2131 SAND HILL ROAD OFFICE DEVELOPMENT PROJECT ENVIRONMENTAL NOISE AND VIBRATION ASSESSMENT

Menlo Park, California

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INTRODUCTION

The proposed 2131 Sand Hill Road Office Development Project is located south of the Sand Hill Road/Sharon Park Drive intersection in Menlo Park, California. The project proposes the construction of a two-story, 39,510 square-foot office building with below-grade parking. The project site is bordered to the north by Sand Hill Road and to the south by single-family residences along Branner Drive, which would be the nearest noise-sensitive receptors. To the east of the project site are existing office buildings. An existing grocery store and other commercial retail land uses are located north of the project site, opposite Sand Hill Road.

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, 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 mitigation measures, where necessary, to provide a compatible project in relation to adjacent noise sources and land uses.

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.

Fundamentals of Ground-borne Vibration

Ground vibration consists of rapidly fluctuating motions or waves with an average motion of zero. Several different methods are typically used to quantify vibration amplitude. One method is the Peak Particle Velocity (PPV). The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. In this report, a PPV descriptor with units of mm/sec or in/sec is used to evaluate construction generated vibration for building damage and human complaints. Table 3 displays the reactions of people and the effects on buildings that continuous vibration levels produce.

The annoyance levels shown in Table 3 should be interpreted with care since vibration may be found to be annoying at much lower levels than those shown, depending on the level of activity or the sensitivity of the individual. To sensitive individuals, vibrations approaching the threshold of perception can be annoying. Low-level vibrations frequently cause irritating secondary vibration, such as a slight rattling of windows, doors, or stacked dishes. The rattling sound can give rise to exaggerated vibration complaints, even though there is very little risk of actual structural damage.

Construction activities can cause vibration that varies in intensity depending on several factors. The use of pile driving and vibratory compaction equipment typically generates the highest construction related ground-borne vibration levels. Because of the impulsive nature of such activities, the use of the PPV descriptor has been routinely used to measure and assess ground-borne vibration and almost exclusively to assess the potential of vibration to induce structural damage and the degree of annoyance for humans.

The two primary concerns with construction-induced vibration, the potential to damage a structure and the potential to interfere with the enjoyment of life, are evaluated against different vibration limits. Studies have shown that the threshold of perception for average persons is in the range of 0.008 to 0.012 in/sec PPV. Human perception to vibration varies with the individual and is a function of physical setting and the type of vibration. Persons exposed to elevated ambient vibration levels, such as people in an urban environment, may tolerate a higher vibration level.

Structural damage can be classified as cosmetic only, such as minor cracking of building elements, or may threaten the integrity of the building. Safe vibration limits that can be applied to assess the potential for damaging a structure vary by researcher and there is no general consensus as to what amount of vibration may pose a threat for structural damage to the building. Construction-induced vibration that can be detrimental to the building is very rare and has only been observed in instances where the structure is at a high state of disrepair and the construction activity occurs immediately adjacent to the structure.

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, November 2009.

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

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

Regulatory Background - Noise

The State of California and the City of Menlo Park have established regulatory criteria that are applicable in this assessment. The State CEQA Guidelines, Appendix G, are used to assess the potential significance of impacts pursuant to local General Plan policies, Municipal Code standards, or the applicable standards of other agencies. A summary of the applicable regulatory criteria is provided below.

State 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) Exposure of persons to or generation of noise levels in excess of standards established in the local General Plan or Noise Ordinance, or applicable standards of other agencies;

(b) Exposure of persons to or generation of excessive ground-borne vibration or ground-borne noise levels;

(c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project;

(d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project;

(e) For a project located within 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; or

(f) For a project within the vicinity of a private airstrip, 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 Measures Section of this report. Checklist items (a), (e) and (f) are discussed with respect to the compatibility of the project with noise and vibration levels at the site in a separate section addressing Noise and Land Use Compatibility for consistency with the policies set forth in the City's General Plan.

