VIVIAN RESIDENTIAL DEVELOPMENT
NOISE IMPACT STUDY
City of San Rafael

RK engineering group, inc.

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NOISE IMPACT STUDY
City of San Rafael, California

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Table of Contents

Table of Contents (Cont.)

List of Attachments

Exhibits

Tables

List of Attachments (Continued)

Tables (cont.)

Appendices

1.0 Introduction

1.1 Purpose of Analysis and Study Objectives

The purpose of this report is to evaluate the potential noise impacts from the proposed Vivian Residential Development (hereinafter referred to as project) and provide recommendations, if necessary, to minimize any project noise impacts. The assessment was conducted within the context of the California Environmental Quality Act (CEQA) and utilizes the noise standards set forth by the applicable Federal, State, and local agencies.

The following is provided in this report:

- A description of the study area and the proposed project
- Information regarding the fundamentals of noise
- Identification of the regulatory setting and applicable noise standards
- Analysis of the existing noise environment
- Analysis of the project's noise/land use compatibility
- Analysis of the project's operational noise impact to adjacent sensitive receptors
- Preliminary analysis of future interior noise levels at the project site
- Analysis of construction noise and vibration impacts
- Summary of recommendations to reduce noise levels

1.2 Site Location

The proposed Vivian Residential Developmental project site is located at 88 Vivian Street, in the City of San Rafael, California. The project site is located approximately 6.5 feet above sea level and is relatively flat.

Existing land uses surrounding the proposed project site include; residential uses to the north and southeast and commercial use to the south, east and west of the site.

The nearest existing noise-sensitive land uses are considered the residential property located at 45 Louise Street and the multifamily residential properties located opposite the project on Belvedere Street.

The project site location map is provided in Exhibit A.

1.3 Project Description

The project proposes to construct and operate 68 multifamily residential units. The 2.41-acre project site is currently occupied by Country Club Bowling facility and an existing parking lot which will be demolished as a part of the project.

The primary sources of noise impacts from the project site would consist of short-term noise impacts from construction activities and long-term noise impacts from the day to day operations of the project. Operational noise from the project would consist of typical residential land use noise and would include HVAC mechanical equipment.

Project construction noise impacts are assessed at each phase of construction and include demolition, site preparation, grading, building construction, paving, and architectural coating activities.

A copy of the project site plan is provided in Exhibit B.

It should be noted that the project site plan has been slightly modified compared to what was originally used in this noise analysis. The changes to the latest site plan resulted in a net increase of two (2) dwelling units. However, the two (2) unit increase of the project is not expected to substantially change the distance of noise sources to adjacent property lines or increase the severity of noise from the project. Therefore, the analysis shown in this report, which is based on the original site plan, still provides an adequate and reasonable assessment of potential project impacts.

1.4 Summary of Analysis Results

Table 1 provides a summary of the noise analysis results, per the CEQA impact criteria checklist. With the implementation of the recommended project design features, the project is not expected to result in 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.

Table 1
CEQA Noise Impact Criteria

Noise Impact Criteria	Potentially Significant	Potentially Significant Unless Mitigated	Less Than Significant Impact	No Impact
Would the project 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?		X		
b) Generation of excessive groundborne vibration or groundborne noise levels?			X	
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, would the project expose people residing or working in the project area to excessive noise levels?				X

1.5 Recommended Mitigation Measures

The following recommended mitigation measures are provided to help ensure the project's construction and operational noise levels do not adversely impact the adjacent noise sensitive land uses.

In some instances, the mitigation measures described below include standard rules, requirements and best practices for meeting building code standards, which would typically be included as part of the project design and conditions of approval. However, to ensure full compliance and enforcement, all of the recommendations in this report are listed as mitigation measures.

MM-1 The final building plans shall ensure that HVAC units are not located within an area of the project site that would contribute to a noise level exceedance at any adjacent property line, per the City of San Rafael Municipal Code requirements. To meet the City's noise standards the following measures should be followed:

- HVAC units should be rated at 68 dB or less.
- All HVAC units should be at least partially enclosed behind a noise screening wall and shielded from line of sight of any adjacent

property line. Noise screening wall should be at least as high as the equipment.

MM-2 The project shall provide a six (6) foot noise barrier wall to shield all habitable backyard areas facing exterior roadways and adjacent properties. The designed noise screening will only be accomplished if the barrier's weight is at least 3.5 pounds per square foot of face area without decorative cutouts or line-of-site openings between the shielded areas and the project site. All gaps (except for weep holes) should be filled with grout or caulking to avoid flanking. Noise control barrier may be constructed using one, or any combination of the following materials:

- Concrete Masonry Unit (CMU) block;
- Stucco veneer over wood framing (or foam core), or 1-inch thick tongue and groove wood of sufficient weight per square foot;
- Transparent glass (3/8 inch thick), acrylic, polycarbonate, or other transparent material with sufficient weight per square foot.

MM-3 Prior to the issuance of building permits the project shall submit a final interior noise analysis to demonstrate that that building construction techniques will achieve the minimum interior noise standard of 45 dBA CNEL for all residential units.

MM-4 A "windows closed" condition is expected to be required for all residential units within the project site to meet the interior noise standard. To accommodate a windows closed conditions, all units shall be equipped with adequate fresh air ventilation, per the requirements of the California Uniform Building Code (UBC).

MM-5 Based on the preliminary results of this analysis, the project shall provide upgraded windows and sliding glass doors with STC ratings of 33 for all units.

MM-6 The project shall comply with California Title 24 building insulation requirements for exterior walls, roofs and common separating assemblies (e.g. floor/ceiling assemblies and demising walls), which shall be reviewed by the City prior to issuance of a building permit. A final acoustical study may be required to demonstrate compliance with building code standards.

- Party wall and floor-ceiling assembly designs must provide a minimum STC of 50, based on lab tests. Field tested assemblies must provide a minimum noise isolation class (NIC) of 45.

- Floor-ceiling assembly designs must provide for a minimum impact insulation class (IIC) of 50, based on lab tests. Field tested assemblies must provide a minimum FIIC of 45.

- Entry doors from interior corridors must provide an STC of 26 or more.

- Penetrations or openings in sound rated assemblies must be treated to maintain required ratings.

- Interior noise levels due to exterior sources must not exceed a community noise equivalent level (CNEL) or a day-night level (LDN) of 45 dBA, in any habitable room.

MM-7 For proper acoustical performance, all exterior windows, doors, and sliding glass doors shall have a positive seal and leaks/cracks must be kept to a minimum.

MM-8 Delivery, loading/unloading activity, and trash pick-up hours shall be limited to daytime (7 a.m. – 9 p.m.) hours only.

MM-9 Limit engine idling time for all delivery vehicles and moving trucks to 5 minutes or less.

MM-10 Outdoor activities in the common open space area should not occur between 9:00 p.m. and 7:00 a.m. Sunday through Thursday and between 10:00 p.m. and 7:00 a.m. on Friday and Saturday.

MM-11 Construction-related noise activities shall comply with the requirements set forth in the City of San Rafael Municipal Code Section 8.13.2.

- Construction, alteration, demolition, maintenance of construction equipment, deliveries of materials or equipment, or repair activities

shall be allowed between the hours 7:00 a.m. to 6:00 p.m. Monday through Friday and 9:00 a.m. to 6:00 p.m. on Saturdays.

- No work is permitted on Sundays or Federal Holidays
- Noise levels at any point outside of the property plane of the project shall not exceed 90 dBA.

MM-12 To help further reduce construction noise levels, the project should prepare a construction management plan to be approved by the City of San Rafael prior to initiating construction. The construction management plan would include best management practices to reduce construction noise levels. Best management practices may include the following:

- All construction equipment shall be equipped with mufflers and other suitable noise attenuation devices (e.g., engine shields).
- Grading and construction contractors shall use quieter equipment as opposed to noisier equipment (such as rubber-tired equipment rather than track equipment), where feasible.
- If feasible, electric hook-ups shall be provided to avoid the use of generators. If electric service is determined to be infeasible for the site, only whisper-quiet generators shall be used (i.e., inverter generators capable of providing variable load.
- Use electric air compressors and similar power tools rather than diesel equipment, where feasible.
- Locate staging area, generators and stationary construction equipment as far from the adjacent residential homes as feasible.
- Construction-related equipment, including heavy-duty equipment, motor vehicles, and portable equipment, shall be turned off when not in use for more than 5 minutes.
- No impact pile driving activities shall be permitted on the project site during construction. If impact pile driving is required, a follow-up noise and vibration impact assessment shall be conducted and

vibration monitoring program should be performed, prior to start of any pile driving activity.

- Post a sign in a readily visible location at the project site that indicates the dates and duration of construction activities, as well as provide a telephone number where residents can inquire about the construction process and register noise complaints to an assigned construction manager.

2.0 Fundamentals of Noise

This section of the report provides basic information about noise and presents some of the terms used within the report.

2.1 Sound, Noise and Acoustics

Sound is a disturbance created by a moving or vibrating source and is capable of being detected by the hearing organs. Sound may be thought of as mechanical energy of a moving object transmitted by pressure waves through a medium to a human ear. For traffic, or stationary noise, the medium of concern is air. *Noise* is defined as sound that is loud, unpleasant, unexpected, or unwanted.

2.2 Frequency and Hertz

A continuous sound is described by its *frequency* (pitch) and its *amplitude* (loudness). Frequency relates to the number of pressure oscillations per second. Low-frequency sounds are low in pitch (bass sounding) and high-frequency sounds are high in pitch (squeak). These oscillations per second (cycles) are commonly referred to as Hertz (Hz). The human ear can hear from the bass pitch starting out at 20 Hz all the way to the high pitch of 20,000 Hz.

2.3 Sound Pressure Levels and Decibels

The *amplitude* of a sound determines it loudness. The loudness of sound increases or decreases, as the amplitude increases or decreases. Sound pressure amplitude is measured in units of micro-Newton per square inch meter (N/m2), also called micro-Pascal (μPa). One μPa is approximately one hundred billionths (0.00000000001) of normal atmospheric pressure. Sound pressure level (SPL or L_p) is used to describe in logarithmic units the ratio of actual sound pressures to a reference pressure squared. These units are called decibels and abbreviated dB.

2.4 Addition of Decibels

Because decibels are on a logarithmic scale, sound pressure levels cannot be added or subtracted by simple plus or minus addition. When two (2) sounds of equal SPL are combined, they will produce an SPL 3 dB greater than the original single SPL. In other words, sound energy must be doubled to produce a 3 dB increase.

If two (2) sounds differ by approximately 10 dB the higher sound level is the predominant sound.

2.5 Human Response to Changes in Noise Levels

In general, the healthy human ear is most sensitive to sounds between 1,000 Hz and 5,000 Hz, (A-weighted scale) and it perceives a sound within that range as being more intense than a sound with a higher or lower frequency with the same magnitude. For purposes of this report as well as with most environmental documents, the A-scale weighting is typically reported in terms of A-weighted decibel (dBA). Typically, the human ear can barely perceive the change in noise level of 3 dB. A change in 5 dB is readily perceptible, and a change in 10 dB is perceived as being twice or half as loud[1]. As previously discussed, a doubling of sound energy results in a 3 dB increase in sound, which means that a doubling of sound energy (e.g. doubling the volume of traffic on a highway), would result in a barely perceptible change in sound level.

2.6 Noise Descriptors

Noise in our daily environment fluctuates over time. Some noise levels occur in regular patterns, others are random. Some noise levels are constant, while others are sporadic. Noise descriptors were created to describe the different time-varying noise levels. Following are the most commonly used noise descriptors along with brief definitions.

A-Weighted Sound Level

The sound pressure level in decibels as measured on a sound level meter using the A-weighted 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 response of the human ear. A numerical method of rating human judgment of loudness.

Ambient Noise Level

The composite of noise from all sources, near and far. In this context, the ambient noise level constitutes the normal or existing level of environmental noise at a given location.

[1] Source: U.S. DOT Federal Highway Administration. Dec. 2011. Highway Traffic Noise: Analysis and Abatement Guidance.

Community Noise Equivalent Level (CNEL)

The average equivalent A-weighted sound level during a 24-hour day, obtained after addition of five (5) decibels to sound levels in the evening from 7:00 to 10:00 PM and after addition of ten (10) decibels to sound levels in the night before 7:00 AM and after 10:00 PM.

Decibel (dB)

A unit for measuring the amplitude of a 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, which is 20 micro-pascals.

dB(A)

A-weighted sound level (see definition above).

Equivalent Sound Level (LEQ)

The sound level corresponding to a steady noise level over a given sample period with the same amount of acoustic energy as the actual time varying noise level. The energy average noise level during the sample period.

Habitable Room

Any room meeting the requirements of the Uniform Building Code or other applicable regulations which is intended to be used for sleeping, living, cooking or dining purposes, excluding such enclosed spaces as closets, pantries, bath or toilet rooms, service rooms, connecting corridors, laundries, unfinished attics, foyers, storage spaces, cellars, utility rooms, and similar spaces.

L(n)

The A-weighted sound level exceeded during a certain percentage of the sample time. For example, L10 is the sound level exceeded 10 percent of the sample time. Similarly L50, L90 and L99, etc.

Noise

Any unwanted sound or sound which is undesirable because it interferes with speech and hearing, or is intense enough to damage hearing, or is otherwise annoying. The State Noise Control Act defines noise as "...excessive undesirable sound...".

Outdoor Living Area

Outdoor spaces that are associated with residential land uses typically used for passive recreational activities or other noise-sensitive uses. Such spaces include patio areas, barbecue areas, jacuzzi areas, etc. associated with residential uses; outdoor patient recovery or resting areas associated with hospitals, convalescent hospitals, or rest homes; outdoor areas associated with places of worship which have a significant role in services or other noise-sensitive activities; and outdoor school facilities routinely used for educational purposes which may be adversely impacted by noise. Outdoor areas usually not included in this definition are: front yard areas, driveways, greenbelts, maintenance areas and storage areas associated with residential land uses; exterior areas at hospitals that are not used for patient activities; outdoor areas associated with places of worship and principally used for short-term social gatherings; and, outdoor areas associated with school facilities that are not typically associated with educational uses prone to adverse noise impacts (for example, school play yard areas).

Percent Noise Levels

See L(n).

Sound Level (Noise Level)

The weighted sound pressure level obtained by use of a sound level meter having a standard frequency-filter for attenuating part of the sound spectrum.

Sound Level Meter

An instrument, including a microphone, an amplifier, an output meter, and frequency weighting networks for the measurement and determination of noise and sound levels.

Single Event Noise Exposure Level (SENEL)

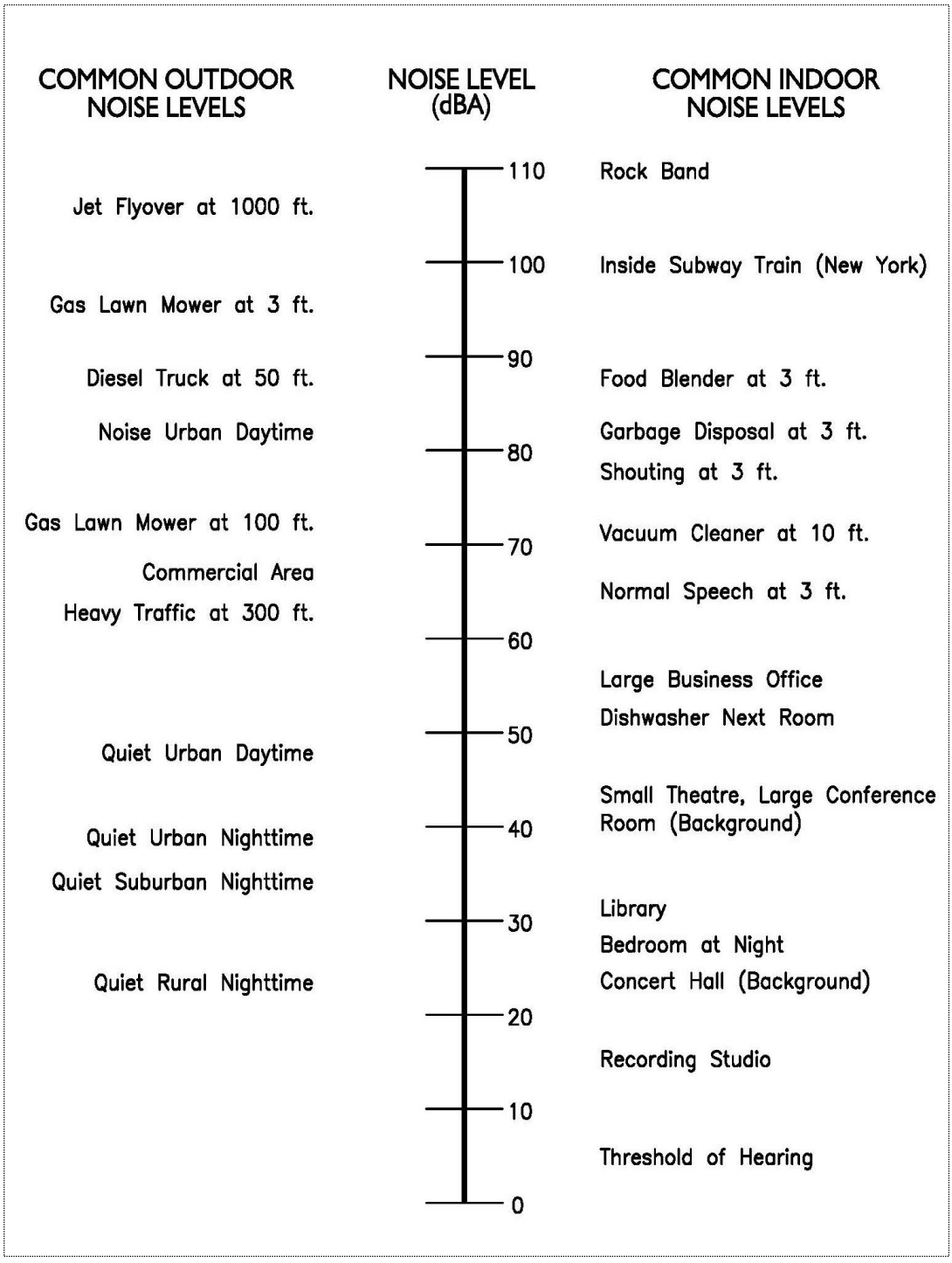
The dBA level which, if it lasted for one (1) second, would produce the same A-weighted sound energy as the actual event.

2.7 Sound Propagation

As sound propagates from a source it spreads geometrically. Sound from a small, localized source (i.e., a point source) radiates uniformly outward as it travels away from the source in a spherical pattern. The sound level attenuates at a rate of 6 dB per doubling of distance. The movement of vehicles down a roadway makes the source of the sound appear to propagate from a line (i.e., line source) rather than a point source. This line source results in the noise propagating from a roadway in a cylindrical spreading versus a spherical spreading that results from a point source. The sound level attenuates for a line source at a rate of 3 dB per doubling of distance.

As noise propagates from the source, it is affected by the ground and atmosphere. Noise models use hard site (reflective surfaces) and soft site (absorptive surfaces) to help calculate predicted noise levels. Hard site conditions assume no excessive ground absorption between the noise source and the receiver. Soft site conditions such as grass, soft dirt or landscaping attenuate noise at an additional rate of 1.5 dB per doubling of distance. When added to the geometric spreading, the excess ground attenuation results in an overall noise attenuation of 3 dB per doubling of distance for a line source and 6.0 dB per doubling of distance for a point source.

Figure 1
Typical Sound Levels from Indoor and Outdoor Noise Sources[2]



[2] Source: AAHSTO. 1993. Guide on Evaluation and Abatement of Traffic Noise

2.8 Vibration Descriptors

Ground-borne vibrations consist of rapidly fluctuating motions within the ground that have an average motion of zero. The effects of ground-borne vibrations typically only cause a nuisance to people, but at extreme vibration levels, damage to buildings may occur. Although ground-borne vibration can be felt outdoors, it is typically only an annoyance to people indoors where the associated effects of the shaking of a building can be notable. Ground-borne noise is an effect of ground-borne vibration and only exists indoors since it is produced from noise radiated from the motion of the walls and floors of a room and may also consist of the rattling of windows or dishes on shelves.

Several different methods are used to quantify vibration amplitude.

PPV

Known as the peak particle velocity (PPV) which is the maximum instantaneous peak in vibration velocity, typically given in inches per second.

RMS

Known as the root mean squared (RMS) can be used to denote vibration amplitude.

VdB

A commonly used abbreviation to describe the vibration level (VdB) for a vibration source.

