BARK LANE RESIDENTIAL PROJECT NOISE AND VIBRATION ASSESSMENT

San José, California

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Prepared for:

Fiona Phung
Associate Project Manager
David J. Powers & Associates, Inc.
1871 The Alameda, Suite 200
San José, CA 95126

Prepared by:

Casey Divine and
Michael S. Thill

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

I&R Job No.: 17-072

INTRODUCTION

The Bark Lane Residential Project is located on a 0.9-acre site at 7201-7245 Bark Lane, between South De Anza Boulevard and Weyburn Lane in San José, California. The project proposes to demolish the existing two-story apartment building and construct 85, two- and three-bedroom residential units in a seven-story building constructed over two levels of underground parking. There is a private open space courtyard on the ground level and a lobby and gym on the ground floor of the building. Landscaping surrounds the building along the street frontage and common property lines. Private patios or balconies are provided for each unit. Ingress and egress to the below grade parking is provided via a driveway near the east end of the site on Bark Lane.

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 criteria, and discusses the results of the ambient noise monitoring survey completed to document existing noise conditions; 2) the General Plan Consistency 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 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 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.

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, September 2013.

Regulatory Background - Noise

The State of California, Santa Clara County, and the City of San José have established regulatory criteria that are applicable in this assessment. The State CEQA Guidelines, Appendix G, California Building Code, Santa Clara County Airport Land Use Commission Comprehensive Land Use Plan, and the City of San José General Plan are used to assess the potential significance of impacts. A summary of the applicable regulatory criteria is provided below.

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

(a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local General Plan or Noise Ordinance, or applicable standards of other agencies;

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

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

Pursuant to recent court decisions, the impacts of site constraints, such as exposure of the proposed project to excessive levels of noise and vibration, are not included in the Impacts and Mitigation Section of this report. These items are discussed in a separate section addressing the project's consistency with the policies set forth in the City's General Plan.

CEQA does not define what noise level increase would be considered substantial. Typically, an increase in the DNL noise level resulting from the project at noise sensitive land uses of 3 dBA or greater would be considered a significant impact when projected noise levels would exceed those considered acceptable for the affected land use. An increase of 5 dBA DNL or greater would be considered a significant impact when projected noise levels would remain within those considered acceptable for the affected land use.

2016 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 Airport Land Use Commission Comprehensive Land Use Plan. The Comprehensive Land Use Plan 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

Policy N-3 Noise impacts shall be evaluated according to the Aircraft Noise Contours presented on Figure 5 (2022 Aircraft Noise Contours).

Policy N-4 No residential or transient lodging construction shall be permitted within the 65 dB CNEL contour boundary unless it can be demonstrated that the resulting interior sound levels will be less than 45 dB CNEL and there are no outdoor patios or outdoor activity areas associated with the residential portion of a mixed-use residential project or a multi-unit residential project. (Sound wall noise mitigation measures are not effective in reducing noise generated by aircraft flying overhead.)

City of San José General Plan. The Environmental Leadership Chapter in the Envision San José 2040 General Plan sets forth policies with the goal of minimizing the impact of noise on people through noise reduction and suppression techniques, and through appropriate land use policies in the City of San José. The following policies are applicable to the proposed project:

EC-1.1 Locate new development in areas where noise levels are appropriate for the proposed uses. Consider federal, state, and City noise standards and guidelines as a part of new development review. Applicable standards and guidelines for land uses in San José include:

Interior Noise Levels

- The City's standard for interior noise levels in residences, hotels, motels, residential care facilities, and hospitals is 45 dBA DNL. Include appropriate site and building design, building construction and noise attenuation techniques in new development to meet this standard. For sites with exterior noise levels of 60 dBA DNL or more, an acoustical analysis following protocols in the City-adopted California Building Code is required to

demonstrate that development projects can meet this standard. The acoustical analysis shall base required noise attenuation techniques on expected Envision General Plan traffic volumes to ensure land use compatibility and General Plan consistency over the life of this plan.

Exterior Noise Levels

- The City's acceptable exterior noise level objective is 60 dBA DNL or less for residential and most institutional land uses (Table EC-1). The acceptable exterior noise level objective is established for the City, except in the environs of the San José International Airport and the Downtown, as described below:

    - For new multi-family residential projects and for the residential component of mixed-use development, use a standard of 60 dBA DNL in usable outdoor activity areas, excluding balconies and residential stoops and porches facing existing roadways. Some common use areas that meet the 60 dBA DNL exterior standard will be available to all residents. Use noise attenuation techniques such as shielding by buildings and structures for outdoor common use areas. On sites subject to aircraft overflights or adjacent to elevated roadways, use noise attenuation techniques to achieve the 60 dBA DNL standard for noise from sources other than aircraft and elevated roadway segments.

EC-1.2 Minimize the noise impacts of new development on land uses sensitive to increased noise levels (Categories 1, 2, 3 and 6) by limiting noise generation and by requiring use of noise attenuation measures such as acoustical enclosures and sound barriers, where feasible. The City considers significant noise impacts to occur if a project would:

- Cause the DNL at noise sensitive receptors to increase by five dBA DNL or more where the noise levels would remain "Normally Acceptable;" or

- Cause the DNL at noise sensitive receptors to increase by three dBA DNL or more where noise levels would equal or exceed the "Normally Acceptable" level.

EC-1.7 Require construction operations within San José to use best available noise suppression devices and techniques and limit construction hours near residential uses per the City's Municipal Code. The City considers significant construction noise impacts to occur if a project located within 500 feet of residential uses or 200 feet of commercial or office uses would:

- Involve substantial noise generating activities (such as building demolition, grading, excavation, pile driving, use of impact equipment, or building framing) continuing for more than 12 months.