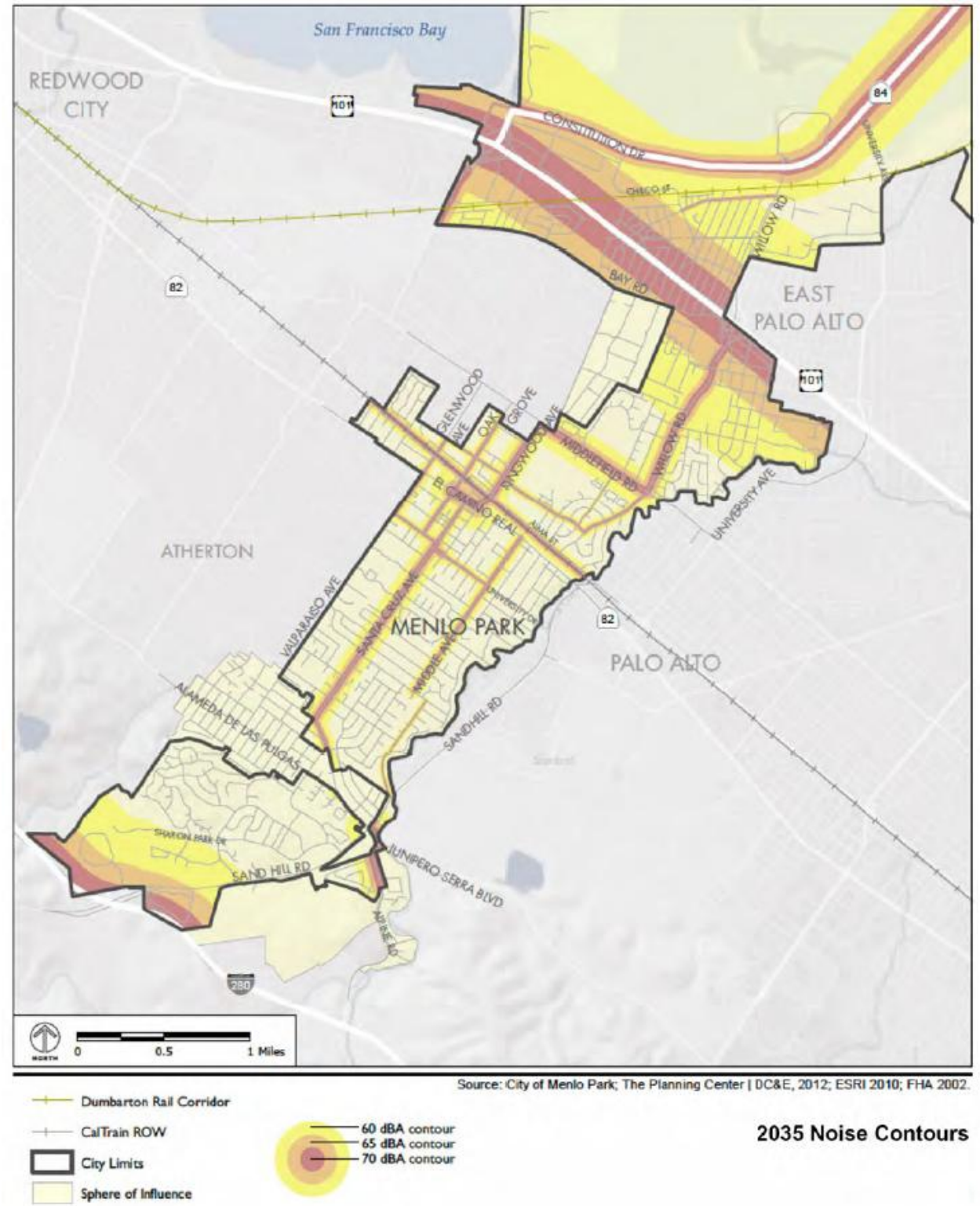
CEQA does not define what noise level increase would be considered substantial. Typically, an increase in the L_{dn}/CNEL noise level resulting from the project at noise-sensitive land uses of 3 dBA or greater would be considered a significant impact when projected noise levels would exceed those considered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

2013 California Building Cal Green Code. The State of California established exterior sound transmission control standards for new non-residential buildings as set forth in the 2013 California Green Building Standards Code (Section 5.507.4.1 and 5.507.4.2). The sections that pertain to this project are as follows:

5.507.4.1 Exterior noise transmission, prescriptive method. Wall and roof-ceiling assemblies exposed to the noise source making up the building envelope shall meet a composite STC rating of at least 50 or a composite OITC rating of no less than 40, with exterior windows of a minimum STC of 40 or OITC of 30 when the building falls within the 65 dBA L_{dn} noise contour of a freeway or expressway, railroad, industrial source or fixed-guideway noise source, as determined by the local general plan noise element.

5.507.4.2 Performance method. For buildings located, as defined by Section 5.507.4.1, wall and roof-ceiling assemblies exposed to the noise source making up the building envelope shall be constructed to provide an interior noise environment attributable to exterior sources that does not exceed an hourly equivalent noise level ($L_{eq\ (1\text{-}hr)}$) of 50 dBA in occupied areas during any hour of operation.

City of Menlo Park General Plan. The Noise Element of the City of Menlo Park General Plan provides the basis for code enforcement and other regulations, including implementation of the City's Noise Ordinance, to control nuisance noise. The 2035 Noise Contours for the City of Menlo Park was included in the General Plan and is shown below. The following goals, policies, and implementing programs established in the Noise Element would be applicable to the proposed project:



Source: City of Menlo Park Open Space, Conservation, Noise and Safety Elements, adopted May 21, 2013.

Goal N1: Achieve Acceptable Noise Levels. Excessive noise is a concern for many residents of Menlo Park. These concerns can be managed with proper mitigation or through the implementation of the City's Noise Ordinance. The City of Menlo Park recognizes the issue of noise and has

standards to protect the peace, health, and safety of residents and the community from unreasonable noise from any and all sources in the community and to strive to locate uses compatible to the area to minimize escalation of noise from mobile and stationary sources.

POLICY N1.1: Compliance with Noise Standards. Consider the compatibility of proposed land uses with the noise environment when preparing or revising community and/or specific plans. Require new projects to comply with noise standards of local, regional, and building code regulations, including but not limited to the City's Municipal Code, Title 24 of the California Code of Regulations, and subdivision and zoning codes.

POLICY N1.2: Land Use Compatibility Noise Standards. Protect people in new development from excessive noise by applying the City's Land Use Compatibility Noise Standards for New Development (see chart on the next page) to the siting and required mitigation for new uses in existing noise environments.

