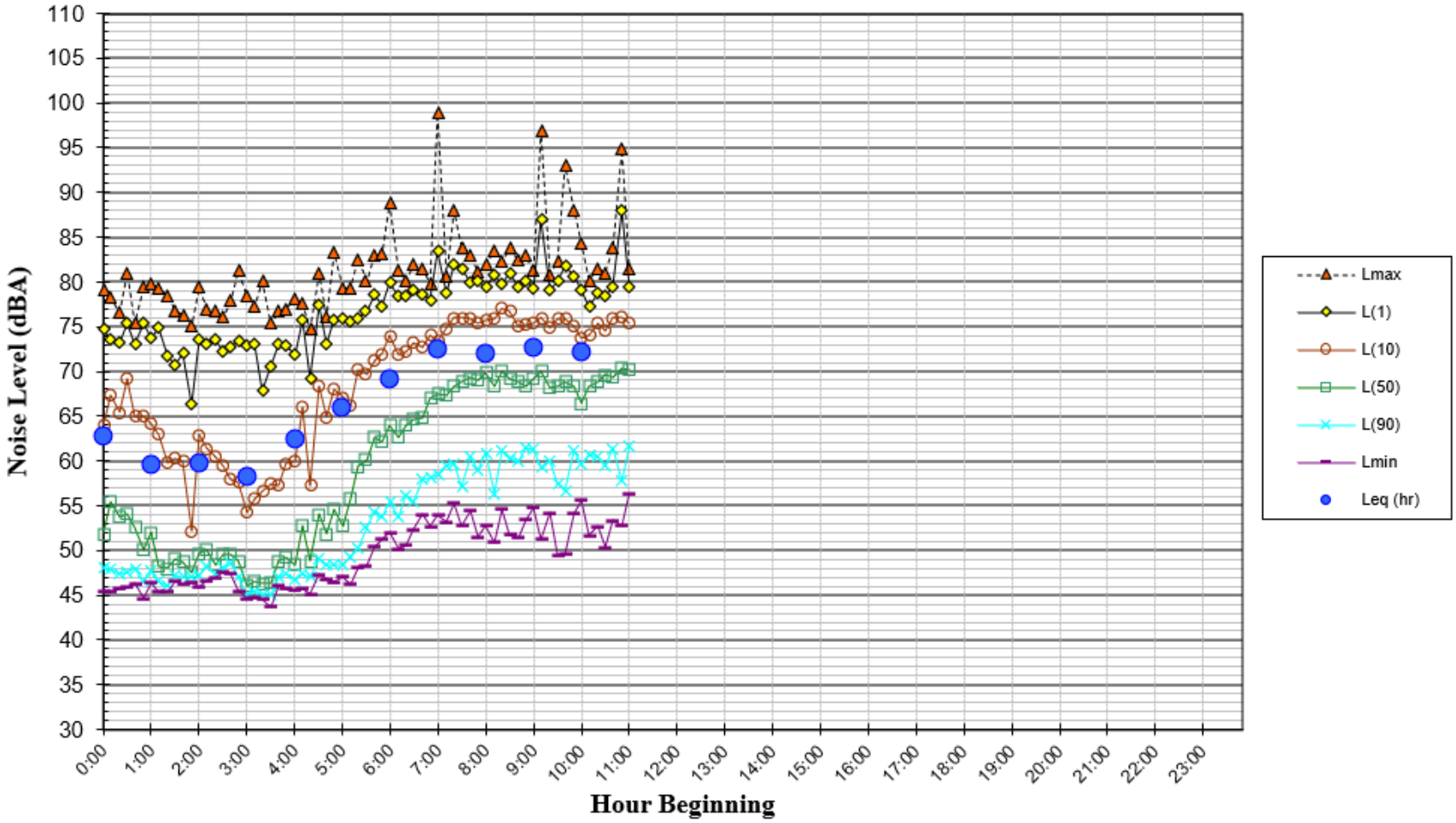


FIGURE A4 Daily Trend in Noise Levels at LT-2, Tuesday, October 10, 2023