For such large or complex projects, a construction noise logistics plan that specifies hours of construction, noise and vibration minimization measures, posting or notification of construction schedules, and designation of a noise disturbance coordinator who would respond to neighborhood complaints will be required to be in place prior to the start of construction and implemented during construction to reduce noise impacts on neighboring residents and other uses.

EC-1.11 Require safe and compatible land uses within the Mineta San José International Airport noise zone (defined by the 65 CNEL contour as set forth in State law) and encourage aircraft operating procedures that minimize noise.

Table EC-1: Land Use Compatibility Guidelines for Community Noise in San José

LAND USE CATEGORY	EXTERIOR NOISE EXPOSURE (DNL IN DECIBELS (DBA)) 55 60 65 70 75 80
1. Residential, Hotels and Motels, Hospitals and Residential Care[1]	
2. Outdoor Sports and Recreation, Neighborhood Parks and Playgrounds	
3. Schools, Libraries, Museums, Meeting Halls, Churches	
4. Office Buildings, Business Commercial, and Professional Offices	
5. Sports Arena, Outdoor Spectator Sports	
6. Public and Quasi-Public Auditoriums, Concert Halls, Amphitheaters	

[1]Noise mitigation to reduce interior noise levels pursuant to Policy EC-1.1 is required.

Normally 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.

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.

Regulatory Background – Vibration

City of San José General Plan. The Environmental Leadership Chapter in the Envision San José 2040 General Plan sets forth policies to achieve the goal of minimizing vibration impacts on people, residences, and business operations in the City of San José. The following policies are applicable to the proposed project:

EC-2.3 Require new development to minimize continuous vibration impacts to adjacent uses during demolition and construction. For sensitive historic structures, including ruins and ancient monuments or building that are documented to be structurally weakened, a continuous vibration limit of 0.08 in/sec PPV (peak particle velocity) will be used to minimize the potential for cosmetic damage to a building. A continuous vibration limit of 0.20 in/sec PPV will be used to minimize the potential for cosmetic damage at buildings of normal conventional construction. Equipment or activities typical of generating continuous vibration include but are not limited to: excavation equipment; static compaction equipment; vibratory pile drivers; pile-extraction equipment; and vibratory compaction equipment. Avoid use of impact pile drivers within 125 feet of any buildings, and within 300 feet of historical buildings, or buildings in poor condition. On a project-specific basis, this distance of 300 feet may be reduced where warranted by a technical study by a qualified professional that verifies that there will be virtually no risk of cosmetic damage to sensitive buildings from the new development during demolition and construction. Transient vibration impacts may exceed a vibration limit of 0.08 in/sec PPV only when and where warranted by a technical study by a qualified professional that verifies that there will be virtually no risk of cosmetic damage to sensitive buildings from the new development during demolition and construction.

Existing Noise Environment

The project site is located on the north side of Bark Lane between South De Anza Boulevard and Weyburn Lane in San José, California. Figure 1 shows the project site plan overlaid on an aerial image of the site vicinity. As shown on Figure 1, the project site is surrounded by existing residential and commercial land uses. Residential apartment buildings adjoin the project site along the north and east property lines, and are located across Bark Lane. A gas station and restaurant on South De Anza Boulevard are located to the west. There will also be a future hotel adjacent to the west of the project site.

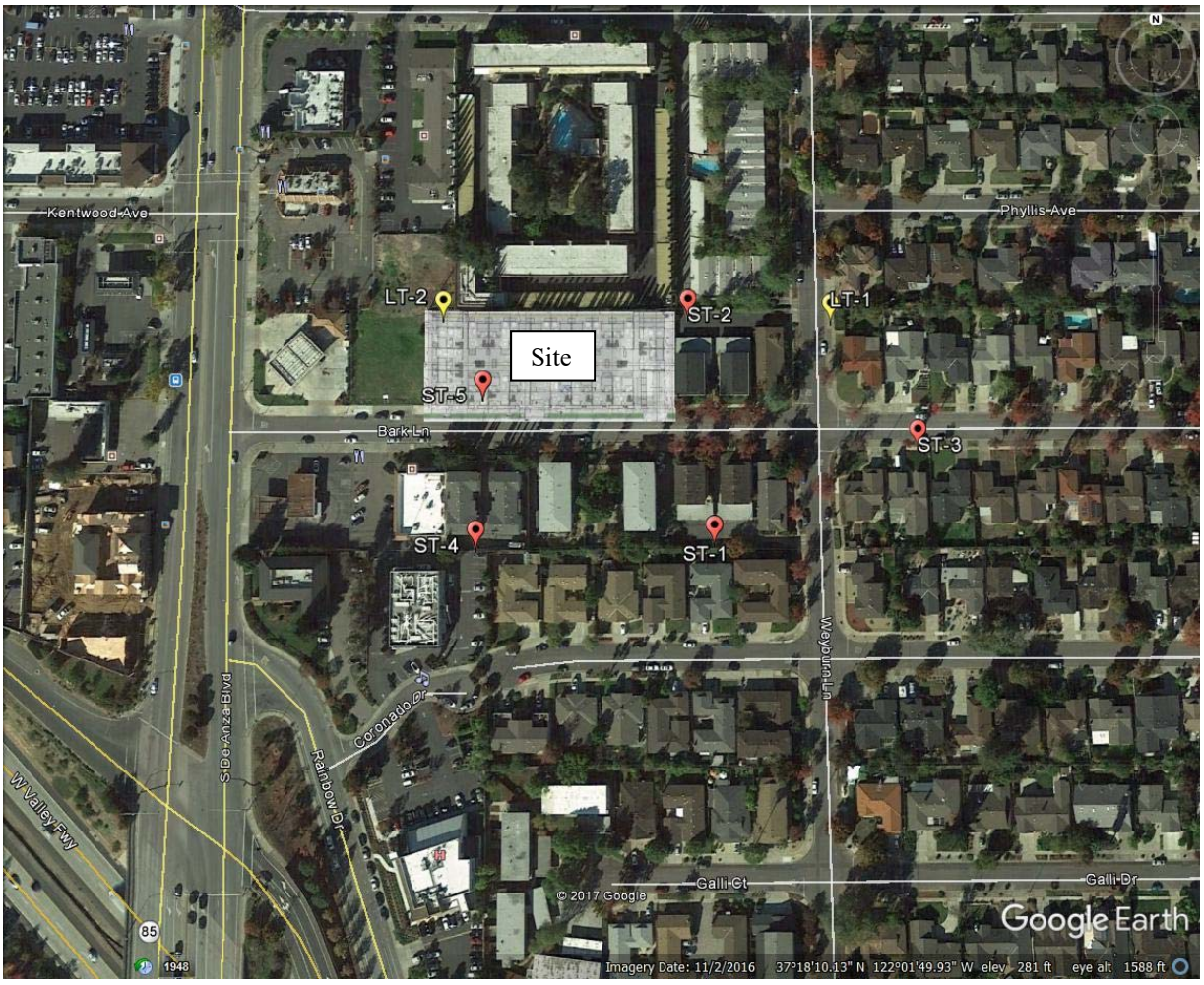
A noise monitoring survey was performed to quantify and characterize ambient noise levels at the site and in the project vicinity beginning on Wednesday, May 31, 2017 and concluding on Friday, June 2, 2017. The monitoring survey included two long-term noise measurements (LT-1 and LT-2) and five short-term noise measurements (ST-1 through ST-5), as shown in Figure 1. The noise environment at the site and at the nearby land uses results primarily from vehicular traffic along the local streets, South De Anza Boulevard, and State Route (S.R. 85). General aviation aircraft also contribute to the noise environment.