POLICY N1.4: Noise-Sensitive Uses. Protect existing residential neighborhoods and noise sensitive uses from unacceptable noise levels and vibration impacts. Noise-sensitive uses include, but are not limited to, hospitals, schools, religious facilities, convalescent homes and businesses with highly sensitive equipment. Discourage the siting of noise-sensitive uses in areas in excess of 65 dBA CNEL without appropriate mitigation and locate noise-sensitive uses away from noise sources unless mitigation measures are included in development plans.

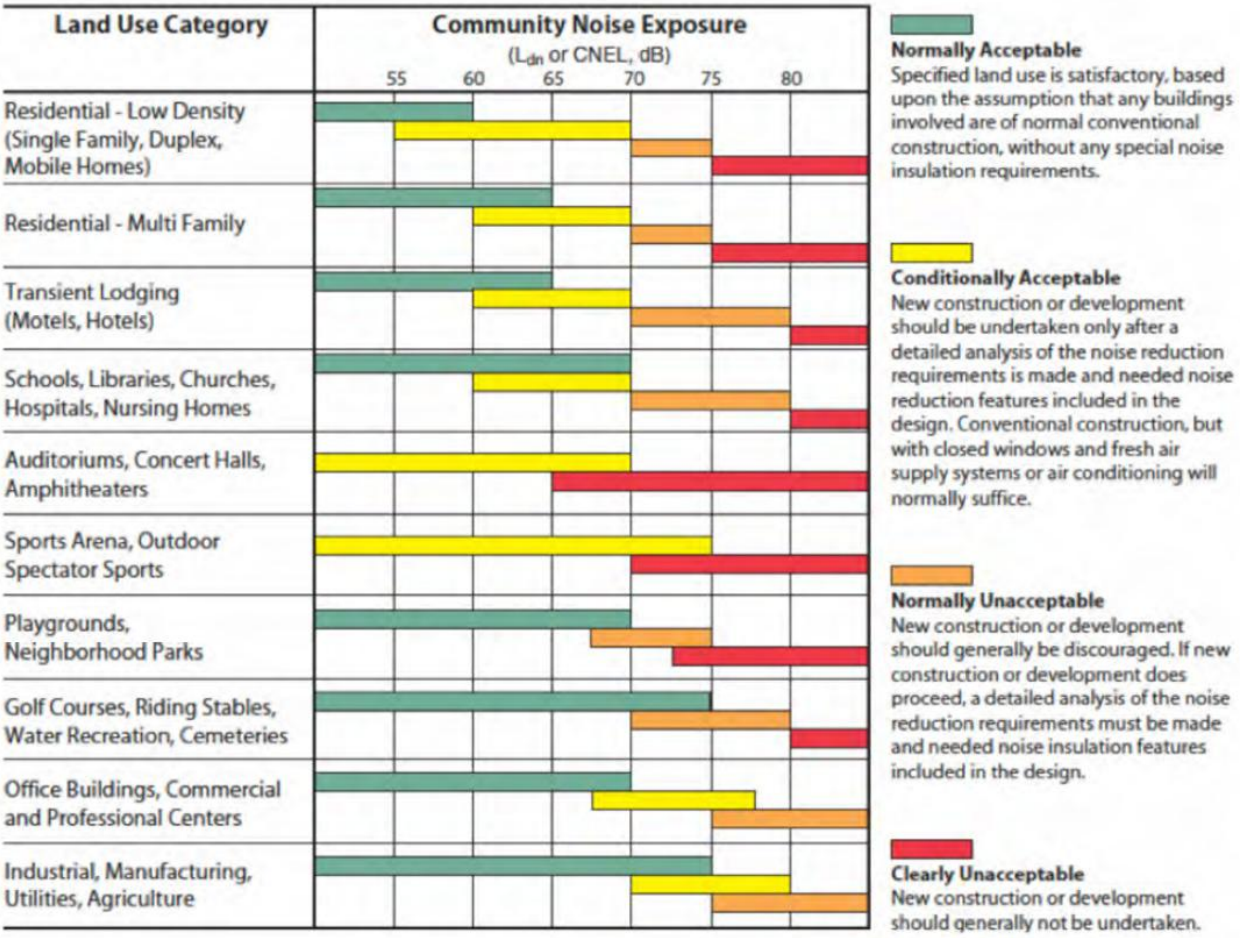
POLICY N1.5: Planning and Design of New Development to Reduce Noise Impacts. Design residential developments to minimize the transportation-related noise impacts to adjacent residential areas and encourage new development to be site planned and architecturally designed to minimize noise impacts on noise-sensitive spaces. Proper site planning can be effective in reducing noise impacts.

POLICY N1.6: Noise Reduction Measures. Encourage the use of construction methods, state-of-the-art noise abating materials and technology and creative site design including, but not limited to, open space, earthen berms, parking, accessory buildings, and landscaping to buffer new and existing development from noise and to reduce potential conflicts between ambient noise levels and noise-sensitive land uses. Use sound walls only when other methods are not practical or when recommended by an acoustical expert.

POLICY N1.7: Noise and Vibration from New Non-Residential Development. Design non-residential development to minimize noise impacts on nearby uses. Where vibration impacts may occur, reduce impacts on residences and businesses through the use of setbacks and/or structural design features that reduce vibration to levels at or below the guidelines of the Federal Transit Administration near rail lines and industrial uses.

POLICY N1.8: Potential Annoying or Harmful Noise. Preclude the generation of annoying or harmful noise on stationary noise sources, such as construction and property maintenance activity and mechanical equipment.