2.9 Vibration Perception

Typically, developed areas are continuously affected by vibration velocities of 50 VdB or lower. These continuous vibrations are not noticeable to humans whose threshold of perception is around 65 VdB. Outdoor sources that may produce perceptible vibrations are usually caused by construction equipment, steel-wheeled trains, and traffic on rough roads, while smooth roads rarely produce perceptible ground-borne noise or vibration. To counter the effects of ground-borne vibration, the Federal Transit Administration (FTA) has published guidance relative to vibration impacts. According to the FTA, fragile buildings can be exposed to ground-borne vibration levels of 0.3 inches per second without experiencing structural damage.

2.10 Vibration Propagation

There are three main types of vibration propagation: surface, compression, and shear waves. Surface waves, or Rayleigh waves, travel along the ground's surface. These waves carry most of their energy along an expanding circular wavefront, similar to ripples produced by throwing a rock into a pool of water. P-waves, or compression waves, are body waves that carry their energy along an expanding spherical wavefront. The particle motion in these waves is longitudinal (i.e., in a "push-pull" fashion). P-waves are analogous to airborne sound waves. S-waves, or shear waves, are also body waves that carry energy along an expanding spherical wavefront. However, unlike P-waves, the particle motion is transverse, or side-to-side and perpendicular to the direction of propagation.

As vibration waves propagate from a source, the vibration energy decreases in a logarithmic nature and the vibration levels typically decrease by 6 VdB per doubling of the distance from the vibration source. As stated above, this drop-off rate can vary greatly depending on the soil but has been shown to be effective enough for screening purposes, in order to identify potential vibration impacts that may need to be studied through actual field tests.

2.11 Construction Related Vibration Level Prediction

Operational activities are separated into two different categories. The vibration can be transient or continuous in nature. Each category can result in varying degrees of ground vibration, depending on the equipment used on the site. Operation of equipment causes ground vibrations that spread through the ground and diminish in strength with distance. Buildings in the vicinity of the project area site respond to these vibrations with varying results ranging from no perceptible effects at the low levels to slight damage at the highest levels. The thresholds from Caltrans Transportation and Construction Induced Vibration Guidance Manual in the table below provide general guidelines as to the maximum vibration limits for when vibration becomes potentially annoying.

Table 2
Vibration Annoyance Potential Criteria

Human Response	PPV (in/sec)	
	Transient Sources	Continuous/Frequent Intermittent Sources
Barely perceptible	0.04	0.01
Distinctly perceptible	0.25	0.04
Strongly perceptible	0.90	0.10
Severe	2.00	0.40

Note: Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

The Caltrans Transportation and Construction Induced Vibration Guidance Manual provides general thresholds and guidelines as to the vibration damage potential from vibratory impacts. The table below provides general vibration damage potential thresholds:

Table 3
Vibration Damage Potential Threshold Criteria

Structure and Condition	PPV (in/sec)	
	Transient Sources	Continuous/Frequent Intermittent Sources
Extremely fragile historic buildings ruin ancient monuments	0.12	0.08
Fragile buildings	0.20	0.10
Historic and some old buildings	0.50	0.25
Older residential structures	0.50	0.30
New residential structures	1.00	0.50
Modern industrial/commercial buildings	2.00	0.50

Soil conditions have an impact on how vibration propagates through the ground. The Caltrans Transportation and Construction Induced Vibration Guidance Manual provides suggested "n" values based on soil class. The table below outlines the manual's suggested values and description.

Table 4
Suggested "n" Values Based on Soil Classes

Soil Class	Description of Soil Material	Suggested Value of "n"
I	Weak or soft soils: loose soils, dry or partially saturated peat and muck, mud, loose beach sand, and dune sand.	1.4
II	Most sands, sandy clays, silty clays, gravel, silts, weathered rock.	1.3
III	Hard soils: densely compacted sand, dry consolidated clay, consolidated glacial till, some exposed rock.	1.1
IV	Hard, component rock: bedrock, freshly exposed hard rock.	1.0

3.0 Regulatory Setting

The proposed project is located in the City of San Rafael and noise regulations are addressed through the various federal, state, and local government agencies. The agencies responsible for regulating noise are discussed below.

3.1 Federal Regulations

The adverse impact of noise was officially recognized by the federal government in the Noise Control Act of 1972, which serves three (3) purposes:

- Publicize noise emission standards for interstate commerce
- Assist state and local abatement efforts
- Promote noise education and research

The Federal Office of Noise Abatement and Control (ONAC) was originally tasked with implementing the Noise Control Act. However, it was eventually eliminated leaving other federal agencies and committees to develop noise policies and programs. Some examples of these agencies are as follows: The Department of Transportation (DOT) assumed a significant role in noise control through its various agencies. The Federal Aviation Agency (FAA) is responsible to regulate noise from aircraft and airports. The Federal Highway Administration (FHWA) is responsible to regulate noise from the interstate highway system. The Occupational Safety and Health Administration (OSHA) is responsible for the prohibition of excessive noise exposure to workers.

The Federal government and the State advocate that local jurisdiction use their land use regulatory authority to arrange new development in such a way that "noise sensitive" uses are either prohibited from being constructed adjacent to a highway or, or alternatively that the developments are planned and constructed in such a manner that potential noise impacts are minimized.

Since the Federal government and the State have preempted the setting of standards for noise levels that can be emitted by the transportation source, the City is restricted to regulating the noise generated by the transportation system through nuisance abatement ordinances and land use planning.

3.2 State Regulations

Established in 1973, the California Department of Health Services Office of Noise Control (ONC) was instrumental in developing regularity tools to control and abate noise for use by local agencies. One significant model is the "Land Use Compatibility for Community Noise Environments Matrix." The matrix allows the local jurisdiction to clearly delineate compatibility of sensitive uses with various incremental levels of noise.

The State of California has established noise insulation standards as outlined in Title 24 and the Uniform Building Code (UBC) which in some cases requires acoustical analyses to outline exterior noise levels and to ensure interior noise levels do not exceed the interior threshold. The State mandates that the legislative body of each county and city adopt a noise element as part of its comprehensive general plan. The local noise element must recognize the land use compatibility guidelines published by the State Department of Health Services. The guidelines rank noise land use compatibility in terms of normally acceptable, conditionally acceptable, normally unacceptable, and clearly unacceptable.

Noise insulation design standards for multi-family residences have been established by the State of California Uniform Building Code (UBC) Chapter 12, Division II and by the Title 24 noise insulation standards of the California Administrative Code. The City is required by the State Housing Law to adopt these State codes as minimum performance standards.

3.3 City of San Rafael Noise Regulations

The City of San Rafael outlines their noise regulations and standards within the Noise Element of the San Rafael 2040 General Plan and Chapter 8.13, Noise, in the Municipal Code. The noise standards from the General Plan and Municipal code are provided in Appendix A.

For purposes of this analysis, the City of San Rafael's noise element is used to evaluate the project's noise/land use compatibility and ensure the project is consistent with the established plans, policies and programs for noise control within the City and the Municipal Code is used to establish the noise limit for project generated noise sources that may affect neighboring properties (i.e. construction noise and HVAC equipment).

3.3.1 City of San Rafael General Plan Noise Element

The City of San Rafael General Plan 2040 Chapter 9 Noise Element establishes planning criteria for determining a development's noise/land use compatibility based on the

community noise equivalent level (CNEL). Table 5 summarizes the City's Noise/Land Use Compatibility guidelines for land uses applicable to this project:

Table 5
City of San Rafael Noise/Land Use Compatibility Guidelines

Land Use	Interior Noise Standard CNEL or Ldn (dBA)	Exterior Noise Limit (dBA CNEL)			
		Clearly Compatible	Normally Compatible	Normally Incompatible	Clearly Incompatible
Residential - Multiple Family	45	<65	65-70	70-75	>75

The City of San Rafael defines the noise compatibility categories as follows:

Normally Acceptable: Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction without any special noise insulation requirements.

Conditionally Acceptable: New construction or development should be undertaken only after detailed analysis of the noise reduction requirements are made and needed noise insulation features in the design are determined. Conventional construction, 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 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.

The General Plan Noise Element also contains noise compatibility guidelines that indicate the acceptability of noise exposure levels for different land uses. The Noise Element indicates that projects should incorporate noise mitigation measures if they will exceed normally acceptable levels as defined by the guidelines.

3.3.2 City of San Rafael Municipal Code

Chapter 8.13, Noise, in the San Rafael Municipal Code describes the noise regulations for controlling unnecessary, excessive and annoying sounds in residential areas that is received on residential property occupied by another person. The noise standards apply to all properties within a residential zone.

As it relates to this project, the Municipal Code noise regulations are used to evaluate offending on-site operational noise sources and on-site construction activity.

Table 6 shows the City of San Rafael Noise Standards, per Chapter 8.13 Noise in the Municipal Code.

Table 6
City of San Rafael Residential Noise Standards

Land Use	Location	Time Period	Intermittent	Constant
Residential Land Use	**EXTERIOR**	Daytime (7 AM – 9 PM)	60 dBA	50 dBA
		Nighttime (9 PM – 7 AM)	50 dBA	40 dBA
	INTERIOR	Daytime (7 AM – 9 PM)	40 dBA	35 dBA
		Nighttime (9 PM – 7 AM)	35 dBA	30 dBA
Commercial Land Use	**EXTERIOR**	All Time of the Day	65 dBA	55 dBA

Construction Noise Regulation

Section 8.13.2 of the City's municipal code states that the noise from the following activities shall be exempted from the provisions of the noise code, provided;

"Construction. Except as otherwise provided by the planning commission or city council as part of the development review for the project, on any construction project on property within the city, construction, alteration, demolition, maintenance of construction equipment, deliveries of materials or equipment, or repair activities otherwise allowed under applicable law shall be allowed between the hours of seven a.m. (7:00 a.m.) and six

p.m. (6:00 p.m.), Monday through Friday, and nine a.m. (9:00 a.m.) and six p.m. (6:00 p.m.) on Saturdays, provided that the noise level at any point outside of the property plane of the project shall not exceed ninety (90) dBA. All such activities shall be precluded on Sundays and holidays. Violation of the foregoing may subject the permittee to suspension of work by the chief building official for up to two (2) days per violation."

4.0 Study Method and Procedures

The following section describes the measurement procedures, measurement locations, and noise modeling procedures and assumptions used in the noise analysis.

4.1 Measurement Procedures and Criteria

Noise measurements are taken to determine the existing noise levels. A noise receiver or receptor is any location in the noise analysis in which noise might produce an impact. The following criteria are used to select measurement locations and receptors:

- Locations expected to receive the highest noise impacts, such as the first row of houses
- Locations that are acoustically representative and equivalent of the area of concern
- Human land usage
- Sites clear of major obstruction and contamination

RK conducted the sound level measurements in accordance with Caltrans technical noise specifications. All measurement equipment meets American National Standards Institute (ANSI) specifications for sound level meters (S1.4-1983 identified in Chapter 19.68.020.AA).

A Piccolo-II Type 2 integrating-averaging sound level meter was used to conduct long-term (24-hour) noise measurements at the project site and property boundaries.

The Leq, Lmin, Lmax, L2, L8, L25, and L50 statistical data were recorded over the measurement time period intervals and the information was utilized to define the noise characteristics for the project. The following gives a brief description of the Caltrans Technical Noise Supplement procedures for sound level measurements:

- Microphones for sound level meters were placed ten (10) feet above ground for long-term noise measurements
- Sound level meters were calibrated before and after each measurement
- Following the calibration of equipment, a windscreen was placed over the microphone
- Frequency weighting was set on "A" and slow response
- Temperature and sky conditions were observed and documented

4.2 Stationary Noise Modeling

On-site stationary noise sources were analyzed using SoundPLAN™ noise modeling software. SoundPLAN™ is a standards-based program that incorporates more than twenty national and international noise modeling guidelines. This project consists of parking lot noise and stationary noise sources which are classified under industrial sources. The following noise prediction standards were used during the performance of this project:

- ISO 9613-2: 1996

Projected noise levels from SoundPLAN™ are based on the following key parameters:

- Developing three-dimensional noise models of the project,
- Predicting the project noise levels at the selected community locations and
- Comparing the predicted noise with the existing community ambient noise levels at the receptor locations.

The sides of the residential buildings, walls, etc. were modeled as reflective surfaces and also as diffractive bodies. Most of the ground within the project site and adjacent areas are covered with paved surfaces and are modeled as a hard site (Ground Factor=0). The Effective Flow Resistivity for paved area is SoundPLAN default. The elevation profile for the project site is derived from Google Maps and all noise receptors are placed at 5 foot above the floor level.

Sound Power and Sound Pressure Level

Sound power level is the acoustic energy emitted by a source which produces a sound pressure level at some distance. While the sound power level of a source is fixed, the sound pressure level depends upon the distance from the source and the acoustic characteristics of the area in which it is located.

SoundPLAN requires that the source noise level be input using sound power level. The sound power level is calculated using SoundPLAN software by calibrating the source noise level to equal the sound pressure level at an equal distance from the source in which the referenced measurement was taken.

4.2.1 HVAC Equipment Noise

The project is expected to use slim-line type Air Conditioner units, similar or equal to the Puron Performance Series Air Conditioner. In order to determine the future noise levels from a/c units, RK requested the specification sheet from the manufacturer and obtained the referenced noise level of the proposed a/c units. Table 7 indicates the referenced noise levels for on-site stationary noise sources.

The manufacture spec sheet is shown in Appendix B.

Table 7
HVAC Referenced Noise Levels[1]

Source	Noise Levels (dBA)
	Lw
HVAC Equipment	68

[1] Noise levels are in Sound Power Level

To estimate the future noise levels during typical operational conditions, referenced noise levels are input into SoundPLAN and projected to the nearest sensitive receptor locations. Adjusted noise levels are based on the distance of the receptor location relative to the noise source, local topography and physical barriers including buildings and sound walls. The noise levels assume that the stationary sources are operating continuously during both daytime and nighttime hours, when in reality will likely operate only intermittently throughout daily operations.

5.0 Existing Noise Environment

The existing noise environment for the project site and surrounding areas has been established based on noise measurement data collected by RK. Noise measurement data indicates that traffic noise propagating from the adjacent roadways, as well as activities from the surrounding properties are the main sources of ambient noise at the project site and surrounding area.

5.1 Long-Term (24-Hour) Noise Measurement Results

To determine the existing noise level environment, RK conducted two (2) 24-hour noise measurements at the project study area. Noise levels were measured on December 10th and December 11th, 2020 using a Piccolo-II Type 2 integrating-averaging sound level meter. The information was utilized to establish the noise characteristics of the existing ambient environment.

The noise monitoring locations were selected based on the proximity and location to adjacent sensitive receptors. Exhibit C graphically illustrates the location of the long-term measurements.

- Long-term noise monitoring location one (LT-1) was taken at the light pole in the parking lot at approximately 40 feet from the southern property line and approximately 65 feet from the western property line.

- Long-term noise monitoring location two (LT-2) was taken at the at the parking lot at approximately 305 feet from the southern property line and approximately 68 feet from the western property line.

Long term noise monitoring locations represent the existing noise levels near the adjacent noise sensitive land uses. Long-term noise measurement results are summarized in Tables 8 and 9. Appendix C includes photographs, field sheets and measured noise data.

However, measured noise levels has been conservatively adjusted by increasing the existing CNEL by +3 dBA to account for reduced traffic volumes along the surrounding roadways and other off-site operational activities surrounding the project site due to COVID-19 pandemic.

Typically, it takes a doubling of traffic volume along a roadway to cause a significant increase in ambient noise levels of more than 3 dBA. Based on the comparison between

the December 2019 and December 2020 traffic volumes along Highway 101, the pandemic has reduced the existing traffic volume by approximately 20% compared to the previous year.[3] Therefore, increasing the existing CNEL is considered conservative. Appendix D includes Caltrans PeMS Report.

Table 8
24 Noise Measurement Results LT-1[1]

Time	Leq (dBA)	Time	Leq (dBA)
12:00 AM	57.7	12:00 PM	63.8
1:00 AM	54.7	1:00 PM	62.2
2:00 AM	56.1	2:00 PM	62.5
3:00 AM	58.5	3:00 PM	66.5
4:00 AM	61.8	4:00 PM	68.3
5:00 AM	63.9	5:00 PM	68.3
6:00 AM	65.0	6:00 PM	65.8
7:00 AM	66.8	7:00 PM	64.3
8:00 AM	64.6	8:00 PM	63.9
9:00 AM	63.4	9:00 PM	63.2
10:00 AM	63.4	10:00 PM	61.1
11:00 AM	63.3	11:00 PM	56.9
Measured 24-Hour CNEL			**68.6**
Adjusted 24-Hour CNEL (+3 dB)[2]			**71.6**

[1] LT-1 was taken at approximately 40 feet from the southern property line and approximately 65 feet from the western property line. LT-1 was recorded on 12/10/2020.

[2] Existing CNEL has been adjusted conservatively to account for reduced traffic volumes and other off-site operational activities surrounding the site due to COVID-19 pandemic.

[3] http://pems.dot.ca.gov/?report_form=1&dnode=VDS&content=loops&tab=det_dow&station_id=402141&s_time_id=1575158400&s_time_id_f=12%2F01%2F2019&e_time_id=1576454340&e_time_id_f=12%2F15%2F2019&tod=all&tod_from=0&tod_to=0&q=flow&fn=1&pct1=25&pct2=75

Table 9
24 Noise Measurement Results, LT-2[1]

Time	Leq (dBA)	Time	Leq (dBA)
12:00 AM	58.2	12:00 PM	62.9
1:00 AM	54.2	1:00 PM	61.6
2:00 AM	56.0	2:00 PM	60.4
3:00 AM	59.3	3:00 PM	66.5
4:00 AM	63.2	4:00 PM	68.7
5:00 AM	64.2	5:00 PM	68.6
6:00 AM	67.2	6:00 PM	65.9
7:00 AM	67.6	7:00 PM	65.7
8:00 AM	63.2	8:00 PM	64.7
9:00 AM	62.3	9:00 PM	63.4
10:00 AM	62.3	10:00 PM	60.4
11:00 AM	64.2	11:00 PM	56.9
Measured 24-Hour CNEL			**69.4**
Adjusted 24-Hour CNEL (+3 dB)[2]			**72.6**

[1] LT-2 was taken at approximately 305 feet from the southern property line and approximately 68 feet from the western property line. LT-2 was recorded on 12/10/2020.

[2] Existing CNEL has been adjusted conservatively to account for reduced traffic volumes and other off-site operational activities surrounding the site due to COVID-19 pandemic.

6.0 Operational Noise Impacts

This assessment analyzes the anticipated noise levels generated by the project and impacts caused by changes to the ambient environment as a result of operational activities. The main sources of operational noise generated by the project would include on-site activities from HVAC equipment. Noise level impacts are compared to the City of San Rafael noise standards.

The project must demonstrate that noise levels generated by the project site would not be in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.

6.1 Stationary Source Noise Impacts

On-site stationary noise impacts are assessed at all adjacent property lines surrounding the project site. Existing land uses surrounding the proposed project site include; existing residential uses to the north and southeast, commercial uses to the east, west and south.

Project operational activities are analyzed for long-term noise impacts associated with the day to day operation of the project; including mechanical HVAC equipment to the nearest adjacent property lines.

The noise study has assumed all mechanical HVAC equipment will be located on ground level and will be shielded behind a noise screening wall from line of sight of any adjacent property line.

SoundPLAN calculation worksheets are shown in Appendix E.

Daytime Stationary Source Noise Impacts

The results of the daytime noise impact analysis are shown in the Tables 10 and are graphically illustrated on Exhibit D and the daytime noise contours are shown in Exhibit E.

The noise analysis considers all project noise sources operating simultaneously during daytime (7 a.m. to 9 p.m.) hours at the nearest adjacent property lines.

Based on the results of this analysis, noise levels generated by the project are not expected to exceed the City's daytime exterior noise standards for all sensitive receptors surrounding the project site.

Nighttime Stationary Source Noise Impacts

The results of the nighttime noise impact analysis are shown in the Tables 11 and are graphically illustrated on Exhibit D and the nighttime noise contours are shown in Exhibit F.

The nighttime noise analysis considers all project noise sources operating simultaneously during nighttime (9 p.m. to 7 a.m.) hours.

Based on the results of this analysis, noise levels generated by the project are not expected to exceed the City's nighttime noise standards for all sensitive receptors surrounding the project site.