Long-term noise measurement LT-1 was made along Weyburn Lane in the block to the north of Bark Lane, approximately 20 feet east of the Weyburn Lane centerline. This location was selected to represent the noise environment at residences in the areas surrounding the project site. Hourly average noise levels at this location typically ranged from 52 to 63 dBA L_{eq} during the day and from 33 to 51 dBA L_{eq} at night. The day-night average noise level from Wednesday, May 31, 2017 through Friday, June 2, 2017 was 57 dBA DNL. The daily trend in noise levels at LT-1 is shown in Figure 2.

Long-term noise measurement LT-2 was made on the northwest corner of the project site, approximately 275 feet east of the South De Anza Boulevard centerline and 140 feet north of the Bark Lane centerline. Hourly average noise levels at this location typically ranged from 54 to 59 dBA L_{eq} during the day and from 45 to 57 dBA L_{eq} at night. The day-night average noise level from Wednesday, May 31, 2017 through Friday, June 2, 2017 was 59 dBA DNL. The daily trend in noise levels at LT-2 is shown in Figure 3.

Short-term noise measurements were made to identify sources of noise and measure variations in noise levels in the vicinity of the project site. Table 4 summarizes the results of the short-term measurements. During the measurements the sky was clear, winds were light at 2-3 mph, and temperatures were in the mid 70's °F.

FIGURE 1 Noise Measurement Locations



Source: Google Earth 2017.