Land Use Compatibility Noise Standards for New Development



POLICY N1.9: Transportation-Related Noise Attenuation. Strive to minimize traffic noise through land use policies, traffic-calming methods to reduce traffic speed, law enforcement and street improvements, and encourage other agencies to reduce noise levels generated by roadways, railways, rapid transit, and other facilities.

POLICY N1.10: Nuisance Noise. Minimize impacts from noise levels that exceed community sound levels through enforcement of the City's Noise Ordinance. Control unnecessary, excessive and annoying noises within the City where not preempted by Federal and State control through implementation and updating the Noise Ordinance.

IMPLEMENTING PROGRAM N1.C: Consider Noise Impacts in Street Design. Emply noise mitigation practices and materials, as necessary, when designing future streets and when improvements occur along existing road segments. Mitigation measures should consider quieter pavements and emphasize the establishment of natural buffers or setbacks between the arterial roadways and adjoining noise-sensitive areas. Strive to maintain smooth street surfaces adjacent to land uses that are sensitive to noise intrusion.

IMPLEMENTING PROGRAM N1.D: Minimize Construction Activity Noise. Minimize the exposure of nearby properties to excessive noise levels from construction-related activity through CEQA review, conditions of approval and enforcement of the City's Noise Ordinance.

City of Menlo Park Municipal Code. Chapter 8.06 of the City's Municipal Code provides provisions to protect the peace, health and safety of the City's citizens from unreasonable noises from all sources including, but not limited to, those specified in the chapter. The following sections of the Municipal Code are relevant for this project:

Section 8.06.030 Noise Limitations.

a. Except as otherwise permitted in this chapter, any source of sound in excess of the sound level limits set forth in Section 8.06.030 shall constitute a noise disturbance. For purposes of determining sound levels from any source of sound, sound level measurements shall be made at a point on the receiving property nearest where the sound source at issue generates the highest sound level. Sound level measurements shall be made with a precision sound level meter (Type 1 or 2) set to A-weighting, and "fast" response for fluctuating sound. Slow or fast response may be used for continual sources. For repetitive, impulsive sound, the one (1) second rms maximum level (L_{max}) shall be used. For continuous sound, use the average level or L_{eq}. In multi-family residential structures, the microphone shall be placed no closer than three and one-half (3 1/2) feet from the wall through which the source of sound at issue is transmitting. The microphone shall also be placed five (5) feet above the floor regardless of whether the source of sound at issue transmits through the floor, ceiling or wall.

    1) For all sources of sound measured from any residential property:

        A. "Nighttime" hours – fifty (50) dBA,

        B. "Daytime" hours – sixty (60) dBA;

    3) Corrections for character of sound: In the event the alleged offensive noise contains a steady, audible tone, such as a whine, screech, beating, pulsating, throbbing or hum the standards set forth in Section 8.06.030(a)(1) and (2) shall be reduced by five (5) dB.

b. Any and all excessively annoying, loud or unusual noises or vibrations such as offend the peace and quiet of persons of ordinary sensibilities and which interfere with the comfortable enjoyment of life or property and affect at the same time an entire neighborhood or any considerable number of persons shall be considered a noise disturbance.

c. It shall be unlawful to create, permit, allow or maintain a noise disturbance in Menlo Park. (Ord. 892 § 2 (part), 1999).

Section 8.06.040 Exceptions. The following are exceptions to the noise limitations set forth in Section 8.06.030. These activities may occur at other times provided they meet the noise levels set forth in Section 8.06.030.

a. Construction Activities.

1) Construction activities between the hours of eight (8) a.m. and six (6) p.m. Monday through Friday,

2) Residents/property owners personally undertaking construction activities to maintain or improve their property on Saturdays, Sundays or holidays between the hours of nine (9) a.m. and five (5) p.m.,

3) A sign, containing the permitted hours of construction activities exceeding the noise limits set forth in Section 8.06.030, shall be posted at all entrances to a construction site upon the commencement of construction, for the purpose of informing contractors and subcontractors and all other persons at the construction site of the basic requirements of this chapter. The sign shall be at least five (5) feet above ground level and shall consist of a white background with black letters,

4) Notwithstanding any other provision set forth above, all powered equipment shall comply with the limits set forth in Section 8.06.040(b);

b. Powered Equipment.

1) Powered equipment used on a temporary, occasional or infrequent basis operated between the hours of eight (8) a.m. and six (6) p.m. Monday through Friday. No piece of equipment shall generate noise in excess of eighty-five (85) dBA at fifty (50) feet,

2) Residents/property owners personally using powered equipment to maintain their property and/or residence on Saturdays, Sundays or holidays between the hours of nine (9) a.m. and five (5) p.m. No piece of equipment shall generate noise in excess of eighty-five (85) dBA at fifty (50) feet.

Existing Noise Environment

A noise monitoring survey was performed at the site on Tuesday, June 14, 2016. The monitoring survey included four short-term noise measurements, as shown in Figure 1. The noise environment at the site and in the surrounding areas results primarily from vehicular traffic along Sand Hill Road. Secondary traffic noise sources include Sharon Park Drive, Alpine Road, and neighborhood roadways. Aircraft associated with San Carlos Airport, Palo Alto Airport, and Moffett Federal Airfield also affect the noise environment at the project site.