TABLE 10
Vivian Residential Development
Daytime Noise Impact Analysis (dBA)

Receptor	Land Use	Location	Daytime Exterior Noise Level dBA[1]			
			Project Noise Contribution (Leq)	Existing Ambient Measurement (Leq)[1]	City of San Rafael Noise Level Criteria (Leq)	Noise Level Exceeds Standard (?)
Receiver at PL-1	Residential	North	33.6	60.4	50.0	No
Receiver at PL-2	Residential	Southeast	34.8	61.1		No
Receiver at PL-3	Commercial	East	39.2	60.4	55.0	No
Receiver at PL-4	Commercial	South	40.6	61.1		No
Receiver at PL-5	Commercial	West	39.2	61.1		No
Receiver at PL-6	Commercial	West	38.6	60.4		No

[1] Lowest Daytime Measured Leq

TABLE 11
Vivian Residential Development
Nighttime Noise Impact Analysis (dBA)

Receptor	Land Use	Location	Nighttime Exterior Noise Level dBA[1]			
			Project Noise Contribution (Leq)	Existing Ambient Measurement (Leq)[1]	City of San Rafael Noise Level Criteria (Leq)	Noise Level Exceeds Standard (?)
Receiver at PL-1	Residential	North	33.6	54.2	40.0	No
Receiver at PL-2	Residential	Southeast	34.8	54.7		No
Receiver at PL-3	Commercial	East	39.2	54.2	55.0	No
Receiver at PL-4	Commercial	South	40.6	54.7		No
Receiver at PL-5	Commercial	West	39.2	54.7		No
Receiver at PL-6	Commercial	West	38.6	54.2		No

[1] Lowest Nighttime Measured Leq

6.2 Existing Noise/Land Use Compatibility

Traffic noise along adjacent roadways, Highway 101 and Highway 580 and other operational noise from the adjacent commercial/industrial uses are the primary sources of ambient noise impacting the project site. Existing noise level measurements were conducted to determine the existing noise levels at the project site, the project's noise/land use compatibility setting and to determine future noise levels to habitable exterior and interior areas on the project site. This section of the analysis does not necessarily apply to CEQA, as recent court rulings have indicated that CEQA is primarily concerned with the project's impact of the environment, not the environment's impact on a project.

Table 12 shows the estimated future traffic noise levels at the project site and the noise/land use compatibly rating based on the San Rafael Plan Noise Element standards.

Table 12
Existing Noise/Land Use Compatibility

Receptor	Exterior Noise Level (dBA CNEL)[1]	Noise/Land Use Compatibility
Exterior Façade	72.6	Normally Unacceptable

[1] CNEL has been adjusted conservatively to account for reduced traffic volumes and other off-site operational activities surrounding the site due to COVID-19 pandemic.

The project may experience noise levels that fall within the normally unacceptable range (70-75 CNEL). The City of San Rafael recommends that new construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of noise reduction requirements must be made and needed noise insulation features included in the design.

The following section provides a preliminary review of interior noise levels.

6.3 Preliminary Interior Noise Analysis

A preliminary interior noise analysis has been prepared for the sensitive receptor locations (i.e. residential dwelling units) using a typical "windows open" and "windows closed" condition. A "windows open" condition assumes 12 dBA of noise attenuation from the

exterior noise level. A "windows closed" condition" assumes 20 dBA of noise attenuation from the exterior noise level.

Table 13 indicates the interior noise levels for the first and second floor residential uses on the project site.

Table 13
Preliminary Interior Noise Compatibility Analysis

Receptor Location	Floor	Exterior Noise Level at Building Facade (dBA CNEL)	Interior Noise Standard (dBA CNEL)	Required Building Shell Noise Reduction (dBA CNEL)	Interior Noise Level with Standard California Construction Windows (STC ≥ 25)		STC Rating for Windows Facing Subject Roadway
					"Windows Open" [1]	"Windows Closed" [2]	
All Buildings	All	72.6	45	27.6	60.6	45	33

[1] A minimum of 12 dBA noise reduction is assumed with the "windows open" condition.

[2] A minimum Window STC rating of 33 is required to achieve interior noise levels of 45 dBA. A final interior noise isolation analysis should be provided prior to the issuance of building permits.

As shown in Table 13, the project is expected to require a "windows closed" condition and upgraded STC rated windows to meet the City/State interior noise standard of 45 dBA. To accommodate a windows closed conditions, all units shall be equipped with adequate fresh air ventilation, per the requirements of the California Uniform Building Code (UBC).

Prior to issuance of building permits, the project proponent should demonstrate to the City building department that the proposed building shell and window assemblies will achieve exterior to interior noise reduction necessary to meet the State of California and City of San Rafael requirements.

Furthermore, the project shall comply with California Title 24 insulation building requirements for multi-family dwelling units for common separating assemblies (e.g. floor/ceiling assemblies and demising walls).

6.4 Recommended Operational Mitigation Measures

MM-1 The final building plans shall ensure that HVAC units are not located within an area of the project site that would contribute to a noise level exceedance at any adjacent property line, per the City of San Rafael Municipal Code requirements. To meet the City's noise standards the following measures should be followed:

- HVAC units should be rated at 68 dB or less.

- All HVAC units should be at least partially enclosed behind a noise screening wall and shielded from line of sight of any adjacent property line. Noise screening wall should be at least as high as the equipment.

MM-2 The project shall provide a six (6) foot noise barrier wall for to shield all habitable backyard areas facing exterior roadways and adjacent properties. The designed noise screening will only be accomplished if the barrier's weight is at least 3.5 pounds per square foot of face area without decorative cutouts or line-of-site openings between the shielded areas and the project site. All gaps (except for weep holes) should be filled with grout or caulking to avoid flanking. Noise control barrier may be constructed using one, or any combination of the following materials:

- Concrete Masonry Unit (CMU) block;

- Stucco veneer over wood framing (or foam core), or 1-inch thick tongue and groove wood of sufficient weight per square foot;

- Transparent glass (3/8 inch thick), acrylic, polycarbonate, or other transparent material with sufficient weight per square foot.

MM-3 Prior to the issuance of building permits the project shall submit a final interior noise analysis to demonstrate that that building construction techniques will achieve the minimum interior noise standard of 45 dBA CNEL for all residential units.

MM-4 A "windows closed" condition is expected to be required for all residential units within the project site to meet the interior noise standard. To accommodate a windows closed conditions, all units shall be equipped with adequate fresh air ventilation, per the requirements of the California Uniform Building Code (UBC).

MM-5 Based on the preliminary results of this analysis, the project shall provide upgraded windows and sliding glass doors with STC ratings of 33 for all units.

MM-6 The project shall comply with California Title 24 building insulation requirements for exterior walls, roofs and common separating assemblies

(e.g. floor/ceiling assemblies and demising walls), which shall be reviewed by the City prior to issuance of a building permit.

- Party wall and floor-ceiling assembly designs must provide a minimum STC of 50, based on lab tests. Field tested assemblies must provide a minimum noise isolation class (NIC) of 45.

- Floor-ceiling assembly designs must provide for a minimum impact insulation class (IIC) of 50, based on lab tests. Field tested assemblies must provide a minimum FIIC of 45.

- Entry doors from interior corridors must provide an STC of 26 or more.

- Penetrations or openings in sound rated assemblies must be treated to maintain required ratings.

- Interior noise levels due to exterior sources must not exceed a community noise equivalent level (CNEL) or a day-night level (LDN) of 45 dBA, in any habitable room.

MM-7 For proper acoustical performance, all exterior windows, doors, and sliding glass doors shall have a positive seal and leaks/cracks must be kept to a minimum.

MM-8 Delivery, loading/unloading activity, and trash pick-up hours shall be limited to daytime (7 a.m. – 9 p.m.) hours only.

MM-9 Limit engine idling time for all delivery vehicles and moving trucks to 5 minutes or less.

MM-10 Outdoor activities in the common open space area should not occur between 9:00 p.m. and 7:00 a.m. Sunday through Thursday and between 10:00 p.m. and 7:00 a.m. on Friday and Saturday.

7.0 Construction Noise and Vibration

Temporary construction noise and vibration impacts have been assessed from the project site to the surrounding adjacent land uses.

7.1 Typical Construction Noise Levels

Table 14 shows typical construction noise levels compiled by the Environmental Protection Agency (EPA) for common type construction equipment. Typical construction noise levels are used to estimate potential project construction noise levels at the adjacent sensitive receptors.

Table 14
Typical Construction Noise Levels[1]

Type	Noise Levels (dBA) at 50 Feet
Earth Moving	
Compactors (Rollers)	73 - 76
Front Loaders	73 - 84
Backhoes	73 - 92
Tractors	75 - 95
Scrapers, Graders	78 - 92
Pavers	85 - 87
Trucks	81 - 94
Materials Handling	
Concrete Mixers	72 - 87
Concrete Pumps	81 - 83
Cranes (Movable)	72 - 86
Cranes (Derrick)	85 - 87
Stationary	
Pumps	68 - 71
Generators	71 - 83
Compressors	75 - 86
Impact Equipment	
Pneumatic Wrenches	82 - 87
Jack Hammers, Rock Drills	80 - 99
Pile Drivers (Peak)	95-105
Other	
Vibrators	68 - 82
Saws	71 - 82

[1] Referenced Noise Levels from the Environmental Protection Agency (EPA)

The degree of construction noise will vary for different areas of the project site and also vary depending on the construction activities. This assessment analyzes potential noise impacts during demolition, site preparation, grading, building construction, paving, and architectural coating. Noise levels are calculated based on a minimum average distance of equipment over an 8-hour period at 50 feet from property line.

Construction phasing and equipment usage assumptions are referenced from the Vivian Residential Development Air Quality and Greenhouse Gas Analysis, City of San Rafael, prepared by RK, December 2020.

7.2 Construction Noise Impact Analysis

This assessment analyzes potential noise impacts during all expected phases of construction, including; demolition, site preparation, grading, building construction, paving, and architectural coating. Noise levels are calculated based on an average distance of equipment at 50 feet over an 8-hour period to the nearest adjacent property.

The project's estimated construction noise levels have been calculated using the Federal Highway Administration Roadway Construction Noise Model Version 1.1. Tables 15 show the noise level impacts at 50 feet from the property line of the project site. Construction noise calculation worksheets are provided in Appendix F.

Table 15
Project Construction Noise Levels

Phase	Equipment	Quantity	Equipment Noise Level at 50 ft (dBA Leq)	Combined Noise Level (dBA Leq)
Demolition	Concrete/Industrial Saws	1	82.6	87.3
	Rubber Tired Dozers	1	77.7	
	Tractors/Loaders/Backhoes	3	80.0	
Site Preparation	Graders	1	81.0	85.0
	Scrapers	1	79.6	
	Tractors/Loaders/Backhoes	1	80.0	
Grading	Graders	1	81.0	85.9
	Rubber Tired Dozers	1	77.7	
	Tractors/Loaders/Backhoes	2	80.0	
Building Construction	Cranes	1	72.6	83.4
	Forklifts	2	71.0	
	Generator Sets	1	77.6	
	Tractors/Loaders/Backhoes	1	80.0	
	Welders	3	70.0	
Paving	Cement and Mortar Mixer	1	74.8	83.4
	Pavers	1	74.2	
	Paving Equipment	1	73.0	
	Rollers	2	73.0	
	Tractors/Loaders/Backhoes	1	80.0	
Architectural Coating	Air Compressors	1	73.7	73.7
Worst Case Construction Phase Noise Level - Leq (dBA)				85.9
City of San Rafael Construction Noise Standard[1]				90.0
Potentially Significant Temporary Impact?				NO

[1] San Rafael Code of Ordinances, Section 8.13.040, Table 8.13-2

As shown in Table 15, the project is not expected to exceed the recommended construction noise threshold provided by the City of San Rafael Municipal Code for adverse community reaction.

7.3 Construction Vibration Impact Analysis

To determine the vibratory impacts during construction, reference construction equipment vibration levels were utilized and then extrapolated to the façade of the nearest adjacent structures. The nearest sensitive receptors are the residential structures located at approximately 25 feet from the east property line. All structures surrounding the project site are "new residential structures" or "modern commercial buildings". No historical or fragile buildings are known to be located within the vicinity of the site.

The construction of the proposed project is not expected to require the use of substantial vibration inducing equipment or activities, such as pile drivers or blasting. The main sources of vibration impacts during construction of the project would be the operation of equipment such as bulldozer activity during site preparation, vibratory compactors and loading trucks during grading and excavation, and vibratory rollers during paving.

The construction vibration assessment utilizes the referenced vibration levels and methodology set-forth within the Caltrans Transportation and Construction Induced Vibration Guidance Manual. Table 16 shows the referenced vibration levels.

Table 16
Typical Construction Vibration Levels[1]

Equipment	Peak Particle Velocity (PPV) (inches/second) at 25 feet	Approximate Vibration Level (LV) at 25 feet
Piledriver (impact)	1.518 (upper range)	112
	0.644 (typical)	104
Piledriver (sonic)	0.734 upper range	105
	0.170 typical	93
Clam shovel drop (slurry wall)	0.202	94
Hydromill	0.008 in soil	66
(slurry wall)	0.017 in rock	75
Vibratory Roller	0.210	94
Hoe Ram	0.089	87
Large bulldozer	0.089	87
Caisson drill	0.089	87
Loaded trucks	0.076	86
Jackhammer	0.035	79
Small bulldozer	0.003	58

[1] Transit Noise and Vibration Impact Assessment, Federal Transit Administration, May 2006.

Table 17 shows the project's construction-related vibration analysis at the nearest structures to the project construction area. Construction impacts are assessed from the closest area on the project site to the nearest adjacent structure.

Table 17
Construction Vibration Impact Analysis

Construction Activity	Distance to Nearest Structure (ft)	Duration	Calculated Vibration Level - PPV (in/sec)	Damage Potential Level	Annoyance Criteria Level
Small Bulldozer	25 ft.	Continuous/Frequent	0.003	No Impact	Barely Perceptible
Loaded Trucks	25 ft.	Continuous/Frequent	0.076	No Impact	Distinctly Perceptible
Vibratory Roller/ Compactor	25 ft.	Continuous/Frequent	0.210	Fragile Buildings	Strongly Perceptible

As shown in Table 17, project related construction activity is not expected to cause any damage potential to the nearest structures as all structures surrounding the project site are "new residential structures" or "modern commercial buildings". The annoyance potential of vibration from construction activities would range from "barely perceptible" to "strongly perceptible". Construction vibration calculation worksheets are shown in Appendix F.

7.4 Recommended Construction Mitigation Measures

The following recommended mitigation measures are provided to help ensure the project's construction noise and vibration impacts do not adversely impact the adjacent land uses.

MM-11 Construction-related noise activities shall comply with the requirements set forth in the City of San Rafael Municipal Code Section 8.13.2.

- Construction, alteration, demolition, maintenance of construction equipment, deliveries of materials or equipment, or repair activities shall be allowed between the hours 7:00 a.m. to 6:00 p.m. Monday through Friday and 9:00 a.m. to 6:00 p.m. on Saturdays.

- No work is permitted on Sundays or Federal Holidays

- Noise levels at any point outside of the property plane of the project shall not exceed 90 dBA.

MM-12 To help further reduce construction noise levels, the project should prepare a construction management plan to be approved by the City of San Rafael prior to initiating construction. The construction management plan would include best management practices to reduce construction noise levels. Best management practices may include the following:

- All construction equipment shall be equipped with mufflers and other suitable noise attenuation devices (e.g., engine shields).

- Grading and construction contractors shall use quieter equipment as opposed to noisier equipment (such as rubber-tired equipment rather than track equipment), where feasible.

- If feasible, electric hook-ups shall be provided to avoid the use of generators. If electric service is determined to be infeasible for the site, only whisper-quiet generators shall be used (i.e., inverter generators capable of providing variable load.

- Use electric air compressors and similar power tools rather than diesel equipment, where feasible.

- Locate staging area, generators and stationary construction equipment as far from the adjacent residential homes as feasible.

- Construction-related equipment, including heavy-duty equipment, motor vehicles, and portable equipment, shall be turned off when not in use for more than 5 minutes.

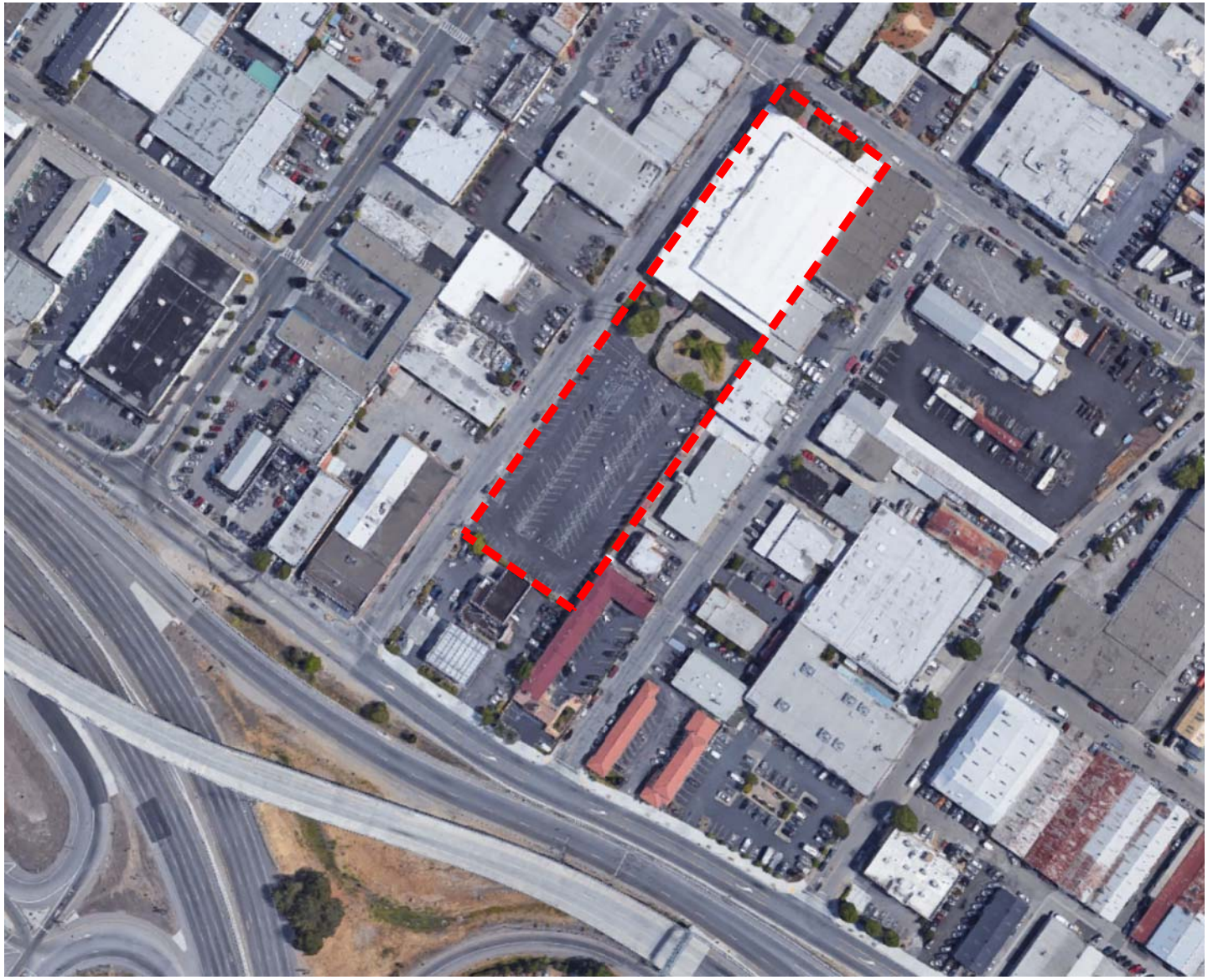
- No impact pile driving activities shall be permitted on the project site during construction. If impact pile driving is required, a follow-up noise and vibration impact assessment shall be conducted and vibration monitoring program should be performed, prior to start of any pile driving activity.

- Post a sign in a readily visible location at the project site that indicates the dates and duration of construction activities, as well as provide a telephone number where residents can inquire about the construction process and register noise complaints to an assigned construction manager.

