38 DEGREES NORTH ENVIRONMENTAL NOISE AND VIBRATION ASSESSMENT

Santa Rosa, California

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INTRODUCTION

The project proposes to construct 172 multi-family residential apartments and the future development of a 20,000 square-foot community shopping center that would include an additional 1,000 square feet of ancillary retail uses on a 10.9 acre lot located at 2660 Petaluma Hill Road. The development would include internal drive aisles, surface parking, and walkways. The residential apartments would be contained within eight (8) three-story buildings. The residential complex also features an outdoor community area, a pool, deck and spa area, and a clubhouse with a fitness center.

This report evaluates the project's potential to result in significant noise and vibration impacts with respect to applicable California Environmental Quality Act (CEQA) guidelines. The report is divided into three sections: 1) the Setting Section provides a brief description of the fundamentals of environmental noise, 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.

Effects of Noise

Sleep and Speech Interference

The thresholds for speech interference indoors are about 45 dBA if the noise is steady and above 55 dBA if the noise is fluctuating. Outdoors the thresholds are about 15 dBA higher. Steady noises of sufficient intensity (above 35 dBA) and fluctuating noise levels above about 45 dBA have been shown to affect sleep. Interior residential standards for multi-family dwellings are set by the State of California at 45 dBA L_{dn}/CNEL. Typically, the highest steady traffic noise level during the daytime is about equal to the L_{dn}/CNEL and nighttime levels are 10 dBA lower. The standard is designed for sleep and speech protection and most jurisdictions apply the same criterion for all residential uses. Typical structural attenuation is 12-17 dBA with open windows. With closed windows in good condition, the noise attenuation factor is around 20 dBA for an older structure and 25 dBA for a newer dwelling. Sleep and speech interference is therefore possible when exterior noise levels are about 57-62 dBA L_{dn}/CNEL with open windows and 65-70 dBA L_{dn}/CNEL if the windows are closed. Levels of 55-60 dBA are common along collector streets and secondary arterials, while 65-70 dBA is a typical value for a primary/major arterial. Levels of 75-80 dBA are normal noise levels at the first row of development outside a freeway right-of-way. In order to achieve an acceptable interior noise environment, bedrooms facing secondary roadways need to be able to have their windows closed; those facing major roadways and freeways typically need special glass windows.

Annoyance

Attitude surveys are used for measuring the annoyance felt in a community for noises intruding into homes or affecting outdoor activity areas. In these surveys, it was determined that the causes for annoyance include interference with speech, radio and television, house vibrations, and interference with sleep and rest. The L_{dn}/CNEL as a measure of noise has been found to provide a valid correlation of noise level and the percentage of people annoyed. People have been asked to judge the annoyance caused by aircraft noise and ground transportation noise. There continues to be disagreement about the relative annoyance of these different sources. When measuring the percentage of the population highly annoyed, the threshold for ground vehicle noise is about 50 dBA L_{dn}/CNEL. At a L_{dn}/CNEL of about 60 dBA, approximately 12 percent of the population is highly annoyed. When the L_{dn}/CNEL increases to 70 dBA, the percentage of the population highly annoyed increases to about 25-30 percent of the population. There is, therefore, an increase of about 2 percent per dBA between a L_{dn}/CNEL of 60-70 dBA. Between a L_{dn}/CNEL of 70-80 dBA, each decibel increase increases by about 3 percent the percentage of the population highly annoyed. People appear to respond more adversely to aircraft noise. When the L_{dn}/CNEL 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.

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.

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 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 and the City of Santa Rosa 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.

2019 State CEQA Guidelines. The CEQA contains guidelines to evaluate the significance of effects of environmental noise attributable to a proposed project. Under CEQA, noise impacts would be considered significant if the project would result in:

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

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

(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.

Checklist items (a) and (b) are applicable to the proposed project. In this case, the project is at least 9.3 miles from the nearest airport (Sonoma County Airport). As a result, the project would not

expose people residing or working in the project area to excessive aircraft noise levels; therefore, item (c) is not carried further in this analysis.

CEQA does not define what noise level increase would be considered substantial. Typically, project-generated noise level increases of 3 dBA L_{dn} or greater would be considered significant where exterior noise levels would exceed the compatible noise level standard (60 dBA L_{dn} for residential land uses and 70 dBA L_{dn} for industrial land uses). Where noise levels would remain at or below the compatible noise level standard with the project, noise level increases of 5 dBA L_{dn} or greater would be considered significant.

2016 California Building Code, Title 24, Part 2. The current version of the California Building Code (CBC) requires interior noise levels attributable to exterior environmental noise sources to be limited to a level not exceeding 45 dBA L_{dn}/CNEL in any habitable room.

2016 California Green Building Standards Code (Cal Green Code). The State of California established exterior sound transmission control standards for new non-residential buildings as set forth in the 2016 California Green Building Standards Code (Section 5.507.4.1 and 5.507.4.2). Section 5.507 states that either the prescriptive (Section 5.507.4.1) or the performance method (Section 5.507.4.2) shall be used to determine environmental control at indoor areas. The prescriptive method is very conservative and not practical in most cases; however, the performance method can be quantitatively verified using exterior-to-interior calculations. For the purposes of this report, the performance method is utilized to determine consistency with the Cal Green Code. The sections that pertain to this project are as follows:

> **5.507.4.1 Exterior noise transmission, prescriptive method.** Wall and roof-ceiling assemblies exposed to the noise source making up the building envelope shall meet a composite STC rating of at least 50 or a composite OITC rating of no less than 40, with exterior windows of a minimum STC of 40 or OITC of 30 when the building falls within the 65 dBA L_{dn} noise contour of a freeway or expressway, railroad, industrial source or fixed-guideway noise source, as determined by the local general plan noise element.
>
> **5.507.4.2 Performance method.** For buildings located, as defined by Section 5.507.4.1, wall and roof-ceiling assemblies exposed to the noise source making up the building envelope shall be constructed to provide an interior noise environment attributable to exterior sources that does not exceed an hourly equivalent noise level ($L_{eq\ (1\text{-}hr)}$) of 50 dBA in occupied areas during any hour of operation.

The performance method, which establishes the acceptable interior noise level, is the method typically used when applying these standards.

City of Santa Rosa General Plan. The Noise and Safety Element of the City of Santa Rosa's General Plan identifies policies that are intended to "maintain an acceptable community noise level to protect the health and comfort of people living, working and/or visiting in Santa Rosa, while maintaining a visually appealing community." Multi-family residential uses are considered to be normally acceptable in areas with a noise environment of L_{dn} of 65 dBA or less, conditionally acceptable in areas exposed to an L_{dn} of 60 to 70 dBA, normally unacceptable in areas exposed to

an L_{dn} of 70 to 75 dBA, and unacceptable in areas exposed to an L_{dn} of 75 dBA or more (see Figure 12-1).

The following policies are applicable to the proposed project:

NS-B-1 Do not locate noise-sensitive uses in proximity to major noise sources, except residential is allowed near rail to promote future ridership.

NS-B-2 Encourage residential developers to provide buffers other than sound walls, where practical. Allow sound walls only when projected noise levels at a site exceed land use compatibility standards.

NS-B-3 Prevent new stationary and transportation noise sources from creating a nuisance in existing developed areas. Use a comprehensive program of noise prevention through planning and mitigation, and consider noise impacts as a crucial factor in project approval.

NS-B-4 Require new projects in the following categories to submit an acoustical study, prepared by a qualified acoustical consultant:

- All new projects that could generate noise whose impacts on other existing uses would be greater than those normally acceptable.
- All new projects proposed for areas with existing noise above 60 dBA L_{dn}. Mitigation shall be sufficient to reduce noise levels below 45 dBA L_{dn} in habitable rooms and 60 dBA L_{dn} in private and shared recreational facilities. Additions to existing housing units are exempt.

NS-B-5 Pursue measures to reduce noise impacts primarily through site planning. Engineering solutions for noise mitigation, such as sound walls, are the least desirable alternatives.

