VETERANS MEMORIAL BUILDING/ SENIOR CENTER NOISE AND VIBRATION ASSESSMENT

Redwood City, California

March 12, 2019

Prepared for:

Caroline Weston
David J. Powers & Associates, Inc.
1871 The Alameda, Suite 200
San José, CA 95126

Prepared by:

Carrie J. Janello and
Michael S. Thill

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

Project: 16-245

INTRODUCTION

A Veterans Memorial Building/Senior Center (VMSC) and YMCA facility is proposed at the northern portion of the Red Morton Community Park in Redwood City, California. The proposed project would be implemented in two phases: Phase 1 would consist of the construction of the VMSC and traffic calming measures; and Phase 2 would consist of the construction of the YMCA. The two-story, approximately 45,000 square foot, VMSC building would be constructed in the portion of the project site south of Madison Avenue and east of Nevada Street as part of Phase 1 of the project. The existing hours of operation for the VMSC, which are 5:30 a.m. to 10:30 p.m. Monday through Friday and 7:00 a.m. to 11:00 p.m. on Saturdays and Sundays would continue under the proposed project. Additionally, Phase 1 of the project would also include traffic calming measures and the conversion of Nevada Street south of Madison Avenue into a pedestrian promenade. The traffic calming measures would include the installation of a new roundabout at the Vera Avenue/Valota Road intersection; expansion of the existing traffic circle at Hudson Street and Madison Avenue; installation of a new mini traffic circle at Madison Avenue and Myrtle Street; and installation of a new median island and curb extensions at the Valota Road and Madison Avenue. The YMCA, which is part of the Phase 2, would be an approximate 35,000 square foot, two-story building, and would be located south of Madison Avenue and west of Nevada Street. The hours of operation for the YMCA would be 7:00 a.m. to 10:30 p.m. Monday through Friday and 7:00 a.m. to 11:00 p.m. on Saturdays and Sundays. Surface parking lots would be located east of the VMSC building and north and west of the YMCA building.

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

SETTING

Fundamentals of Environmental Noise

Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. The objectionable nature of sound could be caused by its *pitch* or its *loudness*. *Pitch* is the height or depth of a tone or sound, depending on the relative rapidity (frequency) of the vibrations by which it is produced. Higher pitched signals sound louder to humans than sounds with a lower pitch. *Loudness* is intensity of sound waves combined with the reception characteristics of the ear. Intensity may be compared with the height of an ocean wave in that it is a measure of the amplitude of the sound wave.

In addition to the concepts of pitch and loudness, there are several noise measurement scales which are used to describe noise in a particular location. A *decibel (dB)* is a unit of measurement which indicates the relative amplitude of a sound. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 decibels represents a ten-fold increase in acoustic energy, while 20 decibels is 100 times more intense, 30 decibels is 1,000 times more intense, etc. There is a relationship between the subjective noisiness or loudness of a sound and its intensity. Each 10 decibel increase in sound level is perceived as approximately a doubling of loudness over a fairly wide range of intensities. Technical terms are defined in Table 1.

There are several methods of characterizing sound. The most common in California is the *A-weighted sound level (dBA).* This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Representative outdoor and indoor noise levels in units of dBA are shown in Table 2. Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This *energy-equivalent sound/noise descriptor* is called L_{eq}. The most common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration.

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

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

Effects of Noise

Sleep and Speech Interference

The thresholds for speech interference indoors are about 45 dBA if the noise is steady and above 55 dBA if the noise is fluctuating. Outdoors the thresholds are about 15 dBA higher. Steady noises of sufficient intensity (above 35 dBA) and fluctuating noise levels above about 45 dBA have been shown to affect sleep. Interior residential standards for multi-family dwellings are set by the State of California at 45 dBA L_{dn}. Typically, the highest steady traffic noise level during the daytime is about equal to the L_{dn} and nighttime levels are 10 dBA lower. The standard is

designed for sleep and speech protection and most jurisdictions apply the same criterion for all residential uses. Typical structural attenuation is 12-17 dBA with open windows. With closed windows in good condition, the noise attenuation factor is around 20 dBA for an older structure and 25 dBA for a newer dwelling. Sleep and speech interference is therefore possible when exterior noise levels are about 57-62 dBA L_{dn} with open windows and 65-70 dBA L_{dn} if the windows are closed. Levels of 55-60 dBA are common along collector streets and secondary arterials, while 65-70 dBA is a typical value for a primary/major arterial. Levels of 75-80 dBA are normal noise levels at the first row of development outside a freeway right-of-way. In order to achieve an acceptable interior noise environment, bedrooms facing secondary roadways need to be able to have their windows closed; those facing major roadways and freeways typically need special glass windows.

Annoyance

Attitude surveys are used for measuring the annoyance felt in a community for noises intruding into homes or affecting outdoor activity areas. In these surveys, it was determined that the causes for annoyance include interference with speech, radio and television, house vibrations, and interference with sleep and rest. The L_{dn} as a measure of noise has been found to provide a valid correlation of noise level and the percentage of people annoyed. People have been asked to judge the annoyance caused by aircraft noise and ground transportation noise. There continues to be disagreement about the relative annoyance of these different sources. When measuring the percentage of the population highly annoyed, the threshold for ground vehicle noise is about 50 dBA L_{dn}. At a L_{dn} of about 60 dBA, approximately 12 percent of the population is highly annoyed. When the L_{dn} increases to 70 dBA, the percentage of the population highly annoyed increases to about 25-30 percent of the population. There is, therefore, an increase of about 2 percent per dBA between a L_{dn} of 60-70 dBA. Between a L_{dn} of 70-80 dBA, each decibel increase increases the percentage of the population highly annoyed by about 3 percent. People appear to respond more adversely to aircraft noise. When the L_{dn} is 60 dBA, approximately 30-35 percent of the population is believed to be highly annoyed. Each decibel increase to 70 dBA adds about 3 percentage points to the number of people highly annoyed. Above 70 dBA, each decibel increase results in about a 4 percent increase in the percentage of the population highly annoyed.

Fundamentals of Groundborne Vibration

Ground vibration consists of rapidly fluctuating motions or waves with an average motion of zero. Several different methods are typically used to quantify vibration amplitude. One method is the Peak Particle Velocity (PPV). The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. In this report, a PPV descriptor with units of mm/sec or in/sec is used to evaluate construction generated vibration for building damage and human complaints. Table 3 displays the reactions of people and the effects on buildings that continuous 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 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 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 paint flaking or minimal extension of cracks in building surfaces; minor, including limited surface cracking; or major, that may threaten the structural integrity of the building. Safe vibration limits that can be applied to assess the potential for damaging a structure vary by researcher. The damage criteria presented in Table 3 include several categories for ancient, fragile, and historic structures, the types of structures most at risk to damage. Most buildings are included within the categories ranging from “Historic and some old buildings” to “Modern industrial/commercial buildings”. Construction-induced vibration that can be detrimental to the building is very rare and has only been observed in instances where the structure is at a high state of disrepair and the construction activity occurs immediately adjacent to the structure.

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

TABLE 1 Definition of Acoustical Terms Used in this Report

Term	Definition
Decibel, dB	A unit describing, the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20 micro Pascals.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micro Pascals (or 20 micro Newtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e. g., 20 micro Pascals). Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hz and 20,000 Hz. Infrasonic sound are below 20 Hz and Ultrasonic sounds are above 20,000 Hz.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
Equivalent Noise Level, L_{eq}	The average A-weighted noise level during the measurement period.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
L_{01}, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Day/Night Noise Level, L_{dn} or DNL	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 p.m. and 7:00 a.m.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 p.m.to 10:00 p.m. and after addition of 10 decibels to sound levels measured in the night between 10:00 p.m. and 7:00 a.m.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

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

TABLE 2 Typical Noise Levels in the Environment

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	110 dBA	Rock band
Jet fly-over at 1,000 feet		
	100 dBA	
Gas lawn mower at 3 feet		
	90 dBA	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	80 dBA	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawn mower, 100 feet	70 dBA	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	60 dBA	
		Large business office
Quiet urban daytime	50 dBA	Dishwasher in next room
Quiet urban nighttime	40 dBA	Theater, large conference room
Quiet suburban nighttime		
	30 dBA	Library
Quiet rural nighttime		Bedroom at night, concert hall (background)
	20 dBA	
		Broadcast/recording studio
	10 dBA	
	0 dBA	

Source: Technical Noise Supplement (TeNS), California Department of Transportation, September 2013.

TABLE 3 Reaction of People and Damage to Buildings from Continuous or Frequent Intermittent Vibration Levels

Velocity Level, PPV (in/sec)	Human Reaction	Effect on Buildings
0.01	Barely perceptible	No effect
0.04	Distinctly perceptible	Vibration unlikely to cause damage of any type to any structure
0.08	Distinctly perceptible to strongly perceptible	Recommended upper level of the vibration to which ruins and ancient monuments should be subjected
0.1	Strongly perceptible	Threshold at which there is a risk of damage to fragile buildings with no risk of damage to most buildings
0.25	Strongly perceptible to severe	Threshold at which there is a risk of damage to historic and some old buildings.
0.3	Strongly perceptible to severe	Threshold at which there is a risk of damage to older residential structures
0.5	Severe - Vibrations considered unpleasant	Threshold at which there is a risk of damage to new residential and modern commercial/industrial structures

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

Regulatory Background

The State of California and the City of Redwood City have established regulatory criteria that are applicable in this assessment. Questions contained in Appendix G of the CEQA Guidelines 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 guidelines are used in this analysis to evaluate the significance of effects of environmental noise attributable to a proposed project. Under CEQA, noise impacts would be considered significant if the project would result in:

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

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

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

CEQA does not define what noise level increase would be considered substantial. Typically, an increase in the L_{dn} 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} or greater would be considered a significant impact when projected noise levels would remain within those considered acceptable for the affected land use.

Pursuant to court decisions, 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. These items are discussed in a separate section addressing the project's consistency with the policies set forth in the City's General Plan.

2016 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 2010 California Green Building Standards Code (Section 5.507.4.1 and 5.507.4.2). These standards were not altered in the 2016 revisions. 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. Both of 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 DNL 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 Redwood City 2010 General Plan. The City of Redwood City's General Plan identifies noise and land use compatibility standards for various land uses and establishes policies to control noise within the community. Table PS-10 from the General Plan shows acceptable levels for various land uses. Applicable goals, policies, and programs presented in the General Plan are as follows:

Goal PS-13 Minimize the impact of point source noise and ambient noise levels throughout the community.

Policy PS-13.3 Consider noise impacts as part of the development review process, particularly the location of parking, ingress/egress/loading, and the refuse collection areas relative to surrounding residential development and other noise-sensitive land uses.