Exhibits

Exhibit A

Location Map



N

Legend:

= Project Site Boundary

Exhibit B
Site Plan

Exhibit C

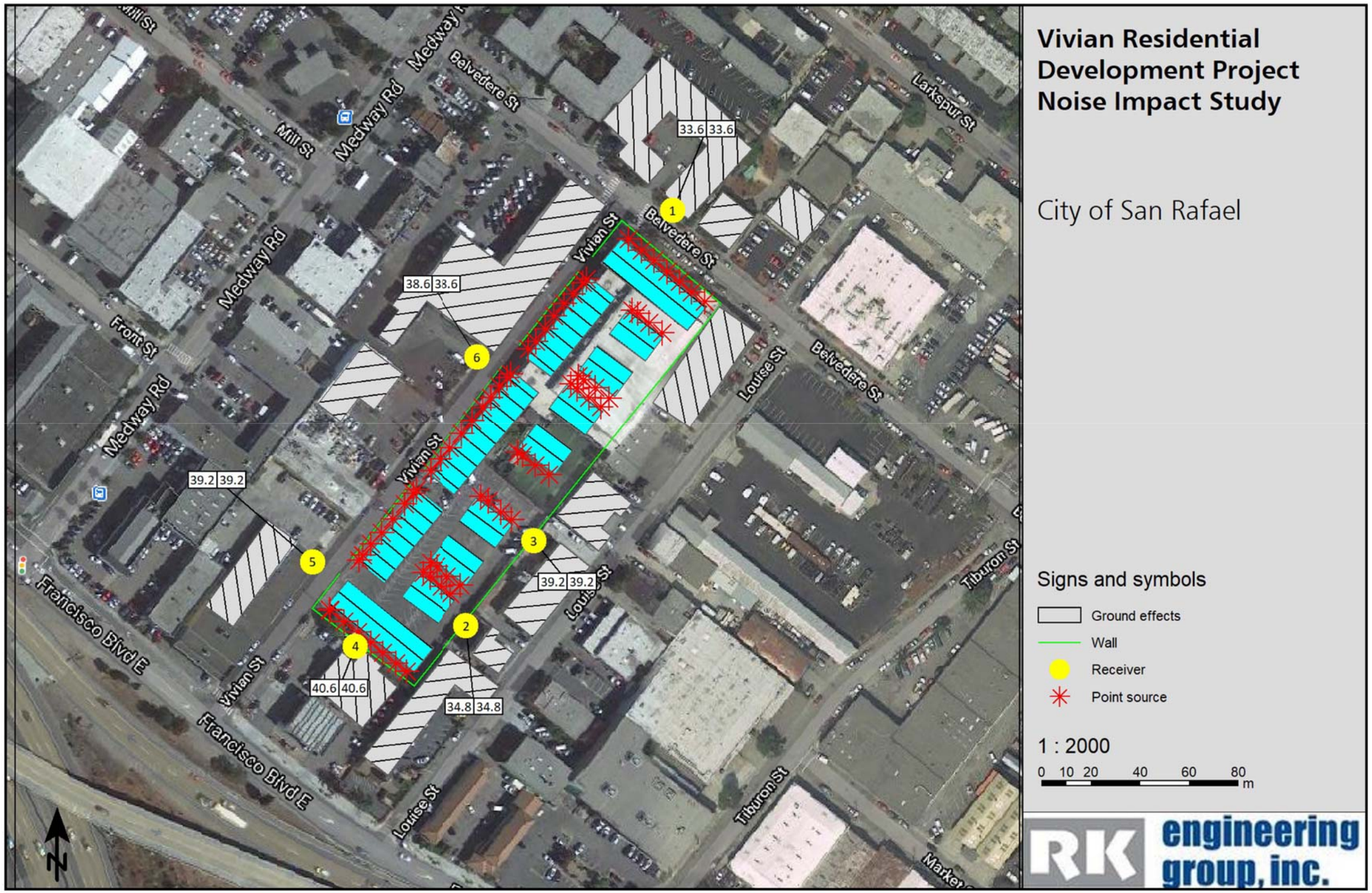
Noise Monitoring Locations

Legend:

(LT-1) = Long Term (24-Hr) Noise Monitoring Location

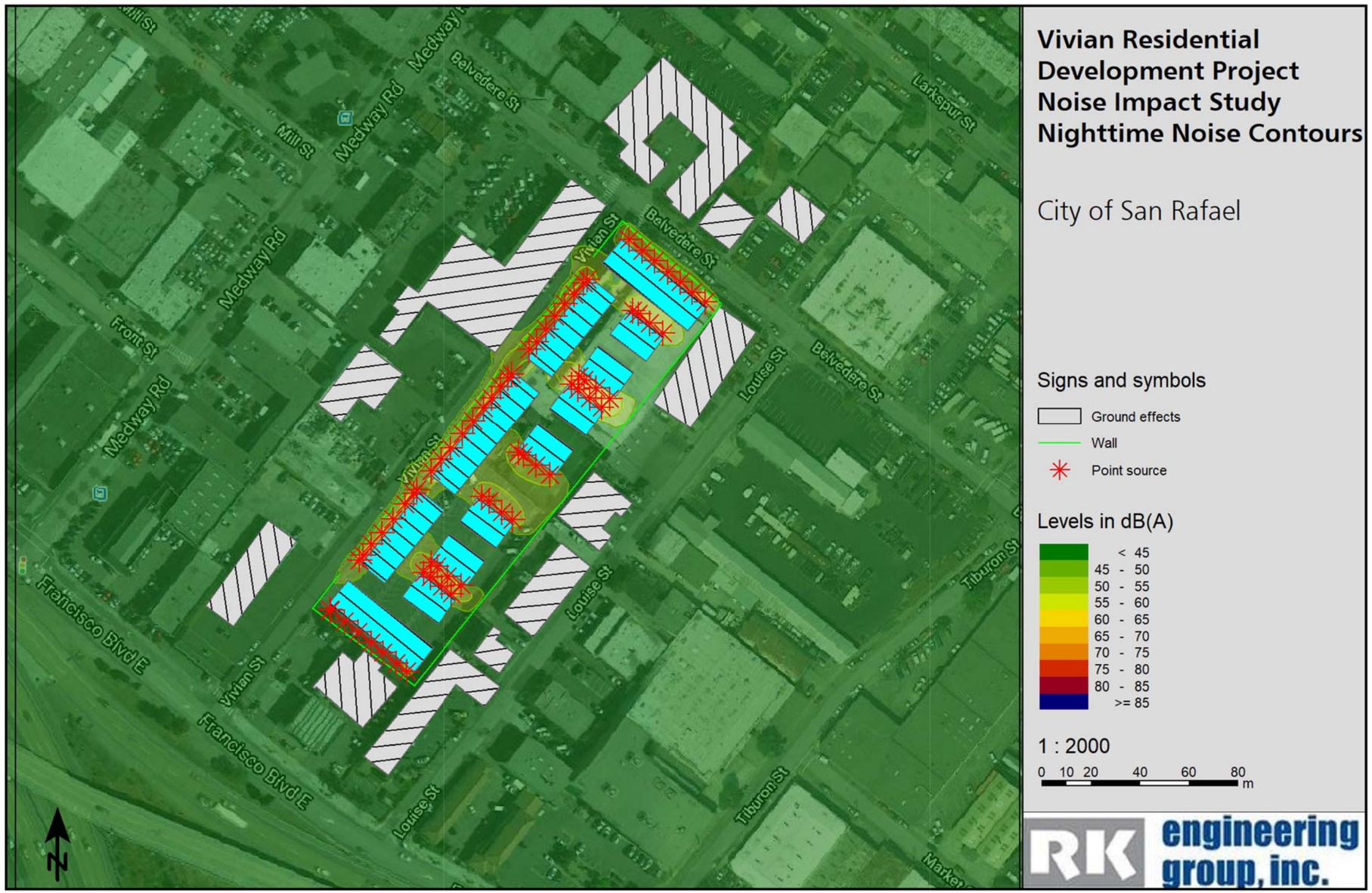
N

SoundPLAN Project Noise Level Results



Project Noise Level Contours - Daytime

Project Noise Level Contours - Nighttime



Appendices

Appendix A

City of San Rafael
General Plan Noise Element and Municipal Code Noise Standards

9 Noise

Introduction

Noise is part of everyday life in a community. In San Rafael, the City's location in a major metropolitan area makes it susceptible to noise conflicts. Each day, hundreds of thousands of cars pass through the city on US 101 and I-580, and on local surface streets. The SMART train passes through town, while trucks and buses crisscross the city. Large and small planes pass over throughout the day and evening. Even in residential neighborhoods, noise sources such as leaf blowers, car alarms, construction equipment, and barking dogs are present and may be a source of annoyance.

Noise has the potential to impact human health and well-being. It can interfere with communication, work, rest, recreation, and sleep, and can have both physiological and psychological effects. Maintaining "peace and quiet" is a basic part of protecting the quality of life. As such, the Noise Element is one of the mandatory elements of the General Plan.

Standards have been developed by the City of San Rafael to curb noise impacts from existing sources and prevent adverse effects from potential new sources. The Noise Element provides the framework for these standards. Local standards are reinforced by State and federal regulations that protect the public from the harmful effects of noise.

The Measurement of Noise

Measuring noise takes three factors into consideration: (1) the magnitude of the sound; (2) the frequency of the sound; and (3) the variation in sound level over time. Noise levels are usually expressed with an indication of the length of the measurement period. For longer periods, the measurement reflects the average level over the period, accounting for the variations in noise that occur over time. A single measure called the "equivalent sound level" or L_{eq} is used to describe average noise over a specified time period.

Sound is typically measured using decibels (dB). A measurement of 10 dB would be considered the lowest threshold of hearing, while 120 dB is extremely loud. Decibels are expressed on a logarithmic scale. In other words, a reading of 50 dB is 10 times louder than 40 dB and 100 times louder than 30 dB. Noise measurements are taken on an "A-weighted" scale (expressed as "dBA") that filters out very low and very high frequencies.

Noise measurements also consider the greater sensitivity of people to noise at night. The term "Community Noise Equivalent Level" or CNEL describes the average noise over a 24-hour period, with a penalty of 5 dB added to sound levels between 7 PM and 10 PM, and a penalty of 10 dB added to sound levels between 10 PM and 7 AM. The term L_{dn} (day-night level) is similar, but excludes the 7 PM to 10 PM adjustment.

The term "ambient noise" describes the composite noise from all sources at a given location. The US Environmental Protection Agency suggests that ideally, outdoor ambient noise levels be no greater than 60 dB L_{dn} in residential areas. The US Department of Housing and Urban Development has a minimum outdoor noise standard of 65 dB L_{dn} for residential uses. Where housing is located in areas with ambient noise that exceeds this level, special insulating measures are usually required to reduce interior noise.

Understanding Noise and Noise Standards

The text box above provides a basic primer on how noise is measured. The standard unit of measurement of the loudness of sound is the A-weighted decibel (dBA). Changes of less than 1 dBA are usually indiscernible. Changes of 1 to 3 dBA are detectable under quiet indoor conditions. A 3 dBA change in noise levels is considered the minimum change that is detectable in an outdoor environment. A change of 5 dBA is readily discernable to most people in an outdoor environment.

Table 9-1 indicates the noise levels associated with various sources. Outdoor noise levels in a suburban setting are typically 40 to 70 dBA, although even noise levels of 40-45 dBA can interrupt sleep. Prolonged noise exposure in excess of 75 dBA may affect blood pressure, heart functions, and the nervous system. Physical damage to human hearing may occur from prolonged exposure to noise levels higher than 85 dBA. Extended noise exposure above 90 dBA can result in permanent hearing loss.

Studies have found that work performance can be affected at noise levels of 65 dBA and above. Noise can make it difficult to think and perform complex tasks. Intermittent noise can be particularly distracting. Some individuals may be more sensitive to noise than others. Standards usually address the needs of the general population and recognize that individual responses vary considerably.

Table 9-1: Typical Sound Levels in an Urban Environment

Perceived Sound Level	Sound Level (dB)	Examples
Painfully Loud	160	Fireworks at 3 feet
	150	Jet takeoff
	140	Threshold of pain
Uncomfortably Loud	130	Power drill
	120	Thunder
	110	Auto horn at 3 feet, Rock band
Very Loud	100	Snowmobile, Pile driver
	90	Diesel truck, lawn mower at 3 feet
	80	Garbage disposal, Siren at 100'
Moderately Loud	70	Vacuum cleaner, leaf blower at 50'
	60	Ordinary conversation
	50	Average home, light traffic
Quiet	40	Library
	30	Quiet conversation
Very Quiet	20	Soft whisper
	10	Rustling leaves
Barely Audible	0	Threshold of hearing

Source: California Air Resources Board

State and federal agencies have developed standards for noise. Both the State of California and the federal government have set 65 dBA L_{dn} as the desirable maximum exterior standard for residential uses. Standard residential construction typically provides at least 20 dBA of noise attenuation (with windows closed), resulting in interior noise levels of 45 dBA or less. The 45 dBA standard for interior noise has been incorporated into Title 24 of the California Building Code, where it applies to all habitable rooms.

The San Rafael Municipal Code likewise addresses noise levels. Chapter 8.13 of the Code sets limits on noise for daytime and nighttime hours. The Code establishes different levels for residential, commercial, industrial, and mixed use areas, as well as different standards for intermittent noise and continuous noise. The Municipal Code also regulates construction noise.

The State of California has developed noise compatibility guidelines for use by local governments. The guidelines indicate the types of uses that are acceptable in a given location based on the ambient noise levels at that location. The guidelines are structured to reflect the sensitivity of different land uses to noise. For example, schools, hospitals, and housing are considered "sensitive receptors" and require a quieter environment than warehouses and manufacturing.

Table 8-2 presents the noise compatibility guidelines for San Rafael, which have been adapted from the State guidelines. The table indicates the exterior noise levels that should be considered *normally acceptable, conditionally acceptable, normally unacceptable, and clearly unacceptable* for major categories of land uses. Where exterior noise levels fall within the "conditionally acceptable" or "normally unacceptable" ranges, acoustical studies are typically required before those land uses are approved.

The designation of an area as "normally unacceptable" for a particular use does not mean the use is prohibited. Rather, it means that this is not an optimal environment for the use and attenuation will be required to address noise issues. This would apply to future residential uses around the Downtown SMART station and San Rafael Transit Center, where ambient noise levels exceed 70 dB L_{dn}. Such uses would likely be required to incorporate extensive sound proofing to achieve the required interior noise level of 45 dBA.

The Noise Environment in San Rafael

Noise measurements were taken in May 2019 to provide a baseline for the noise policies in the 2040 General Plan and to determine where ambient noise levels may exceed the compatibility standards. There were 22 short-term (15-minute) measurements during the morning and evening rush hours and 10 long-term measurements taken over a 48-hour period. The locations of the noise measurements, as well as the data collected, are shown in General Plan Appendix I.

During the monitoring period, noise levels at the long-term monitoring locations ranged from 47 to 74 dBA L_{dn}. Residential areas generally had noise levels of 60 dBA L_{dn} or below. The highest noise levels were in Downtown San Rafael and were just over 70 dBA L_{dn}. For the short-term noise measurements, noise levels were highest in Downtown San Rafael and along major thoroughfares with high traffic volumes.

Traffic Noise

Traffic is the primary noise source in San Rafael. In general, higher ambient noise levels are associated with proximity to US 101 and I-580. Sound walls have been installed by Caltrans to reduce effects on adjacent residential areas. The aesthetic impacts of a sound wall can be controversial and there may be concerns about the displacement of sound to other locations. Other approaches to reducing traffic noise include the use of rubberized asphalt and specialized paving materials. Changes in motor vehicle design, including increased use of electric cars, may reduce traffic noise in the future.

Stationary Noise

Most urban land uses generate some degree of noise. Industrial and commercial uses generate noise from heating, ventilation, and air conditioning (HVAC) systems, as well as machinery, compressors, chillers, boilers, loading dock activities, and various processes. Some of these systems may run 24 hours a day, while others may be intermittent. Nightclubs, outdoor dining areas, gas stations, car washes, fire stations, drive-throughs, school playgrounds, and athletic and music events all generate noise. Even residential uses generate noise through landscaping, maintenance, air conditioning systems, swimming pool and hot tub pumps, generators, and domestic activities.

For certain businesses, conditional use permits may be used to establish hours of operation or limits on activities to reduce the potential for noise conflicts. Various Code requirements may be applied to identify noise muffling and buffering requirements and establish measurable noise thresholds for activities.

Table 9-2: Noise Compatibility Guidelines for San Rafael[1]

Land Uses	Interior CNEL or L_{dn} (dBA)	Exterior Noise Exposure, CNEL or L_{dn} (dBA) 55 60 65 70 75 80
Residential-Low Density Single-Family, Duplex, Mobile Homes	45*	
Residential-Multiple Family	45*	
Transient Lodging, Motels, Hotels	45*	
Schools, Libraries, Churches, Hospitals, Nursing Homes	45*	
Auditoriums, Concert Halls, Amphitheaters	--	
Sports Arena, Outdoor Spectator Sports	--	
Playgrounds, Neighborhood Parks	--	
Golf Courses, Riding Stables, Water Recreation, Cemeteries	--	
Office Buildings, Businesses, Commercial and Professional	50	
Industrial, Manufacturing, Utilities, Agricultural	--	

Normally Acceptable:
Specified land use is satisfactory based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.

Conditionally Acceptable:
New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and the needed noise insulation features are 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 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 generally should not be undertaken.

** Noise level requirement with closed windows, mechanical ventilation, or other means of ventilation shall be provided per Chapter 12 Section 1205 of the Building Code.*

[1] *The standards are derived from the 2017 General Plan Guidelines prepared by the State Office of Planning and Research (OPR).*

Construction Noise

Construction noise occurs throughout San Rafael. Although it is temporary and intermittent, such noise can be particularly intrusive because of its very high output and repetitive nature. At a distance of 50 feet, a jackhammer may generate noise levels exceeding 88 dBA. The San Rafael Municipal Code includes exemptions for construction during business hours but does not allow construction on Sundays and federal holidays. It further establishes that construction noise levels may not exceed 90 dBA L_{max} at the property line at any time. Larger projects may be subject to specific requirements to avoid potential conflicts.

Aircraft Noise

Aircraft noise can occasionally be an issue in San Rafael due to aircraft passing overhead and planes taking off and landing at San Rafael Airport, a small private airport in the Smith Ranch area. The City is also home to a private heliport, located in southeast San Rafael near Point San Quentin. Aircraft noise is regulated by Federal Aviation Administration standards and by the California Code of Regulations. The State Code limits noise-sensitive land uses such as housing in areas where aircraft exterior noise levels exceed 65 dBA CNEL. As the maps in Appendix I indicate, noise levels are below this level at San Rafael Airport and are expected to remain below this level in the future. The heliport is located in a developed industrial area and does not impact noise-sensitive land uses.

Rail Noise

Sonoma Marin Area Rapid Transit (SMART) is the only source of rail noise in San Rafael. A Quiet Zone has been established in Marin County; this eliminates the requirement that trains sound their horns at all grade crossings. Noise monitoring completed for the General Plan in 2019 indicated that the trains did not generate substantial ambient noise relative to other activities in the Planning Area, such as highways.