NS-B-9 Encourage developers to incorporate acoustical site planning into their projects. Recommended measures include:

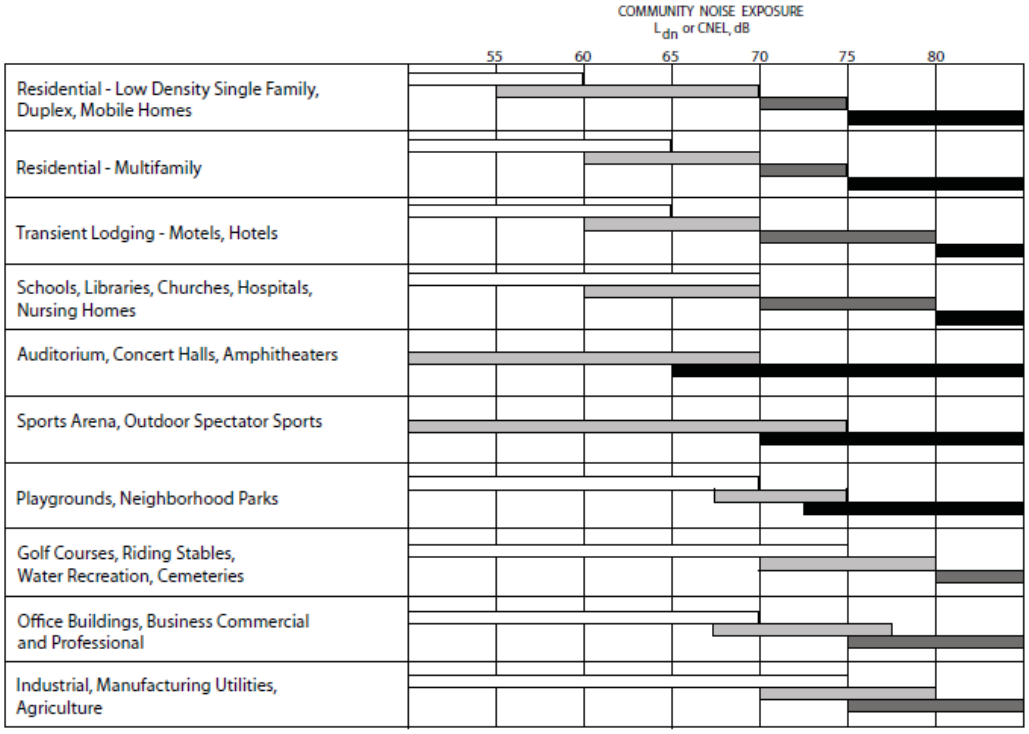
- Incorporating buffers and/or landscaped earth berms;
- Orienting windows and outdoor living areas away from unacceptable noise exposure;
- Using reduced-noise pavement (rubberized-asphalt);
- Incorporating traffic calming measures, alternative intersection designs, and lower speed limits; and
- Incorporating state-of-the-art structural sound attenuation and setbacks.

NS-B-10 Work with private enterprises to reduce or eliminate nuisance noise from industrial and commercial sources that impact nearby residential areas. If progress is not made within a reasonable time, the City shall issue abatement orders or take other legal measures.

NS-B-14 Discourage new projects that have potential to create ambient noise levels more than 5 dBA L_{dn} above existing background, within 250 feet of sensitive receptors.

Figure 12-1

Land Use Compatibility Standards



LEGEND:

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

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

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

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

Source: Environmental Science Associates, 2001

City of Santa Rosa Municipal Code.

17-16.030 Ambient base noise level criteria. The following criteria will be used as a base (ambient noise level) from which noise levels can be compared.

Zone	Time	Sound Level A (decibels) Community Environment Classification
R1 and R2	10 p.m. to 7 a.m.	45
R1 and R2	7 p.m. to 10 p.m.	50
R1 and R2	7 a.m. to 7 p.m.	55
Multi-family	10 p.m. to 7 a.m.	50
Multi-family	7 a.m. to 10 p.m.	55
Office & Commercial	10 p.m. to 7 a.m.	55
Office & Commercial	7 a.m. to 10 p.m.	60
Intensive Commercial*	10 p.m. to 7 a.m.	55
Intensive Commercial	7 a.m. to 10 p.m.	65
Industrial	Anytime	70

17-16.120 Machinery and equipment. It is unlawful for any person to operate any machinery, equipment, pump, fan, air-conditioning apparatus or similar mechanical device in any manner so as to create any noise which would cause the noise level at the property line of any property to exceed the ambient base noise level by more than five decibels.

Existing Noise Environment

The project site is located east of Petaluma Hill Road, between Kawana Springs Road on the north and the future Farmers Lane Extension on the south. Franz Kafka Avenue bounds the site to the east. A noise monitoring survey was performed in the vicinity of the site beginning on Monday, June 10, 2019 and concluding on Wednesday, June 12, 2019. The monitoring survey included two long term and three short-term measurements, as shown in Figure 1.

Long-term noise measurement LT-1 was made in an oak tree just outside the front yard fence of 1386 Petaluma Hill Road. The primary noise source at this location was traffic along Petaluma Hill Road. Hourly average noise levels typically ranged from 69 to 74 dBA L_{eq} during daytime hours and from 56 to 71 dBA L_{eq} at night. The daily trend in noise levels at LT-1 is shown on Figures 2 through 4.

Measurement LT-2 was located at the southwest corner of 1150 Franz Kafka Avenue. The primary noise source measured at this location was construction of Phase 1 of the 38 Degrees North project. Ambient noise levels were quantified when construction ceased for the day. Hourly average noise levels at this location typically ranged from 46 to 61 dBA L_{eq} during the day and from 46 to 55 dBA L_{eq} at night. The daily trend in noise levels at LT-2 is shown on Figures 5 through 7.

Three short term noise measurements were made to complete the noise survey. Table 4 summarizes the results of the short-term noise measurements.

TABLE 4 Summary of Short-Term Noise Measurement Data, June 12, 2019

ID	Location (Date, Time)	Measured Noise Levels, dBA					Primary Noise Source
		L_1	L_{10}	L_{50}	L_{90}	L_{eq}	
ST-1	South End of Pern Place (6/12/19, 3:10 p.m. to 3:20 p.m.)	53	46	42	41	44	Traffic on Kawana Terrace
ST-2	South End of Site ~ 710 feet from Petaluma Hill Road (6/12/19, 3:30 p.m. to 3:40 p.m.)	58	51	46	44	49	Traffic on Petaluma Hill Road
ST-3	25 feet from the center of Kawana Springs Road (6/12/19, 4:00 p.m. to 4:10 p.m.)	74	70	62	61	66	Traffic on Kawana Springs Road, Construction