Each of the short-term noise measurements were conducted on Tuesday June 14, 2016 in ten-minute intervals, starting at 1:30 p.m. and concluding at 2:40 p.m. ST-1 was made at the southwestern corner of the project site, approximately 140 feet southeast of the centerline of Sand Hill Road. The ten-minute average noise level measured at ST-1 was 61 dBA $L_{eq(10)}$. ST-2 was made at the shared property line of the single-family residences located along the southern boundary of the project site, just in front of the existing fence line. ST-2 was approximately 270 feet southeast of the centerline of Sand Hill Road. The ten-minute $L_{eq(10)}$ measured at ST-2 was 58 dBA $L_{eq(10)}$. ST-3 was taken near the eastern boundary of the project site, approximately 285 feet southeast of the centerline of Sand Hill Road and approximately 110 feet southeast of the existing driveway to the adjacent office building. The ten-minute $L_{eq(10)}$ measured at ST-3 was 55 dBA

$L_{eq(10)}$. The final short-term measurement ST-4 was made across from the 2382 Brenner Drive residence in the adjacent residential development. The ten-minute $L_{eq(10)}$ measured at ST-4 was 52 dBA $L_{eq(10)}$. Table 4 summarizes the results of the short-term measurements.

FIGURE 1 Noise Measurement Locations

Source: Google Earth

TABLE 4 Summary of Short-Term Noise Measurements

Noise Measurement Location (Date, Time)	Measured Noise Level, dBA					
	L_{max}	$L_{(1)}$	$L_{(10)}$	$L_{(50)}$	$L_{(90)}$	$L_{eq(10)}$
ST-1: Southwest corner of project site (6/14/2016, 13:30-13:40)	67	66	64	60	53	61
ST-2: Southern boundary at shared fence line with adjacent residences (6/14/2016, 13:50-14:00)	68	64	61	58	53	58
ST-3: Eastern boundary of project site (6/14/2016, 14:10-14:20)	62	60	58	55	51	55
ST-4: Across from 2382 Brenner Drive (6/14/2016, 14:30-14:40)	61	59	55	51	49	52

PLAN CONSISTENCY ANALYSIS

Noise and Land Use Compatibility

The Land Use Compatibility Noise Standards for New Development table, provided in the City's General Plan, indicates that exterior noise levels at outdoor use areas at the proposed office building should be maintained at or below 70 dBA CNEL to be considered "normally acceptable" by the City of Menlo Park. These noise standards would apply to community outdoor recreational areas and not to private decks or balconies.

The project would construct a two-story office building with an at-grade parking lot and a below-grade parking garage. The future noise environment at the project site would continue to result primarily from traffic along Sand Hill Road, adjacent roadways, and aircraft overflights. According to the General Plan 2035 Noise Contour Map, the proposed project would be exposed to a future noise environment of less than 60 dBA CNEL. A traffic impact analysis for the proposed project was provided by *Hexagon Transportation Consultants, Inc.*[1] While future cumulative plus project conditions were not considered in the traffic study, it did provide near-term plus project conditions, which estimates within three years of existing conditions (2019). Based on the near-term plus project traffic volumes, the noise increase calculated along Sand Hill Road from existing conditions was less than 1 dBA CNEL by 2019. Therefore, the future noise environment at the project site would be less than 60 dBA CNEL by the year 2035, as represented in the Noise Contours provided in the City's General Plan.

Future Exterior Noise Environment

The project proposes a first-floor patio located to the west of the proposed office building and five second-floor balconies. It is unclear from the site plan whether these balconies are common use areas or private use areas. However, for the sake of this study, the balconies are assumed to be common use. Exterior noise thresholds are not typically applied at private use balconies.

The center of the first-floor patio would be set back from the centerline of Sand Hill Road by approximately 180 feet. Based on the 2035 Noise Contours and the estimated noise level increase under project conditions, the future noise environment at the proposed patio would be below the City's threshold of 70 dBA CNEL.

Four of the second-floor balconies have direct line-of-sight to Sand Hill Road and have setbacks ranging from 150 to 170 feet, as measured from the centerline of the roadway. The final balcony would be located at the rear of the building on the eastern façade. At this location, the outdoor use area would be shielded from traffic noise by the proposed office building. Based on the 2035 Noise Contours and the estimated noise level increase under project conditions, the future noise environment at each of the balconies would be below the City's threshold of 70 dBA CNEL

[1] Hexagon Transportation Consultants, Inc., "2131 Sand Hill Road Office Development Traffic Impact Analysis," September 19, 2016.

Future Interior Noise Environment

The State of California requires that wall and roof-ceiling assemblies exposed to the adjacent roadways have a composite Sound Transmission Class (STC)[2] rating of at least 50 or a composite Outdoor-Indoor Transmission Class (OITC) rating of no less than 40, with exterior windows of a minimum STC of 40 or OITC of 30 when the commercial property falls within the 65 dBA CNEL noise contour for a freeway. According to the 2035 Noise Contour provided in the City's General Plan Noise Element, the site of the proposed office building does not fall within the 65 dBA CNEL 2030 contour for Sand Hill Road. Therefore, the Cal Green Code does not apply to the proposed project.

Standard construction materials for office buildings typically provide 20 to 30 dBA reduction from exterior to interior. Since future 2035 exterior levels are at or below 60 dBA CNEL, future 2035 interior noise levels would be at or below 40 dBA CNEL. Existing short-term measurements ranged from 55 to 61 dBA L_{eq} during the daytime hours. Under future project conditions, exterior noise measurements would also range from 55 to 61 dBA L_{eq}, which would result in future interior noise levels being up to 41 dBA L_{eq}, below the Cal Green Code interior noise level threshold of 50 dBA L_{eq}.