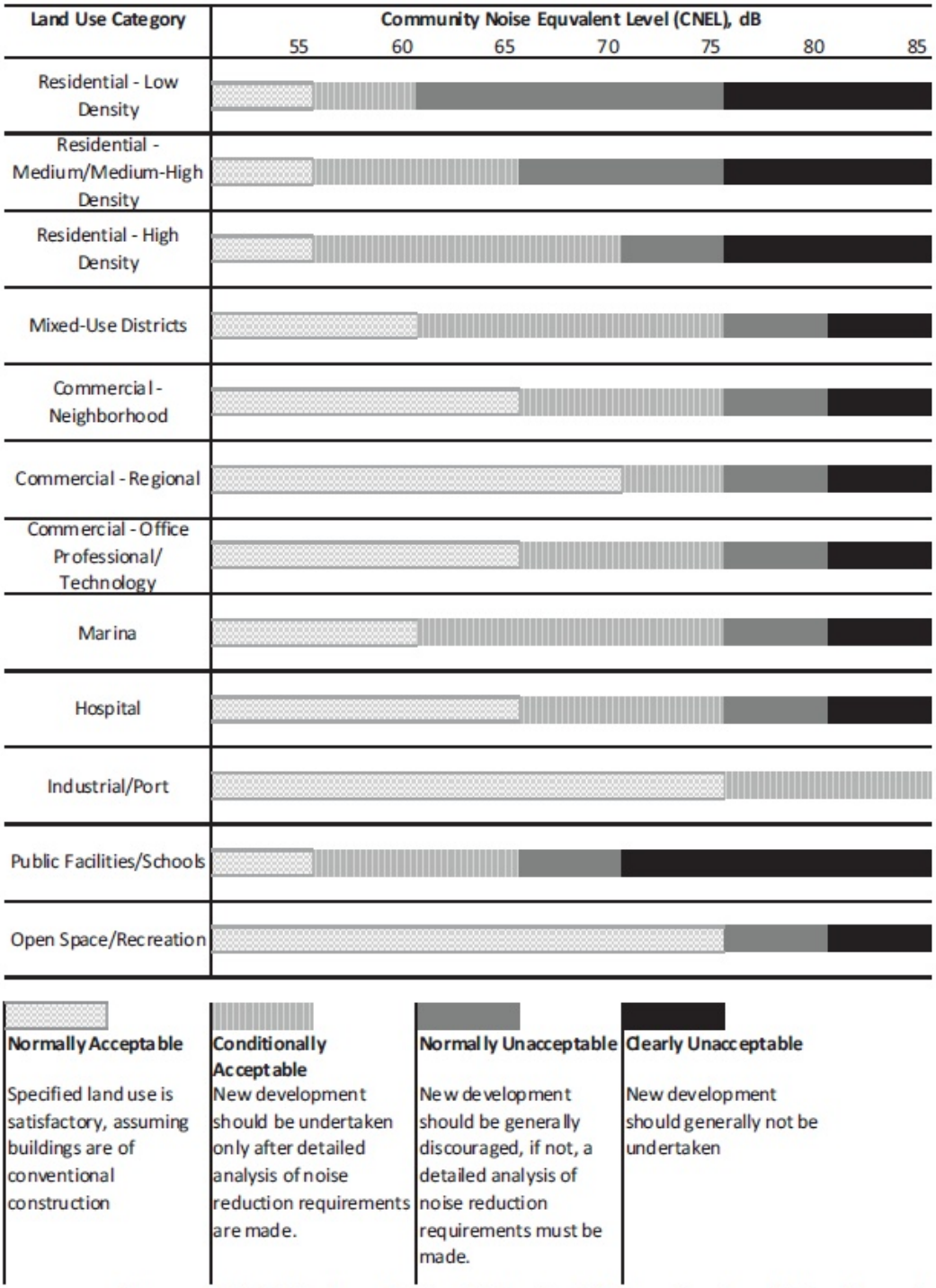


Figure PS-10: Redwood City Noise Guidelines for Land Use Planning

Policy PS-13.4 In accordance with the Municipal Code and noise standards contained in the General Plan, strive to provide a noise environment that is at an acceptable noise level near schools, hospitals, and other noise-sensitive areas.

Policy PS-13.5 Limit the hours of operation at all noise generation sources that are adjacent to noise-sensitive areas, wherever practical.

Policy PS 13-6 Require all exterior noise sources (construction operations, air compressors, pumps, fans, and leaf blowers) to use available noise suppression devices and techniques to bring exterior noise down to acceptable levels that are compatible with adjacent land uses.

Policy PS-13.8 Implement appropriate standard construction noise controls for all construction projects.

Policy PS-13.9 Require noise created by new non-transportation noise sources to be mitigated so as not to exceed acceptable interior and exterior noise level standards.

Program PS-63 **Enforcing Construction and Maintenance Noise Regulations.** Minimize noise from property maintenance equipment, construction activities, and other non-transportation noise sources by enforcing construction and maintenance hours, including vehicle start-up and preparation. Enforce standard construction noise controls such as:

- Limit construction to the hours of 8:00 a.m. to 5:00 p.m. on weekdays, and 9:00 a.m. to 5:00 p.m. on Saturdays, with no noise-generating construction on Sundays or holidays.
- Control noise from construction workers' radios to the point where they are not audible at existing residences that border the project site.
- Equip all internal combustion engine-driven equipment with mufflers that are in good condition and appropriate for the equipment.
- Utilize quiet models of air compressors and other stationary noise sources where technology exists.
- Locate stationary noise-generating equipment as far as possible from sensitive receptors when sensitive receptors adjoin or are near a construction project area.
- Prohibit unnecessary idling of internal combustion engines.
- Notify residents adjacent to the project site of the construction schedule in writing.

Program PS-68 **Maintenance Equipment Restrictions.** Consider the possible restriction of certain types of heating, ventilating, and air condition systems (HVAC) and/or maintenance equipment (such as leaf blowers) within the City.

Program PS-71 **Quiet Pavement Surfaces.** Consider quiet pavement surfaces in the City's repaving plans as an opportunity to make a noticeable reduction in traffic noise along City streets.

City of Redwood City Municipal Code Noise Regulation. The City's Municipal Code establishes noise level performance standards assemblages of three or persons, as well as for fixed sources of noise. The following sections from the Municipal Code apply to this project:

Section 24.31. Prohibited Noise Levels. It shall be unlawful for any person to suffer or allow noise levels to be generated by:

A. Construction activities, including demolition, alteration, repair or remodeling of or to existing structures and construction of new structures on property within the City, at more than 110 dB measured at any point within a residential district of the City and outside of the plane of said property; or

B. An individual item of machinery, equipment or device used during construction activities, including demolition, alteration, repair or remodeling of or to existing structures and construction of new structures on property within the City, at more than 110 dB measured within a residential district of the City at a distance of twenty-five feet (25') from said machinery, equipment or device. If said machinery, equipment or device is housed within a structure on the property, then the measurement shall be made at a distance as near to twenty-five feet (25') from said machinery, equipment or device as possible.

Section 24.32. Time Limitations. Notwithstanding the provisions in this Division to the contrary, it shall be unlawful for any person to engage in construction activities, including demolition, alteration, repair or remodeling of or to existing structures and the construction of new structures on property in a residential district or within five hundred feet (500') of a residential district in the City, between the hours of eight o'clock (8:00) p.m. and seven o'clock (7:00) a.m. the following day, Monday through Friday of any week or at any time on Saturdays, Sundays, or holidays if the noise level generated by any such activity exceeds the local ambient measured at any point within the residential district and outside of the plane of said property.

Existing Noise Environment

The project site is located south of Madison Avenue, between Valota Road and Hawes Street, in Redwood City. The site is currently developed with the existing senior center, memorial pool facilities, and associated parking lots. The land uses surrounding the project site include outdoor baseball and soccer fields to the south and to the east and single-family residences to the north and to the west.

The noise environment in the project vicinity results primarily from vehicular traffic along nearby Jefferson Avenue and the local roadways in the project vicinity, such as Madison Avenue and Valota Road. The occasional overhead aircraft associated with the San Carlos Airport may also affect the noise environment sporadically.

Illingworth & Rodkin, Inc. completed a noise monitoring survey in the vicinity of the Red Morton Community Park back in 2015. The survey started on Thursday, March 12, 2015 and concluded on Tuesday, March 17, 2015. Two long-term noise measurements (LT-1 and LT-2) and two short-term noise measurements (ST-1 and ST-2), as shown in Figure 1, were made as part of this monitoring survey.

Long-term noise measurement LT-1 was located across from the single-family residence at 634 Hawes Street. The measurement was positioned approximately 110 feet north of the centerline of Madison Avenue and approximately 20 feet east of the centerline of Hawes Street. Hourly average noise levels at this location typically ranged from 49 to 65 dBA L_{eq} during the day, and from 43 to 58 dBA L_{eq} at night. The community noise equivalent level from Thursday March 12, 2015 through Tuesday March 17, 2015 ranged from 56 to 58 dBA CNEL. The daily trend in noise levels at LT-1 is shown in Figures 2 through 7.

Located northeast of Mitchell Field in the front of 715 Myrtle Street was the long-term measurement, LT-2. LT-2 was positioned approximately 20 feet east of the centerline of Myrtle Street, and approximately 130 feet south of the centerline of Madison Avenue. Hourly average noise levels at this location ranged from 47 to 66 dBA L_{eq} during the day and from 36 to 56 dBA L_{eq} at night. The community noise equivalent level ranged from 56 to 59 dBA CNEL for the duration of the testing period. The daily trends are shown in Figures 8 through 13.

Short-term noise measurements, ST-1 and ST-2, were conducted on Thursday March 12, 2015 in 10-minute intervals starting at 1:20 p.m. The ST-1 measurement was made near the existing senior center, approximately 150 feet east of the centerline of Valota Road. ST-1 was approximately 35 feet south of the parking lot for the existing senior center and approximately 95 feet southeast of single-family residences. The 10-minute $L_{eq(10\text{-}min)}$ measured at ST-1 was 49 dBA $L_{eq(10\text{-}min)}$. ST-2 was made near the playground located by the tennis courts in the southeastern corner of the park. ST-2 was approximately 80 feet southeast of the tennis courts and approximately 200 feet north of the centerline of Roosevelt Avenue, with shielding from the roadway provided by single-family residences. The 10-minute $L_{eq(10\text{-}min)}$ measured at ST-2 was 56 dBA $L_{eq(10\text{-}min)}$. Table 4 summarizes the results for all of the short-term measurements.

FIGURE 1 Noise and Vibration Measurement Locations

Source: Google Earth 2018.