FIGURE 1 Noise Measurement Locations

FIGURE 2 Daily Trend in Noise Levels at LT-1, Tuesday, June 10, 2019

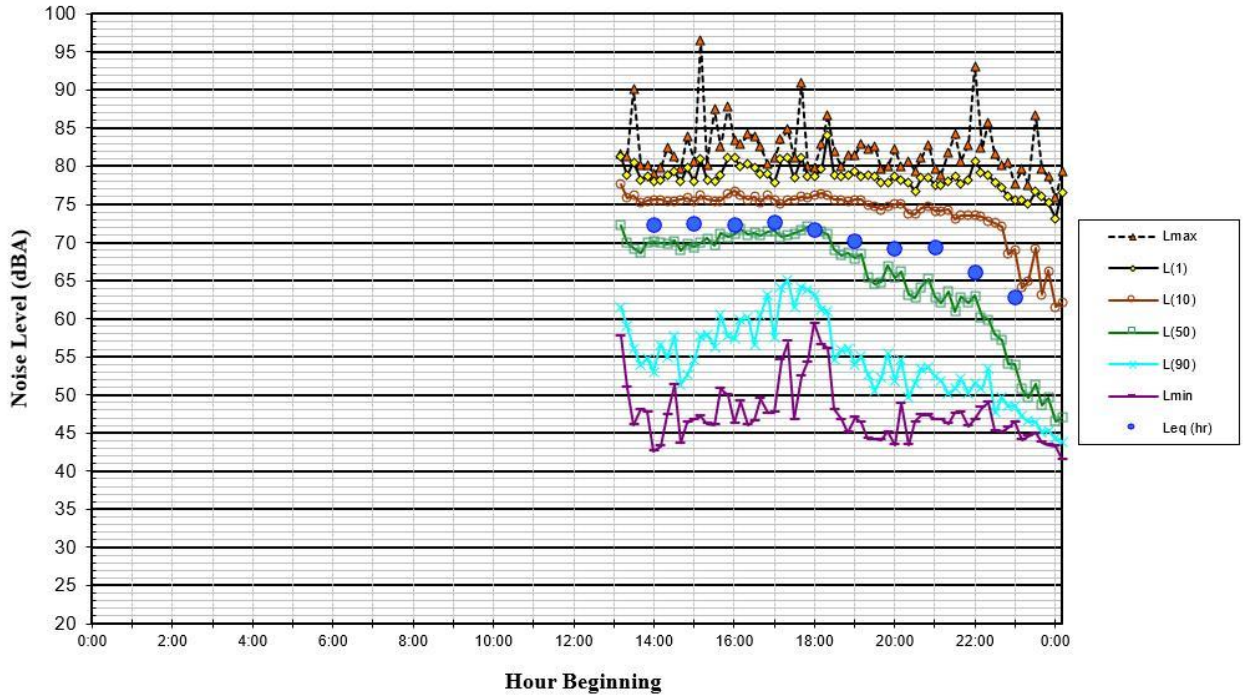


FIGURE 3 Daily Trend in Noise Levels at LT-1, Wednesday, June 11, 2019

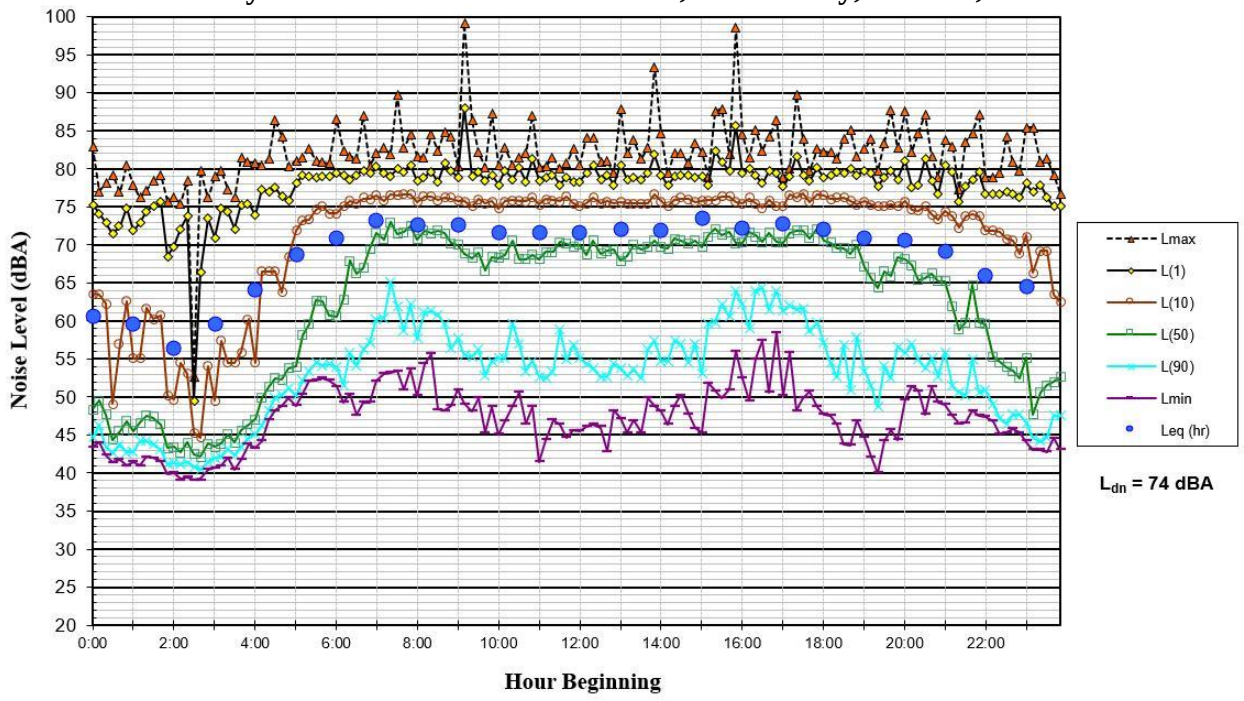


FIGURE 4 Daily Trend in Noise Levels at LT-1, Thursday, June 12, 2019

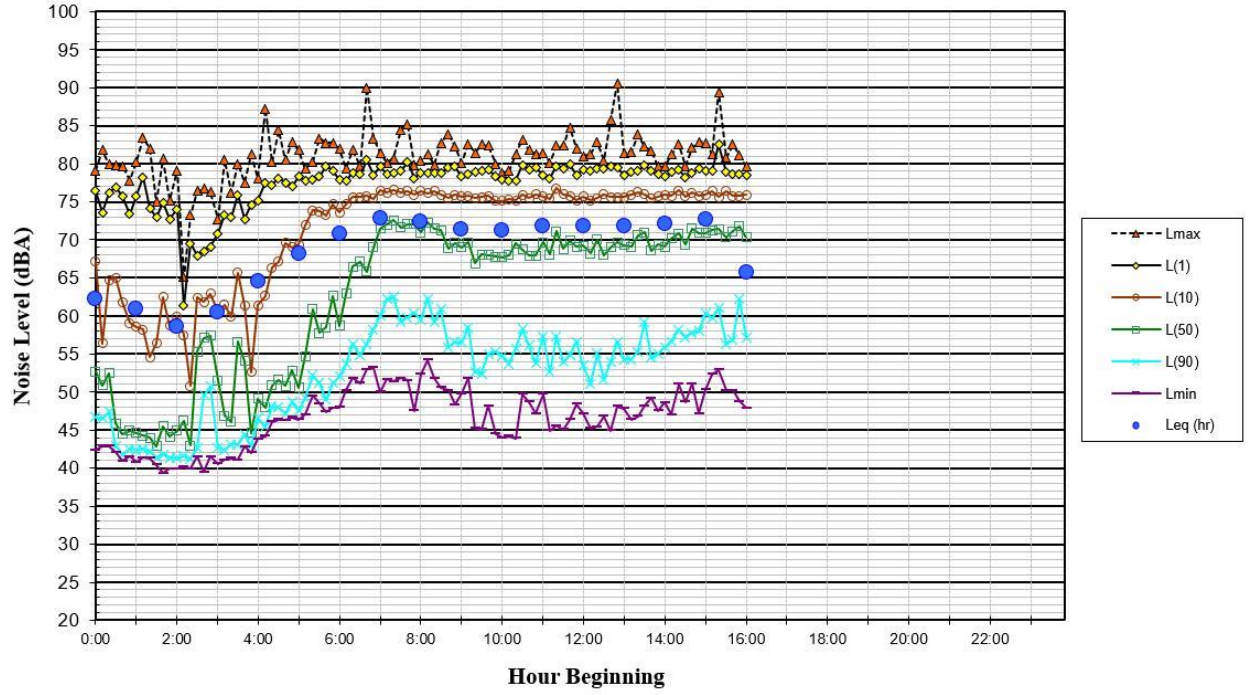


FIGURE 5 Daily Trend in Noise Levels at LT-2, Tuesday, June 10, 2019

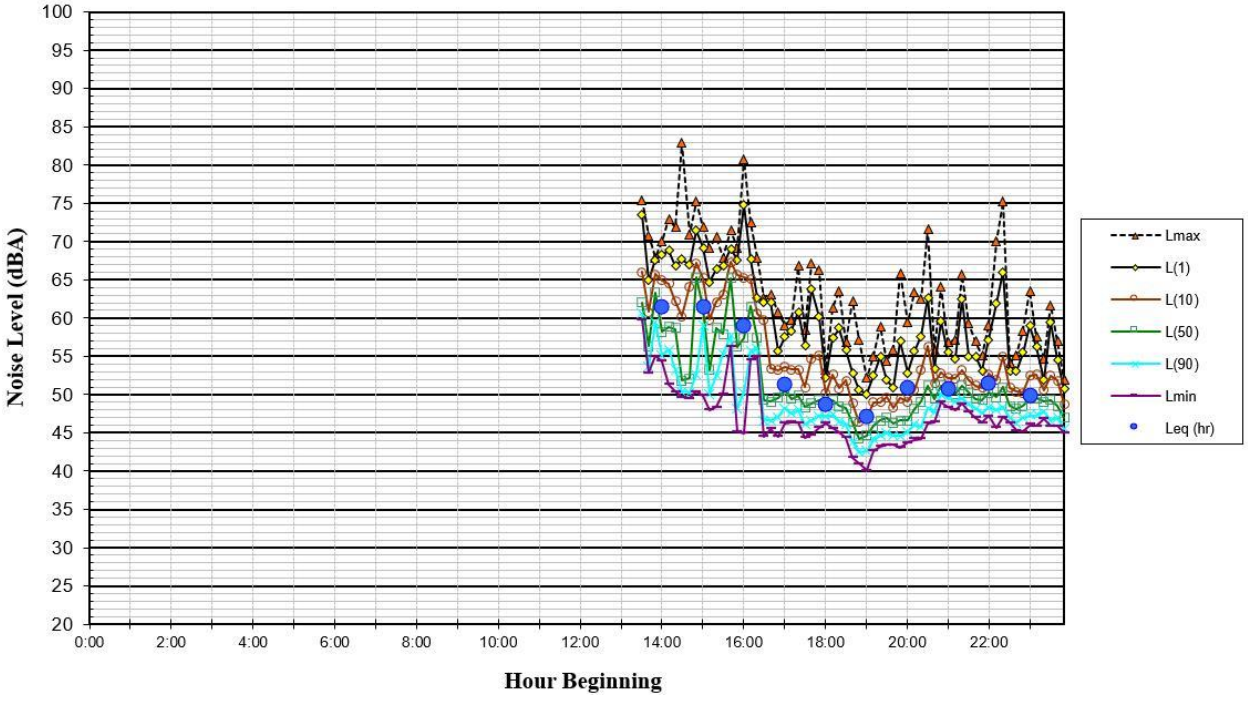


FIGURE 6 Daily Trend in Noise Levels at LT-2, Wednesday, June 11, 2019

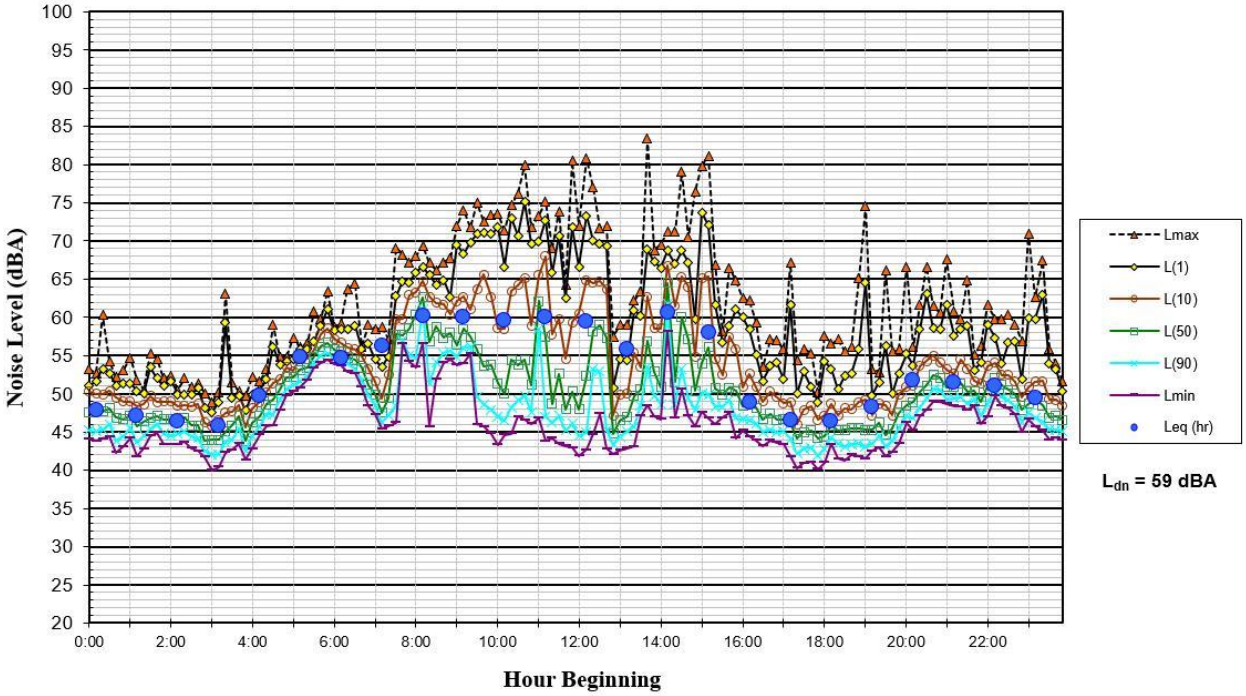
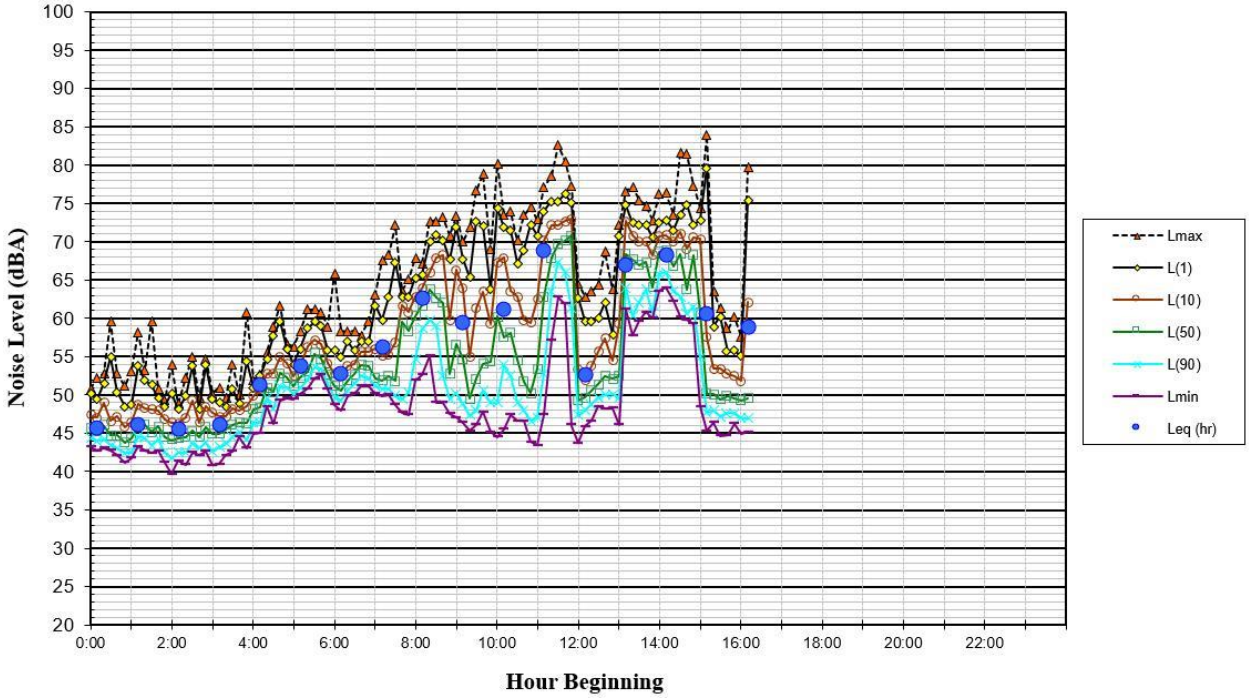


FIGURE 7 Daily Trend in Noise Levels at LT-2, Thursday, June 12, 2019



GENERAL PLAN CONSISTENCY ANALYSIS

The impacts of site constraints such as exposure of the proposed project to excessive levels of noise and vibration are not considered under CEQA. This section addresses the compatibility of the project with respect to the applicable policies and standards set forth in the City's General Plan.

Noise and Land Use Compatibility

The Noise and Safety Element of City of Santa Rosa's 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 Santa Rosa. The applicable General Plan policies were presented in detail in the Regulatory Background section and are summarized below for the proposed project:

- The City's acceptable exterior noise level objective is 65 dBA L_{dn} or less for multi-family residential uses.

- For playgrounds and neighborhood parks, the acceptable exterior noise level would be 70 dBA L_{dn}.

- The City's acceptable exterior noise level objective is 70 dBA L_{dn} for proposed restaurant or commercial uses.

- The City's interior noise level standard for residences is 45 dBA L_{dn}.

- The Cal Green Code standards specify an interior noise environment attributable to exterior sources not to exceed an hourly equivalent noise level ($L_{eq\ (1\text{-}hr)}$) of 50 dBA in occupied areas of nonresidential uses during any hour of operation.

Future Exterior Noise Environment

The primary source of noise affecting the project site under future conditions will continue to be vehicular traffic on Petaluma Hill Road. Local traffic along the future Franz Kafka Avenue and the future Farmers Lane extensions would also affect the noise environment at the site. A traffic impact study was prepared for the proposed project by *W-Trans* in July 2019.[1] Peak hour traffic volumes for the future traffic scenario were not included in the project's traffic study, but other traffic studies for projects in the vicinity of the site were reviewed to identify peak hour turning movements for future conditions.[2] When the peak hour trips for the proposed project were added to the future traffic volumes along Petaluma Hill Road, the estimated noise level increase would be 1 dBA over existing levels.

The site plan for the proposed project shows an outdoor pool area, a tot lot, and open space. These outdoor use areas would be subject to the City's exterior noise thresholds shown above, which would be enforced at the center of each outdoor space. While the 1.04-acre parcel in the southwest