Aircraft Noise

San Carlos Airport is a public airport located over 6.5 miles northwest of the project site. The 2035 Aircraft Noise Contours shown in the Airport Land Use Compatibility Plan[3] for the San Carlos Airport indicate that the project site is outside the 60 dBA CNEL contour. Moffett Federal Airfield is a joint civil-military airport located over 7.5 miles east of the project site. According to the 2022 Aircraft Noise Contour[4], the project site does not fall within the airport influence area and is located outside the 60 dBA CNEL noise contour. Palo Alto Airport is a small, public airport typically used for general aviation. This airport is located approximately 4.7 miles northeast of the project site. According to the Comprehensive Land Use Plan for the Palo Alto Airport,[5] the project site lies outside the 55 dBA CNEL noise contour in the year 2022. Noise from aircraft would not substantially increase ambient noise levels at the project site, and interior noise levels resulting from aircraft would be compatible with the proposed project.

[2] **Sound Transmission Class (STC)** A single figure rating designed to give an estimate of the sound insulation properties of a partition. Numerically, STC represents the number of decibels of speech sound reduction from one side of the partition to the other. The STC is intended for use when speech and office noise constitute the principal noise problem.

[3] ESA, "Airport Land Use Compatibility Plan: San Carlos Airport Initial Study," April 2015.

[4] Walter B. Windus, PE, "Comprehensive Land Use Plan Santa Clara County: Moffett Federal Airfield," adopted November 2, 2012

[5] Walter B. Windus, PE, "Comprehensive Land Use Plan Santa Clara County: Palo Alto Airport," adopted November 19, 2008.

NOISE IMPACTS AND MITIGATION MEASURES

Significance Criteria

Paraphrasing from Appendix G of the CEQA Guidelines, a project would normally result in significant noise impacts if noise levels generated by the project conflict with adopted environmental standards or plans, if the project would generate excessive ground-borne vibration levels, or if ambient noise levels at sensitive receivers would be substantially increased over a permanent, temporary, or periodic basis. 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 expose persons to or generate noise levels that would exceed applicable noise standards presented in the General Plan or Municipal Code.

- A significant impact would be identified if the construction of the project would expose persons to excessive vibration levels. Ground-borne vibration levels exceeding 0.3 in/sec PPV would have the potential to result in cosmetic damage to normal buildings.

- A significant impact would be identified if traffic generated by the project would substantially increase noise levels at sensitive receivers in the vicinity. A substantial increase would occur if: a) the noise level increase is 5 dBA CNEL or greater, with a future noise level of less than 60 dBA CNEL, or b) the noise level increase is 3 dBA CNEL or greater, with a future noise level of 60 dBA CNEL or greater.

- A significant noise impact would be identified if construction-related noise would temporarily increase ambient noise levels at sensitive receptors. Hourly average noise levels exceeding 60 dBA $L_{eq,}$ and the ambient by at least 5 dBA L_{eq}, for a period of more than one year would constitute a significant temporary noise increase at adjacent residential land uses.

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

Mechanical Equipment Noise

According to the City's Municipal Code, all sources of noise must not exceed 60 dBA L_{eq} during daytime hours (i.e., between 7:00 a.m. and 10:00 p.m.) or 50 dBA L_{eq} during nighttime hours (i.e., between 10:00 p.m. and 7:00 a.m.), as measured at single-family residential properties. Additionally, no powered equipment shall exceed 85 dBA L_{eq} at 50 feet.

The proposed project would include mechanical equipment, such as heating, ventilation, and air conditioning systems. Information regarding the number, type, and size of the mechanical equipment units to be used in the proposed project was not available at the time of this study. According to the site plan, three rooftop locations have been identified for such mechanical units.

Typical air conditioning units and heat pumps for office buildings range from about 63 to 67 dBA L_{eq} at a distance of 50 feet. The nearest sensitive receptors would be located to the southeast of the proposed office building, and the distance from the residential property line to the nearest mechanical unit would be approximately 105 feet. Taking into account the rooftop elevation, the unmitigated mechanical equipment noise would range from 56 to 60 dBA L_{eq}. These levels would be at or below the City's 60 dBA L_{eq} daytime limit but would potentially exceed the 50 dBA L_{eq} nighttime limit. The impact would be potentially significant.

Construction Noise

Assuming that all construction activities for the proposed project are limited to the allowable hours specified in the City's Municipal Code, which are between 8:00 a.m. and 6:00 p.m. Monday through Friday, noise generated by construction activities would be exempt from the stationary equipment noise limits of 60 dBA L_{eq} during the day and 50 dBA L_{eq} at night. Construction activities for the proposed project would not occur on weekends or holidays, as specified in the Municipal Code. This would be a less-than-significant impact.

Mitigation Measure 1:

Mechanical equipment shall be selected and designed to reduce impacts on surrounding uses to meet the City's noise level requirements. A qualified acoustical consultant shall be retained to review mechanical noise, as these systems are selected, to determine specific noise reduction measures necessary to reduce noise to comply with the City's noise level requirements. Noise reduction measures could include, but are not limited to, selection of equipment that emits low noise levels and/installation of noise barriers, such as enclosures and parapet walls, to block the line-of-sight between the noise source and the nearest receptors.