FIGURE 2 Daily Trend in Noise Levels at LT-1

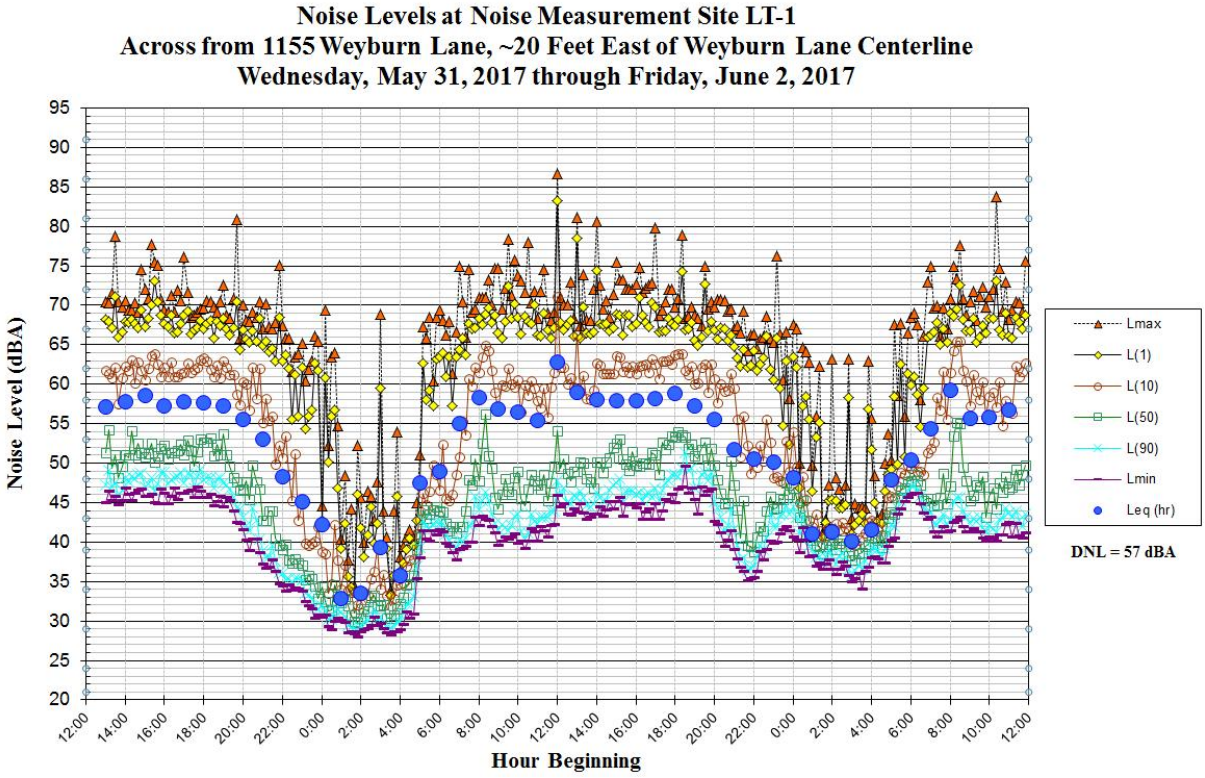


FIGURE 3 Daily Trend in Noise Levels at LT-2

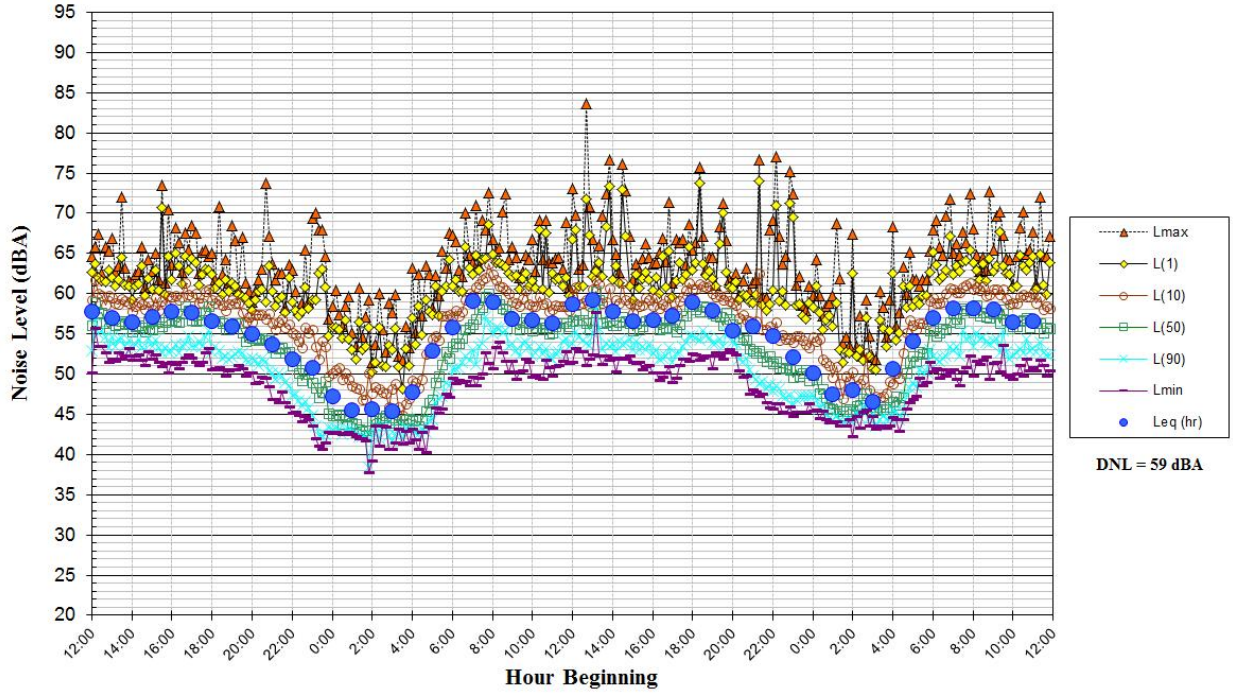


TABLE 4 Summary of Short-Term Noise Measurement Data

Noise Measurement Location	L_{max}	$L_{(1)}$	$L_{(10)}$	$L_{(50)}$	$L_{(90)}$	L_{eq}
ST-1: South side of 7180 Bark Lane Apartments 5/31/2017, 12:20 p.m. – 12:30 p.m.	59	53	48	45	44	46
ST-2: North side of 7183 Bark Lane Apartments 5/31/2017, 12:40p.m. – 12:50 p.m.	65	63	52	47	44	51
ST-3: In front of 7140 Bark Lane 5/31/2017, 1:00 p.m. – 1:10 p.m.	65	61	54	48	46	51
ST-4: South side of 7240 Bark Lane Apartments 5/31/2017, 1:20 p.m. – 1:30 p.m.	68	55	52	49	48	51
ST-5a: In front of 7245 Bark Lane 2nd Floor 6/2/2017, 12:20 p.m. – 12:30 p.m.	66	63	56	52	49	54
ST-5b: In front of 7245 Bark Lane 1st Floor 6/2/2017, 12:30 p.m. – 12:40 p.m.	72	66	57	52	49	55

PLAN CONSISTENCY ANALYSIS

Noise and Land Use Compatibility

The ambient noise levels measured along the roadways bordering the project site ranges from 57 to 59 dBA DNL. The primary roadways affecting the noise environment at the project are currently and would continue in the future to be South De Anza Boulevard and Bark Lane. The San José General Plan 2040 EIR indicates that the future traffic noise levels in the West Valley area of San José (where the project site is located) would increase by up to 1 dBA DNL by the year 2035. Future noise exposures at lower floor residential facades are calculated to reach 58 to 60 dBA DNL. The higher floors would be more exposed to South De Anza Boulevard and S.R. 85 traffic. West and south upper floor facades would experience noise levels two to three dBA higher than lower floors resulting in a maximum future exterior noise exposure level of 63 dBA DNL.

Future Exterior Noise Environment

The exterior noise threshold established in the City's General Plan for new residential projects is 60 dBA DNL at usable outdoor activity areas, excluding balconies and porches.

The project proposes an open space courtyard enclosed by the proposed residential building. The large courtyard would be acoustically shielded from roadway noise by the proposed building, reducing the noise level in the courtyard to 50 to 55 dBA DNL. Exterior noise levels at the acoustically shielded residential outdoor use courtyard would not exceed the City's 60 dBA DNL exterior noise standard and would be considered compatible with the proposed land use.