[1] W-Trans, "Draft Report: Traffic Impact Study for the 38º North Phase 2 Project," July 11, 2019.

[2] W-Trans, "Traffic Impact Study for the Yolanda Mixed-Use Project," February 7, 2019.

corner of the project site is identified for future development of a commercial use, details pertaining to the locations of commercial outdoor use areas were not available at this time. For purposes of this study, setback distances from the centerline of the surrounding roadways were provided for the commercial outdoor use areas meeting the City's exterior noise threshold.

Residential Component

The residential component of this project includes an outdoor pool area and three outdoor patios attached to the clubhouse, each of which would be subject to the City's 65 dBA L_{dn} threshold. The center of the pool area would be approximately 385 feet from the centerline of Petaluma Hill Road and approximately 455 feet from the centerline of the future Farmers Lane extension, which would connect to Yolanda Avenue at the Petaluma Hill Road intersection. The outdoor pool would be partially shielded from traffic along both roadways by intervening project buildings (i.e., Buildings 1, 2, 6, and 7 and the club house). Additionally, the pool area would be set back from the centerline of Franz Kafka Avenue by approximately 245 feet. At these setbacks and being partially shield by intervening buildings, the future exterior noise levels at the proposed outdoor pool area would be below 65 dBA L_{dn}.

The outdoor patios at the clubhouse, which would also be partially shielded by intervening project buildings, would be set back from the centerline of Petaluma Hill Road by 285 to 350 feet and from the centerline of Franz Kafka Avenue by 280 to 350 feet. At these distances and assuming partial shielding, the future exterior noise levels at each of the outdoor patios located at the clubhouse would be below 65 dBA L_{dn}.

Tot Lot and Open Space

The tot lot would be located west of Building 2, with setbacks from Petaluma Hill Road and the future Farmers Lane extension of 270 and 240 feet, respectively, when measured from the centerline of each roadway to the center of the outdoor use area. Buildings 1, 2, and 7 would provide partial shielding for the tot lot, as would the commercial building on the future development site. At these distances and assuming partial shielding, the future exterior noise levels at the proposed tot lot would be below 65 dBA L_{dn}, which would meet the City's exterior noise level threshold.

The open space area would be located to the north of the future development parcel, the tot lot, and Building 2. The proposed open space would abut Petaluma Hill Road and Franz Kafka Avenue, with minimum setbacks of 45 feet from the centerline of each roadway. For the portion of the open space adjoining Franz Kafka Avenue, future exterior noise levels would be below 70 dBA L_{dn} even at 35 feet. However, within 100 feet of the centerline of Petaluma Hill Road, future exterior noise levels would range from 70 to 74 dBA L_{dn}. Beyond 100 feet, the City's 70 dBA L_{dn} threshold would be met.