The implementation of the measure outlined above would reduce the impact to a less-than-significant level.

Impact 2: **Exposure to Excessive Ground-borne Vibration due to Construction.** Construction-related vibration levels resulting from activities at the project site would not exceed 0.3 in/sec PPV at the nearest residential and commercial land uses. **This is a less-than-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 site preparation work, foundation work, and new building framing and finishing. Based on a review of the construction equipment list provided at the time of this study, the proposed project is not expected to require pile driving, which can cause excessive vibration.

For structural damage, the California Department of Transportation recommends a vibration limit of 0.5 in/sec PPV for buildings structurally sound and designed to modern engineering standards, 0.3 in/sec PPV for buildings that are found to be structurally sound but where structural damage is a major concern, and a conservative limit of 0.08 in/sec PPV for ancient buildings or buildings that are documented to be structurally weakened. No ancient buildings or buildings that are

documented to be structurally weakened adjoin the project site. Therefore, ground-borne vibration levels exceeding 0.3 in/sec PPV would have the potential to result in a significant vibration impact.

Table 5 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.

The single-family residential land uses adjacent to the project site to the southeast would range from 35 to 60 feet from construction site boundary. At these distances, vibration levels would be up to 0.15 in/sec PPV. Additionally, the nearest residential land uses located to the north of the project site, opposite Sand Hill Road, are approximately 150 feet or more from the project's property line. At these distances, vibration levels would be up to 0.03 in/sec PPV. The surrounding commercial buildings range from 120 to 200 feet from the project site. At these distances, vibration levels would be at or below 0.04 in/sec PPV. All vibration levels expected at nearby commercial and residential buildings would, therefore, be below the 0.3 in/sec PPV significance threshold. This is a less-than-significant impact.

TABLE 5 Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 ft. (in/sec)	Approximate L_v at 25 ft. (VdB)
Pile Driver (Impact)	upper range	1.158	112
	typical	0.644	104
Pile Driver (Sonic)	upper range	0.734	105
	typical	0.170	93
Clam shovel drop		0.202	94
Hydromill (slurry wall)	in soil	0.008	66
	in rock	0.017	75
Vibratory Roller		0.210	94
Hoe Ram		0.089	87
Large bulldozer		0.089	87
Caisson drilling		0.089	87
Loaded trucks		0.076	86
Jackhammer		0.035	79
Small bulldozer		0.003	58

Source: Transit Noise and Vibration Impact Assessment, United States Department of Transportation, Office of Planning and Environment, Federal Transit Administration, May 2006.

Mitigation Measure 2: None required.

Impact 3: **Permanent Noise Level Increase.** The proposed project would not result in a substantial permanent noise level increase at the existing residential land uses in the project vicinity. **This is a less-than-significant impact.**

Project-Generated Traffic Noise

Typically, a significant permanent noise increase would occur if the project would increase noise levels at noise-sensitive receptors by 3 dBA CNEL or greater 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 CNEL or greater would be considered significant. According to the City's General Plan, the "normally acceptable" outdoor noise level standard for the single-family residences in the project vicinity would be 60 dBA CNEL, and existing noise contour plots indicate ambient levels are below this threshold. Therefore, a significant impact would occur if traffic due to the proposed project would permanently increase ambient levels by 5 dBA CNEL.

The traffic report provided by *Hexagon Transportation Consultants, Inc.*[1] provided peak hour volumes for the project-generated traffic at intersections in the project vicinity. According to the study, the project is projected to add 47 trips during the peak morning hour and 36 trips during the peak evening hour. These peak hour trips were included in the Existing Plus Project traffic volumes. When this scenario was compared to the Existing traffic volumes, the traffic noise level increase was less than 1 dBA CNEL at each of the intersections included in the study. Therefore, the permanent noise level increase due to this project-generated traffic increase at the noise-sensitive receptors in project vicinity would be approximately 1 dBA CNEL or less. The proposed project would not cause a substantial permanent noise level increase at the nearby noise-sensitive receptors. This is a less-than-significant impact.

Parking Garage Traffic Noise

The proposed project would include two below-grade parking levels, with entrances at the front and rear of the proposed office building. Since all parking garage noise would take place below grade, the adjacent residences would be acoustically shielded from parking garage noise. The operation of the parking garage would not produce noise levels exceeding existing traffic noise levels along Sand Hill Road or cause a permanent noise level increase at nearby sensitive receptors. This would be a less-than-significant impact.

Mitigation Measure 3: **None required.**

Impact 4: **Temporary Construction Noise.** Existing noise-sensitive land uses would be exposed to a temporary increase in ambient noise levels due to project construction activities. The incorporation of construction best management practices as project conditions of approval would result in a **less-than-significant** temporary noise impact.

Noise impacts resulting from construction depend upon the noise generated by various pieces of construction equipment, the timing and duration of noise-generating activities, and the distance between construction noise sources and noise-sensitive areas. Construction noise impacts primarily result when construction activities occur during noise-sensitive times of the day (e.g., early morning, evening, or nighttime hours), the construction occurs in areas immediately adjoining noise-sensitive land uses, or when construction lasts over extended periods of time.

Where noise from construction activities exceeds 60 dBA L_{eq} at residential land uses or 70 dBA L_{eq} at commercial land uses and exceeds the ambient noise environment by at least 5 dBA L_{eq} at noise-sensitive uses in the project vicinity for a period exceeding one year, the impact would be considered significant.