Future Interior Noise Environment

The State of California and the City of San José requires that interior noise levels be maintained at 45 dBA DNL or less for residential land uses. Residential units would be located on the first

floor through the seventh floor. The west and south upper floor facades would experience maximum future exterior noise exposure level of 63 dBA DNL.

Interior noise levels would vary depending upon the design of the buildings (relative window area to wall area) and the selected construction materials and methods. 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 DNL, 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, at the discretion of the residents, to control noise. Where noise levels exceed 65 dBA DNL, 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.

Assuming windows to be partially open for ventilation, the interior noise levels for the proposed project would be up to 48 dBA DNL at the units along the upper western and southern façades of proposed building. This would exceed the 45 dBA DNL threshold for interior noise.

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 at residential uses to 45 dBA DNL or less:

- 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.

The implementation of these noise insulation features would reduce interior noise levels to 45 dBA

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 at existing noise-sensitive receptors surrounding the project site.

- A significant noise impact would be identified if construction-related noise would temporarily increase ambient noise levels at sensitive receptors. The City of San José considers large or complex projects involving substantial noise-generating activities and lasting more than 12 months significant when within 500 feet of residential land uses or within 200 feet of commercial land uses or offices.

- A significant permanent noise level increase would occur if project-generated traffic would result in: a) a noise level increase of 5 dBA DNL or greater, with a future noise level of less than 60 dBA DNL, or b) a noise level increase of 3 dBA DNL or greater, with a future noise level of 60 dBA DNL or greater.

- 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.

- A significant impact would be identified if the construction of the project would generate excessive vibration levels surrounding receptors. Groundborne vibration levels exceeding 0.2 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. **This is a 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.

Policy EC-1.7 of the City's General Plan requires that all construction operations within the City to use best available noise suppression devices and techniques and to limit construction hours near residential uses per the Municipal Code allowable hours, which are between the hours of 7:00 a.m. and 7:00 p.m. Monday through Friday when construction occurs within 500 feet of a residential land use. Further, the City considers significant construction noise impacts to occur if a project located within 500 feet of residential uses or 200 feet of commercial or office uses would involve substantial noise-generating activities (such as building demolition, grading, excavation, pile driving, use of impact equipment, or building framing) continuing for more than 12 months.

Existing multi-family residences are located adjacent to the project site to the north and east, as well as opposite Bark Lane to the south. Commercial buildings are located adjacent to the project site to the west. The residences to the east of the site have ambient noise environments represented by LT-1 and ST-1 through ST-3, which range from 46 to 63 dBA L_{eq} during daytime hours. There

will be a future hotel adjacent to the west of the project site. The residences to the north and south of the site, and the future hotel to the west, have ambient noise environments represented by LT-2, ST-4, and ST-5, which range from 54 to 59 dBA L_{eq} during daytime hours.

Construction activities generate considerable amounts of noise, especially during earth-moving activities when heavy equipment is used. The highest maximum noise levels generated by project construction would typically range from about 80 to 90 dBA L_{max} at a distance of 50 feet from the noise source. A list of typical maximum instantaneous noise levels measured at 50 feet are provided in Table 5. Typical hourly average construction-generated noise levels for residential buildings are about 81 to 88 dBA L_{eq} measured at a distance of 50 feet from the center of the site during busy construction periods (e.g., earth moving equipment, impact tools, etc.), as shown in Table 6. 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 can provide an additional 5 to 10 dBA noise reduction at distant receptors.

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

Equipment Category	L_{max} Level (dBA)[1,2]	Impact/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.

A detailed list of equipment expected to be used for the proposed project construction and phasing information were not available at the time of this study. However, construction activities for the proposed project are expected to take over 12 months to complete, and pile driving is not anticipated. To estimate the construction noise levels generated by the proposed project, the noise levels provided in Table 6 for domestic housing were used to estimate the range of construction noise levels expected at the nearby existing land uses. The estimates were calculated by measuring from the center of the project site to the property lines of the nearby receptors. The estimated results are summarized in Table 7. These levels do not assume reductions due to intervening buildings or other existing shielding features, such as sound walls.

As shown in Table 7, ambient levels at the surrounding uses would potentially be exceeded by 5 dBA L_{eq} or more at various times throughout construction. Since project construction would last for a period of more than one year and considering that the project site is within 500 feet of existing

residences and within 200 feet of existing commercial uses, the proposed project would be considered a significant temporary impact.

TABLE 7 Estimated Construction Noise Levels at Nearby Land Uses

Proposed Project Construction	Estimated Noise Levels at Nearby Land Uses, dBA L_{eq}		
	East Residences and Future West Hotel (150 feet)	North Residences (60 feet)	South Residences (130 feet)
Ground Clearing	73 dBA L_{eq}	81 dBA L_{eq}	75 dBA L_{eq}
Excavation	78 dBA L_{eq}	86 dBA L_{eq}	80 dBA L_{eq}
Foundations	71 dBA L_{eq}	79 dBA L_{eq}	73 dBA L_{eq}
Erection	71 dBA L_{eq}	79 dBA L_{eq}	73 dBA L_{eq}
Finishing	78 dBA L_{eq}	86 dBA L_{eq}	80 dBA L_{eq}

Mitigation Measure 1a:

Policy EC-1.7 of the City's General Plan states that for large or complex projects within 500 feet of residential land uses or within 200 feet of commercial land uses or offices involving substantial noise-generating activities lasting more than 12 months, a construction noise logistics plan that specifies hours of construction, noise and vibration minimization measures, posting or notification of construction schedules, and designation of a noise disturbance coordinator who would respond to neighborhood complaints will be required to be in place prior to the start of construction and implemented during construction to reduce noise impacts on neighboring residents and other uses.

Modification, placement, and operation of construction equipment are possible means for minimizing the noise impact on the existing sensitive receptors. Construction equipment should be well-maintained and used judiciously to be as quiet as possible. Additionally, construction activities for the proposed project should include the following best management practices to reduce noise from construction activities near sensitive land uses:

- Construction activities shall be limited to the hours between 7:00 am and 7:00 pm, Monday through Friday, unless permission is granted with a development permit or other planning approval. No construction activities are permitted on the weekends at sites within 500 feet of a residence.