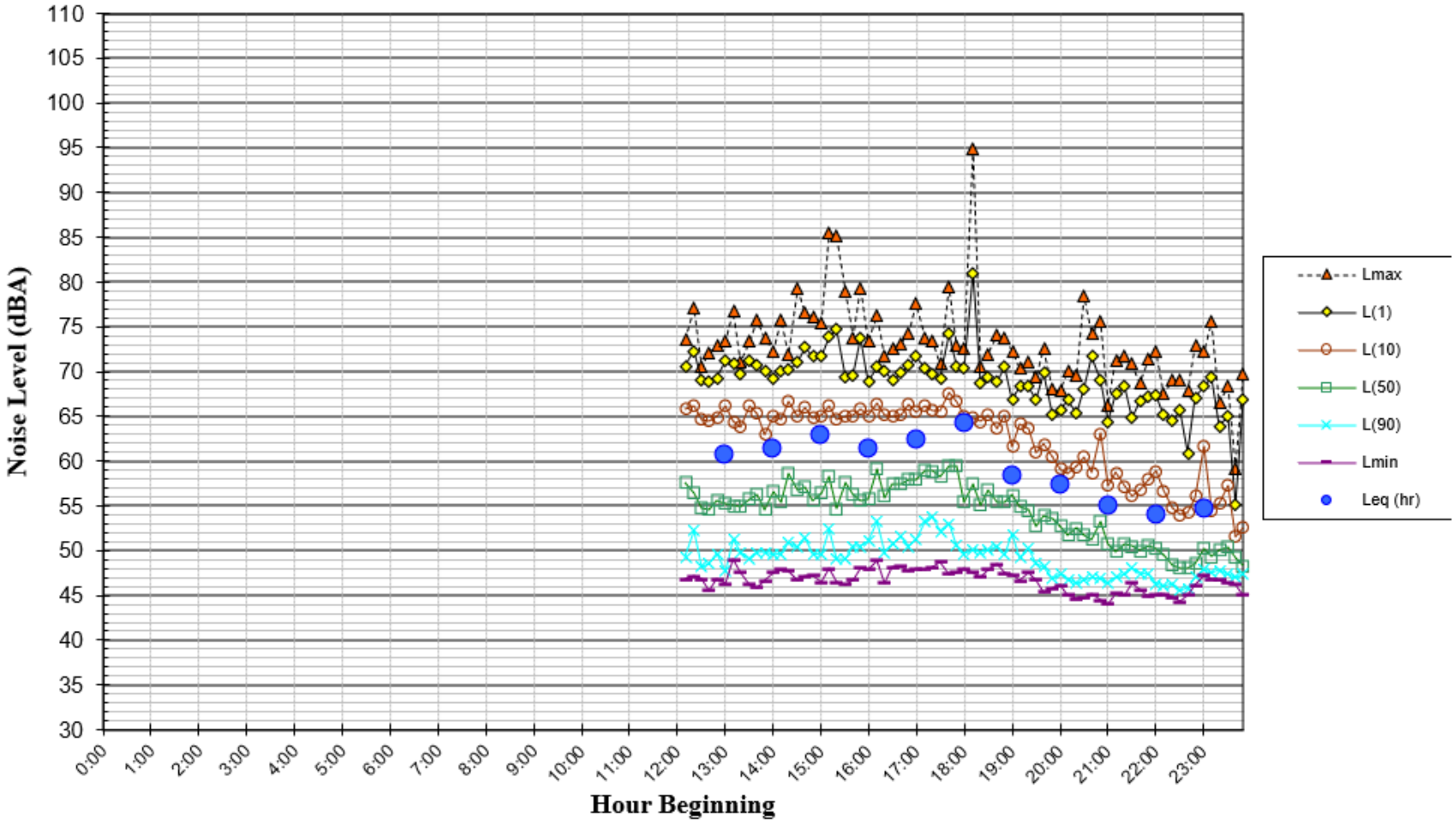


FIGURE A5 Daily Trend in Noise Levels at LT-2, Wednesday, October 11, 2023