Photo Credit: Frank Johnson

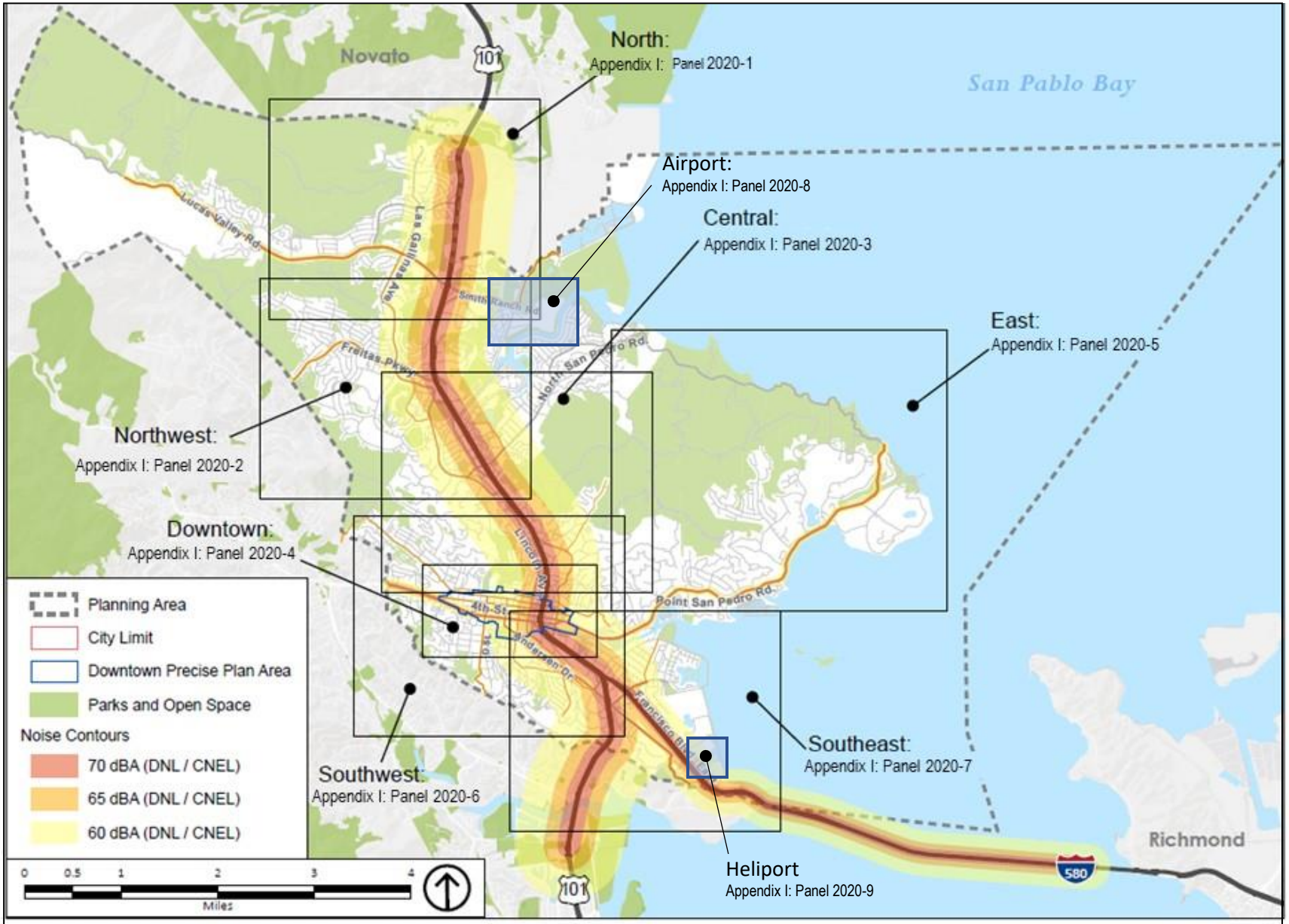
2020 and 2040 Noise Contour Diagrams

Transportation-related noise conditions across San Rafael have been estimated using a computer model developed by the Federal Highway Administration. The model considers traffic volumes, vehicle speed, and roadway geometry to determine the likely noise levels at various distances from freeways and major thoroughfares. The outcome is expressed using a contour diagram showing the expected ambient daily noise levels in 5 decibel interval bands.

Figure 9-2 shows 2020 noise contours using traffic data collected in 2019. Because of the map scale, areas along the freeways are shown at a finer level of detail in seven "panels" (inset maps) in Appendix I of General Plan 2040. Two additional inset maps are included for San Rafael Airport and the heliport near the east end of Kerner Boulevard. Figure 9-3 shows projected noise levels for 2040, using the traffic forecasts from the Mobility Element of the General Plan. Like the 2020 Map, there are panel maps in Appendix I that display the data at a finer scale.

There are only minor differences between the 2020 and 2040 maps. At most locations near the freeways, daily traffic noise levels are projected to increase by less than one decibel. Noise associated with increased traffic along surface streets increases by zero to 2.5 decibels over the 20-year period. These are cumulative measurements that consider increased regional traffic volumes as well as the sum of traffic from all development that may added in San Rafael during the 20-year planning horizon.

The 2040 diagram does not consider potential reductions in noise that may occur due to changes in road design and vehicle technology between now and 2040. It is possible that a shift to electric vehicles or the introduction of new road surface materials could lead to substantially quieter conditions by 2040. Nonetheless the contour diagrams provide a good indication of where additional sound proofing may be required in response to current ambient noise conditions, especially along the US 101 corridor and in Downtown San Rafael.



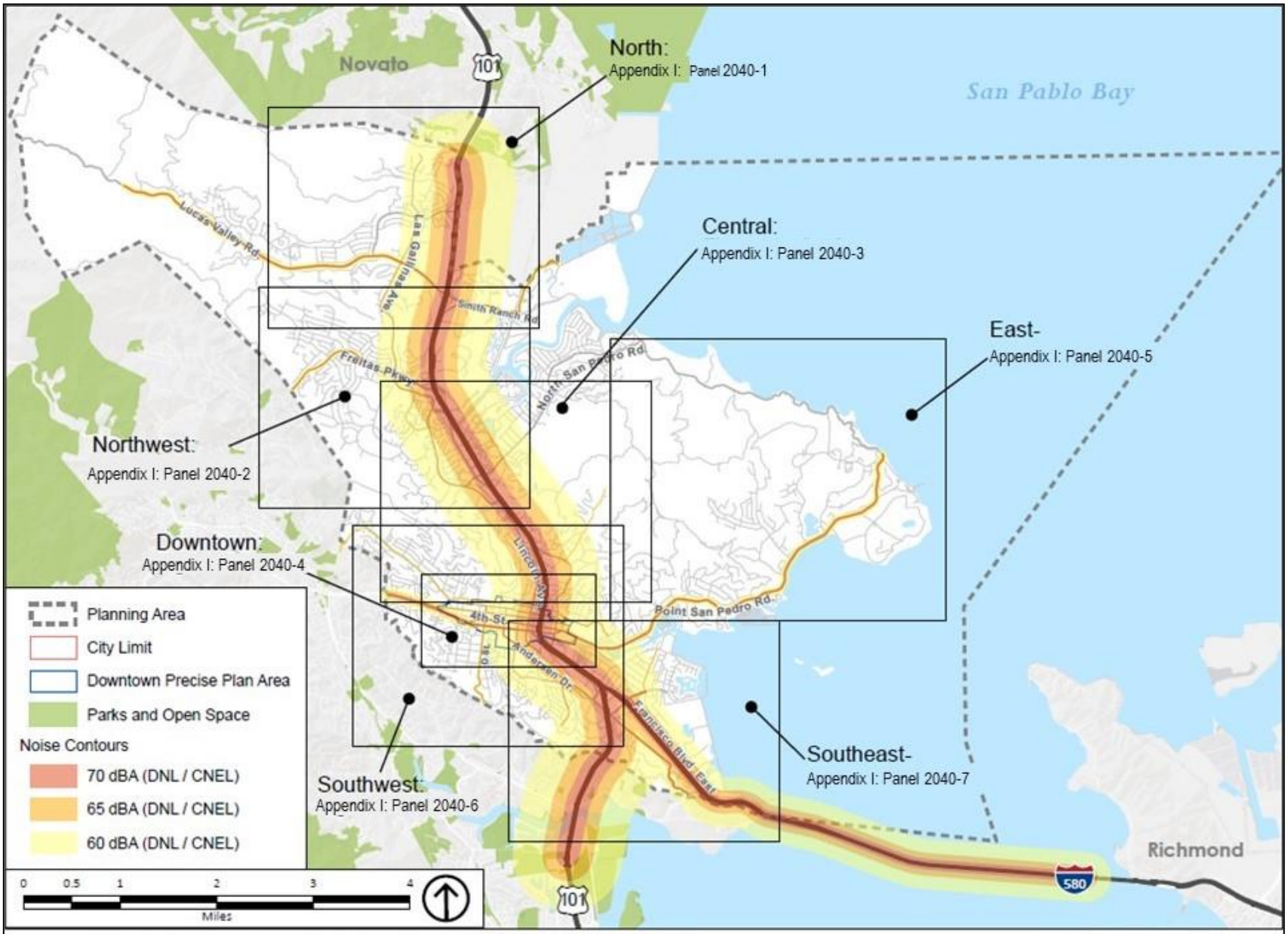
Source: ESRI, 2017; County of Marin, 2009; City of San Rafael, 2019; PlaceWorks, 2019.

SAN RAFAEL General Plan 2040

See Appendix I for inset maps of the seven subareas shown above

Figure 9-2:

2020 Noise Contours



Source: ESRI, 2017; County of Marin, 2009; City of San Rafael, 2019; PlaceWorks, 2019.

SAN RAFAEL General Plan 2040

See Appendix I for inset maps of the seven subareas shown above

Figure 9-3:

2040 Noise Contours

Goal N-1: Acceptable Noise Levels

Protect the public from excessive unnecessary, and unreasonable noise.

Excessive noise is a concern for many residents of San Rafael. This concern can be addressed through the implementation of standards to protect public health and reduce noise conflicts in the community, including the Noise Ordinance.

The General Plan seeks to limit the impacts of noise on residents and employees in several ways. First, the Plan contains standards to determine the suitability of new land uses depending on ambient noise levels in the area. Second, policies limit the extent of new noise sources that might impact "sensitive" uses such as schools and homes. Third, the Plan calls for continued implementation of the City's Noise Ordinance, to limit "nuisance noise" and other common sources. Finally, the Plan identifies different ways that noise can be mitigated, including construction methods, site planning, and barriers (sound walls, berms, etc.).

Policy N-1: Land Use Compatibility Standards for Noise

Protect people from excessive noise by applying noise standards in land use decisions. The Land Use Compatibility standards in Table 9-2 are adopted by reference as part of this General Plan and shall be applied in the determination of appropriate land uses in different ambient noise environments.

> ***Program N-1A: Residential Noise Standards.*** *As shown in Table 9-2, maintain a maximum noise standard for backyards, decks, and common / usable outdoor areas of 60 L_{dn} dB for single family homes and 65 L_{dn} dB for multi-family and mixed use areas. As required by Title 24 insulation requirements, interior noise levels shall not exceed 45 L_{dn} in all habitable rooms in residential units.*

Policy N-2: Maintaining Acceptable Noise Levels

Use the following performance standards to maintain an acceptable noise environment in San Rafael:

(a) New development shall not increase noise levels by more than 3 dB L_{dn} in a residential area, or by more than 5 dB L_{dn} in a non-residential area.

(b) New development shall not cause noise levels to increase above the "normally acceptable" levels shown in Table 9-2.

(c) For larger projects, the noise levels in (a) and (b) should include any noise that would be generated by additional traffic associated with the new development.

(d) Projects that exceed the thresholds above may be permitted if an acoustical study determines that there are mitigating circumstances (such as higher existing noise levels) and nearby uses will not be adversely affected.

> ***Program N-2A: Acoustical Study Requirements.*** *Require acoustical studies for new single family residential projects within the projected 60 dB L_{dn} noise contour and for multi-family or mixed use projects within the projected 65 dB L_{dn} contour (see Figure 9-3). The studies should include projected noise from additional traffic, noise associated with the project itself, and cumulative noise resulting from other approved projects. Mitigation measures should be identified to ensure that noise levels remain at acceptable levels.*

Program N-2B: Approval Conditions. *Establish conditions of approval for activities with the potential to create significant noise conflicts and enforce these conditions once projects become operational.*

Policy N-3: Reducing Noise Through Planning and Design

Use a range of design, construction, site planning, and operational measures to reduce potential noise impacts.

Program N-3A: Site Planning. *Where appropriate, require site planning methods that minimize potential noise impacts. By taking advantage of terrain and site dimensions, it may be possible to arrange buildings, parking, and other uses to reduce and possibly eliminate noise conflicts. Site planning techniques include:*

(a) Maximizing the distance between potential noise sources and the receiver.
(b) Placing non-sensitive uses such as parking lots, maintenance facilities, and utility areas between the source and receiver.
(c) Using non-sensitive uses such as garages to shield noise sensitive areas.
(d) Orienting buildings to shield outdoor spaces from noise sources.
(e) Incorporating landscaping and berms to absorb sound.

Program N-3B: Architectural Design. *Where appropriate, reduce the potential for noise conflicts through the location of noise-sensitive spaces. Bedrooms, for example, should be placed away from freeways. Mechanical and motorized equipment (such as air conditioning units) should be located away from noise-sensitive rooms. Interior courtyards with water features can mask ambient noise and provide more comfortable outdoor spaces.*

Program N-3C: Noise Barriers. *Where appropriate, use absorptive noise barriers to reduce noise levels from ground transportation and industrial noise sources. A barrier should provide at least L_{dn} 5 dB of noise reduction to achieve a noticeable change in noise levels.*

Program N-3D: Noise Reduction through Construction Materials. *Where appropriate, reduce noise in interior spaces through insulation and the choice of materials for walls, roofs, ceilings, doors, windows, and other construction materials.*

Policy N-4: Sound Walls

Discourage the use of sound walls when other effective noise reduction measures are available. Vegetation, berms, and the mitigation measures in Policy N-3 are the preferred methods of absorbing sound along roads, rail, and other transportation features. Where there are no other feasible options (for example, along many sections of US Highway 101), the City will review and comment on sound wall design. Sound walls should be aesthetically pleasing, regularly maintained, and designed to minimize the potential displacement of sound.

Policy N-5: Mixed Use

Mitigate the potential for noise-related conflicts in mixed use development combining residential and non-residential uses.

Program N-5A: Disclosure Agreements. *Where appropriate, require disclosure agreements for residents in mixed use projects advising of potential noise impacts from nearby commercial enterprises, such as restaurants and entertainment venues.*

Policy N-6: Traffic Noise

Minimize traffic noise through land use policies, law enforcement, street design and improvements, and site planning and landscaping.

Program N-6A: Interagency Coordination. *Work with Caltrans, Marin County, the Transportation Authority of Marin, and other agencies to achieve noise reduction along freeways and major arterials in San Rafael. This shall include noise mitigation measures in any redesign plan for the I-580/US 101 interchange.*

Program N-6B: California Vehicle Code. *Enforce applicable sections of the California Vehicle Code relating to noise.*

Program N-6C: Paving and Transit Improvements. *Pursue cost-effective paving technologies to minimize traffic noise and support the use of quieter buses and other mass transit vehicles. Noise reduction should be considered an important benefit as the City and its transit service providers transition to electric vehicles.*

Policy N-7: Aviation-Related Noise

To the extent allowed by federal and state law, ensure that the noise impacts of any changes in facilities or operations are considered when granting or modifying use permits at the San Rafael Airport in North San Rafael and the heliport in East San Rafael (see Noise Contours for San Rafael Airport and Heliport in Appendix I). (*See also Program M-1.4B on drones*).

Policy N-8: Train Noise

Work with Sonoma Marin Area Rail Transit (SMART) to minimize noise and vibration associated with train service and to reduce the potential for impacts on nearby residences.

Program N-8A: Quiet Zones. *Maintain the Marin County designated "Quiet Zone" along the rail line. The Zone ensures that train horns are not sounded except when trains are leaving the station, or if there is an emergency.*

Quiet Zones

The San Rafael City Council has established a Quiet Zone for SMART rail trains passing through the city. The Quiet Zone designation means that a train operator is not required to blow the train horn as it approaches a vehicular or pedestrian crossing unless there is a hazard on the track.

Policy N-9: Maintaining Peace and Quiet

Minimize noise conflicts resulting from everyday activities such as construction, sirens, yard equipment, business operations, night-time sporting events, and domestic activities.

Program N-9A: Noise Ordinance. *Maintain and enforce the noise ordinance, which addresses common noise sources such as amplified music, mechanical equipment use, and construction. Updates to the ordinance should be periodically considered in response to new issues (for example, allowing portable generators during power outages).*

Program N-9B: Construction Noise. *Use the environmental review process to identify measures to reduce the exposure of neighboring properties to excessive noise levels from construction activity.*

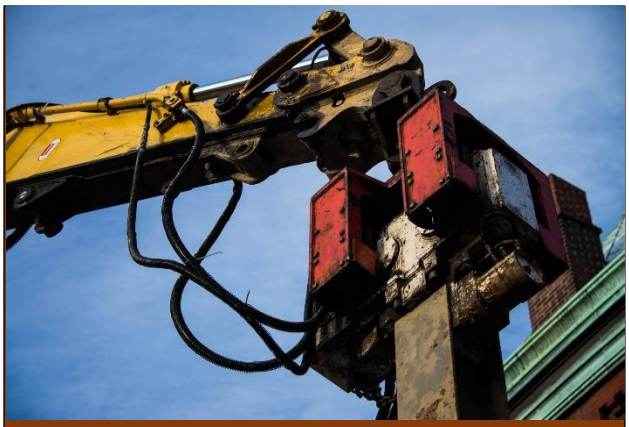
Program N-9C: Noise Specifications. *Include noise specifications in requests for equipment information and bids for new City equipment and consider this information as part of evaluation of the bids.*

Policy N-10: City-County Coordination

Coordinate with the County of Marin to consider and mitigate noise impacts when activities in one jurisdiction may affect the other.

Program N-10E: San Rafael Rock Quarry*. Seek to minimize noise impacts of the quarry and brickyard operations through cooperative efforts with the County of Marin through its code enforcement and land use entitlement processes.*

Photo Credit: Owen Iverson



Vibration

Like noise, vibration is transmitted in waves—in this case, through earth or solid objects. Vibration is typically felt rather than heard. It may be natural or human-caused. Common sources include heavy trucks, buses, and construction activities such as pile driving. Quarrying also may have vibration impacts. At high levels, vibration can be perceived as unpleasant or annoying. It can also cause structural damage, such as cracked plaster.

Policy N-11: Vibration

Ensure that the potential for vibration is addressed when transportation, construction, and non-residential projects are proposed, and that measures are taken to mitigate potential impacts.

Program N-11A: Vibration-Related Conditions of Approval. *Adopt Standard conditions of approval to reduce the potential for vibration-related construction impacts for development projects near sensitive uses such as housing and schools. Vibration impacts shall be considered as part of project level environment al evaluation and approval for individual future projects.*

Chapter 8.13 - NOISE

Sections:

It is hereby declared to be the policy of the City of San Rafael, in the exercise of its police power, to protect the peace, health, safety and general welfare of the citizens of San Rafael from excessive, unnecessary and unreasonable noises from any and all sources in the community. It is the intention of the city council to control the adverse effect of such noise sources on the citizens by prescribing standards prohibiting detrimental levels of noise and by providing a remedy for violations. The provisions of this chapter and the remedies contained in this code shall be cumulative and are not intended to replace any otherwise available remedies for public or private nuisances, nor any other civil or criminal remedies otherwise available. In addition, the regulations contained herein are not intended to substitute for any noise analysis conducted as a part of the city's environmental review process for discretionary permit approvals, nor is it intended to limit more strict noise control requirements for discretionary permit approvals should more strict measures be found to be necessary in order to maintain noise levels that are not detrimental to the health and welfare of the citizens of the city.

(Ord. 1789 § 3 (part), 2002).

For the purposes of this chapter, certain terms are defined as follows:

1. "'A'-Weighted Sound Level (dBA)" means a decibel scale that approximates the way the human ear responds to various acoustic frequencies.
2. "Commercial property" means property zoned for commercial, office, marine, marine commercial, or water uses, as provided in the City of San Rafael Zoning Ordinance, San Rafael Municipal Code Title 14, or properties zoned as planned development where the principal use is commercial, marine, marine commercial, or water use.
3. "Constant noise" means a continuous noise produced where there is no noticeable change in the level of the noise source. Examples would include such noises as those associated with air conditioners and pool equipment.
4. "Daytime" for purposes of this chapter means the period between seven a.m. (7:00 a.m.) and nine p.m. (9:00 p.m.) Sunday through Thursday and between seven a.m. (7:00 a.m.) and ten p.m. (10:00 p.m.) on Friday and Saturday.
5. "Decibel" means the measurement unit used for the level of sound/noise.
6. "Emergencies or utility power outages" means: Any city, county, or state declared emergencies; any interruption of utility power due to preventive utility shut-off measures or due to damage to utility infrastructure from accidents, earthquakes, fires, floods, storms, winds, or other acts; or any event deemed to be an emergency by city officials to preserve and protect life or property.
7. "Holidays" mean those holidays designated as federal holidays and the day after Thanksgiving.