While the 70 dBA L_{dn} threshold would be exceeded within 100 feet of the centerline of Petaluma Hill Road, the affected open space land would account for less than 20% of the total open space area, and the future noise levels within 100 feet would fall within the City's conditionally acceptable threshold for parks. Considering this area would be treated as a preserve and park, a sound wall constructed to reduce noise levels near Petaluma Hill Road would obstruct from the open space aesthetic. Therefore, implementation of noise features to further reduce noise levels at

the open space is not recommended, and the applicant should obtain permission from the City to allow conditionally acceptable noise levels near the western boundary adjoining Petaluma Hill Road.

Commercial Use

Details pertaining to the proposed grocery store have not been identified at the future development parcel; therefore, specific outdoor use areas, if any, are unknown at this time. To meet the City's 70 dBA L_{dn} threshold for commercial uses, unmitigated outdoor use areas must be located 100 feet or more from the centerline of Petaluma Hill Road. Other options would include shielding the outdoor use areas from Petaluma Hill Road with the project building. Once details for the future development is available, the site plan would need to be reviewed to ensure the City's 70 dBA L_{dn} threshold is met at any proposed outdoor use areas.

Future Interior Noise Environment

Residential Component

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

For the proposed project, the western façades of Buildings 6 and 7 would have direct line-of-sight to Petaluma Hill Road, with setbacks of 50 and 100 feet, respectively, from the centerline of the roadway. At these distances, the rooms along these façades would be exposed to future exterior noise levels of 73 and 70 dBA L_{dn}, respectively. Building 5 would be setback 200 feet or more from the centerline of Petaluma Hill Road, with partial shielding provided by Buildings 6 and 7, as well as the future buildings of the Phase 1 development to north. At 200 feet and assuming partial shielding, the exterior-facing rooms along the western façade of Building 5 would be exposed to future exterior noise levels at or below 65 dBA L_{dn}. The remaining residential buildings proposed north of the open space (i.e., Buildings 3, 4, and 8) would be set back 370 feet or more from the centerline of Petaluma Hill Road, with partial shielding provided by on-site buildings and buildings located on the Phase 1 development site. These buildings would also be set back approximately 50 feet or more from the centerline of Franz Kafka Avenue. All exterior-facing rooms in these buildings would be exposed to future exterior noise levels at or below 60 dBA L_{dn}.

Building 1 would be located along the Farmers Lane extension, with the southern façade set back approximately 70 feet from the centerline of the roadway. Additionally, the western façade of this

building would be setback approximately 285 feet from the centerline of Petaluma Hill Road. At these setbacks, the exterior-facing rooms would be exposed to future exterior noise levels of 62 to 66 dBA L_{dn}. Building 2 would be partially shielded from the Farmers Lane extension by Building 1 and potentially from Petaluma Hill Road by the future commercial development. With setbacks of 215 feet from the centerline of the Farmers Lane extension and of 300 feet from the centerline of Petaluma Hill Road, the exterior-facing rooms would be exposed to future exterior noise levels at or below 62 dBA L_{dn}.

Assuming standard residential construction materials, the exterior-facing rooms of Building 6 would have future interior noise levels of 58 dBA L_{dn}, and the exterior-facing rooms of Building 1 would have future interior noise levels of 51 dBA L_{dn}. The residential buildings of the proposed project site would require noise insulation features to meet the City's interior noise thresholds.

Commercial Use

The performance method enforced in the Cal Green Code requires that interior noise levels be maintained at 50 dBA $L_{eq(1\text{-}hr)}$ or less during hours of operation at the proposed nonresidential buildings.

According to the preliminary site plan available at the time of this study, the future grocery store would be set back approximately 40 feet from the centerline of Petaluma Hill Road and approximately 60 feet from the centerline of the future Farmers Lane extension. At these distances, the future exterior noise levels at the building would range from 69 to 74 dBA $L_{eq(1\text{-}hr)}$ during daytime hours and from 56 to 71 dBA $L_{eq(1\text{-}hr)}$ during nighttime hours. Typically, hours of operation are limited to daytime hours; however, grocery stores could potentially be open 24 hours a day. Therefore, the 50 dBA $L_{eq(1\text{-}hr)}$ interior noise performance threshold would be enforced during both daytime and nighttime hours.

Standard construction materials for commercial uses would provide 25 to 30 dBA of noise reduction in interior spaces provided that an adequate form of forced-air mechanical ventilation is included in the design so windows may be kept closed at the occupant's discretion to control noise. The standard construction materials in combination with forced-air mechanical ventilation would satisfy the daytime threshold of 50 dBA $L_{eq(1\text{-}hr)}$ during daytime and nighttime hours.

Noise Insulation Features Recommended to Reduce Future Residential Interior Noise Levels

For consistency with the General Plan, the following noise insulation features are recommended as Conditions of Approval for consideration by the City:

- Provide a suitable form of forced-air mechanical ventilation, as determined by the local building official, for all residential buildings, so that windows can be kept closed to control noise.

- Provide sound-rated windows and doors for Buildings 1, 6, and 7 to maintain interior noise levels or below the City's 45 dBA L_{dn} interior noise threshold. Preliminary calculations show that sound-rated windows and doors with minimum STC ratings of 30 would be satisfactory for units located in Buildings 6 and 7. Windows and doors for Building 1 would

require STC ratings of 28 to meet the interior noise threshold. Standard residential grade windows and doors (minimum STC 26) would be required for all remaining units.

- A qualified acoustical specialist shall prepare a detailed analysis of interior residential noise levels resulting from all exterior sources during the final design phase of the project pursuant to requirements set forth in the General Plan and State Building Code. The study will review the final site plan, building elevations, and floor plans prior to construction and confirm building treatments necessary to reduce interior noise levels to 45 dBA L_{dn} or less. Treatments would include, but are not limited to, sound-rated windows and doors as specified above, acoustical caulking, protected ventilation openings, etc. The specific determination of what noise insulation treatments are necessary shall be conducted on a unit-by-unit basis during final design of the project. Results of the analysis, including the description of the necessary noise control treatments, shall be submitted to the City, along with the building plans and approved design, prior to issuance of a building permit.

NOISE IMPACTS AND MITIGATION MEASURES

This section describes the significance criteria used to evaluate project impacts under CEQA, provides a discussion of each project impact, and presents mitigation measures, where necessary, to provide a compatible project in relation to adjacent noise sources and land uses.

Significance Criteria

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

1. **Temporary or Permanent Noise Increases in Excess of Established Standards:** A significant impact would be identified in the following cases:

    a. Operational Noise in Excess of Standards. A significant noise impact would be identified if the project operations would generate noise levels that would exceed applicable noise standards presented in the Santa Rosa General Plan or Municipal Code.

    b. Permanent Noise Increase. A significant permanent noise increase would occur if project traffic resulted in an increase of 3 dBA L_{dn} or greater at noise-sensitive land uses where existing or projected noise levels would equal or exceed the noise level considered satisfactory for the affected land use (60 dBA L_{dn} for single-family residential areas) and/or an increase of 5 dBA L_{dn} or greater at noise-sensitive land uses where noise levels would continue to be below those considered satisfactory for the affected land use.

    c. Temporary Noise Increase. A significant temporary 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} at the property lines shared with residential land uses, 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. Hourly average noise levels exceeding 70 dBA L_{eq} at the property lines shared with commercial land uses, 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 commercial land uses.

2. **Generation of Excessive Groundborne Vibration:** A significant impact would be identified if the construction of the project would expose persons to excessive vibration levels. Groundborne vibration levels exceeding 0.3 in/sec PPV would have the potential to result in cosmetic damage to buildings.

Impact 1a: Noise Increases Due to Project Operations in Excess of Established Standards. On-site operational noise could exceed City limits at existing noise-sensitive land uses. **This is a potentially significant impact.**

Noise-generating on-site operational components of the project would include mechanical equipment, truck deliveries at the future commercial uses, parking lot activities, and outdoor pool and playground activities. The City of Santa Rosa Municipal Code Section 17-16.030 defines ambient base noise level criteria for various land uses. For single-family residences, ambient noise levels are defined as 55 dBA L_{eq} from 7:00 a.m. to 7:00 p.m., 50 dBA L_{eq} from 7:00 p.m. to 10:00 p.m., and 45 dBA L_{eq} from 10:00 p.m. to 7:00 a.m., while for multi-family residential areas, ambient noise levels are defined as 55 dBA L_{eq} from 7:00 a.m. to 10:00 p.m. and 50 dBA L_{eq} from 10:00 p.m. to 7:00 a.m. Commercial ambient base noise levels are 60 dBA L_{eq} from 7:00 a.m. to 10:00 p.m. and 55 dBA L_{eq} from 10:00 p.m. to 7:00 a.m.

Section 17-16.120 of the City's Municipal Code further states that mechanical equipment noise is not permitted to exceed the ambient base noise levels by more than 5 dBA. This analysis assesses all operational components of the project against these criteria.

Mechanical Equipment

The proposed residential component of the project would include mechanical equipment, such as heating, ventilation, and air conditioning systems (HVAC). Detailed information on the location and specific equipment to be used were not available at the time of this analysis. Typical residential HVAC units are anticipated to generate noise levels of 53 to 63 dBA at 3 feet from the equipment, depending on the equipment selected.