FIGURE 2 Daily Trends in Noise Levels at LT-1, Thursday, March 12, 2015

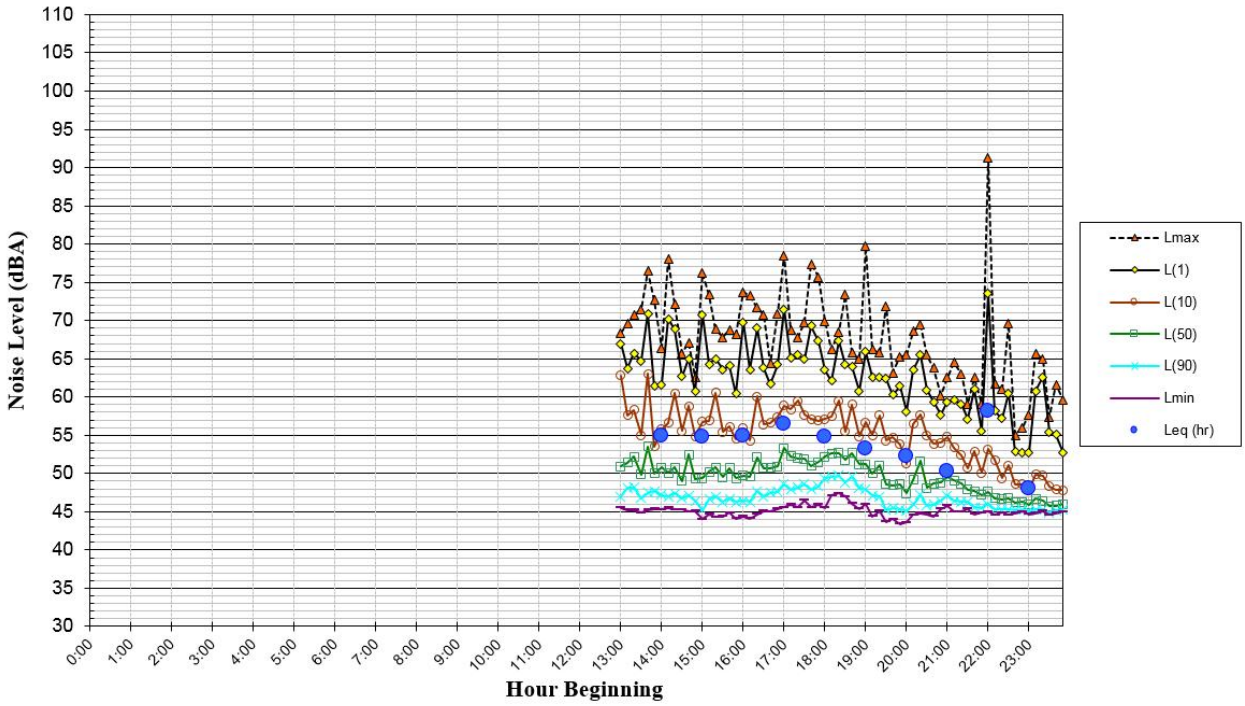


FIGURE 3 Daily Trends in Noise Levels at LT-1, Friday, March 13, 2015

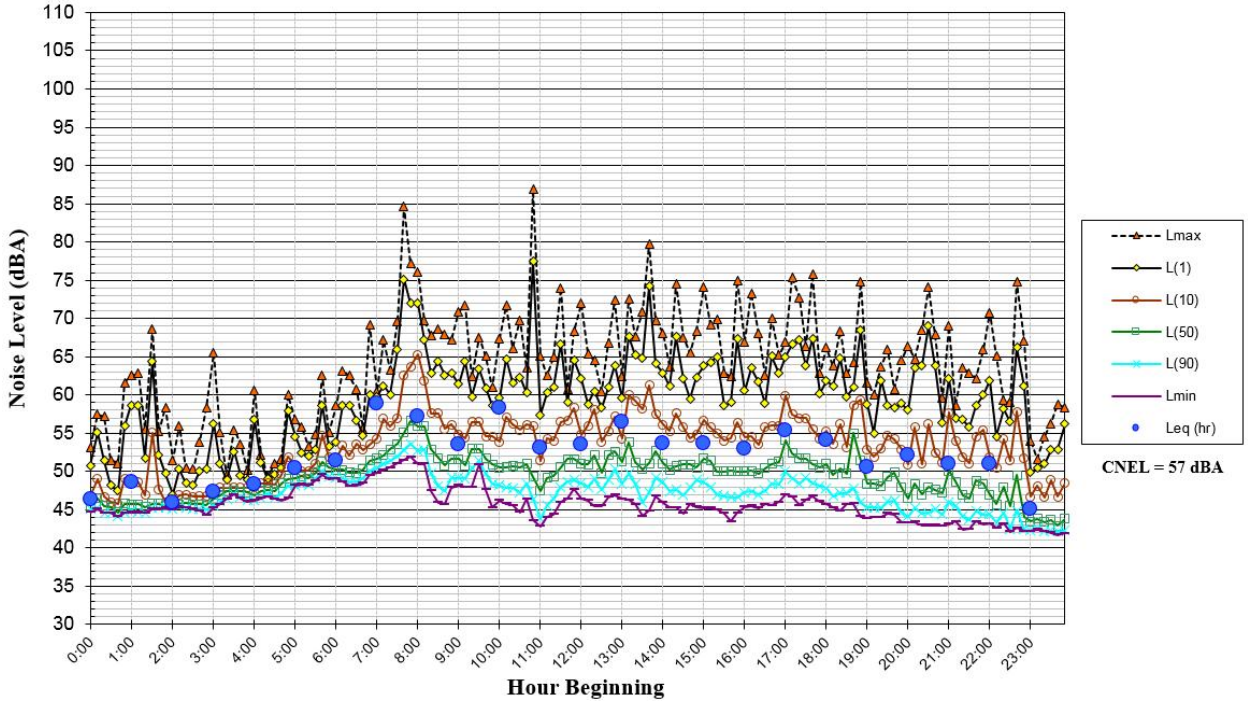


FIGURE 4 Daily Trends in Noise Levels at LT-1, Saturday, March 14, 2015

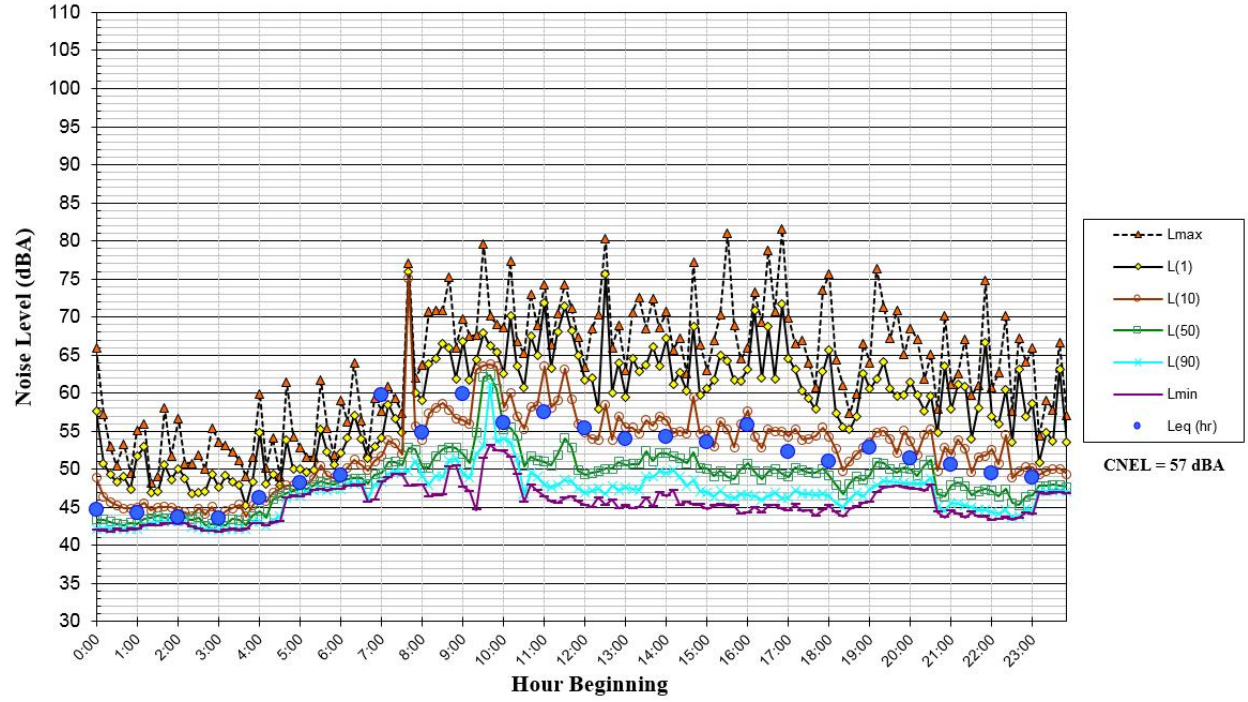


FIGURE 5 Daily Trends in Noise Levels at LT-1, Sunday, March 15, 2015

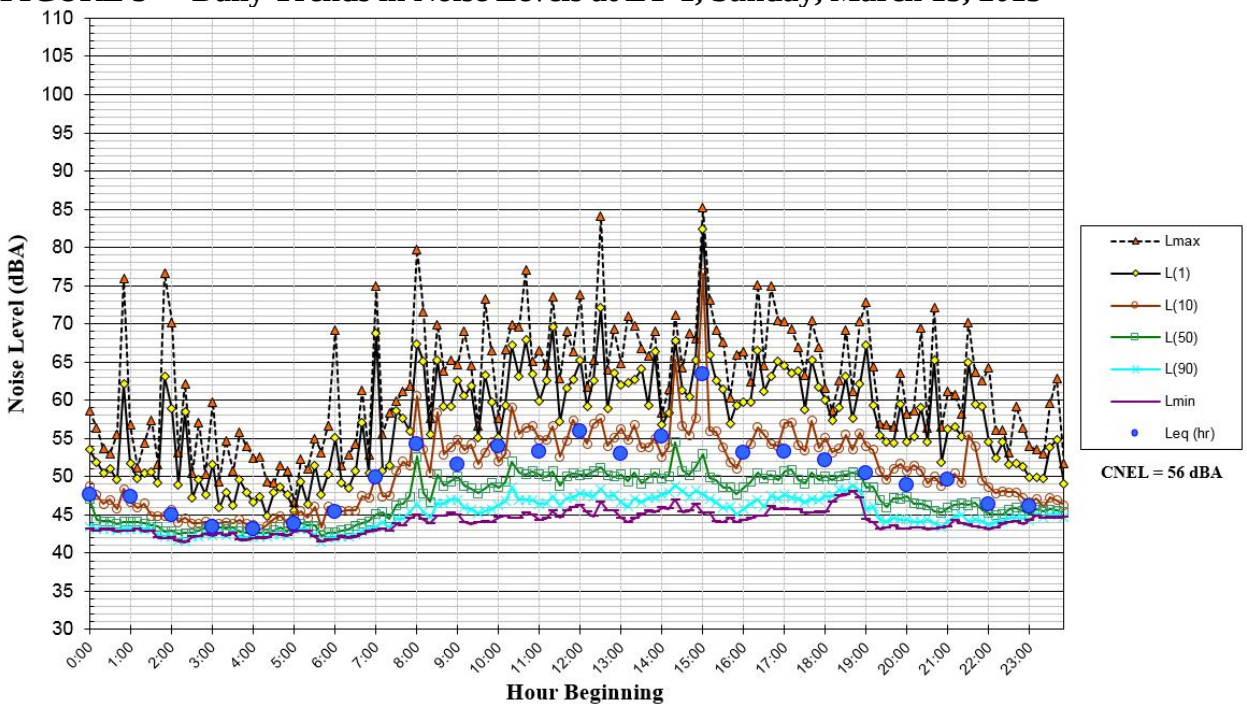


FIGURE 6 Daily Trends in Noise Levels at LT-1, Monday, March 16, 2015

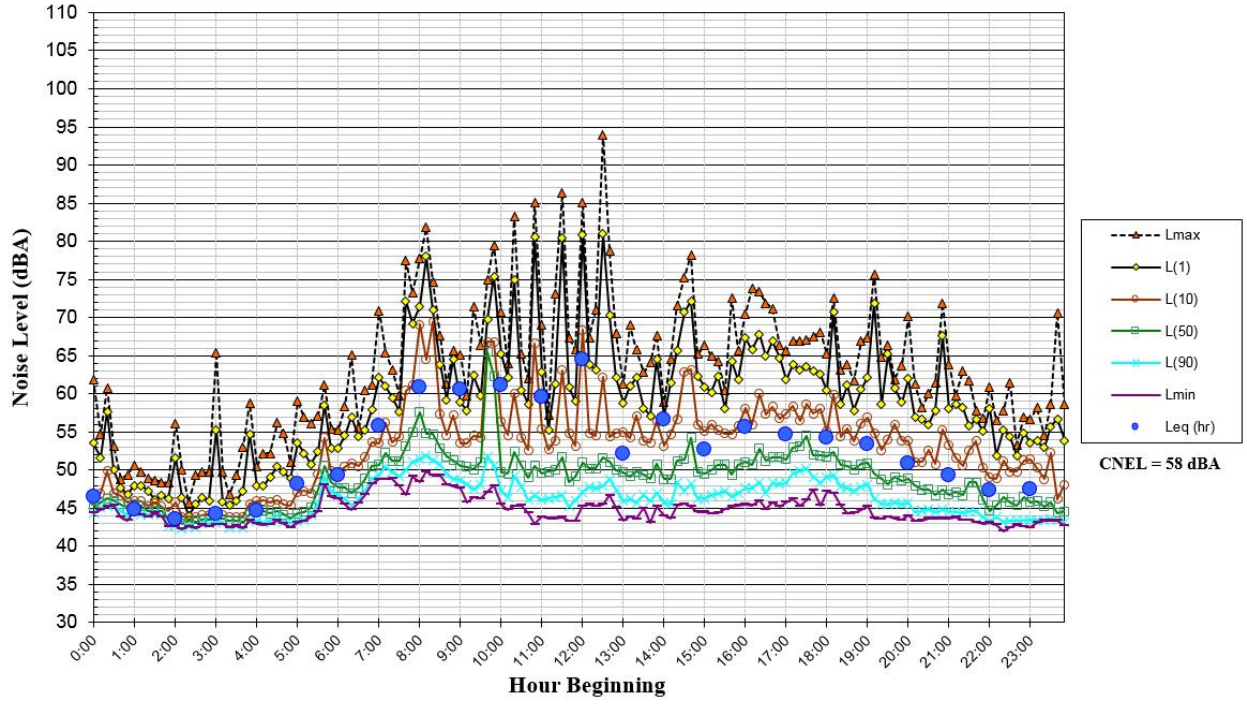


FIGURE 7 Daily Trends in Noise Levels at LT-1, Tuesday, March 17, 2015

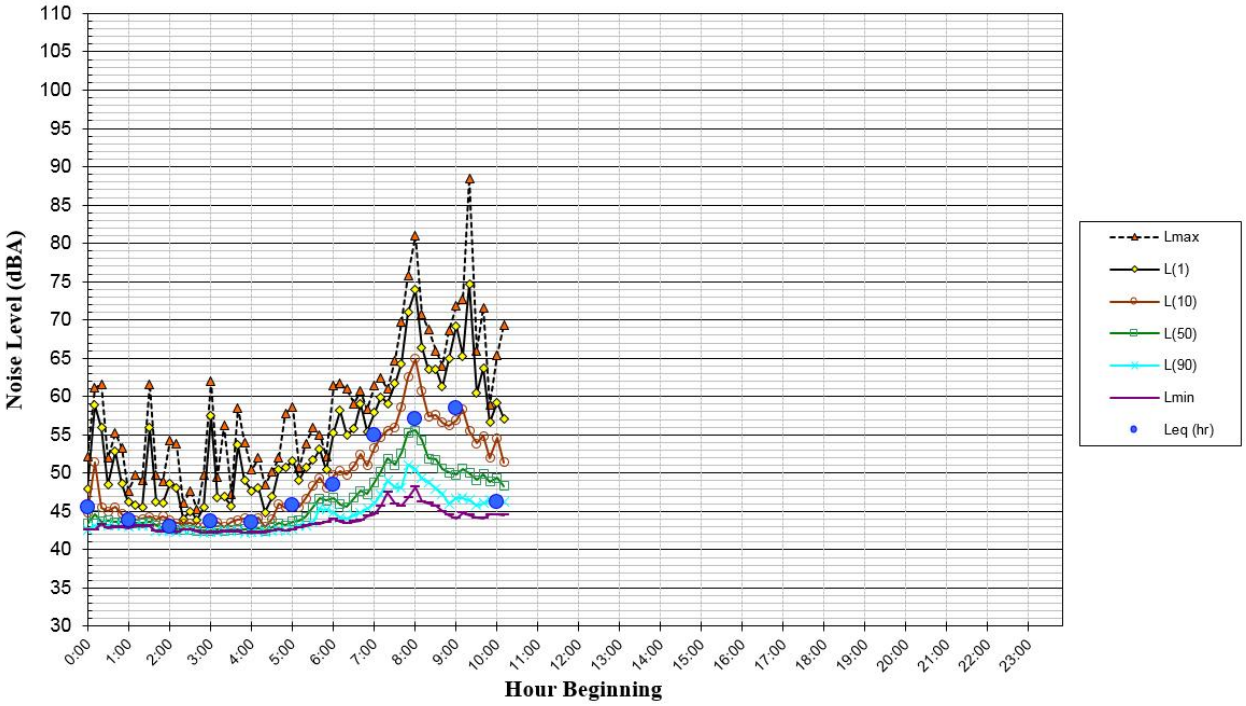


FIGURE 8 Daily Trends in Noise Levels at LT-2, Thursday, March 12, 2015

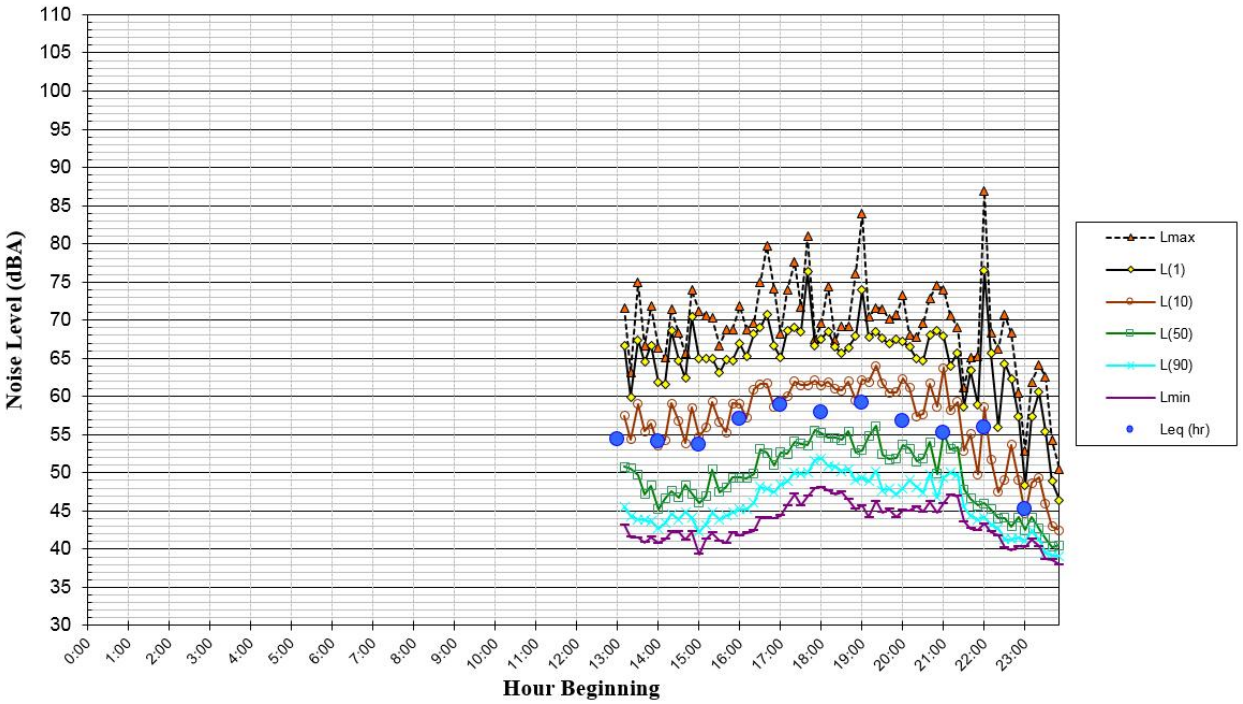


FIGURE 9 Daily Trends in Noise Levels at LT-2, Friday, March 13, 2015

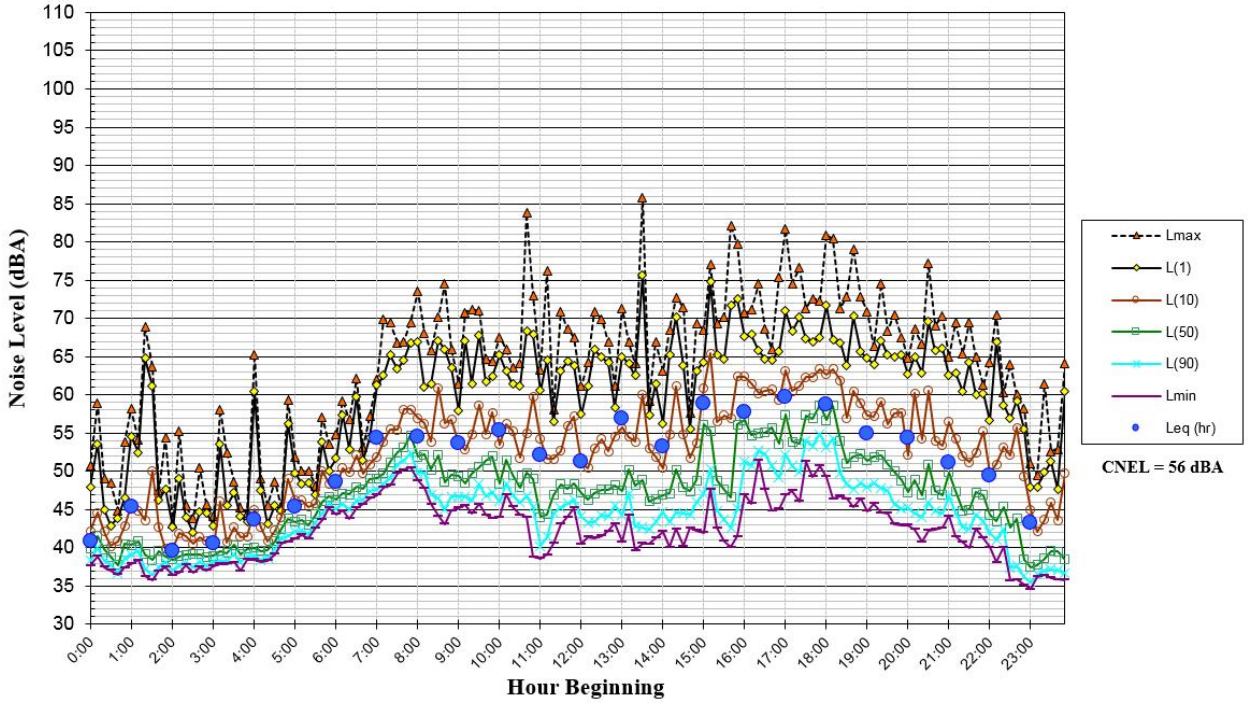


FIGURE 10 Daily Trends in Noise Levels at LT-2, Saturday, March 14, 2015

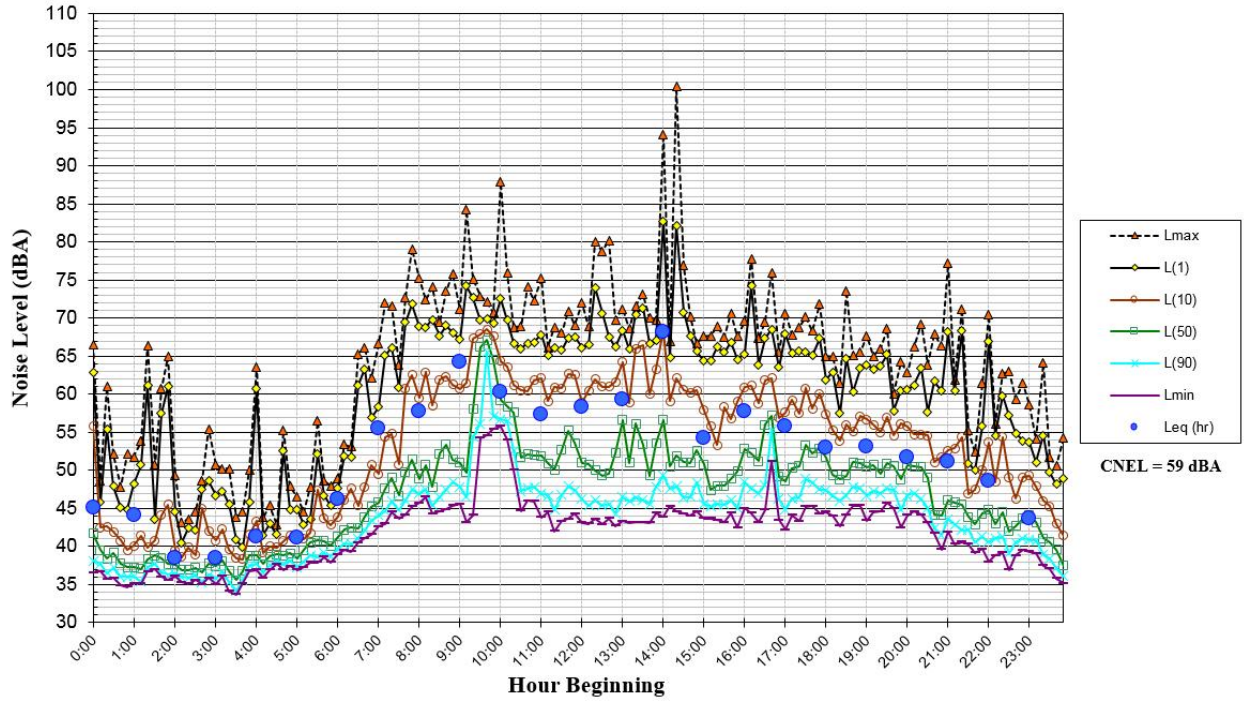


FIGURE 11 Daily Trends in Noise Levels at LT-2, Sunday, March 15, 2015

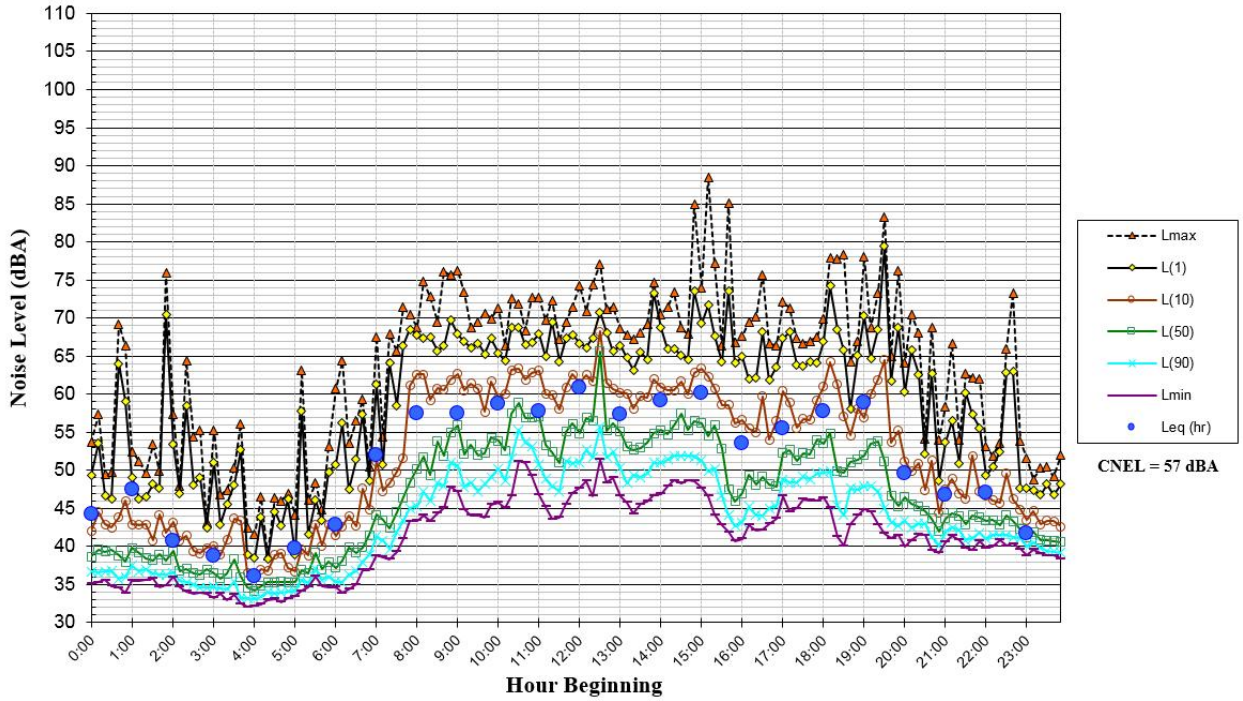


FIGURE 12 Daily Trends in Noise Levels at LT-2, Monday, March 16, 2015

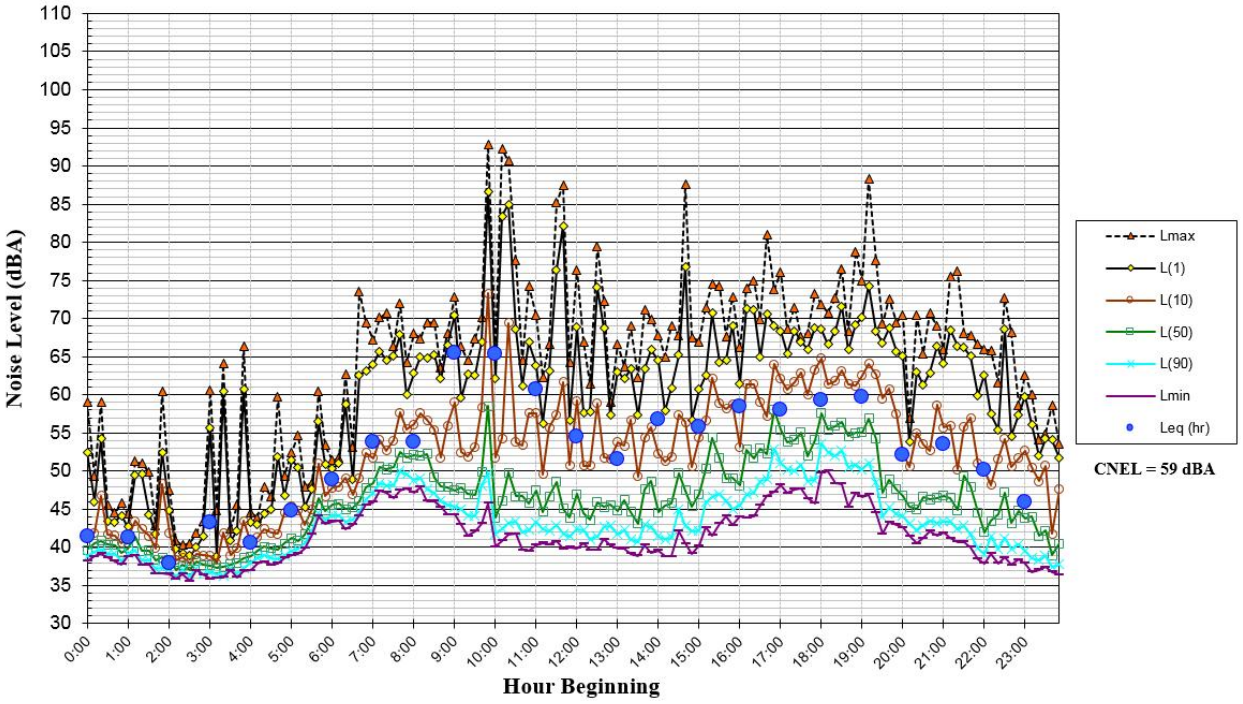


FIGURE 13 Daily Trends in Noise Levels at LT-2, Tuesday, March 17, 2015

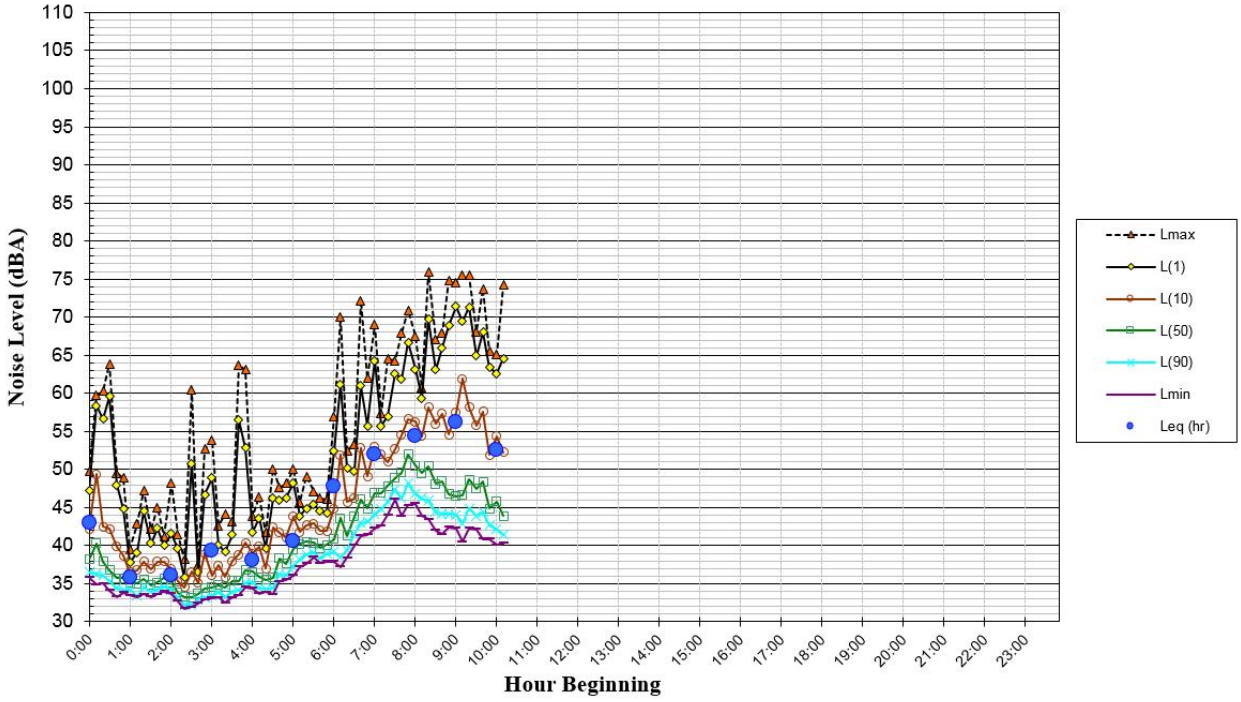


TABLE 4 Summary of Short-Term Noise Measurements (dBA)

Noise Measurement Location	Measured Noise Level, dBA					
	L_{max}	$L_{(1)}$	$L_{(10)}$	$L_{(50)}$	$L_{(90)}$	L_{eq}
ST-1: Near parking lot at the senior center, ~150 feet east of centerline of Valota Rd. (3/12/2015, 13:20-13:30)	61	59	51	46	43	49
ST-2: Near tennis courts and play-ground, back yard equivalent of 1223 Roosevelt Ave. (3/12/2015, 13:50-14:00)	74	68	57	49	46	56

GENERAL PLAN CONSISTENCY ANALYSIS

Noise and Land Use Compatibility

Figure PS-10 of the Public Safety section of the Redwood City General Plan provides exterior noise standards for common outdoor use areas at various types of land uses in Redwood City. The VMSC and YMCA buildings would fall within the open space/recreation category, and for this type outdoor use, noise levels are required to be at or below 75 dBA CNEL. The performance method of the State of California's Cal Green Code requires interior noise levels to be maintained at or below 50 dBA $L_{eq(1\text{-}hr)}$ during hours of operation. This interior noise level performance standard would apply to noise levels within the two proposed buildings.

The future noise environment at the project site would continue to result from vehicular traffic along Jefferson Avenue and Madison Avenue. *Hexagon Transportation Consultants, Inc.* prepared a traffic analysis for the proposed project, which included peak hour traffic volumes for

roadways in the vicinity of the project site. By comparing the cumulative plus project traffic volumes to the existing traffic volumes, noise level increases at the project site were calculated to be 2 dBA.