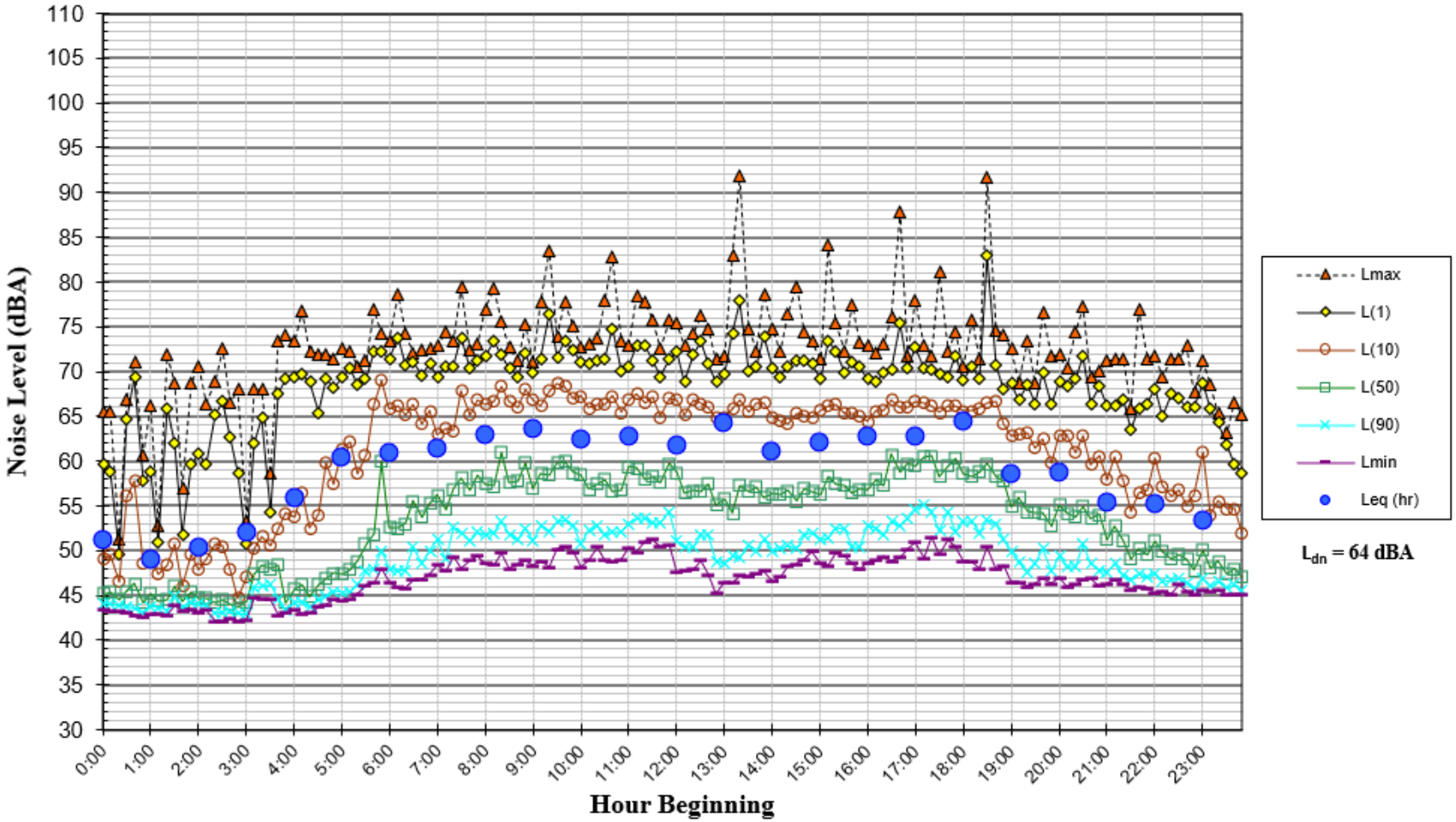


FIGURE A6 Daily Trend in Noise Levels at LT-2, Thursday, October 12, 2023