Without knowing the specific locations for these units, the worst-case conditions were assumed for this analysis, which would be ground-level units located at either ends of each residential building. For multi-family residential buildings, it is typical for multiple HVAC units to operate simultaneously at any given time. Assuming up to eight units would operate simultaneously from the same relative location at the end of a building, the worst-case scenario was calculated by estimating HVAC noise levels to the property lines of the nearest existing and future residential land uses surrounding the site. Table 5 summarizes the distance to the nearest surrounding residential land uses, the project building used to represent the worst-case scenario, and the calculated mechanical equipment noise at that distance.

TABLE 5 Summary of Mechanical Equipment Noise Generated at the Residential Buildings on the Project Site

Surrounding Residential Land Use	Nearest Project Building	Distance from edge of Project Building to Nearest Residential Property Line	Estimated Mechanical Equipment Noise Level
Single-family residences west of the site, opposite Petaluma Hill Road	Building 6	70 feet	35 to 45 dBA
Multi-family residences north of the site, part of Phase 1 construction	Building 3	30 feet	42 to 52 dBA
Single-family residences east of the site, opposite Franz Kafka Avenue	Building 3	85 feet	33 to 43 dBA
Multi-family residences south of the site, opposite Farmers Lane extension	Building 1	95 feet	32 to 42 dBA

Assuming the HVAC units run continuously during daytime and nighttime hours, the noise levels summarized in Table 5 would be compared to the City's thresholds described above. The future residences to the south of Farmers Lane Extension would be multi-family residences. Comparing the estimated HVAC noise levels in Table 5 for the single-family residences west and east of the site to the City's thresholds of 60 dBA from 7:00 a.m. to 7:00 p.m., 55 dBA from 7:00 p.m. to 10:00 p.m., and 50 dBA from 10:00 p.m. to 7:00 a.m., this would be a less-than-significant impact. Comparing the estimated HVAC noise levels for the multi-family residences of Phase 1 and the future residences south of the Farmers Lane Extension to the City's thresholds of 60 dBA from 7:00 a.m. to 10:00 p.m. and 55 dBA from 10:00 p.m. to 7:00 a.m., this would be a less-than-significant impact.

The City's Municipal Code includes mechanical equipment noise thresholds for industrial land uses, which would be 75 dBA at any time. The nearest residential building to the existing industrial site located to the west of the project, opposite Petaluma Hill Road, would be Building 7. The nearest building façade of Building 7 would be 145 feet from the nearest industrial property line. At this distance, mechanical equipment HVAC units would be below 40 dBA, which would be a less-than-significant impact.

The future grocery store would also include mechanical equipment, such as intake and exhaust fans, condensers, etc. Typically, intake and exhaust fans and small condensing units are expected to produce noise levels of 55 to 65 at a distance of 3 feet. Depending on the size of refrigeration condensing units, a 4-fan unit would generate noise levels of 69 dBA at 10 feet, while a 10-fan unit would generate noise levels of 73 dBA at 10 feet. The number, capacity, and location of such units would influence the mechanical equipment noise exposure at the surrounding residences, including the future on-site Phase 2 residences. With the number of inherent factors that are unknown at this time, the impact cannot be assessed. Conservatively, the mechanical equipment noise generated at the future grocery store is assumed to result in a significant impact at existing off-site or future on- or off-site residences.

Inclusion of **Mitigation Measure 1** presented below would reduce this impact to less-than-significant level.

Truck Deliveries

The future grocery store would include multiple truck deliveries a week. While details pertaining to the number of deliveries and hours of deliveries were not available at the time of this study, it is assumed for a store of this size that 1 to 2 heavy-duty trucks would make deliveries per week and approximately 6 small- to medium-sized truck deliveries would make deliveries per day. While the City of Santa Rosa does not define allowable delivery hours, it is assumed that the proposed grocery store would restrict truck deliveries to the hours of 7:00 a.m. to 7:00 p.m. to reduce the potential impact to surrounding residences.

Deliveries would occur at the loading zone, which is shown in the site plan at the northwest corner of the proposed grocery store. Details regarding recessed ramps are unknown at this time; however, dock seals for the dock-to-truck interface, which are required by the State energy code, would serve to limit noise transfer from unloading activities into the surrounding environment.

Heavy-duty trucks typically generate maximum instantaneous noise levels of 70 to 75 dBA L_{max} at a distance of 50 feet. Smaller medium-sized delivery trucks typically generate maximum noise levels of 60 to 65 dBA L_{max} at the same distance. Low speed truck noise results from a combination of engine, exhaust, and tire noise, as well as the intermittent sounds of back-up alarms and releases of compressed air associated with truck/trailer air brakes. The noise levels produced by backup alarms can vary depending on the type and directivity of the sound, but maximum noise levels are typically between 65 to 75 dBA L_{max} at a distance of 50 feet.

Future off-site residences to the south and to the east would be shielded from loading dock activities by the proposed grocery store and other residential buildings included in Phase 2. The nearest existing off-site residence to the west would be approximately 160 feet from the center of the loading dock. Maximum unshielded noise levels from heavy-duty trucks could reach 65 dBA L_{max}, and maximum unshielded noise levels from medium-sized delivery trucks could reach 55 dBA L_{max} at these closest off-site receptors. Considering that trucks are expected to travel in this area at low speeds and that the actual cumulative time in which maximum noise occurs during the unloading of trucks is typically limited to 1 minute or less, under worst-case maximum conditions (i.e., 2 heavy truck and 6 medium truck deliveries in an hour), the equivalent hourly average noise level at the nearest noise-sensitive residence to the west would be 54 dBA L_{eq}. However, under more normal operational conditions, with one truck visiting the loading dock in a given hour, the equivalent hourly average noise level this residence would result in an hourly L_{eq} of 53 dBA with 1 heavy truck delivery in an hour or an hourly L_{eq} of 51 dBA with 1 medium truck delivery in an hour. Assuming deliveries would occur during daytime hours between 7:00 a.m. and 7:00 p.m., this would be a less-than-significant impact.

Additionally, future on-site residences would be exposed to truck delivery noise. While Building 1 would be shielded from truck deliveries at the loading dock by the grocery store, Buildings 2 and 7 would be approximately 250 and 200 feet from the center of the loading dock, respectively. Unmitigated maximum noise levels would be 61 to 63 dBA L_{max} for heavy trucks and 51 to 53 dBA L_{max} for medium trucks at these buildings. Under worst-case conditions of 2 heavy truck

deliveries and 6 medium truck deliveries in 1 hour, hourly average noise levels would be 50 to 52 dBA L_{eq} at Buildings 2 and 7. One heavy truck delivery would generate hourly average noise levels of 49 to 51 dBA L_{eq}, while one medium truck delivery would generate hourly average noise levels of 47 to 49 dBA L_{eq}. This would be a less-than-significant impact.

The property line of the industrial site would be approximately 75 feet from the center of the loading dock. At this distance, unmitigated maximum noise levels would be up to 72 dBA L_{max} for heavy trucks and up to 62 dBA L_{max} for medium trucks. The worst-hour conditions would result in hourly average noise levels of 61 dBA L_{eq}, while one heavy truck would result in hourly average noise levels of 60 dBA L_{eq} and one medium truck would result in hourly average noise levels of 58 dBA L_{eq}. This is a less-than-significant impact.

Parking Lot

Parking would be provided to residences throughout the site. The largest concentration of parking would be located between Buildings 5 through 8. These buildings would provide shielding for the surrounding residences. Parking would also be located north of Buildings 3 through 6. Residential parking spaces would also be located between Buildings 1 and 2 and to the east of Building 2. Additionally, 33 surface-level parking spaces are conceptualized for the future grocery store, while 60 additional parking spaces would be provided underground. Underground parking lot noise would not impact the surrounding land uses.

Noise sources associated with the surface parking lot would include vehicular circulation, loud engines, car alarms, squealing tires, door slams, and human voices. Typical noise levels from a car traveling at 15 mph would be about 50 to 60 dBA L_{max} at a distance of 50 feet. The noise of an engine starting would be similar. Door slams typically produce noise levels lower than engine starts. The hourly average noise level resulting from all these noise-generating activities in a small parking lot would reach 40 dBA L_{eq} at a distance of 50 feet from the parking area.

For the existing off-site receptors, distances from the centers of the nearest concentration of residential parking spaces to the residential property lines were measured to be approximately 115 feet for the residences west of the project site and 105 feet for the existing and future residences to the east. Future residences south of the project site would be shielded from residential parking lots by intervening project buildings. The Phase 1 development to the north would share the parking lots with Phase 2, as shown in the site plan by connecting driveways. Therefore, these residences would be contributing to the noise generation and would not be considered a receptor for residential parking lot noise. At 115 and 105 feet, maximum noise levels would be up to 63 and 64 dBA L_{max}, respectively, with hourly average noise levels being 33 and 34 dBA L_{eq}, respectively. This would be below the City's daytime, evening, and nighttime thresholds for single-family residences. This is a less-than-significant impact.