While long-term noise measurements were not made along Madison Avenue in 2015, the community noise exposure level for both LT-1 and LT-2 were similar, with daily average noise levels ranging from 56 to 58 dBA CNEL and 56 to 59 dBA CNEL, respectively. With Madison Avenue located between the two side streets where LT-1 and LT-2 were located, it is assumed that Madison Avenue would be the dominant noise source for both of these measurement locations. Conservatively, the future noise environment at a distance of 20 feet from the centerline of Madison Avenue would range from 67 to 70 dBA CNEL, based on the 2015 noise measurements from LT-1 and LT-2 and the calculated 2 dBA increase assumed under cumulative plus project conditions.

Future Exterior Noise Environment

Outdoor activity areas at the proposed project site include a dining area on the north side of the VMSC building, a roof terrace with a trellis located on the roof of the VMSC building, a lawn and potential public art area on the north side of the YMCA building, a child play area and pool on the south side of the YMCA building, and a promenade located between the two proposed buildings.

The outdoor dining area along the northern façade of the VMSC building would be set back from the centerline of Madison Avenue by approximately 75 feet or more. At this distance, the future exterior noise levels would range from 61 to 64 dBA CNEL. The second-floor roof terrace would include outdoor seating and a track for walking or running. This outdoor space would be partially shielded from traffic noise by the northern building façade when considering the relative elevation of the outdoor use area with respect to the roadway. With a setback of 225 feet or more, the roof terrace at the VMSC building would have future exterior noise levels below 60 dBA CNEL.

The lawn area north of the YMCA building would be set back 35 feet or more from the centerline of Madison Avenue. At this distance, the future exterior noise levels at the lawn would range from 64 to 67 dBA CNEL. The child play area and outdoor pool would be located south of the YMCA building, and thus, would be partially shielded by the building. With a setback of 310 feet or more, the future exterior noise levels would be below 60 dBA CNEL.

The promenade would have outdoor seating and open lawn for extended outdoor use. The promenade would be 45 feet or more from the centerline of Madison Avenue. At this distance, the future exterior noise levels would be up to 63 to 66 dBA CNEL.

The future noise levels for each of the proposed outdoor use areas would meet the City's 75 dBA CNEL "normally acceptable" threshold for open space/recreation land uses. No further measures would be required to achieve the exterior noise standard.

Future Interior Noise Environment

Hourly average noise levels within proposed non-residential land uses during operational hours would be required to meet the 50 dBA $L_{eq(1\text{-}hr)}$ threshold established by the 2016 Cal Green Code. Standard construction materials for these types of land uses would typically range from 20 to 25 dBA of noise reduction in interior spaces. The inclusion of adequate forced-air mechanical ventilation systems is normally required so windows may be kept closed at the occupants' discretion.