- 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 receiver 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. Construct temporary noise barriers to screen stationary noise-generating equipment when located near adjoining sensitive land uses. Temporary noise barriers could reduce construction noise levels by 5 dBA.

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

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

- 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.

- Notify all adjacent business, residences, and other noise-sensitive land uses of the construction schedule, in writing, and provide a written schedule of "noisy" construction activities to the adjacent land uses and nearby residences.

- Additional temporary noise control blanket barriers could be erected, if necessary, along other residential building facades facing the site if determined to be necessary during construction. This mitigation would only be necessary if conflicts occurred which were irresolvable by proper scheduling. Noise control blanket barriers can be rented and quickly erected.

- 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: **Cumulative Construction Noise.** Existing noise-sensitive land uses would be exposed to cumulative construction noise levels in excess of ambient noise levels. The incorporation of construction best management practices provided in Mitigation Measure 1a as project conditions of approval would result in a **less-than-significant** cumulative construction noise impact.

The construction of the proposed residential project could occur concurrently or sequentially with

the hotel development proposed west of the site. If the projects are constructed concurrently, combined project construction noise levels would be approximately 3 dBA higher than individual project construction noise levels; however the total duration of construction activities to which the surrounding noise-sensitive receptors would be exposed would be shorter. If construction for the two projects would occur sequentially, then construction noise levels would be moderate, as described in Impact 1a, but the total time of construction noise exposure could be up to two or more years in duration. Policy EC-1.7 of the City's General Plan states that any construction activity lasting for one year or more would be considered less-than-significant with the incorporation of the construction best management practices provided in Mitigation Measure 1a of this report. Therefore, the cumulative noise exposure from the two projects constructed either concurrently or sequentially would be considered less-than-significant with the implementation of Mitigation Measure 1a.

Mitigation Measure 1b: No further mitigation required.

Impact 1c: Permanent Traffic Noise Level Increase. The proposed project is not expected to cause a substantial permanent noise level increase at the existing residential land uses in the project vicinity. **This is a less-than-significant impact.**

According to Policy EC-1.2 of the City's General Plan, a significant permanent noise increase would occur if the project would increase noise levels at noise-sensitive receptors by 3 dBA DNL or more where ambient noise levels exceed the "normally acceptable" noise level standard. Where ambient noise levels are at or below the "normally acceptable" noise level standard, noise level increases of 5 dBA DNL or more would be considered significant. The City's General Plan defines the "normally acceptable" outdoor noise level standard for the residential land uses to be 60 dBA DNL. Existing ambient levels, based on the measurements made in the project vicinity, do not exceed 60 dBA DNL. Therefore, a significant impact would occur if traffic due to the proposed project would permanently increase ambient levels by 5 dBA DNL. For reference, a 3 dBA DNL noise increase would be expected if the project would double existing traffic volumes along a roadway.

The traffic report provided by *Hexagon Transportation Consultants*[1] peak hour volumes for the project-generated traffic along local and major roadways in the immediate project vicinity. Traffic volume information was reviewed to calculate the permanent noise increase attributable to project-generated traffic. By comparing the existing plus project traffic scenario to the existing scenario, the project's contribution to the overall noise level increase was determined to be 1 dBA DNL or less along each roadway segment in the project vicinity. Therefore, the project would not result in a permanent noise increase of 5 dBA DNL or more at noise-sensitive receptors in the project vicinity. This is a less-than-significant impact.

Mitigation Measure 1c: None required.

Impact 1d: Cumulative Traffic Noise Level Increase. The proposed project would not make a cumulatively considerable contribution to future noise levels at residential land uses in the vicinity. **This is a less-than-significant impact.**

[1] Hexagon Transportation Consultants, "Bark Lane Apartments TIA", July 2017.

A significant impact would occur if the cumulative traffic noise level increase was 3 dBA DNL or greater for future levels exceeding 60 dBA DNL or was 5 dBA DNL or greater for future levels at or below 60 dBA DNL and 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 DNL or more attributable solely to the proposed project.

Cumulative traffic noise level increases were calculated by comparing the cumulative (no project) traffic volumes and the cumulative plus project volumes to existing traffic volumes from the future adjacent hotel uses' traffic study.[2] Up to a 1 dBA DNL increase was calculated along Bark Lane under both cumulative (no project) and cumulative plus project scenarios, while all other roadway segments resulted in a less than 1 dBA DNL increase. The estimated cumulative noise increase would be less than 3 dBA DNL along each roadway segment included in the traffic report. Additionally, the proposed project would not result in a cumulatively considerable contribution to the future noise levels since both cumulative scenarios would increase the noise environment by 1 dBA DNL or less. This would be a less-than-significant impact.

Mitigation Measure 1d: None required.

Impact 1e: Noise Levels in Excess of Standards. The proposed project could generate noise in excess of standards established in the City's General Plan at the nearby sensitive receptors. **This is a significant noise impact.**

Noise levels from building equipment should not exceed a noise level of 55 dBA DNL at receiving noise-sensitive land uses. Noise-sensitive receptors surrounding the site would include existing residences adjoining the site to the north and east; existing residences to the south of the site opposite Bark Lane; and the future hotel use adjoining the site to the west.

Multi-family residential buildings typically require various mechanical equipment, such as air conditioners, exhaust fans, and air handling equipment for ventilation of the buildings. The site plans do not indicate where mechanical units or rooms would be located. Due to the number of variables inherent in the mechanical equipment needs of the project (location, number and types of units, size, housing, specs, etc.), the impacts of mechanical equipment noise on nearby noise-sensitive uses should be assessed during the final project design stage. Design planning should take into account the noise criteria associated with such equipment and utilize site planning to locate equipment in less noise-sensitive areas. Other controls could include, but shall not be limited to, fan silencers, enclosures, and screen walls.