The nearest residential land uses would be approximately 175 feet south from the center of the grocery store parking lot. These future residences would be exposed to hourly average noise levels of 29 dBA L_{eq} from parking activities. Maximum noise levels would be up to 59 dBA L_{max} at the future residences to the south. The existing single-family residence to the west would be more than 230 feet from the center of the grocery store parking lot and would be partially shielded by the grocery store building. Assuming no shielding effects, maximum noise levels would be up to 57

dBA L_{max}, and hourly average noise levels would be 27 dBA L_{eq} at the nearest residence to the west. Parking lot activity noise would not exceed the City's daytime thresholds of 60 dBA (between 7:00 a.m. and 7:00 p.m.) and 55 dBA (between 7:00 p.m. and 10:00 p.m.) or the nighttime threshold of 50 dBA L_{eq} at single-family residences. This is a less-than-significant impact.

The nearest on-site residences (i.e., Buildings 1 and 2) would be 130 feet or more from the center of the grocery store parking lot. At this distance, maximum noise levels would be up to 62 dBA L_{max}, and hourly average noise levels would be 32 dBA L_{eq} at the nearest on-site multi-family residences. This would not exceed the daytime threshold of 60 dBA or the nighttime threshold of 55 dBA. This is a less-than-significant impact.

The industrial site to the west would be mostly shielded from the parking lot activity by the grocery store. At a distance of 190 feet, the unmitigated hourly average noise levels would be 28 dBA L_{eq}, which is below the City's threshold of 75 dBA. This is a less-than-significant impact.

Outdoor Pool and Playground

The site plan shows an outdoor pool area between the club house and Building 8. Additionally, the site plan shows a 6-foot fence surrounding the pool area. The primary noise source normal conversation, laughing, etc., which would typically generate noise levels of 60 to 65 dBA at a distance of 3 feet. The nearest off-site residences to the pool would be those to the east, opposite Franz Kafka Avenue. The property line of these residences would be approximately 275 feet from the center of the proposed pool area. At this distance, noise levels generated in the pool area would range from 21 to 26 dBA, assuming a no reduction from the perimeter fence. These noise levels would not generally be distinguishable above ambient conditions. All other off-site receptors would be shielded from the pool area by intervening project buildings. Therefore, noise levels generated at the pool area would be even lower. This is a less-than-significant impact.

Playground noise would primarily result from children laughing, yelling, etc. The tot lot is shown to the west of Building 2. Typical noise levels resulting from various playground activities range from 59 to 67 dBA L_{eq} at a distance of 50 feet from the center of busy playground at a school or daycare facility. These source levels are relatively high, considering tot lots like the one proposed here would likely not have more than a few kids at any given time. However, for purposes of estimating worst-case scenario noise levels, these source levels would provide a very conservative analysis. The nearest residences with direct line-of-sight to the tot lot would be the future residences south of the Farmers Lane extension, which are 255 feet from the center of the tot lot, and the existing single-family residences west of Petaluma Hill Road, which are 315 feet from the tot lot. At these distances, a noisy playground would be up to 53 dBA at the residential property line south of the site and up to 51 dBA at the residential property line west of the site. Assuming maximum activity for an entire hour, these hourly average noise levels would meet the City's daytime noise levels of 60 dBA between 7:00 a.m. and 7:00 p.m. and 55 dBA between 7:00 p.m. and 10:00 p.m. Since playgrounds are only occupied during daytime hours, the nighttime threshold would not apply. All other off-site residences would be exposed to even lower noise levels due to intervening project buildings providing shielding. This would be a less-than-significant impact.

Since activities at the pool area and tot lot would be generated by the on-site residences, these outdoor use activity areas would not be considered a noise source affecting the on-site residences.

Mitigation Measure 1a:

The following mitigation measures would reduce this impact to a less-than-significant level:

Mechanical Equipment Noise
The proposed residential component of the project would meet the City's noise requirements and would not require mitigation.

Prior to the issuance of building permits, mechanical equipment generated at the future grocery store shall be selected and designed to reduce impacts on surrounding uses to meet the City's requirements. 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 50 dBA L_{eq} residential noise limit at the nearest residential 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 enclosures and parapet walls to block the line-of-sight between the noise source and the nearest receptors. Alternate measures may include locating equipment in less noise-sensitive areas, where feasible. The measures recommended by the acoustical consultant to ensure compliance with the City's requirements would be implemented as project conditions of approval.

Truck Deliveries
Require truck deliveries to occur between 7:00 a.m. and 7:00 p.m. to ensure noise impact would not occur at on- and off-site residential land uses.

Impact 1b: **Permanent 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.**

A significant permanent noise increase would occur if project-generated traffic would substantially increase noise levels at sensitive receptors in the project vicinity. A substantial increase would occur if: a) the noise level increase is 5 dBA L_{dn} or greater, with a future noise level of less than 60 dBA L_{dn}, or b) the noise level increase is 3 dBA L_{dn} or greater, with a future noise level of 60 dBA L_{dn} or greater. Future noise levels in the project vicinity would be 75 dBA L_{dn} at LT-1 and 60 dBA L_{dn} at LT-2; therefore, a significant impact would occur if project-generated traffic resulted in a noise level increase of 3 dBA L_{dn}. For reference, a 3 dBA L_{dn} increase would occur if traffic volumes along a roadway would double.

The traffic study completed for the proposed project included peak hour turning movements for eight intersections in the project vicinity. When the peak hour trips for both the residential and commercial components were added to the existing peak hour traffic volumes, the existing plus project scenario was calculated. By comparing the existing plus project traffic volumes to the existing traffic volumes, the noise level increase attributable solely to the project was determined to be 1 dBA L_{dn} or less along every roadway segment in the project vicinity. This increase would not typically be noticeable and would be below the 3 dBA L_{dn} threshold of significance. This is a less-than-significant impact.

Mitigation Measure 1b: None required.

Impact 1c: 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.

Construction noise levels vary on a day-to-day basis, depending on the type and amount of equipment operating on-site and the specific task that is being completed on a given day. Construction activities generate considerable amounts of noise, especially during earth-moving activities when heavy equipment is used. Table 6 summarizes the maximum instantaneous noise levels generated by typical construction equipment that generate either non-impact or impact sounds at a distance of 50 feet from the noise source. 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. As shown in the table, impact pile driving generates noise levels up to 105 dBA L_{max}, and vibratory pile driving would generate noise levels up to 95 dBA L_{max}. Pile driving is not expected for the proposed project. Typical hourly average construction-generated noise levels for various types of projects are summarized in Table 7 at a distance of 50 feet from the center of the site during busy construction periods (e.g., earth moving equipment, impact tools, etc.).

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 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.

Source: Mitigation of Nighttime Construction Noise, Vibrations and Other Nuisances, National Cooperative Highway Research Program, 1999.

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.

The City of Santa Rosa does not define allowable construction hours in the General Plan or Municipal Code. Nor are temporary construction noise thresholds defined by the City. However, limiting construction to weekday daytime hours between 7:00 a.m. and 7:00 p.m. would reduce the disturbance to existing noise-sensitive receptors surrounding the project site. The Fundamentals of Noise section of this report discusses the threshold for indoor speech interference to be 45 dBA. Assuming a 15 dB exterior-to-interior reduction for standard residential construction with windows open and a 25 dB exterior-to-interior reduction for standard commercial construction with windows closed, this would correlate to an exterior threshold of 60 dBA L_{eq} at residential land uses and 70 dBA L_{eq} at commercial land uses. Therefore, assumed daytime temporary construction noise would be considered a significant impact if noise levels due to construction activities would exceed 60 dBA L_{eq} at residential land uses or exceed 70 dBA L_{eq} at commercial land uses and exceeds the ambient noise environment by at least 5 dBA L_{eq} for a period exceeding one year.

Construction activities for the proposed project would include the construction of the residential development from early September 2020 through the end of December 2021 and the construction of the future grocery store, which would occur following the completion of the residential development; however, the existing and future residences surrounding the project site are expected to be exposed to continuous construction activities for all of Phase 2 for a period of about 17 months.

The Federal Highway Administration's (FHWA's) Roadway Construction Noise Model (RCNM) was used to calculate the hourly average noise levels anticipated for the worst-case scenario for each construction phase, based on the equipment list provided by the applicant at the time of this study. RCNM includes representative sound levels for the most common types of construction equipment and the approximate usage factors of such equipment that were developed based on an extensive database of information gathered during the construction of the Central Artery/Tunnel

Project in Boston, Massachusetts (CA/T Project or "Big Dig"). The usage factors represent the percentage of time that the equipment would be operating at full power. To estimate the worst-case scenario for each phase of the proposed project, it was assumed that all equipment provided for each phase would operate simultaneously. Additionally, all mobile equipment will be fitted with backup alarms per OSHA requirements. The noise level of backup alarms can vary depending on the type and directivity of the sound, but maximum noise levels are typically in the range of 65 to 75 dBA L_{max} at a distance of 50 feet.

Tables 8 and 9 summarize all equipment and quantities expected to be used for each construction phase, the duration of each phase, and the estimated worst-case scenario noise levels expected at the property lines of the nearest surrounding noise-sensitive land use. Table 8 shows the results for construction activities occurring at the Phase 2 residential development, while Table 9 shows the results for construction occurring at the future grocery store parcel. During construction at both areas, construction equipment would likely be spread throughout the sites, but for purposes of modeling the worst-case scenario, all equipment was assumed to be operating in relatively the same area, with the geometrical center of construction equipment being the center of the construction sites. Therefore, the propagation distances were estimated from the center of the active construction site to the property lines of the surrounding receptors. No shielding effects were assumed for the estimated noise levels shown in Tables 8 and 9.