Operational hours during weekdays would be 5:30 a.m. to 10:30 p.m. for the VMSC and 7:00 a.m. to 10:30 p.m. for the YMCA. The northern façade of the VMSC building would be set back approximately 90 feet from the centerline of Madison Avenue. At this distance, the northern building façade would be exposed to future exterior noise levels ranging from 45 to 70 dBA $L_{eq(1\text{-}hr)}$ during operation hours on weekdays. Assuming a conservative 20 dBA exterior-to-interior noise reduction, the interior noise levels at the VMSC would be at or below 50 dBA $L_{eq(1\text{-}hr)}$. The northern façade of the YMCA building would be set back approximately 195 feet from the centerline of Madison Avenue. At this distance, the northern building façade would be exposed to future exterior noise levels ranging from 49 to 65 dBA $L_{eq(1\text{-}hr)}$ during operation hours on weekdays. Assuming a conservative 20 dBA exterior-to-interior noise reduction, the interior noise levels at the YMCA would be at or below 45 dBA $L_{eq(1\text{-}hr)}$.

On weekends, both buildings would operate from 7:00 a.m. to 11:00 p.m. With a setback of 90 feet from the centerline of Madison Avenue, the northern façade of the VSMC building would be exposed to future exterior noise levels ranging from 51 to 68 $L_{eq(1\text{-}hr)}$ during operational hours. Assuming a minimum of 20 dBA of exterior-to-interior noise reduction, the future interior noise levels would be at or below 48 dBA $L_{eq(1\text{-}hr)}$ at the VSMC building. At a distance of 195 feet from the centerline of Madison Avenue, the northern façade of the YMCA building would be exposed to future exterior noise levels ranging from 46 to 64 $L_{eq(1\text{-}hr)}$ during operational hours. Assuming a minimum of 20 dBA of exterior-to-interior noise reduction, the future interior noise levels would be at or below 44 dBA $L_{eq(1\text{-}hr)}$ at the YMCA building.

With standard construction materials and methods, noise levels within building interiors would meet the daytime operational noise level threshold established in the Cal Green Code. No special noise insulation features would be required to achieve a compatible interior noise environment.

IMPACTS AND MITIGATION MEASURES

Significance Criteria

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

- A significant noise impact would be identified if the project would generate a substantial temporary or permanent noise level increase over ambient noise levels at existing noise-sensitive receptors surrounding the project site and that would exceed applicable noise

standards presented in the General Plan or Municipal Code at existing noise-sensitive receptors surrounding the project site.

  - Hourly average noise levels during construction that would exceed 60 dBA L_{eq} at residential land uses and exceed the ambient noise environment by at least 5 dBA L_{eq} would constitute a significant temporary noise increase in the project vicinity.

  - A significant permanent noise level increase would occur if project-generated traffic would result in: a) a noise level increase of 5 dBA CNEL or greater, with a future noise level of less than 55 dBA CNEL, or b) a noise level increase of 3 dBA CNEL or greater, with a future noise level of 55 dBA CNEL or greater.