Given the close proximity of noise-sensitive uses to the project site and lack of sufficient details about the mechanical equipment, mechanical rooms, and rooftop enclosure, there is the potential for noise from mechanical equipment to exceed 55 dBA DNL at noise-sensitive land uses in the immediate project vicinity. The final design plans should be reviewed by a qualified acoustical consultant to address any potential conflicts. This is a potentially significant impact.

[2] Hexagon Transportation Consultants, Inc., "Bark Lane Hotel Transportation Impact Analysis," April 9, 2018.

Mitigation Measure 1e:

Prior to the issuance of building permits, mechanical equipment shall be selected and designed to reduce impacts on surrounding uses to meet the 55 dBA DNL threshold. A qualified acoustical consultant shall be retained by the project applicant to review mechanical noise as the equipment systems are selected in order to determine specific noise reduction measures necessary to reduce noise to comply with the City's noise limit at the shared property lines. Noise reduction measures could include, but are not limited to, selection of equipment that emits low noise levels and/or installation of noise barriers, such as mechanical equipment screens or enclosures.

Impact 2: **Exposure to Excessive Groundborne Vibration due to Construction.** Construction-related vibration levels resulting from activities near the northern, southern, and western boundaries of the project site would exceed 0.2 in/sec PPV. **This is a 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. While pile driving equipment can cause excessive vibration, it is not expected to be required for the proposed project.

According to Policy EC-2.3 of the City of San José General Plan, a vibration limit of 0.20 in/sec PPV shall be used to minimize damage at buildings of normal conventional construction. There are no sensitive historical structures near the project site that would be affected by construction vibration.

Table 8 presents typical vibration levels that could be expected from 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. Jackhammers typically generate vibration levels of 0.035 in/sec PPV, and drilling typically generates vibration levels of 0.09 in/sec PPV at a distance of 25 feet. Vibration levels would vary depending on soil conditions, construction methods, and equipment used. Table 8 also summarizes the distances to the 0.2 in/sec PPV threshold for normal buildings.

TABLE 8 Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 ft. (in/sec)	Minimum Distance to Meet 0.2 in/sec PPV (feet)
Clam shovel drop		0.202	26
Hydromill (slurry wall)	in soil	0.008	1
	in rock	0.017	2
Vibratory Roller		0.210	27
Hoe Ram		0.089	12
Large bulldozer		0.089	12
Caisson drilling		0.089	12
Loaded trucks		0.076	10
Jackhammer		0.035	5
Small bulldozer		0.003	<1

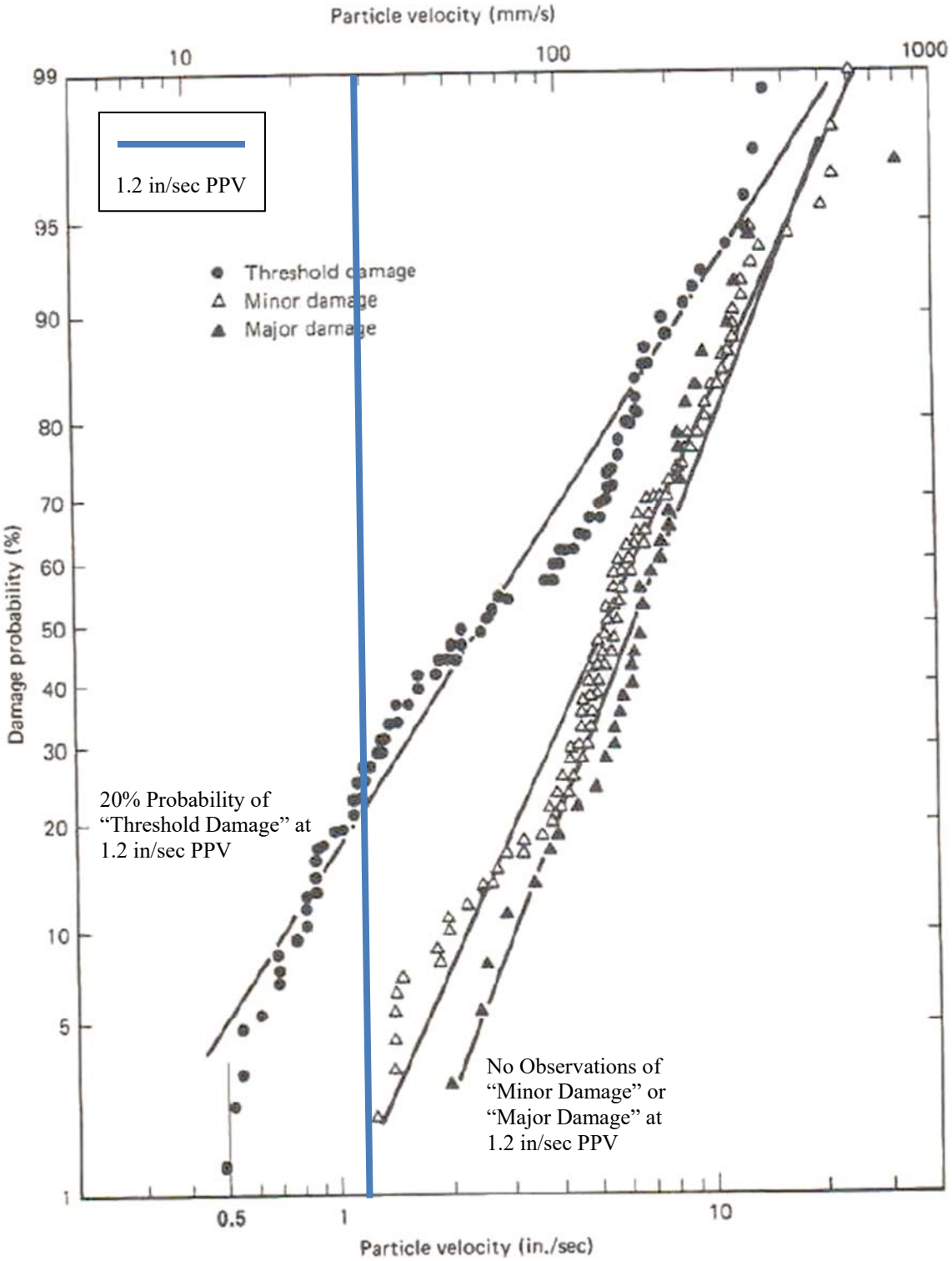
Source: Transit Noise and Vibration Impact Assessment, United States Department of Transportation, Office of Planning and Environment, Federal Transit Administration, May 2006, as modified by Illingworth & Rodkin, Inc., July 2019.