8. "Industrial property" means property zoned for industrial or light industrial use as provided in the City o Rafael Zoning Ordinance, San Rafael Municipal Code Title 14, or properties zoned as planned developme the principal use is industrial or light industrial.
9. "Intermittent" noise means repetitive noises where there is a distinction between the onset and decay of the sound. Examples would include hammering and dog barking.
10. "Mixed use property" means property zoned for both residential and for office and/or commercial use as provided in the City of San Rafael Zoning Ordinance, San Rafael Municipal Code Title 14.
11. "Multi-family residential structure" means any dwelling structure where two (2) or more dwellings are separated by a common wall, floor, or ceiling, including, but not limited to, apartments, condominiums and townhouses.
12. "Nighttime" for purposes of this chapter means the period between nine p.m. (9:00 p.m.) and seven a.m. (7:00 a.m.) Sunday through Thursday and between ten p.m. (10:00 p.m.) and seven a.m. (7:00 a.m.) on Friday and Saturday.
13. "Noise level" means the maximum constant or intermittent sound level produced by a source or group of sources as measured with a sound level meter using fast response and "A"-weighting. In order to measure a noise level, the controls of the sound level meter should be arranged to the setting appropriate to the type of noise being measured.
14. "Portable generator" means any UL listed diesel or gas fired generator not connected to a building's electrical system and only intended to provide power during emergencies or utility power outages. Generators must not exceed 69 dBA during full speed diagnostics and normal operations when measured at seven (7) meters with no loads, must meet setback requirements for mechanical equipment provided in the City of San Rafael Zoning Ordinance, San Rafael Municipal Code Title 14 and must meet all fuel storage requirements provided in the California Fire Code.
15. "Property plane" means a vertical plane including the property line that determines the property boundaries in space.
16. "Public property" means property zoned for public/quasi-public or parks/open space use as provided in the City of San Rafael Zoning Ordinance, San Rafael Municipal Code Title 14, or the San Rafael City Plaza, or any public street, right-of-way, or easement.
17. "Residential power equipment" means any mechanically powered saw, sander, drill, grinder, leaf blower, lawnmower, hedge trimmer, edger, or any other similar tool or device, when used in or on any residential property.
18. "Residential property" means property zoned for residential use as provided in the City of San Rafael Zoning Ordinance, San Rafael Municipal Code Title 14, or properties zoned for mixed use or as planned development where the principal use is residential.
19. "Routine testing" means the required and routine testing per manufacturer's recommendations to maintain and keep ready stationary generators; usually on a weekly or monthly schedule.
20. "Sound level meter" means a device for measuring sound level in decibel units within the performance specifications in the American National Standards Institute Standard S1.4, "Specification for Sound Level Meters."

21. "Stationary generator" means any UL 2200 listed natural gas and/or propane fired generator permanent connected to the building's electrical system and only intended to provide power during emergencies or power outages. Generators must not exceed 69 dBA during full speed diagnostics and normal operation measured at seven (7) meters with no loads and must meet setback requirements for mechanical equip provided in the City of San Rafael Zoning Ordinance, San Rafael Municipal Code Title 14.

(Ord. 1789 § 3 (part), 2002; Ord. No. 1977 , div. 2, 11-18-2019)

8.13.030 - Loud or unusual noises prohibited.

No person shall maintain, emit or make, or cause, suffer or permit to be maintained, emitted or made, any noise or sound produced by human, animal, mechanical or other means, which by reason of its raucous or nerve-wracking nature, shall disturb the peace or comfort or be injurious to the health of any person or persons; and such a noise or sound may be deemed in violation of this section regardless whether it is found to be within the noise limits established elsewhere in this chapter for the location or type of noise or sound.

(Ord. 1789 § 3 (part), 2002).

8.13.040 - General noise limits.

Subject to the exceptions and exemptions set forth in Sections 8.13.050 and 8.13.060 of this chapter, the general noise limits set forth in this section shall apply. A summary of the general noise limits set forth in this section is set forth in Table 8.13-1. Where two or more noise limits may apply, the more restrictive noise limit shall govern. For purposes of determining sound levels from any source of sound, a sound level measurement shall be made at any point on any receiving private or public property. Notwithstanding the foregoing, in multi-family structures, the microphone shall be placed no closer than 3-½ feet from a wall through which the source of sound at issue is transmitting, and shall also be placed five (5) feet above the floor regardless of whether the source of sound at issue transmits through the floor, ceiling or wall. Sound level measurements shall be made with a sound level meter (Type 1 or 2) set to A-weighting, and "fast" response for intermittent sound. Slow or fast response may be used for constant noise sources. For intermittent sound, the one second rms maximum level (Lmax) shall be used. For constant sound, the average level (Leq) shall be used.

A. Residential property noise limits.

1. No person shall produce, suffer or allow to be produced by any machine, animal or device, or by any other means, a noise level greater than the following, when measured on any residential property:

a. Daytime: 60 dBA intermittent

50 dBA constant

b. Nighttime: 50 dBA intermittent

40 dBA constant

2. No person shall produce, suffer or allow to be produced by any machine, animal, or device, or by any other means, a noise level greater than the following, when measured on any mixed use property:

a. Daytime: 65 dBA intermittent

55 dBA constant

b. Nighttime: 55 dBA intermittent

45 dBA constant

3. No person shall produce, suffer or allow to be produced by any machine, animal or device, or by any other means, within the interior of a multi-family residential structure, a noise level greater than the following, when measured through a common interior partition (wall, floor or ceiling) from any other interior location:

a. Daytime: 40 dBA intermittent

35 dBA constant

b. Nighttime: 35 dBA intermittent

30 dBA constant

B. Commercial property noise limits.

No person shall produce, suffer or allow to be produced by any machine, animal, or device, or by any other means, a noise level greater than sixty-five (65) dBA intermittent or fifty-five (55) dBA constant, when measured on any commercial property.

C. Industrial property noise limits.

No person shall produce, suffer or allow to be produced by any machine, animal or device, or by any other means, a noise level greater than seventy (70) dBA intermittent or sixty (60) dBA constant, when measured on any industrial property.

D. Public property noise limits.

No person shall produce, suffer or allow to be produced by any machine, animal or device, or by any other means, a noise level, when measured on any public property, that is greater than the most restrictive noise standard applicable under this chapter to any private property adjoining the receiving public property.

TABLE 8.13-1—GENERAL NOISE LIMITS

Property type or zone	Daytime limits	Nighttime limits
Residential	60 dBA Intermittent 50 dBA Constant	50 dBA Intermittent 40 dBA Constant
Mixed-use	65 dBA Intermittent 55 dBA Constant	55 dBA Intermittent 45 dBA Constant
Multifamily residential (interior sound source)	40 dBA Intermittent 35 dBA Constant	35 dBA Intermittent 30 dBA Constant
Commercial	65 dBA Intermittent 55 dBA Constant	65 dBA Intermittent 55 dBA Constant
Industrial	70 dBA Intermittent 60 dBA Constant	70 dBA Intermittent 60 dBA Constant
Public Property	Most restrictive noise limit applicable to adjoining private property	Most restrictive noise limit applicable to adjoining private property

(Ord. 1789 § 3 (part), 2002).

8.13.050 - Standard exceptions to general noise limits.

The following standard exceptions to the provisions of Section 8.13.040 shall be allowed as of right, to the extent and during the hours specified. A summary of the standard exceptions provided in this section is set forth in Table 8.13-2.

A. Construction. Except as otherwise provided in subsection B of this section, or by the planning commission or city council as part of the development review for the project, on any construction project on property within the city, construction, alteration, demolition, maintenance of construction equipment, deliveries of materials or equipment, or repair activities otherwise allowed under applicable law shall be allowed between the hours of seven a.m. (7:00 a.m.) and six p.m. (6:00 p.m.), Monday through Friday, and nine a.m. (9:00 a.m.) and six p.m. (6:00 p.m.) on Saturdays, provided that the noise level at any point outside of the property plane of the project shall not exceed ninety (90) dBA. All such activities shall be precluded on Sundays and holidays. Violation of the foregoing may subject the permittee to suspension of work by the chief building official for up to two (2) days per violation.

For any construction project involving the construction of one or more new buildings or residences within the city, or when required by the planning commission or city council as part of their development review for the property, the property owner or occupant shall post a sign at all entrances to the construction site upon commencement of construction, for the purpose of informing all contractors and subcontractors, their employees, agents, materialmen and all other persons at the construction site, of the basic requirements of this chapter.

1. Said sign(s) shall be posted in a conspicuous place visible from the public right-of-way near the entrance to the job site, at least five feet (5') above ground level, and shall be of a white background, with legible black lettering, which lettering shall be a minimum of one and one-half inches (1 1/2") in height.
2. Said sign shall read as follows (or as consistent with other hours approved by the planning commission or city council):

CONSTRUCTION HOURS
(includes any and all deliveries)

MONDAY—FRIDAY	7:00 a.m. to 6:00 p.m.
SATURDAY	9:00 a.m. to 6:00 p.m.
SUNDAY/HOLIDAYS	Prohibited

NOISE LIMITS

Noise level at any point outside of the construction property plane shall not exceed ninety (90) dBA.

Violation of the construction hours and noise limits may be enforced as either an infraction or a misdemeanor punishable by fines or jail time or both, or by an administrative citation with a fine, or by a civil action with a monetary penalty, injunction and/or other remedies, as provided in Chapter 1.42 of this code. In addition, the chief building official may issue a stop work order requiring suspension of work for up to two (2) days per violation.

B. Residential Power Equipment and Construction Activities by Residential Property Owners. Residential power equipment, and construction activities undertaken by residential property owners to maintain or improve their property, shall be allowed between the hours of eight a.m. (8:00 a.m.) and eight p.m. (8:00 p.m.), Monday through Friday, and nine a.m. (9:00 a.m.) and six p.m. (6:00 p.m.) on Saturdays, Sundays and holidays, providing such equipment and/or activities do not produce a noise level that exceeds ninety (90) dBA beyond the property plane of the property on which the equipment is being used or the activity is occurring. For purposes of this subsection, "construction activities undertaken by the residential property owner" shall include work personally done by the property owner(s) and by a family member, friend or other persons assisting the property owner(s).

C. Sound Performances; Sound-Generating Devices. Notwithstanding anything in this chapter to the contrary, on public property or any other open area to which the public has access, whether publicly or privately owned, sound-generating devices or instruments used for any indoor or outdoor sound performances, athletic events, and special events shall be permitted, provided they do not exceed a noise level of eighty (80) dBA measured at a distance of not less than fifty feet (50') from the property plane or such other limit as may be established by any required approvals and permits therefor obtained from the appropriate governmental entity. Except pursuant to an approved special event, street closure or parade permit, the use of any sound-generating device or instrument for such performances or events between the hours of ten p.m. (10:00 p.m.) and ten a.m. (10:00 a.m.) is unlawful.

D. Refuse Collection. Refuse collection activities shall be permitted as specified in this section, provided they do not produce a noise level in excess of ninety-five (95) dBA measured at a distance of twenty-five feet (25') from the activity:

1. Residential or mixed-use property: between the hours of six a.m. (6:00 a.m.) and nine p.m. (9:00 p.m.), Monday through Saturday;
2. Industrial or commercial property: between the hours of four a.m. (4:00 a.m.) and nine p.m. (9:00 p.m.) daily.

TABLE 8.13-2 - STANDARD EXCEPTIONS TO GENERAL NOISE LIMITS

Type of Activity	Maximum Noise Level	Days/Hours Permitted

Construction	90 dBA	Mon-Fri 7:00 a.m.—6:00 p.m. Sat 9:00 a.m.—6:00 p.m. Sun, Hol.—prohibited or as otherwise set by city approval
Residential Power Equipment and Construction Activities Undertaken by Residential Property Owners	90 dBA	Mon-Fri 8:00 a.m.—8:00 p.m. Sat, Sun, Hol. 9:00 a.m.—6:00 p.m.
Sound performances	80 dBA measured fifty (50) feet or more from property plane, or as excepted by permit approval	Every day 10:00 a.m.—10:00 p.m., or as excepted by permit approval
Refuse Collection	95 dBA	Residential or mixed-use property: Mon-Sat 6:00 a.m.—9:00 p.m. Industrial or commercial property: Daily 4:00 a.m.—9:00 p.m.

(Ord. 1838 § 7, 2005; Ord. 1789 § 3 (part), 2002).

8.13.060 - Exceptions allowed with permit.

A. In addition to the standard exceptions permitted pursuant to Section 8.13.050 of this chapter, the director of community development or his designee may grant a permit allowing an exception from any or all provisions of this chapter where the applicant can show that a diligent investigation of available noise abatement techniques indicates that immediate compliance with the requirements of this chapter would be impractical or unreasonable, or that no public detriment will result from the proposed exception. Any such permit shall be issued with appropriate conditions to minimize the public detriment caused by the permitted exceptions. Any such permit shall be of such duration, as approved by the director of community development or his designee, up to a maximum period of six (6) months, but shall be renewable upon a showing of good cause, and shall be conditioned by a schedule for compliance and details of methods therefor in appropriate cases. At the discretion of the director of community

development or his designee, an exception permit may be issued and reissued for successive short periods of time in order to allow monitoring of the adverse noise impacts of the excepted activity, and additional conditions may be imposed upon reissuance of the permit, if the director of community development or his designee determines that such additional conditions are necessary to mitigate noise impacts from the excepted activity to a level he deems acceptable under all the circumstances.

B. Any application for an exception permit under this section shall be accompanied by a fee to be set by resolution of the city council.

C. Prior to granting any permit under this section, the director of community development or his designee shall provide at least ten (10) calendar days' written notice to all property owners within three hundred feet (300') of the property for which the application is made, and shall consider any objections to the granting of such permit received before issuance of the permit.

D. Any person aggrieved with the decision of the director of community development or his designee may appeal to the city council, by writing filed with the city clerk within five (5) business days after the date of such decision; however, such decision shall not stay the effective date of the permit.

(Ord. 1838 § 8, 2005; Ord. 1789 § 3 (part), 2002).

8.13.070 - Exemptions.

The following shall be exempt from the provisions of this chapter:

1. Aerial warning devices which are required by law to protect the health, safety and welfare of the community;
2. Emergency vehicle responses and all necessary equipment utilized for the purpose of responding to an emergency, or necessary to restore, preserve, protect or save lives or property from imminent danger of loss or harm;
3. Aviation, railroad, and public transit operations;
4. The operation of any municipal or public utility vehicles;
5. Public safety training exercises conducted between the hours of eight a.m. (8:00 a.m.) and eight p.m. (8:00 p.m.);
6. Uses established through any applicable discretionary review process containing specific noise conditions of approval and/or mitigation measures;
7. Work on capital improvements, or repairs on public property by employees or contractors of the city;
8. Vehicle noise subject to regulation under the California Vehicle Code;
9. Emergency repair work performed by, or at the request of, a property owner on his or her private property, where the delay required to obtain an exception permit under this chapter would result in substantial damage, personal injuries, or property loss to the owner, provided that such emergency work shall be subject to such reasonable conditions as may be imposed by authorized city employees to mitigate the noise level of the activity.
10. Portable generator used during emergencies or utility power outages per manufacturer's recommendations.

11. Stationary generator installed and used during emergencies, utility power outages or routine testing per manufacturer's recommendations. Routine testing for stationary generators shall be conducted betwee of ten a.m. (10:00 a.m.) and four p.m. (4:00 p.m.).

(Ord. 1789 § 3 (part), 2002; Ord. No. 1977 , div. 2, 11-18-2019)

8.13.080 - Violations, penalties.

Any violation of this chapter may be enforced either as an infraction or as a misdemeanor, or by any remedy available to the city under this code, or under state law.

(Ord. 1789 § 3 (part), 2002).

Appendix B

HVAC Specification Sheet

24AHA4
Performance Series Air Conditioner
with Puron Refrigerant
1-1/2 to 5 Nominal Tons

Product Data

Puron

Performance SERIES

Fig. 1 — 24AHA4 Unit

NOTE: Images are for illustration purposes **only**. Actual models may differ slightly.

Carrier air conditioners with **Puron**® refrigerant provide a collection of features unmatched by any other family of equipment. The 24AHA4 has been designed utilizing Carrier's **Puron**® refrigerant. This environmentally sound refrigerant allows you to make a responsible decision in the protection of the earth's ozone layer.

NOTE: Ratings contained in this document are subject to change at any time. Always refer to the AHRI directory (www.ahridirectory.org) for the most up-to-date ratings information.

TABLE OF CONTENTS

INDUSTRY LEADING FEATURES / BENEFITS

Energy Efficiency

- 14 SEER/11.7 - 12.2 EER

(Based on tested combinations)

Sound

- Levels as low as 66 dBA

Design Features

- Small footprint
- WeatherArmor cabinet
  - All steel cabinet construction
  - Mesh coil guard

Reliability, Quality and Toughness

- Scroll compressor
- Factory-supplied filter drier
- High pressure switch
- Line lengths up to 250ft (76.2 m)
- Low ambient operation (down to -20°F/-28.9°C with low ambient accessories)

ELECTRICAL DATA

UNIT SIZE - VOLTAGE, SERIES	V/PH	OPER VOLTS*		COMPR		FAN	MCA	MAX FUSE** OR CKT BRK AMPS
		MAX	MIN	LRA	RLA	FLA		
18-30	208/230/1	253	197	56.3	9.0	0.50	11.8	20
24-30				62.9	10.9	0.50	14.1	25
30-30				73.0	14.1	0.70	18.3	30
36-30				77.0	14.1	1.20	18.8	30
48-30				124.0	18.5	1.20	24.3	40
60-30				152.5	23.7	1.45	31.1	50
36-50	208/230/3	253	197	71.0	9.0	1.20	12.5	20
48-50				83.1	13.7	1.20	18.3	30
60-50				110.0	15.9	1.45	21.4	35
36-60	460/3	506	414	38.0	5.6	0.60	7.6	15
48-60				41.0	6.2	0.60	8.4	15
60-60				52.0	7.1	0.80	9.7	15

LEGEND:
FLA - Full Load Amps
HACR - Heating, Air Conditioning, Refrigeration
LRA - Locked Rotor Amps
NEC - National Electrical Code
RLA - Rated Load Amps (compressor)

* Permissible limits of the voltage range at which the unit operates satisfactorily
** Time-Delay fuse.
Complies with 2007 requirements of ASHRAE Standards 90.1

A−WEIGHTED SOUND POWER (dBA)

UNIT SIZE	STANDARD RATING (DBA)	TYPICAL OCTAVE BAND SPECTRUM (DBA, WITHOUT TONE ADJUSTMENT)						
		125	250	500	1000	2000	4000	8000
18	69	50.5	57.0	59.5	64.5	60.5	53.5	43.0
24	66	50.5	58.5	60.5	59.5	56.5	51.0	41.5
30	68	55.5	59.5	61.5	63.5	60.0	58.0	49.5
36	71	59.5	59.5	62.0	65.5	63.5	62.0	55.0
48	70	57.5	59.5	64.0	66.0	63.0	60.5	54.5
60	73	60.0	61.5	64.5	67.0	66.0	65.5	58.0

NOTE: Tested in accordance with AHRI Standard 270-08 (not listed in AHRI).

A−WEIGHTED SOUND POWER (dBA) WITH ACCESSORY SOUND SHIELD

UNIT SIZE	STANDARD RATING (DBA)	TYPICAL OCTAVE BAND SPECTRUM (DBA, WITHOUT TONE ADJUSTMENT)						
		125	250	500	1000	2000	4000	8000
18	68	52.5	58.0	58.5	64.5	59.5	52.5	42.5
24	65	54.5	57.5	59.5	59.0	56.0	50.5	40.5
30	68	55.0	60.0	61.5	62.5	60.0	58.0	49.5
36	71	59.5	59.5	62.5	65.0	63.0	61.5	55.0
48	70	57.5	59.5	63.0	65.0	62.5	60.0	54.0
60	73	61.0	62.0	64.0	67.0	65.5	65.5	57.5

NOTE: Tested in accordance with AHRI Standard 270-08 (not listed in AHRI).

SOUND PRESSURE LEVELS, (dBA)

UNIT SIZE	AT DISTANCE 10' FROM UNIT	AT DISTANCE 15' FROM UNIT	AT DISTANCE 20' FROM UNIT
18	51.5	48.0	45.5
24	48.5	45.0	42.5
30	50.5	47.0	44.5
36	53.5	50.0	47.5
48	52.5	49.0	46.5
60	55.5	52.0	49.5

NOTE: Sound pressure data vs distance converted using AHRI 275 Standard under certain environmental and layout assumptions.

CHARGING SUB−COOLING (TXV−TYPE EXPANSION DEVICE

UNIT SIZE-SERIES	REQUIRED SUBCOOLING °F (°C)
18	12 (6.7)
24	12 (6.7)
30	12 (6.7)
36	8 (4.4)
48	12 (6.7)
60	10 (5.6)

NOTE: The conversion is accurate **only** when all the assumptions are correct.

Appendix C

Noise Measurement Data

Field Sheet

Project: Vivian Residential Development
Engineer: D. Shivaiah
Date: 12/10/2020
JN: 2948-2020-01

Measurement Address: 88 Vivian Street
City: San Rafael

Sound Level Meter:
Piccolo II
Serial # P0218042101
Serial # P0218092808

Calibrator:
CA114 Sound Calibrator
Serial # 500732

Calibration Record:

	Input, dB/	Reading, dB/	Offset, dB/	Time
1	94.0			11:37 AM
2	94.0			11:37 AM
3				
4				
5				

Notes:
Temp:
Windspeed:
Direction:
Skies:
Camera:
Photo Nos.