  - A significant noise impact would be identified if the project would expose persons to or generate noise levels that would exceed applicable noise standards presented in the General Plan or Municipal Code.

- A significant impact would be identified if the construction of the project would generate excessive vibration levels surrounding receptors. Groundborne vibration levels exceeding 0.3 in/sec PPV would have the potential to result in cosmetic damage to normal buildings.

- A significant noise impact would be identified if the project would expose people residing or working in the project area to excessive aircraft noise levels.

Impact 1a: **Temporary Construction Noise.** Existing noise-sensitive land uses would be exposed to a temporary increase in ambient noise levels due to project construction activities. The incorporation of construction best management practices as project conditions of approval would result in a **less-than-significant** temporary noise impact.

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

Section 24.31 of the City's Municipal Code restricts construction activities to 110 dBA at any time within residential districts and limits noise produced by any individual piece of construction equipment used within a residential district to no more than 110 dBA at a distance of 25 feet or 25 feet from the housing if the equipment is enclosed. Section 24.32 states that construction activities would be unlawful in a residential district or within 500 feet of a residential district between the hours of 8:00 p.m. and 7:00 a.m. Monday through Friday or at any time on weekends or holidays if the noise level generated by any construction activity exceeds local ambient noise levels within the residential district. Additionally, Program PS-63 of the City's

General Plan enforces standard construction noise controls to minimize noise from construction activities. These include the following:

- Limit construction to the hours of 8:00 a.m. to 5:00 p.m. on weekdays, and 9:00 a.m. to 5:00 p.m. on Saturdays, with no noise-generating construction on Sundays or holidays.

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

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

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

- Locate stationary noise-generating equipment as far as possible from sensitive receptors when sensitive receptors adjoin or are near a construction project area.

- Prohibit unnecessary idling of internal combustion engines.

- Notify residents adjacent to the project site of the construction schedule in writing.

The noise level threshold for speech interference indoors is 45 dBA. Assuming a 15 dBA exterior-to-interior reduction for standard residential construction, this would correlate to an exterior threshold of 60 dBA L_{eq} at residential land uses. Additionally, temporary construction would be annoying to surrounding land uses if the ambient noise environment increased by at least 5 dBA L_{eq} for an extended period of time. Therefore, the temporary construction noise impact would be considered significant if project construction activities exceeded 60 dBA L_{eq} at nearby residences or exceeded 70 dBA L_{eq} at nearby commercial land uses and exceeded the ambient noise environment by 5 dBA L_{eq} or more.

Based on the 2015 measurements made in the residential neighborhood surrounding the site at LT-1 and LT-2, existing hourly average noise levels ranged from 51 to 66 dBA L_{eq} during daytime hours on weekdays and from 47 to 64 dBA L_{eq} during daytime hours on weekends.

Construction noise would primarily result from the operation of heavy construction equipment and arrival and departure of heavy-duty trucks. The highest maximum noise levels generated by project construction would typically range from about 80 to 90 dBA L_{max} at a distance of 50 feet from the noise source. A list of typical maximum instantaneous noise levels measured at 50 feet are provided in Table 5. Typical hourly average construction-generated noise levels for this type of facility are about 75 to 89 dBA L_{eq} measured at a distance of 50 feet from the center of the site during busy construction periods (e.g., earth moving equipment, impact tools, etc.), as shown in Table 6. As part of the proposed project, roadway improvements would also be made in the project site vicinity. Hourly average noise levels for this type of work would range from 78 to 84 dBA L_{eq}. 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.

A detailed list of construction equipment was not provided for the proposed project, but it is assumed that pile driving, which generates up to 105 dBA L_{max} at a distance of 50 feet, would not be required for the proposed project. Under this assumption, a single piece of equipment expected for this project would generate noise levels up to 96 dBA L_{max} at a distance of 25 feet, which would meet the City's requirements for a single piece of equipment. For 110 dBA to be exceeded at any residential property surrounding the project site, a concrete saw, hydra break ram or a hoe ram would have to be operated within 5 feet of the residential property line or other equipment in Table 5 to be used within 1 to 3 feet of the property lines. The heavy construction work for the proposed project would be completed where the buildings are to be located on the site. Therefore, this type of noisy equipment would not be expected within 25 feet of residential property lines. This would satisfy the City's thresholds under Section 24.31 of the Municipal Code.

As described in the project description, dated January 30, 2019, the project would be completed in two phases. Phase 1 includes the construction of the VMSC building and traffic calming measures at four nearby intersections. The following traffic calming measures are proposed: 1) install a new roundabout at Vera Avenue and Valota Road; 2) expand the existing traffic circle at Hudson Street and Madison Avenue; 3) install a new mini traffic circle at Madison Avenue and Myrtle Street; and 4) install a new median island and curb extensions at the Valota Road and Madison Avenue intersection. Phase 1 would start as early as January 2020 and be completed as early as December 2021, lasting for a total of 24 months. As part of Phase 2, the YMCA building would be constructed. Phase 2 would start once Phase 1 is complete and is also expected to last 24 months, starting in January 2022 and concluding in December 2023.

The hourly average noise levels summarized in Table 6 were used to calculate the hourly average noise levels at the property line of the surrounding residences, as measured from the center of the active construction site. For the construction of the VMSC building in Phase 1, the center of the active construction site would be the center of the future building. The existing Veterans Building, which is located where the future YMCA would be constructed, would remain open during Phase 1 construction. This existing building would provide partial shielding for the residences located to the west of the project site; however, for purposes of assuming worst-case conditions, no noise level reduction due to intervening buildings was assumed for this assessment. Table 7 shows the estimated hourly average noise levels at the nearby residences during the construction of the VMSC building. Additionally, Table 8 shows the estimated hourly average noise levels for the residences located at each of the intersections where traffic calming measures are proposed. For estimating the noise levels in Table 8, the distances to the nearest residential property were measured from the center of each intersection. Table 9 summarizes the noise levels generated by Phase 2 construction, as measured at the nearest surrounding residential property lines. As with the VMSC building construction, shielding due to intervening buildings was not assumed for the noise level calculations in Table 9.

TABLE 5 Construction Equipment 50-Foot Noise Emission Limits

Equipment Category	L_{max} Level (dBA)[1,2]	Impact/Continuous
Arc Welder	73	Continuous
Auger Drill Rig	85	Continuous
Backhoe	80	Continuous
Bar Bender	80	Continuous
Boring Jack Power Unit	80	Continuous
Chain Saw	85	Continuous
Compressor[3]	70	Continuous
Compressor (other)	80	Continuous
Concrete Mixer	85	Continuous
Concrete Pump	82	Continuous
Concrete Saw	90	Continuous
Concrete Vibrator	80	Continuous
Crane	85	Continuous
Dozer	85	Continuous
Excavator	85	Continuous
Front End Loader	80	Continuous
Generator	82	Continuous
Generator (25 KVA or less)	70	Continuous
Gradall	85	Continuous
Grader	85	Continuous
Grinder Saw	85	Continuous
Horizontal Boring Hydro Jack	80	Continuous
Hydra Break Ram	90	Impact
Impact Pile Driver	105	Impact
Insitu Soil Sampling Rig	84	Continuous
Jackhammer	85	Impact
Mounted Impact Hammer (hoe ram)	90	Impact
Paver	85	Continuous
Pneumatic Tools	85	Continuous
Pumps	77	Continuous
Rock Drill	85	Continuous
Scraper	85	Continuous
Slurry Trenching Machine	82	Continuous
Soil Mix Drill Rig	80	Continuous
Street Sweeper	80	Continuous
Tractor	84	Continuous
Truck (dump, delivery)	84	Continuous
Vacuum Excavator Truck (vac-truck)	85	Continuous
Vibratory Compactor	80	Continuous
Vibratory Pile Driver	95	Continuous
All other equipment with engines larger than 5 HP	85	Continuous

Notes:

[1] Measured at 50 feet from the construction equipment, with a "slow" (1 sec.) time constant.

[2] Noise limits apply to total noise emitted from equipment and associated components operating at full power while engaged in its intended operation.

[3] Portable Air Compressor rated at 75 cfm or greater and that operates at greater than 50 psi.

TABLE 6 Typical Ranges of Construction Noise Levels at 50 Feet, L_{eq} (dBA)

	Domestic Housing		Office Building, Hotel, Hospital, School, Public Works		Industrial Parking Garage, Religious Amusement & Recreations, Store, Service Station		Public Works Roads & Highways, Sewers, and Trenches	
	I	**II**	**I**	**II**	**I**	**II**	**I**	**II**
Ground Clearing	83	83	84	84	84	83	84	84
Excavation	88	75	89	79	89	71	88	78
Foundations	81	81	78	78	77	77	88	88
Erection	81	65	87	75	84	72	79	78
Finishing	88	72	89	75	89	74	84	84

I - All pertinent equipment present at site.
II - Minimum required equipment present at site.

Source: U.S.E.P.A., Legal Compilation on Noise, Vol. 1, p. 2-104, 1973.

TABLE 7 Estimated Construction Noise Levels at Nearby Land Uses During Phase 1 Construction of the VMSC Building

Proposed Project Construction	Estimated Noise Levels at Nearby Land Uses, dBA L_{eq}			
	North Res. (210ft)	East Res. (540ft)	West Res. (380ft)	South Res. (885ft)
Ground Clearing	72 dBA L_{eq}	63 dBA L_{eq}	66 dBA L_{eq}	59 dBA L_{eq}
Excavation	67-77 dBA L_{eq}	58-68 dBA L_{eq}	61-71 dBA L_{eq}	54-64 dBA L_{eq}
Foundations	66 dBA L_{eq}	57 dBA L_{eq}	60 dBA L_{eq}	53 dBA L_{eq}
Erection	63-75 dBA L_{eq}	54-66 dBA L_{eq}	57-69 dBA L_{eq}	50-62 dBA L_{eq}
Finishing	63-77 dBA L_{eq}	54-68 dBA L_{eq}	57-71 dBA L_{eq}	50-64 dBA L_{eq}

TABLE 8 Estimated Construction Noise Levels at Nearby Land Uses During Phase 1 Construction of the Traffic Calming Measures

Proposed Project Construction	Estimated Noise Levels at Nearby Land Uses, dBA L_{eq}			
	Res. at Vera Ave/Valota Rd (25ft)	Res. at Hudson St/Madison Ave (40ft)	Res. at Madison Ave/Myrtle St (35ft)	Res. at Valota Rd/Madison Ave (30ft)
Ground Clearing	90 dBA L_{eq}	86 dBA L_{eq}	87 dBA L_{eq}	88 dBA L_{eq}
Excavation	84-94 dBA L_{eq}	80-90 dBA L_{eq}	81-91 dBA L_{eq}	82-92 dBA L_{eq}
Foundations	94 dBA L_{eq}	90 dBA L_{eq}	91 dBA L_{eq}	92 dBA L_{eq}
Erection	84-85 dBA L_{eq}	80-81 dBA L_{eq}	81-82 dBA L_{eq}	82-83 dBA L_{eq}
Finishing	90 dBA L_{eq}	86 dBA L_{eq}	87 dBA L_{eq}	88 dBA L_{eq}

TABLE 9 Estimated Construction Noise Levels at Nearby Land Uses During Phase 2 Construction of the YMCA Building

Proposed Project Construction	Estimated Noise Levels at Nearby Land Uses, dBA L_{eq}			
	North Res. (2850ft)	East Res. (745ft)	West Res. (210ft)	South Res. (775ft)
Ground Clearing	69 dBA L_{eq}	61 dBA L_{eq}	72 dBA L_{eq}	60 dBA L_{eq}
Excavation	64-74 dBA L_{eq}	56-66 dBA L_{eq}	67-77 dBA L_{eq}	55-65 dBA L_{eq}
Foundations	63 dBA L_{eq}	55 dBA L_{eq}	66 dBA L_{eq}	54 dBA L_{eq}
Erection	60-72 dBA L_{eq}	52-64 dBA L_{eq}	63-75 dBA L_{eq}	51-63 dBA L_{eq}
Finishing	60-74 dBA L_{eq}	52-66 dBA L_{eq}	63-77 dBA L_{eq}	51-65 dBA L_{eq}

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. Construction activities will be conducted in accordance with the provisions of the City's General Plan and the Municipal Code. Program PS-63 of the City's General Plan enforces construction and maintenance noise regulations using the following standard construction noise controls:

- Limit construction to the hours of 8:00 a.m. to 5:00 p.m. on weekdays, and 9:00 a.m. to 5:00 p.m. on Saturdays, with no noise-generating construction on Sundays or holidays.

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

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

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

- Locate stationary noise-generating equipment as far as possible from sensitive receptors when sensitive receptors adjoin or are near a construction project area.

- Prohibit unnecessary idling of internal combustion engines.

- Notify residents adjacent to the project site of the construction schedule in writing.