The adjacent multi-family residential building to the east and the future hotel to the west are approximately 5 feet from the project boundary and would be exposed to vibration levels up to 1.2 in/sec PPV. To the north, the multi-family residential buildings would be approximately 45 feet from the project boundary, respectively. At 45 feet, the multi-family residence would be exposed to vibration levels up to 0.11 in/sec PPV. Opposite Bark Lane to the south, the multi-family buildings would be approximately 75 feet from the project site. At this distance, vibration levels would be 0.06 in/sec PPV. Therefore, the City's threshold of 0.2 in/sec PPV for conventional buildings would be exceeded when construction activities at the project site occur along the eastern and western property lines.

A study completed by the US Bureau of Mines analyzed the effects of blast-induced vibration on buildings in USBM RI 8507.[3] The findings of this study have been applied to buildings affected by construction-generated vibrations.[4] As reported in USBM RI 8507[5] and reproduced by Dowding,[6] Figure 4 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 4, maximum vibration levels of 1.2 in/sec PPV would result in approximately 20% of threshold damage or cosmetic damage, while no minor or major damage was observed with maximum vibration levels of 1.2 in/sec PPV.

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

FIGURE 4 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., May 2018.

Typical construction equipment, shown in Table 9, would have the potential to produce vibration levels of 0.2 in/sec PPV or more at the non-historical buildings surrounding 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.

TABLE 9 Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 ft. (in/sec)		
		East Residences and Future West Hotel (5 feet)	**North Residences (45 feet)**	**South Residences (75 feet)**
Clam shovel drop		**1.186**	0.106	0.060
Hydromill (slurry wall)	in soil	0.047	0.004	0.002
	in rock	0.100	0.009	0.005
Vibratory Roller		**1.233**	0.110	0.063
Hoe Ram		**0.523**	0.047	0.027
Large bulldozer		**0.523**	0.047	0.027
Caisson drilling		**0.523**	0.047	0.027
Loaded trucks		**0.446**	0.040	0.023
Jackhammer		**0.206**	0.018	0.010
Small bulldozer		0.018	0.002	0.001

Source: Transit Noise and Vibration Impact Assessment, United States Department of Transportation, Office of Planning and Environment, Federal Transit Administration, May 2006, as modified by Illingworth & Rodkin, Inc., July 2019.

At these locations, and in other surrounding areas within 200 feet, vibration levels would potentially be perceptible. By use of administrative controls, such as notifying neighbors of scheduled construction activities and scheduling construction activities with the highest potential to produce perceptible vibration during hours with the least potential to affect nearby businesses, perceptible vibration can be kept to a minimum.

Mitigation Measure 2:

The following measures, in addition to the best practices specified in Mitigation Measure 1a of this report, are recommended to reduce vibration impacts from construction activities to a less-than-significant impact:

- A list of all heavy construction equipment to be used for this project and the anticipated time duration of using the equipment that is known to produce high vibration levels (tracked vehicles, vibratory compaction, jackhammers, hoe rams, 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 required for continuous vibration monitoring.

- Prohibit the use of heavy vibration-generating construction equipment, such as vibratory rollers or excavation using clam shell or chisel drops, within 30 feet of any adjacent building.

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

- Place operating equipment on the construction site as far as possible from vibration-sensitive receptors.

- Use smaller equipment to minimize vibration levels below the limits.

- Avoid using vibratory rollers and tampers near sensitive areas.

- Select demolition methods not involving impact tools.

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

- Avoid dropping heavy objects or materials.

Implementation of this mitigation measure would reduce the impact to a less-than-significant level.

Impact 3: **Excessive Aircraft Noise.** The project site is located more than 6.5 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 with the implementation of forced-air mechanical ventilation. **This is a less-than-significant impact.**

Norman Y. Mineta San José International Airport is a public-use airport located approximately 6.5 miles southwest of the project site. The project site lies outside the 60 dBA CNEL 2027 noise contour of the airport, according to the Norman Y. Mineta San José International Airport Master Plan Update Project[5] report published in February 2010 as an addendum to the Environmental Impact Report (see Figure 5). Future exterior noise levels due to aircraft from Norman Y. Mineta San José International Airport would not exceed 60 dBA CNEL/DNL. According to Policy EC-1.11 of the City's General Plan, the required safe and compatible threshold for exterior noise levels would be at or below 65 dBA CNEL/DNL for aircrafts. Assuming standard construction materials for aircraft noise below 60 dBA DNL, the future interior noise levels resulting from aircraft would below 45 dBA DNL. Therefore, future exterior and interior noise at the proposed building would be compatible with aircraft noise. This would be a less-than-significant impact.

Mitigation Measure 3: **None required.**

[5] City of San José, "Norman Y. Mineta San José International Airport Master Plan Update Project: Eighth Addendum to the Environmental Impact Report," City of San José Public Project File No. PP 10-024, February 10, 2010.

FIGURE 5 2027 CNEL Noise Contours for SJIA Relative to Project Site