Meter Settings:
☒ A-WTD ☐ LINEAR ☒ SLOW ☐ 1/1 OCT ☒ INTERVALS ___10____- MINUTE
☐ C-WTD ☐ IMPULSE ☐ FAST ☐ 1/3 OCT ☒ L_N PERCENTILE VALUES

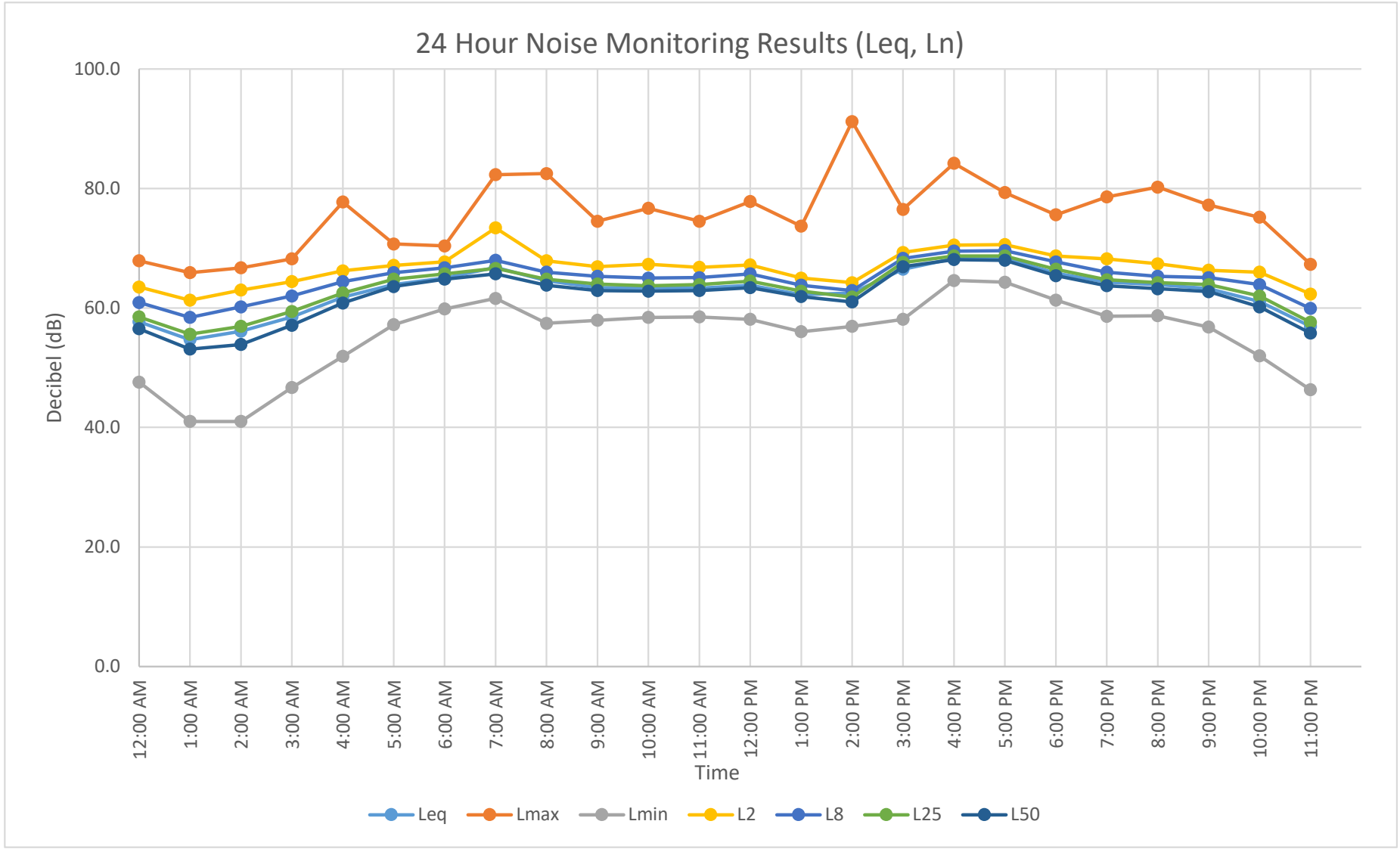
Notes:

Measurement Type:
Long-term X
Short-term

		Start Time	Stop Time	Leq	Lmax	Lmin	L2	L8	L25	L50
Locations	LT-1	Long-term noise monitoring location one (LT-1) was taken at the light pole in the parking lot at approximately 40 feet from the southern property line and approximately 65 feet from the western property line.								
	LT-2	Long-term noise monitoring location two (LT-2) was taken at the at the parking lot at approximately 305 feet from the southern property line and approximately 68 feet from the western property line.								

RK engineering group, inc.

PROJECT:	Vivian Residential Development					JOB #:	2948-2020-02
NOISE METER	Piccolo II SLM, 24-Hour Measurement					DATE:	10-Dec-20
LOCATION:	88 Vivian Street, San Rafael					BY:	D. Shivaiah
Time	Leq	Lmax	Lmin	L2	L8	L25	L50
12:00 AM	57.7	67.9	47.6	63.5	60.9	58.5	56.5
1:00 AM	54.7	65.9	41.0	61.3	58.4	55.6	53.1
2:00 AM	56.1	66.7	41.0	63.0	60.2	56.9	53.9
3:00 AM	58.5	68.2	46.7	64.4	62.0	59.4	57.1
4:00 AM	61.8	77.7	51.9	66.2	64.4	62.5	60.8
5:00 AM	63.9	70.7	57.2	67.1	65.9	64.8	63.6
6:00 AM	65.0	70.4	59.8	67.7	66.7	65.7	64.8
7:00 AM	66.8	82.3	61.6	73.4	68.0	66.6	65.7
8:00 AM	64.6	82.5	57.4	67.9	66.0	64.8	63.8
9:00 AM	63.4	74.5	57.9	66.9	65.3	64.0	62.9
10:00 AM	63.4	76.7	58.4	67.3	65.0	63.7	62.8
11:00 AM	63.3	74.5	58.5	66.8	65.1	63.9	62.9
12:00 PM	63.8	77.8	58.1	67.2	65.7	64.5	63.4
1:00 PM	62.2	73.7	56.0	65.0	63.8	62.8	61.9
2:00 PM	62.5	91.2	56.9	64.2	62.9	61.8	61.0
3:00 PM	66.5	76.5	58.1	69.3	68.3	67.6	66.9
4:00 PM	68.3	84.2	64.6	70.5	69.5	68.7	68.1
5:00 PM	68.3	79.3	64.3	70.6	69.6	68.7	68.0
6:00 PM	65.8	75.6	61.3	68.7	67.7	66.5	65.4
7:00 PM	64.3	78.6	58.6	68.2	66.0	64.7	63.7
8:00 PM	63.9	80.2	58.7	67.4	65.3	64.2	63.2
9:00 PM	63.2	77.2	56.8	66.3	65.1	63.9	62.7
10:00 PM	61.1	75.2	52.0	66.0	63.9	62.0	60.2
11:00 PM	56.9	67.3	46.3	62.3	59.9	57.6	55.8
Daytime	65.0	91.2	52.0	68.5	66.5	65.4	64.5
Nighttime	60.8	77.7	41.0	65.0	63.2	61.6	60.2


24 Hour Noise Monitoring Results (Leq, Ln)
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80.0
60.0
40.0
20.0
0.0
Decibel (dB)
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
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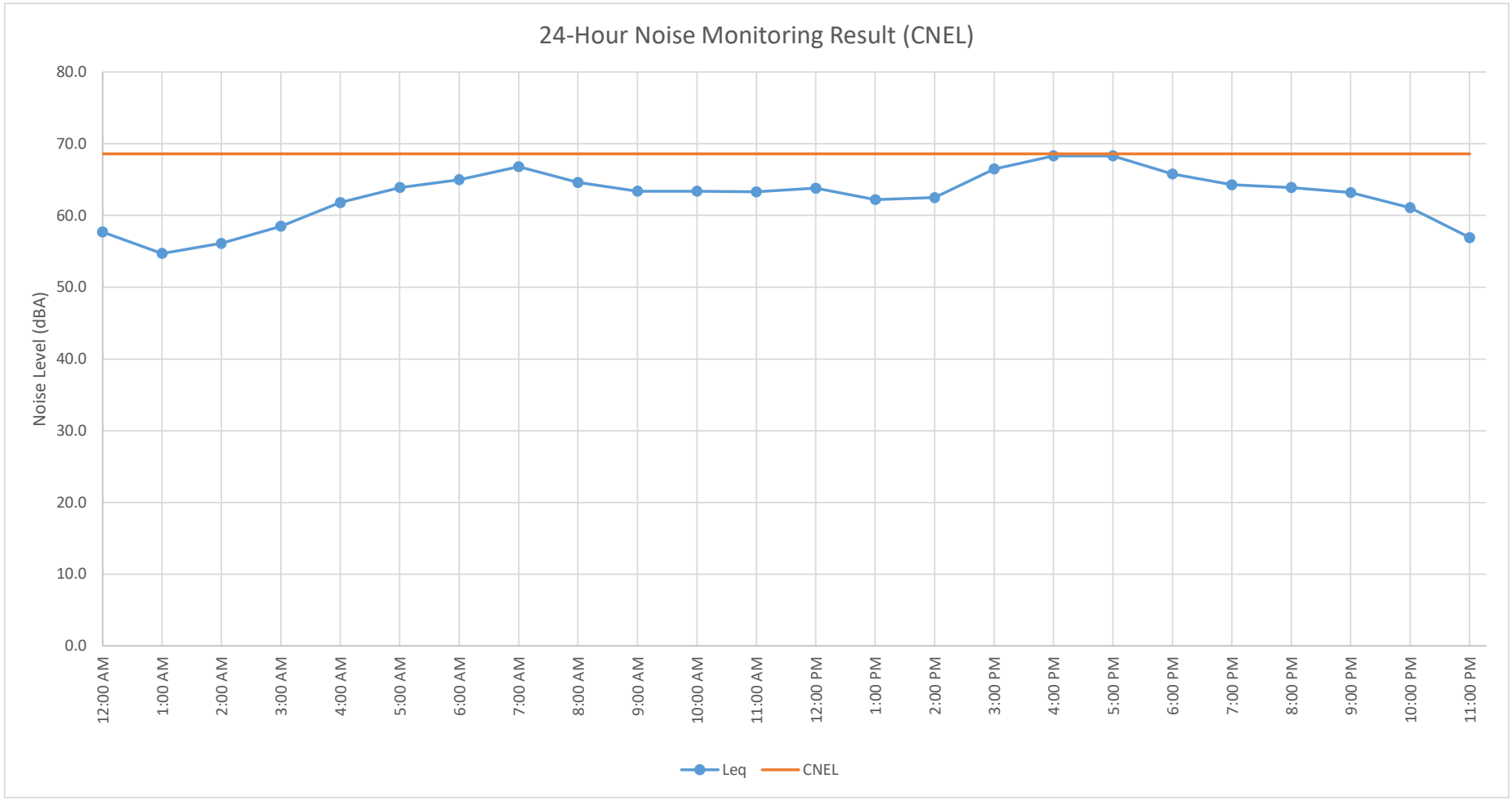
Leq
Lmax
Lmin
L2
L8
L25
L50

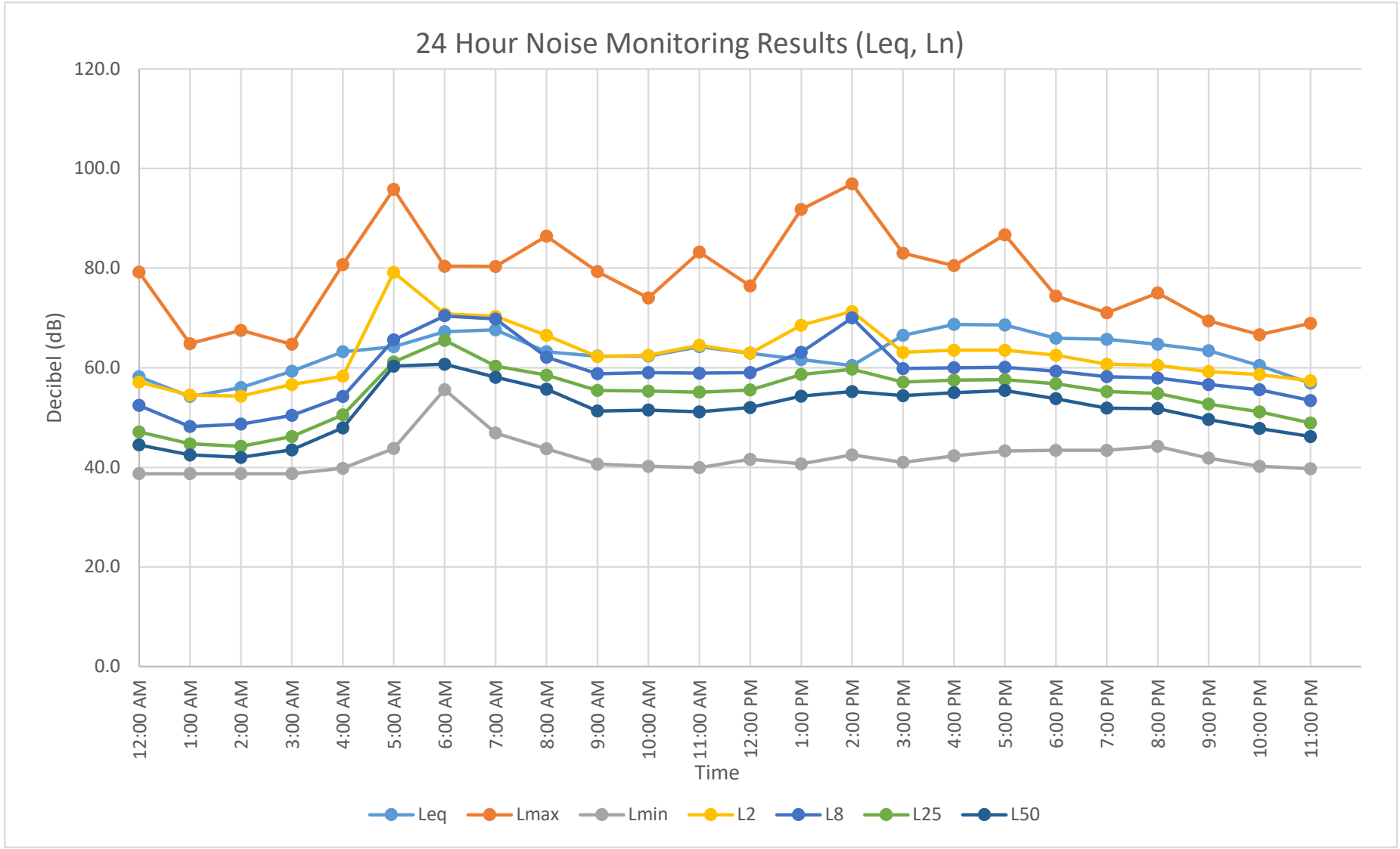

24-Hour Noise Monitoring Result (CNEL)
Noise Level (dBA)
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM
Leq
CNEL

Field Sheet - ST1 Location Photos

Project: Vivian Residential Development	**Engineer:** D. Shivaiah	**Date:**	12/10/2020
		JN:	2948-2020-02
Measurement Address: 88 Vivian Street	**City:** San Rafael	**Site No.:**	LT-1

RK engineering group, inc.

PROJECT:	Vivian Residential Development					JOB #:	2948-2020-02
NOISE METER	Piccolo II SLM, 24-Hour Measurement					DATE:	10-Dec-20
LOCATION:	88 Vivian Street, San Rafael					BY:	D. Shivaiah
Time	Leq	Lmax	Lmin	L2	L8	L25	L50
12:00 AM	58.2	79.2	38.7	57.1	52.4	47.1	44.5
1:00 AM	54.2	64.8	38.7	54.5	48.2	44.7	42.5
2:00 AM	56.0	67.5	38.7	54.3	48.7	44.2	42.0
3:00 AM	59.3	64.7	38.7	56.6	50.4	46.2	43.5
4:00 AM	63.2	80.7	39.8	58.3	54.2	50.5	47.9
5:00 AM	64.2	95.8	43.8	79.1	65.6	61.1	60.3
6:00 AM	67.2	80.4	55.6	70.8	70.4	65.5	60.7
7:00 AM	67.6	80.3	46.9	70.3	69.8	60.3	58.1
8:00 AM	63.2	86.4	43.7	66.5	62.1	58.5	55.7
9:00 AM	62.3	79.3	40.6	62.2	58.8	55.4	51.3
10:00 AM	62.3	74.0	40.2	62.5	59.0	55.3	51.5
11:00 AM	64.2	83.2	39.9	64.5	58.9	55.1	51.1
12:00 PM	62.9	76.4	41.6	62.9	59.0	55.5	52.0
1:00 PM	61.6	91.8	40.7	68.5	63.1	58.6	54.3
2:00 PM	60.4	96.9	42.5	71.3	70.0	59.7	55.2
3:00 PM	66.5	83.0	41.0	63.1	59.8	57.1	54.4
4:00 PM	68.7	80.5	42.3	63.5	60.0	57.5	55.0
5:00 PM	68.6	86.7	43.3	63.5	60.1	57.6	55.4
6:00 PM	65.9	74.4	43.4	62.5	59.3	56.8	53.8
7:00 PM	65.7	71.0	43.4	60.7	58.2	55.2	51.9
8:00 PM	64.7	75.0	44.2	60.5	57.9	54.8	51.8
9:00 PM	63.4	69.4	41.8	59.2	56.6	52.7	49.6
10:00 PM	60.4	66.6	40.2	58.6	55.6	51.1	47.8
11:00 PM	56.9	68.9	39.7	57.4	53.4	48.9	46.2
Daytime	65.1	96.9	39.9	65.4	63.0	56.9	53.8
Nighttime	62.0	95.8	38.7	70.8	62.9	58.1	54.8


24 Hour Noise Monitoring Results (Leq, Ln)
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100.0
80.0
60.0
40.0
20.0
0.0
Decibel (dB)
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1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
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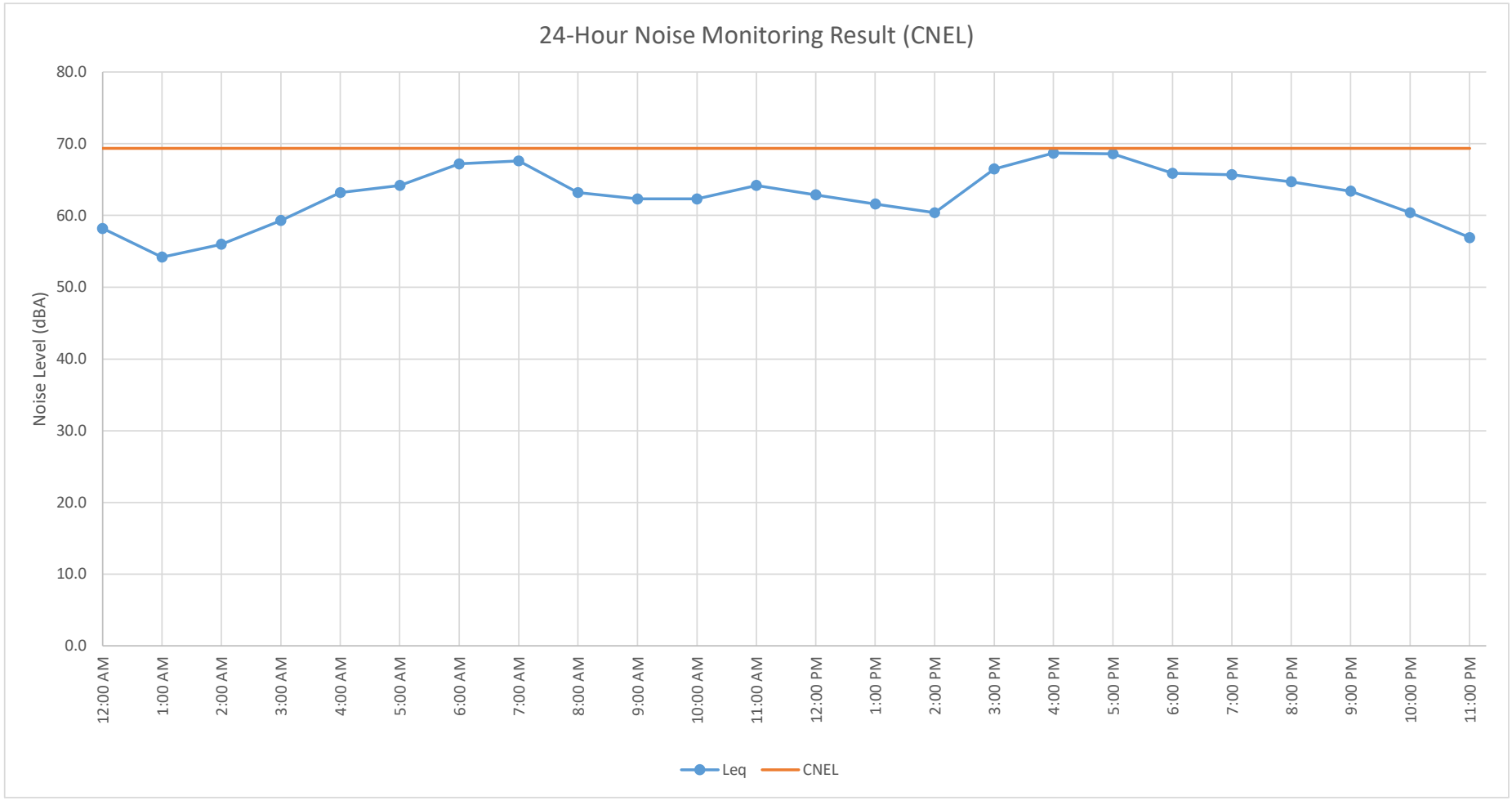
Time
Leq
Lmax
Lmin
L2
L8
L25
L50