These noise controls shall be incorporated into the project to minimize noise disturbance to the surrounding neighbors. The City's Municipal Code further defines construction allowable hours between 7:00 a.m. and 8:00 p.m. Monday through Friday. If the ambient noise environment is exceeded within a residential district, the Municipal Code prohibits construction on weekends and holidays.

Based on the results of Tables 7 through 9, the nearest noise-sensitive receptors would at times be exposed to temporary construction noise in excess of existing ambient conditions. Further, noise levels would at times exceed 60 dBA L_{eq} at the nearest residences and at times exceed ambient noise levels by 5 dBA L_{eq} or more. Since total project construction is expected to last for about four years, this would be considered a significant impact.

Mitigation Measure 1a:

In addition to the noise controls specified in the General Plan, the City shall require the construction crew to adhere to the following construction best management practices to further 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 construction best management controls:

- If residents surrounding the project site complain about Saturday construction noise or if work is disruptive to the adjacent Red Morton Community Park activities occurring on Saturdays, all weekend construction work shall cease, as specified in the allowable construction hours stated in the City's Municipal Code.

- Construct temporary noise barriers, where feasible, to screen stationary noise-generating equipment when located within 200 feet of adjoining sensitive land uses. Temporary noise barrier fences would provide a 5 dBA noise reduction if the noise barrier interrupts the line-of-sight between the noise source and receptor and if the barrier is constructed in a manner that eliminates any cracks or gaps.

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

- 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.

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

- Where feasible, temporary power service from local utility companies should be used instead of portable generators.

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

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

- Substitute nail guns for manual hammering, where feasible.

- Avoid the use of circular saws, miter/chop saws, and radial arm saws near the adjoining noise-sensitive receptors. Where feasible, shield saws with a solid screen with material having a minimum surface density of 2 lbs/ft^2 (e.g., such as ¾" plywood).

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

- Maintain smooth vehicle pathways for trucks and equipment accessing the site, and avoid local residential neighborhoods as much as possible.

- During interior construction, the exterior windows facing noise-sensitive receptors should be closed.

- During interior construction, locate noise-generating equipment within the building to break the line-of-sight to the adjoining receptors.

- 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 these reasonable and feasible controls, as well as the noise control measures provided in the General Plan, would reduce construction noise levels emanating from the site in order to minimize disruption and annoyance. With the implementation of these measures, the lack of high-intensity construction equipment required for the proposed project, and the fact that noise generated by construction activities would occur over a temporary period following the applicable General Plan and Municipal Code thresholds, the temporary increase in ambient noise levels at each of the proposed development sites would be reduced to a less-than-significant level.

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

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 future ambient noise levels exceed the "normally acceptable" noise level standard. Where future ambient noise levels would remain below the "normally acceptable" noise level standard, noise level increases of 5 dBA CNEL or greater would be considered significant. According to Figure PS-10 of the City's General Plan, 55 dBA CNEL would be the "normally acceptable" noise level threshold for single-family residences. Since existing ambient noise levels in the vicinity of the project site exceed 55 dBA CNEL, it is expected that ambient noise levels would continue to exceed 55 dBA CNEL under future conditions. Therefore, a significant impact would occur if traffic due to the proposed project would permanently increase ambient levels by 3 dBA CNEL. For reference, a 3 dBA CNEL noise increase would be expected if the project would double existing traffic volumes along a roadway.

The traffic study completed for the proposed project includes peak hour traffic turning movements for 14 intersections in the vicinity of the project site. The existing plus project scenario was compared to the existing volumes to estimate the noise level increase due to project-generated traffic. Two roadway segments resulted in a doubling of traffic on the weekends and tripling of traffic on the weekdays due to the project: 1) Saint Francis Street between Jefferson Avenue and Madison Avenue, and 2) the parking lot access driveway at the Saint Francis Street/Madison Avenue intersection. However, the existing traffic volumes along Saint Francis Street are fewer than 100 vehicles per hour on weekdays and weekends, and the residences adjoining this roadway also adjoin Jefferson Avenue and Madison Avenue, which are the dominant noise sources at the residences. With the substantially higher traffic volumes along Jefferson Avenue and Madison Avenue and the calculated noise level increase due to project-generated traffic along these roadways being 2 dBA or less, the increase in traffic volumes along Saint Francis Street would not significantly increase the overall noise environment.

All other roadway segments included in the traffic study resulted in noise level increases due to project-generated traffic of 2 dBA or less on weekdays and weekends. Therefore, the proposed project would not cause a substantial permanent noise level increase at the surrounding noise-sensitive receptors. This is a less-than-significant impact.

Mitigation Measure 1b: None required.

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

Mechanical Equipment

The proposed project would include mechanical equipment, such as heating, ventilation, air conditioning systems, exhaust units, etc. Information regarding the number, type, size, and noise level data of the mechanical equipment units to be used in the proposed project was not available at the time of this study. Typically, mechanical equipment at these types of buildings would be located within mechanical equipment rooms or on the rooftops.

The City of Redwood City does not identify specific noise regulations for mechanical equipment.

Without knowing specific information such as the number and types of units, size, housing specifications, source noise levels, and precise locations, the impact of mechanical equipment noise on nearby noise-sensitive uses cannot be assessed at this time. Conservatively, mechanical equipment noise for the proposed project has the potential to exceed the ambient noise levels at the residential land uses during daytime or nighttime conditions. This is conservatively considered a potentially significant impact.

Truck Loading and Unloading

While the frequency of truck deliveries was not provided at the time of this study, these buildings are expected to have regular deliveries for the kitchens and dining areas. Two delivery drop-off locations were identified in the site plan, and both locations were along the eastern building façade of the VMSC building in the eastern parking lot. Truck deliveries at these locations would have the potential to generate noise.

This analysis assumes that the proposed project would have one to two truck deliveries per week. Typical deliveries would take approximately 15 minutes or less and would be assumed to only occur during the daytime. Based on the size of the proposed buildings, smaller delivery trucks would be expected at the project site. These trucks typically would generate maximum noise levels of 65 to 70 dBA at a distance of 50 feet.

The nearest residences with direct line-of-sight to the proposed delivery zones would be 120 feet north, opposite Madison Avenue. Using a 6 dBA per doubling of the distance propagation rate, noise levels due to deliveries at the nearest residences would range from 57 to 62 dBA, which would fall in the range of daytime ambient noise levels of 49 to 65 dBA L_{eq} (LT-1) While the nearest residences to the east would also have direct line-of-sight to the delivery zones, the distance from these residences to the delivery zones would be 435 feet or more. At 435 feet, truck deliveries would produce noise levels ranging from 46 to 51 dBA, which would fall in the range of daytime ambient noise levels of 47 to 66 dBA L_{eq} (LT-2). The nearest residences to the west would be shielded by the VMSC building and would not be affected by the truck deliveries.

Residences to the south would be 845 feet or more away from the nearest delivery zone and would be exposed to truck delivery noise levels below 50 dBA.

Daytime truck deliveries would result in a less-than-significant impact.

Mitigation Measure 1c:

Mechanical equipment shall be selected and designed to reduce impacts on surrounding uses to meet ambient noise conditions at the nearest residential land uses during both daytime and nighttime conditions. 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. Alternate measures may include locating equipment in less noise-sensitive areas, such as indoors or the rooftop of the buildings away from the building's edge nearest the noise-sensitive receptors, where feasible.

Impact 2: **Exposure to Excessive Groundborne 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 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 demolition, preparation work, foundation work, and new building framing and finishing. The proposed project is not expected to require pile driving, which can cause excessive vibration. Critical factors pertaining to the impact of construction vibration on sensitive receptors include the proximity of the existing structures to the project site, the soundness of the structures, and the methods of construction used.

For structural damage, the California Department of Transportation recommends a vibration limit of 0.5 in/sec PPV for buildings structurally sound and designed to modern engineering standards, 0.3 in/sec PPV for buildings that are found to be structurally sound but where structural damage is a major concern, and a conservative limit of 0.08 in/sec PPV for ancient buildings or buildings that are documented to be structurally weakened. No known ancient buildings or buildings that are documented to be structurally weakened adjoin the project area. Therefore, conservatively, groundborne vibration levels exceeding 0.3 in/sec PPV would have the potential to result in a significant vibration impact.

Table 10 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. Vibration levels would vary depending on soil conditions, construction methods, and equipment used.

For the construction work expected during Phases 1 and 2, vibration levels from Table 10 were propagated from the project's nearest boundaries to the nearest offsite buildings. The estimated vibration levels at nearby buildings are summarized in Table 11. Vibration levels at the nearest residences to the north and to the west of the project site would be below the 0.3 in/sec PPV threshold. Additionally, the nearest building south, which is an existing building associated with Red Morton Community Park would also be exposed to vibration levels below the 0.3 in/sec PPV threshold. The nearest residence to the south would be farther from the project site, and thus, would be exposed to lower vibration levels. The nearest residences to the west of the site, which would adjoin the west parking lot and access driveway, would be 10 to 15 feet from the shared property line. At these distances, vibration levels would be as high as 0.37 to 0.58 in/sec PPV, as shown in Table 11. This would exceed the 0.3 in/sec PPV threshold.

For each of the traffic calming measures, vibration levels in Table 10 were propagated from the edge of the intersection to the nearest residence. Table 12 summarizes the vibration levels calculated for construction activities related to each of the traffic calming measures. At each intersection, the nearest residence would be set back 25 feet or more from construction work areas, which would result in vibration levels below the 0.3 in/sec PPV threshold.

The construction-generated vibration levels for the proposed project could potentially result in cosmetic damage (e.g., hairline cracks in plaster, opening of old cracks, etc.) at the existing structures adjoining the project site to the west. Additionally, construction vibration would be strongly perceptible to severe to occupants of the adjacent residences. This would be a significant impact.

TABLE 10 Vibration Source Levels for Construction Equipment

Equipment		**PPV at 25 ft. (in/sec)**
Clam shovel drop		0.202
Hydromill (slurry wall)	in soil	0.008
	in rock	0.017
Vibratory Roller		0.210
Hoe Ram		0.089
Large bulldozer		0.089
Caisson drilling		0.089
Loaded trucks		0.076
Jackhammer		0.035
Small bulldozer		0.003

Source: Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, September 2018.

TABLE 11 Estimated Vibration Levels for Construction Equipment Used at the Project Site

Equipment		Vibration Levels at Nearest Building (in/sec PPV)			
		PPV at 55 ft. (in/sec) at Nearest Res. (north)	PPV at 335 ft. (in/sec) at Nearest Res. (east)	PPV at 10 to 15 ft. (in/sec) at Nearest Res. (west)	PPV at 325 ft. (in/sec) at Nearest Park Building (south)
Clam shovel drop		0.085	0.012	**0.354-0.553**	0.012
Hydromill (slurry wall)	in soil	0.003	0.0005	0.014-0.022	0.0005
	in rock	0.007	0.01	0.030-0.047	0.001
Vibratory Roller		0.088	0.012	**0.368-0.575**	0.012
Hoe Ram		0.037	0.005	0.156-0.244	0.005
Large bulldozer		0.037	0.005	0.156-0.244	0.005
Caisson drilling		0.037	0.005	0.156-0.244	0.005
Loaded trucks		0.032	0.004	0.133-0.208	0.005
Jackhammer		0.015	0.002	0.061-0.096	0.002
Small bulldozer		0.001	0.0002	0.005-0.008	0.0002

Source: Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, September 2018, as modified by Illingworth & Rodkin, Inc., March 2019.

TABLE 12 Estimated Vibration Levels for Construction Equipment Used at the Intersections Included in the Traffic Calming Measures

Equipment		Vibration Levels at Nearest Building (in/sec PPV)			
		PPV at 35 ft. (in/sec) at Nearest Res. to Vera Ave/Valota Rd	PPV at 25 ft. (in/sec) at Nearest Res. to Hudson St/Madison Ave	PPV at 40 ft. (in/sec) at Nearest Res. to Madison Ave/Myrtle St	PPV at 30 ft. (in/sec) at Nearest Res. to Valota Rd/Madison Ave
Clam shovel drop		0.140	0.202	0.120	0.165
Hydromill (slurry wall)	in soil	0.006	0.008	0.005	0.007
	in rock	0.012	0.017	0.010	0.014
Vibratory Roller		0.145	0.210	0.125	0.172
Hoe Ram		0.061	0.089	0.053	0.073
Large bulldozer		0.061	0.089	0.053	0.073
Caisson drilling		0.061	0.089	0.053	0.073
Loaded trucks		0.052	0.076	0.045	0.062
Jackhammer		0.024	0.035	0.021	0.029
Small bulldozer		0.002	0.003	0.002	0.002

Source: Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, September 2018, as modified by Illingworth & Rodkin, Inc., March 2019.