TABLE 8 Estimated Construction Noise Levels at the Nearby Residences during Phase 2 Residential Construction

Phase	Time Duration	Construction Equipment (Quantity)	Calculated Hourly Average L_{eq} at Residence, dBA			
			North Res (310ft)	South Res (480ft)	East Res (385ft)	West Res (305ft)
Site Preparation	9/7/2020-9/25/2020	Scraper (1) Grader (1) Rubber-Tired Dozer (1) Tractor/Loader/Backhoe (1) Off-Highway Truck (1)	73	69	71	73
Grading/ Excavation	9/28/2020-10/30/2020	Excavator (1) Grader (1) Rubber-Tired Dozer (1) Tractor/Loader/Backhoe (1) Trucking – Stockpile on-sites (1)	73	69	71	73
Foundation	10/26/2020-12/25/2020	Tractor/Loader/Backhoe (1) Excavator (1) Skid Steer (1) Concrete Pre-Mix Truck (1) Concrete Pump (1)	72	68	70	72
Trenching/ Utilities	11/2/2020-1/8/2021	Tractor/Loader/Backhoe (1) Excavator (1) Skid Steer (1) Plate Compactor (1)	72-73[a]	68-70[a]	70-72[a]	72-74[a]
Building-Framing & Exterior	11/30/2020-5/28/2021	Air Compressor (1) Aerial Lift (2) Rough Terrain Forklift (1)	71-74[b]	67-70[b]	69-72[b]	71-74[b]
Paving/ Hardscape	9/6/2021-12/31/2021	Concrete Pre-Mix Truck (1) Concrete Pump (1)	73	69	71	73

Phase	Time Duration	Construction Equipment (Quantity)	Calculated Hourly Average L_{eq} at Residence, dBA			
			North Res (310ft)	South Res (480ft)	East Res (385ft)	West Res (305ft)
		Paver (1) Paving Equipment (1) Roller (1) Tractor/Loader/Backhoe (1) Skid Steer (1)				
Misc[c] (Deliveries/ Day-to-Day)	9/7/2020-2/4/2022	Crane (1) Forklift (3) Generator Set (1) Tractor/Loader/Backhoe (3) Welder (1)	70	66	68	70

[a] The range of levels for the trenching/utilities phase reflects the trenching/utilities equipment only and the overlapping period with the foundation phase.
[b] The range of levels for the building-framing and exterior phase reflects the building-framing and exterior equipment only and the overlapping period with the trenching/utilities and foundation phases.
[c] The miscellaneous equipment would be used on a day-to-day basis throughout project construction, and the noise generated from these equipment are included in the previous rows for each phase of construction.

TABLE 9 Estimated Construction Noise Levels at the Nearby Residences during Future Commercial Grocery Store Construction

Phase	Time Duration	Construction Equipment (Quantity)	Calculated Hourly Average L_{eq} at Residence, dBA			
			On-Site Phase 2 Res (115ft)	South Res (165ft)	East Res (435ft)	West Res (240ft)
Future Commercial Grading/ Excavation	1/3/2022-2/4/2022	Excavator (1) Grader (1) Rubber-Tired Dozer (1) Tractor/Loader/Backhoe (1) Trucking – Haul off-site (1)	81	78	69	74

[a] The miscellaneous equipment summarized in Table 8 are included noise level calculations for the future commercial development.

Daytime ambient noise levels at the residences along Petaluma Hill Road would range from 69 to 74 dBA L_{eq}, as described above. For receptors to the east of the project site, ambient noise levels would range from 46 to 61 dBA L_{eq} during daytime hours. As shown in Tables 8 and 9, construction activities could potentially generate noise levels exceeding 60 dBA L_{eq} at residences surrounding the site throughout project construction. Additionally, daytime ambient conditions could potentially be exceeded by 5 dBA L_{eq} or more at existing and future residences to the east of the site throughout project construction. Since total project construction is expected to last for a period of more than one year, this would be considered a significant impact and would require mitigation.

Mitigation Measure 1c:

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

life. The City shall require the contractor 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 during all phases of the residential and commercial construction.

Construction Best Management Practices

Develop a construction noise control plan to be implemented during the construction of both the residential and commercial components of the project. This noise control plan would include, but not limited to, the following available controls:

- Construction activities shall be limited to allowable construction hours (typically 7:00 am to 7:00 pm on weekdays). No construction activities are permitted on Sundays and holidays.

- Limit use of the concrete saw to a distance of 50 feet or greater from residences, where feasible.

- 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 as feasible. If they must be located near receptors, adequate muffling (with enclosures where feasible and appropriate) shall be used to reduce noise levels at the adjacent sensitive receptors. Any enclosure openings or venting shall face away from sensitive receptors.

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

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

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

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

- 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.

- 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, minimizing disruption and annoyance. With the implementation of these controls, and considering that construction is temporary, the impact would be reduced to a less-than-significant level.

Impact 2: **Generation of Excessive Groundborne Vibration due to Construction.** Construction-related vibration levels would not exceed the conservative 0.3 in/sec PPV at existing off-site residences and would not exceed the 0.5 in/sec PPV threshold at future residences on- and off-site, which would be considered structurally sound buildings designed to modern engineering standards. **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 demolition, preparation work, foundation work, and new building framing and finishing. The proposed project would not require pile driving, which can cause excessive vibration.

The City of Santa Rosa does not define vibration thresholds. 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, which typically consist of buildings constructed since the 1990s. A conservative vibration limit of 0.3 in/sec PPV has been used for buildings that are found to be structurally sound but where structural damage is a major concern (see Table 3 above for further explanation). For historical buildings or buildings that are documented to be structurally weakened, a conservative limit of 0.08 in/sec PPV is often used to provide the highest level of protection. No historical buildings or buildings that are documented to be structurally weakened adjoin the project site. Conservatively, construction-generated groundborne vibration levels exceeding 0.3 in/sec PPV at existing off-site structures and 0.5 in/sec PPV at future on-site (Phases 1 and 2) and off-site (opposite Farmers Lane extension) structures would have the potential to result in a significant vibration impact.

Table 10 presents typical vibration levels that could be expected from construction equipment at a distance of 25 feet. 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. Vibration levels would vary depending on soil conditions, construction methods, and equipment used.

Equipment in Table 10 could be used during the construction of the residences or the future commercial development included in Phase 2. In addition to source levels at 25 feet, Table 10 also summarizes the vibration levels expected at the nearest building façades surrounding the site when each piece of heavy equipment is used near the project boundary, which would represent the worst-case scenario. For future residences located to the south of the project site, opposite the Farmers Lane extension, vibration levels were calculated at an assumed building set back of 25 feet from the centerline of the future roadway.

As summarized in Table 10, all existing residences to the west and to the east of the project site would be exposed to construction vibration levels below the conservative 0.3 in/sec PPV threshold, while all future residences adjoining the site to the north (Phase 1) and opposite the Farmers Lane extension to the south would be exposed to construction vibration levels below the 0.5 in/sec PPV threshold used for buildings structurally sound and designed to modern engineering standards.

Additionally, the on-site residential buildings to be constructed as part of Phase 2 would be exposed to construction vibration during the construction of the grocery store. Buildings 1 and 2 would be 50 and 60 feet, respectively, from the nearest construction activity for the grocery store. At these distances, vibration levels would be at or below 0.080 in/sec PPV and at or below 0.098 in/sec PPV, respectively, for all equipment shown in Table 10. All other Phase 2 buildings would be 140 feet or more from the grocery store construction and, therefore, would be exposed to vibration levels at or below 0.032 in/sec PPV. Vibration generated by construction work at the grocery store would be below 0.5 in/sec PPV at the on-site Phase 2 buildings.

While construction activity may be perceptible at the adjacent residences, the proposed project is not expected to result in “architectural” damage to any surrounding structure. This is a less-than-significant impact.

TABLE 10 Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 ft. (in/sec)	Vibration Levels at Nearest Surrounding Building Façades (in/sec PPV)			
			North Res. (15ft)[a]	East Res. (65ft)	West Res. (85ft)	South Res. (95ft)[a]
Clam shovel drop		0.202	0.354	0.071	0.053	0.047
Hydromill (slurry wall)	in soil	0.008	0.014	0.003	0.002	0.002
	in rock	0.017	0.030	0.006	0.004	0.004
Vibratory Roller		0.210	0.368	0.073	0.055	0.048
Hoe Ram		0.089	0.156	0.031	0.023	0.020
Large bulldozer		0.089	0.156	0.031	0.023	0.020
Caisson drilling		0.089	0.156	0.031	0.023	0.020
Loaded trucks		0.076	0.133	0.027	0.020	0.018
Jackhammer		0.035	0.061	0.012	0.009	0.008
Small bulldozer		0.003	0.005	0.001	0.001	0.001

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

[a] Future residences to the north and to the south of the site would be subject to the 0.5 in/sec PPV threshold, while existing residences to the east and to the west would be subject to the conservative 0.3 in/sec PPV threshold.

Mitigation Measure 2: None required.