The adjacent noise-sensitive receptors, located approximately 35 feet southeast of the project site, would have existing daytime ambient noise levels similar to the measurements taken at ST-2, which was 58 dBA L_{eq}. The residences located approximately 150 feet to the north, opposite Sand Hill Road, would have existing ambient noise levels of 61 dBA L_{eq} during daytime hours, as represented by ST-1. The adjacent commercial receptor, which is approximately 200 feet east of the project site, have existing ambient levels similar to those measured at ST-3 and would be 55 dBA L_{eq} during daytime hours. Similar to the residential land uses opposite Sand Hill Road, the existing ambient environment for the commercial buildings located to opposite Sand Hill Road would be 61 dBA L_{eq}.

The typical range of maximum instantaneous noise levels would be 78 to 90 dBA L_{max} at a distance of 50 feet (see Table 6). Hourly average noise levels generated by construction are about 75 to 89 dBA L_{eq} 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 result in lower construction noise levels at distant receptors.

The proposed project is expected to take a total of 14 months to complete. Construction activities would include site preparation, grading/excavation, trenching, building construction, and paving. During each stage of construction, there would be a different mix of equipment operating, and noise levels would vary by stage and vary within stages, based on the amount of equipment in operation and the location at which the equipment is operating. Table 7 shows the average noise level ranges, by construction phase. Once construction moves indoors, minimal noise would be generated at off-site locations.

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.

A list of construction equipment, separated by phase, was provided for the proposed project, which included start and stop dates for each phase and number of usage days for each piece of equipment. Table 8 summarizes the phases of construction, the time duration for each phase, the equipment expected to be used during each phase, and the estimated construction noise levels for each phase at the nearest residence. Dates were not provided for the trenching phase, but considering the building exterior phase starts at the completion of the grading/excavation phase, it is assumed that trenching would be completed simultaneously with grading/excavation. Therefore, the range provided in the trenching phase reflects use of the trenching equipment alone and with the grading/excavation equipment.

As shown in Table 8, noise levels would exceed 60 dBA L_{eq} at the residential land uses or exceed 70 dBA L_{eq} at the commercial land uses at times during project construction phases. With ambient levels at the nearby residences ranging from 58 to 61 dBA L_{eq}, construction noise levels would exceed the ambient noise environment by 5 dBA L_{eq} or more during each construction phase. Additionally, the ambient levels at the nearby commercial land uses, which ranges from 55 to 61 dBA L_{eq}, would be exceeded by 5 dBA L_{eq} or more during each construction phase. Since construction noise for the proposed project is expected to exceed 60 dBA L_{eq} at surrounding residential land uses or exceed 70 dBA L_{eq} at surrounding commercial land uses and exceed ambient levels by more than 5 dBA L_{eq} for a period of more than one year, this would be a significant impact.

TABLE 8 Estimated Construction Noise Levels at the Nearby Land Uses

Phase	Time Duration	Construction Equipment (Quantity)	Calculated Hourly Average L_{eq} at Each Surrounding Land Use, dBA			
			Adjacent Residences (35ft)	Residence Opp. Sand Hill Rd. (150ft)	Adjacent Comm. (200ft)	Comm. Opp. Sand Hill Rd. (120ft)
Site Prep	6/1/2017-7/1/2017 (22 days)	Excavator (1) Grader (1)	86	73	70	75
Grading/ Excavation	7/1/2017-9/1/2017 (45 days)	Excavator (1) Crawler Tractor (1) Bore/Drill Rig (1)	85	73	70	75
Trenching	Dates unspecified (5 days)	Excavator (1) Tractor/Loader/Backhoe (1)	85-88[a]	72-75[a]	70-73[a]	74-77[a]
Building-Exterior	9/1/2017-7/1/2018 (216 days)	Crane (1) Other construction equip. (1)	86	73	71	75
Paving	7/1/2018-9/1/2018 (45 days)	Grader (1) Tractor/Loader/Backhoe (1)	87	74	72	76

[a] Range of noise levels indicates trenching equipment alone and combined with the equipment from the grading/excavation phase.

Reasonable regulation of the hours of construction, as well as regulation of the arrival and operation of heavy equipment and the delivery of construction materials, are necessary to protect the health and safety of persons, promote the general welfare of the community, and maintain the quality of life.

Construction activities will be conducted in accordance with the provisions of the City's Municipal Code, which limits construction work between the hours of 8:00 a.m. and 6:00 p.m. Monday through Friday and prohibits construction on weekends and holidays. Further, the City shall require the construction crew to adhere to the following construction best management practices to reduce construction noise levels emanating from the site and minimize disruption and annoyance at existing noise-sensitive receptors in the project vicinity.

Construction Best Management Practices

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

- Construct temporary noise barriers, where feasible, to screen stationary noise-generating equipment from 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.

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

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

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

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

- Construction staging areas shall be established at locations that will create the greatest distance between the construction-related noise sources and noise-sensitive receptors nearest the project site during all project construction.

- Locate material stockpiles, as well as maintenance/equipment staging and parking areas, as far as feasible from residential receptors.

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

- The contractor shall prepare a detailed construction 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.

- 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.

The implementation of the reasonable and feasible controls outlined above would reduce construction noise levels emanating from the site by 5 to 10 dBA in order to minimize 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 4: No further mitigation required.