Mitigation Measure 2:

In addition to the noise controls outlined in Program PS-63 of the City's General Plan and **Mitigation Measure 1a**, the following measures shall be implemented where vibration levels due to construction activities would exceed 0.3 in/sec PPV at nearby sensitive uses:

- Comply with the construction noise ordinance to limit hours of exposure. The City's

Municipal Code allows construction activities between the hours of 7:00 a.m. and 8:00 p.m. Monday through Friday. If the ambient noise environment is exceeded within a residential district, the Municipal Code prohibits construction on weekends and holidays.

- Prohibit the use of heavy vibration-generating construction equipment within 20 feet of the structures located adjacent to the project site.

- The contractor shall alert heavy equipment operators to the close proximity of the adjacent structures so they can exercise extra care.

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

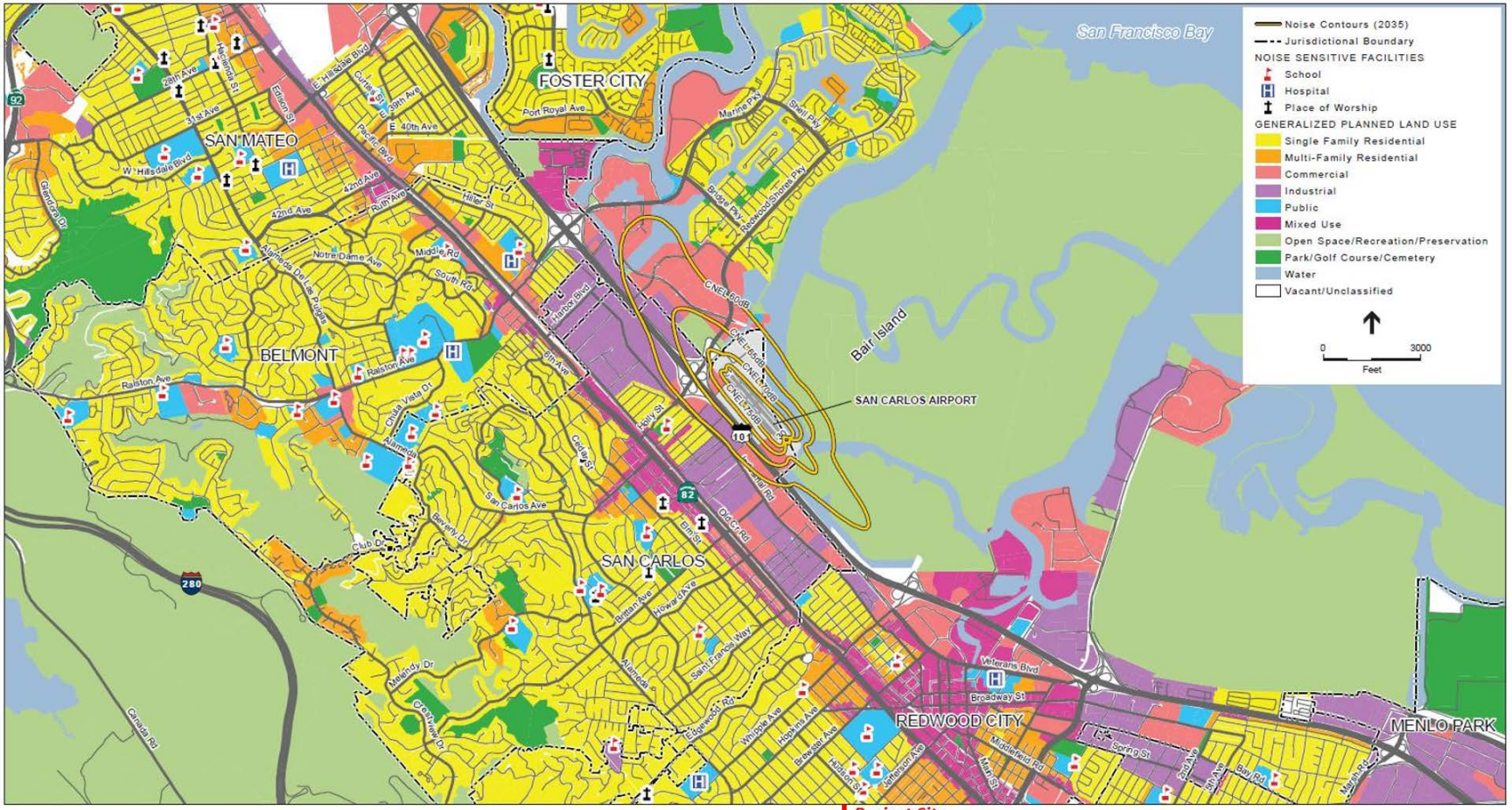
Impact 3: **Excessive Aircraft Noise.** The project site is located approximately 2.5 miles south of San Carlos Airport but would not expose people residing or working in the project area to excessive aircraft noise levels. **This is a less-than-significant impact.**

San Carlos Airport is a public airport located about 2.5 miles north of the project site. According to the 2035 noise contours for the airport, which are included in the Comprehensive Airport Land Use Compatibility Plan for the Environs of San Carlos Airport,[1] the project site falls outside the 60 dBA CNEL noise contour. Figure 14 below shows the location of the project site with respect to the 2035 noise contours for the airport. While aircraft flyovers may at times be audible at the outdoor use areas on the project site, noise levels due to aircraft would not exceed 60 dBA CNEL, and therefore, both the exterior and interior noise levels resulting from aircraft would be compatible with the proposed project. This is a less-than-significant impact.

Mitigation Measure 3: **None required.**

[1] ESA Airports, "Comprehensive Airport Land Use Compatibility Plan for the Environs of San Carlos Airport," prepared for City/County Association of Governments of San Mateo County, adopted October 2015.

FIGURE 14 2035 Noise Contours for San Carlos Airport



SOURCE: Belmont, 1982; San Mateo County, 1986; Foster City, 1993; Menlo Park, 1994; San Carlos, 2009; City of San Mateo, 2010; Redwood City, 2010; ESRI, 2014; ESA Airports, 2015

San Carlos Airport ALUCP . 130753

Exhibit 4-2

Future Conditions (2035) Aircraft Noise Contours

Impact 4a: **Cumulative Noise Increase.** The proposed project would not make a cumulatively considerable contribution to future noise levels at residential land uses in the vicinity. **This is a less-than-significant impact.**

A significant impact would occur if the cumulative traffic noise level increase was 3 dBA CNEL or greater for future levels exceeding normally acceptable levels or was 5 dBA CNEL or greater for future levels at or below normally acceptable levels and if the project would make a "cumulatively considerable" contribution to the overall traffic noise increase. A "cumulatively considerable" contribution would be defined as an increase of 1 dBA CNEL or more attributable solely to the proposed project.

Cumulative traffic noise level increases were calculated by comparing the cumulative traffic volumes and the cumulative plus project volumes to existing traffic volumes. The traffic noise increases calculated under the cumulative plus project scenario resulted in a 3 dBA CNEL or more increase along Saint Francis Street between Jefferson Avenue and Madison Avenue and the parking lot entrance for the YMCA over existing volumes during peak AM, PM, Saturday, and Sunday hours. The increase calculated from the comparison of the cumulative traffic to the existing w less than 1 dBA CNEL. However, as discussed above in **Impact 1b**, existing volumes along each of these segments are fewer than 100 vehicles per hour, and ambient noise levels at the adjacent residences are dominated by Jefferson Avenue and Madison Avenue. Therefore, the noise level increase over existing volumes at the residences affected by traffic increase along these roadway segments would be less than 3 dBA CNEL.

All other noise level increases calculated by comparing the cumulative and cumulative plus project volumes to the existing volumes resulted in an increase of 2 dBA CNEL or less. Therefore, the proposed project would not make a cumulatively considerable contribution to increased noise levels. This would be a less-than-significant impact.

Mitigation Measure 4a: **None required.**

Impact 4b: **Cumulative Construction Noise.** Existing noise-sensitive land uses are not expected to be exposed to cumulative construction noise levels in excess of project-generated construction noise levels. The incorporation of construction best management practices provided in Mitigation Measure 1a as project conditions of approval would result in a **less-than-significant** cumulative construction noise impact.

Several approved or pending projects are expected to be constructed in Redwood City or nearby cities. These projects are as follows:

- 175 multi-family residential units currently under construction at 103 Wilson Street, Redwood City, California (more than 4,500 feet from the project site).

- Kaiser Hospital Phase II, which includes 196,100 square feet of medical space, currently under construction at 1175 Marshall Street, Redwood City, California (approximately 1.3 miles from the project site).

- 520 residential units, 420,000 square feet of office space, and 18,800 square feet of retail space proposed at 1401 Broadway and Bay Road, Redwood City, California (approximately 1.4 miles from the project site).

- 350 residential rental units currently under construction at 1409 El Camino Real, Redwood City, California (more than 4,100 feet from the project site).

- 12 townhouses currently under construction at 150 El Camino Real, Redwood City, California (approximately 1.3 miles from the project site).

- 131 residential units approved for construction at 1548 Maple Street, Redwood City, California (approximately 1.8 miles from the project site).

- 2 residential units and 24,700 square feet of office space currently under construction at 1629 Main Street, Redwood City, California (more than 4,800 feet from the project site).

- 92-room Holiday Inn Express hotel approved for construction at 1690 Broadway, Redwood City, California (approximately 1.3 miles from the project site).

- 80,000 square feet of office space and 13,515 square feet of retail space at 2075 Broadway, Redwood City, California (approximately 1 mile from the project site).

- High-tech office campus proposed at 320 to 350 Blomquist Street, Redwood City, California (approximately 1.7 miles from the project site).

- 125 residential units approved for construction at 353 Main Street, Redwood City, California (approximately 1.4 miles from the project site).

- 17 townhouses approved for construction at 433 Harrison Avenue, Redwood City, California (more than 2,900 feet from the project site).

- 69,486 square feet of office space under construction at 550 Allerton Street, Redwood City, California (approximately 1.1 miles from the project site).

- 550 residential units and 100,000 square feet of sports club space proposed at 557 East Bayshore Road, Redwood City, California (approximately 1.7 miles from the project site).

- 33 residential units currently under construction at 601 El Camino Real, Redwood City, California (approximately 1 mile from the project site).

- 20 residential units for affordable living approved for construction at 612 Jefferson Avenue, Redwood City, California (approximately 1.2 miles from the project site).

- 117 residential units for affordable/senior housing and 8,000 square feet of child care space approved for construction at 707 Bradford Street, Redwood City, California (approximately 1.2 miles from the project site).

- 90 multi-family units currently under construction at 849 Veterans Boulevard, Redwood City, California (approximately 1.3 miles from the project site).

- 80,000 square feet of retail and 6,910 square feet of retail space above office space currently under construction at 851 Main Street, Redwood City, California (approximately 1.1 miles from the project site).

- 10 condominiums approved for construction at 910 Woodside Road, Redwood City, California (more than 4,500 feet from the project site).

- 8,002 square feet of retail space approved for construction at 929 Main Street, Redwood City, California (approximately 1 mile from the project site).

- 570,000 square feet of office space, 31,159 square feet of recreation space, 14,000 square feet of child care space, and 5,053 square feet of storage space currently under construction at Stanford, Redwood City, California (approximately 2.1 miles from the project site).

- 272 residential units, 589,700 square feet of office space, 10,000 square feet of retail space, and 10,000 square feet of child care space proposed at 1601 El Camino Real, Redwood City, California (more than 4,300 feet from the project site).

- 7 residential units proposed at 31 Center Street, Redwood City, California (approximately 1.1 miles from the project site).

- 12 residential units proposed at 120 El Camino Real, Redwood City, California (approximately 1.4 miles from the project site).

- 201,000 square feet of automotive dealership proposed at 525 East Bayshore Road, Redwood City, California (approximately 1.6 miles from the project site).

- 63,835 square feet of office space proposed at 610 Walnut Street, Redwood City, California (approximately 1.2 miles from the project site).

- 200,000 square feet of commercial space at the County Center, Redwood City, California (approximately 1.2 miles from the project site).

- 72 residential units proposed at 150 Charter Street, Redwood City, California (approximately 1.1 miles from the project site).

While some of the approved or proposed projects may be under construction concurrently with the proposed project, these other construction sites are not located within 1,000 feet of the Red Morton Community Park, and therefore, would not measurably contribute to the noise levels expected from project-generated construction alone.

Additionally, the Magical Bridge Playground project, which is currently under construction at the Red Morton Community Park, is on schedule to be completed in December 2019. The proposed project is expected to start construction in January 2020. Construction from the two projects would not be concurrent; however, the surrounding residences would be exposed to

continual construction due to the two projects, which would extend disruption and annoyance due to construction noise. With the incorporation of the construction best management practices provided in **Mitigation Measure 1a** of this report, the cumulative noise exposure from the two projects constructed sequentially would be considered less-than-significant.

Mitigation Measure 4b: No further mitigation required.