24-Hour Noise Monitoring Result (CNEL)
Noise Level (dBA)
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
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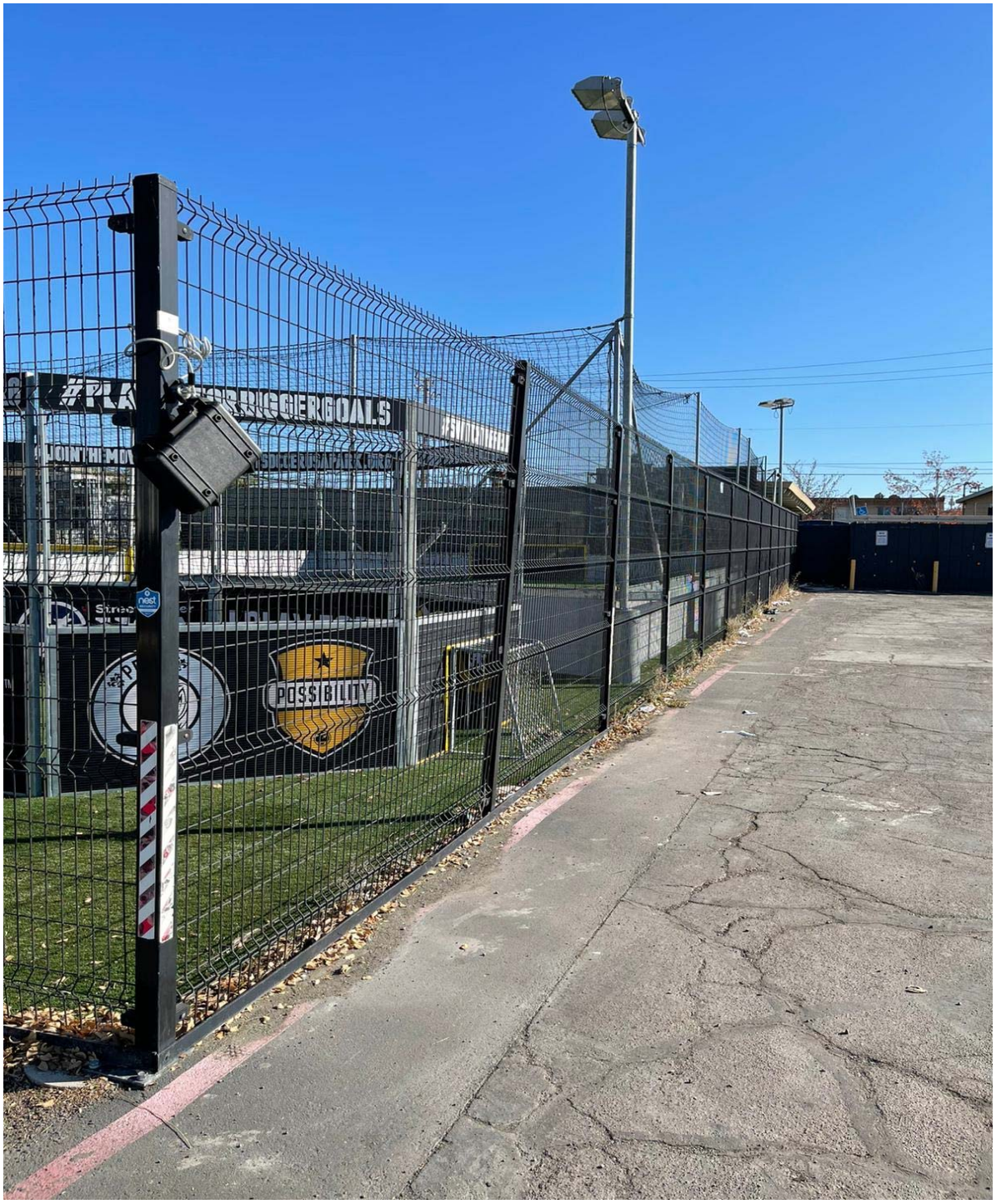
Leq
CNEL

Field Sheet - ST1 Location Photos

Project: Vivian Residential Development	**Engineer:** D. Shivaiah	**Date:**	12/10/2020
		JN:	2948-2020-02
Measurement Address: 88 Vivian Street	**City:** San Rafael	**Site No.:**	LT-2



RK engineering group, inc.

Appendix D

Caltrans PeMS Report

Report Description

Report	Aggregates>Day of Week
Route Name	
Route Description	
Report link	***http://pems.dot.ca.gov/?report_form=1&dnode=VDS&content=loops&tab=det_dow&station_id=402141&s_time_id=1575158400&s_time_id_f=12%2F01%2F2019&e_time_id=1576454340&e_time_id_f=12%2F15%2F2019&tod=all&tod_from=0&tod_to=0&q=flow&fn=1&pct1=25&pct2=75***
Report generated	12/29/2020 09:39
PeMS version	caltrans_pems-20.0.0

Report Parameters

Parameter	Value
Quantity	Flow
Data	25,908 Lane Points
Data Quality	98.9% Observed
Segment Type	VDS
Segment Name	Mainline VDS 402141 - SB OFF-RAMP TO FRANCISCO BLVD
start date	12/01/2019 00:00:00
end date	12/15/2019 23:59:59

Report Data 2019

Day	Minimum	Mean	Maximum	# Lane Points	% Observed
Sun	50,599.00	66,085.33	79,971.00	5178	98.40
Mon	94,448.00	96,729.00	99,010.00	3456	99.70
Tue	99,747.00	100,775.00	101,803.00	3456	96.50
Wed	99,030.00	99,164.00	99,298.00	3456	100.00
Thu	102,992.00	103,323.50	103,655.00	3450	98.80
Fri	102,258.00	104,486.50	106,715.00	3456	99.50
Sat	85,844.00	92,564.00	99,284.00	3456	100.00

Report Description

Report	Aggregates>Day of Week
Route Name	
Route Description	
Report link	***http://pems.dot.ca.gov/?report_form=1&dnode=VDS&content=loops&tab=det_dow&station_id=402141&s_time_id=1606780800&s_time_id_f=12%2F01%2F2020&e_time_id=1608076740&e_time_id_f=12%2F15%2F2020&tod=all&tod_from=0&tod_to=0&q=flow&fn=1&pct1=25&pct2=75***
Report generated	12/29/2020 09:38
PeMS version	caltrans_pems-20.0.0

Report Parameters

Parameter	Value
Quantity	Flow
Data	25,914 Lane Points
Data Quality	99.7% Observed
Segment Type	VDS
Segment Name	Mainline VDS 402141 - SB OFF-RAMP TO FRANCISCO BL
start date	12/01/2020 00:00:00
end date	12/15/2020 23:59:59

Report Data 2020

Day	Minimum	Mean	Maximum	# Lane Points	% Observed
Sun	48,525.00	55,825.00	63,125.00	3456	100.00
Mon	76,544.00	77,378.00	78,212.00	3456	98.80
Tue	77,769.00	79,051.33	81,225.00	5184	100.00
Wed	79,257.00	80,606.50	81,956.00	3456	99.10
Thu	80,808.00	82,010.00	83,212.00	3456	100.00
Fri	83,400.00	85,295.00	87,190.00	3456	100.00
Sat	67,643.00	72,249.50	76,856.00	3450	100.00

Appendix E

SoundPLAN Worksheets

Noise emissions of industry sources

Source name	Reference	Level		Frequency spectrum [dB(A)]							Corrections		
				125	250	500	1	2	4	8	Cwall	CI	CT
			dB(A)	Hz	Hz	Hz	kHz	kHz	kHz	kHz	dB	dB	dB
HVAC-1	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-2	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-3	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-4	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-5	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-6	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-7	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-8	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-9	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-10	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-11	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-12	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-13	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-14	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-15	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-16	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-17	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-18	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-19	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-20	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-21	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-22	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-23	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-24	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-25	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-26	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-27	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-28	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-29	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-30	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-31	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-32	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-33	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-

Noise emissions of industry sources

Source name	Reference	Level		Frequency spectrum [dB(A)]							Corrections		
				125	250	500	1	2	4	8	Cwall	CI	CT
			dB(A)	Hz	Hz	Hz	kHz	kHz	kHz	kHz	dB	dB	dB
HVAC-33		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-34	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-35	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-36	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-37	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-38	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-39	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-40	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-41	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-42	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-43	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-44	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-45	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-46	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-47	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-48	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-49	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-50	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-51	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-52	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-53	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-54	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-55	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-56	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-57	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-58	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-59	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-60	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-61	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-62	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-63	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-64	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-65	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-

Noise emissions of industry sources

Source name	Reference	Level		Frequency spectrum [dB(A)]							Corrections		
				125	250	500	1	2	4	8	Cwall	CI	CT
			dB(A)	Hz	Hz	Hz	kHz	kHz	kHz	kHz	dB	dB	dB
HVAC-66	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-67	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-68	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
HVAC-69	Lw/unit	Day	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-
		Night	68.0	40.2	51.7	59.1	64.3	62.0	59.8	49.2	-	-	-

Receiver list

No.	Receiver name	Building side	Floor	Limit		Level w/o NP		Level w NP		Difference		Conflict	
				Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
				dB(A)		dB(A)		dB(A)		dB		dB	
1	Receptor at PL-1	-	GF	-	-	43.9	43.9	33.6	33.6	-10.3	-10.3	-	-
2	Receptor at PL-2	-	GF	-	-	42.4	42.4	34.8	34.8	-7.5	-7.5	-	-
3	Receptor at PL-3	-	GF	-	-	43.8	43.8	39.2	39.2	-4.7	-4.7	-	-
4	Receptor at PL-4	-	GF	-	-	50.7	50.7	40.6	40.6	-10.1	-10.1	-	-
5	Receptor at PL-5	-	GF	-	-	45.3	45.3	39.2	39.2	-6.1	-6.1	-	-
6	Receptor at PL-6	-	GF	-	-	46.4	46.4	38.6	38.6	-7.8	-7.8	-	-

Contribution levels of the receivers

Source name	Traffic lane	Level w/o NP		Level w NP	
		Day	Night	Day	Night
		dB(A)		dB(A)	
Receptor at PL-1 GF		43.9	43.9	33.6	33.6
HVAC-1	-	36.0	36.0	24.8	24.8
HVAC-2	-	38.0	38.0	25.7	25.7
HVAC-3	-	36.8	36.8	26.2	26.2
HVAC-4	-	36.7	36.7	25.3	25.3
HVAC-5	-	32.3	32.3	24.5	24.5
HVAC-6	-	30.9	30.9	23.9	23.9
HVAC-7	-	28.0	28.0	22.5	22.5
HVAC-8	-	7.8	7.8	7.8	7.8
HVAC-9	-	9.0	9.0	9.0	9.0
HVAC-10	-	9.8	9.8	9.8	9.8
HVAC-11	-	9.7	9.7	9.7	9.7
HVAC-12	-	26.5	26.5	15.5	15.5
HVAC-13	-	26.3	26.3	14.7	14.7
HVAC-14	-	5.8	5.8	9.8	9.8
HVAC-15	-	5.5	5.5	9.1	9.1
HVAC-16	-	4.7	4.7	8.7	8.7
HVAC-17	-	23.5	23.5	8.2	8.2
HVAC-18	-	5.5	5.5	3.8	3.8
HVAC-19	-	4.4	4.4	3.4	3.4
HVAC-20	-	4.1	4.1	4.1	4.1
HVAC-21	-	4.3	4.3	4.3	4.3
HVAC-22	-	4.5	4.5	4.5	4.5
HVAC-23	-	4.8	4.8	4.8	4.8
HVAC-24	-	4.3	4.3	4.3	4.3
HVAC-25	-	4.3	4.3	4.3	4.3
HVAC-26	-	4.1	4.1	4.1	4.1
HVAC-27	-	4.9	4.9	4.9	4.9
HVAC-28	-	-0.1	-0.1	-0.1	-0.1
HVAC-29	-	0.1	0.1	0.1	0.1
HVAC-30	-	0.4	0.4	0.4	0.4
HVAC-31	-	0.4	0.4	0.4	0.4
HVAC-32	-	0.7	0.7	0.7	0.7
HVAC-33	-	-0.4	-0.4	-0.4	-0.4
HVAC-34	-	0.2	0.2	0.0	0.0
HVAC-35	-	0.7	0.7	0.6	0.6
HVAC-36	-	2.6	2.6	2.1	2.1
HVAC-37	-	2.4	2.4	2.4	2.4
HVAC-38	-	1.7	1.7	1.7	1.7
HVAC-39	-	1.3	1.3	1.2	1.2
HVAC-40	-	0.7	0.7	0.5	0.5
HVAC-41	-	0.1	0.1	0.0	0.0
HVAC-42	-	-0.3	-0.3	-0.5	-0.5
HVAC-43	-	-2.8	-2.8	-2.8	-2.8
HVAC-44	-	-3.1	-3.1	-3.1	-3.1
HVAC-45	-	-3.4	-3.4	-3.4	-3.4
HVAC-46	-	-2.9	-2.9	-3.2	-3.2
HVAC-47	-	-3.2	-3.2	-3.6	-3.6
HVAC-48	-	-2.9	-2.9	-3.1	-3.1
HVAC-49	-	-3.9	-3.9	-4.2	-4.2
HVAC-50	-	-4.2	-4.2	-4.5	-4.5
HVAC-51	-	-4.4	-4.4	-4.7	-4.7
HVAC-52	-	-4.2	-4.2	-4.2	-4.2
HVAC-53	-	-4.1	-4.1	-4.1	-4.1
HVAC-54	-	-3.3	-3.3	-3.3	-3.3
HVAC-55	-	-3.2	-3.2	-3.2	-3.2
HVAC-56	-	-3.3	-3.3	-3.3	-3.3
HVAC-57	-	-3.3	-3.3	-3.3	-3.3
HVAC-58	-	-3.4	-3.4	-3.4	-3.4
HVAC-59	-	-3.5	-3.5	-3.5	-3.5
HVAC-60	-	-3.5	-3.5	-3.5	-3.5
HVAC-61	-	-3.5	-3.5	-3.5	-3.5
HVAC-62	-	-6.6	-6.6	-6.6	-6.6
HVAC-63	-	-7.7	-7.7	-7.7	-7.7

Contribution levels of the receivers

Source name	Traffic lane	Level w/o NP		Level w NP	
		Day	Night	Day	Night
		dB(A)		dB(A)	
HVAC-64	-	-6.7	-6.7	-6.7	-6.7
HVAC-65	-	-5.5	-5.5	-5.6	-5.6
HVAC-66	-	-4.8	-4.8	-4.8	-4.8
HVAC-67	-	-4.8	-4.8	-4.9	-4.9
HVAC-68	-	-5.4	-5.4	-5.5	-5.5
HVAC-69	-	-6.6	-6.6	-6.6	-6.6
Receptor at PL-2	GF	42.4	42.4	34.8	34.8
HVAC-1	-	-3.0	-3.0	-3.5	-3.5
HVAC-2	-	-5.0	-5.0	-5.0	-5.0
HVAC-3	-	-5.0	-5.0	-5.0	-5.0
HVAC-4	-	-2.4	-2.4	-2.9	-2.9
HVAC-5	-	-2.6	-2.6	-3.4	-3.4
HVAC-6	-	-5.4	-5.4	-5.4	-5.4
HVAC-7	-	11.5	11.5	-2.8	-2.8
HVAC-8	-	3.1	3.1	-2.8	-2.8
HVAC-9	-	-1.8	-1.8	-3.2	-3.2
HVAC-10	-	-2.2	-2.2	-3.3	-3.3
HVAC-11	-	-2.1	-2.1	-3.3	-3.3
HVAC-12	-	-1.2	-1.2	-1.7	-1.7
HVAC-13	-	-1.2	-1.2	-1.7	-1.7
HVAC-14	-	-1.6	-1.6	-2.2	-2.2
HVAC-15	-	-1.3	-1.3	-1.8	-1.8
HVAC-16	-	-1.5	-1.5	-1.6	-1.6
HVAC-17	-	-0.6	-0.6	-0.6	-0.6
HVAC-18	-	-3.0	-3.0	-3.0	-3.0
HVAC-19	-	-3.6	-3.6	-3.6	-3.6
HVAC-20	-	3.4	3.4	3.4	3.4
HVAC-21	-	1.8	1.8	-0.2	-0.2
HVAC-22	-	1.3	1.3	0.0	0.0
HVAC-23	-	2.1	2.1	1.5	1.5
HVAC-24	-	0.9	0.9	0.2	0.2
HVAC-25	-	0.8	0.8	-0.2	-0.2
HVAC-26	-	1.2	1.2	-0.1	-0.1
HVAC-27	-	5.8	5.8	0.8	0.8
HVAC-28	-	27.1	27.1	21.6	21.6
HVAC-29	-	22.6	22.6	16.0	16.0
HVAC-30	-	8.6	8.6	3.9	3.9
HVAC-31	-	7.4	7.4	3.9	3.9
HVAC-32	-	4.7	4.7	3.6	3.6
HVAC-33	-	4.7	4.7	3.3	3.3
HVAC-34	-	19.9	19.9	15.0	15.0
HVAC-35	-	12.9	12.9	1.9	1.9
HVAC-36	-	0.1	0.1	-0.1	-0.1
HVAC-37	-	-1.0	-1.0	-1.3	-1.3
HVAC-38	-	-0.3	-0.3	-0.9	-0.9
HVAC-39	-	0.0	0.0	-0.6	-0.6
HVAC-40	-	0.3	0.3	-0.3	-0.3
HVAC-41	-	1.2	1.2	0.7	0.7
HVAC-42	-	0.6	0.6	0.1	0.1
HVAC-43	-	1.2	1.2	0.6	0.6
HVAC-44	-	1.4	1.4	0.4	0.4
HVAC-45	-	2.2	2.2	2.1	2.1
HVAC-46	-	3.2	3.2	3.0	3.0
HVAC-47	-	3.6	3.6	3.4	3.4
HVAC-48	-	3.8	3.8	3.5	3.5
HVAC-49	-	4.0	4.0	3.6	3.6
HVAC-50	-	5.3	5.3	4.7	4.7
HVAC-51	-	5.9	5.9	4.6	4.6
HVAC-52	-	4.1	4.1	3.8	3.8
HVAC-53	-	4.4	4.4	4.1	4.1
HVAC-54	-	38.0	38.0	30.1	30.1
HVAC-55	-	35.8	35.8	28.6	28.6
HVAC-56	-	26.4	26.4	18.8	18.8
HVAC-57	-	31.8	31.8	24.3	24.3

Contribution levels of the receivers

Source name	Traffic lane	Level w/o NP		Level w NP	
		Day	Night	Day	Night
		dB(A)		dB(A)	
HVAC-58	-	31.0	31.0	19.8	19.8
HVAC-59	-	30.6	30.6	23.6	23.6
HVAC-60	-	29.1	29.1	22.5	22.5
HVAC-61	-	28.3	28.3	21.8	21.8
HVAC-62	-	4.9	4.9	4.3	4.3
HVAC-63	-	5.3	5.3	4.6	4.6
HVAC-64	-	6.0	6.0	5.3	5.3
HVAC-65	-	7.0	7.0	6.0	6.0
HVAC-66	-	8.1	8.1	6.8	6.8
HVAC-67	-	8.9	8.9	6.1	6.1
HVAC-68	-	25.8	25.8	8.0	8.0
HVAC-69	-	4.9	4.9	4.3	4.3
Receptor at PL-3 GF		43.8	43.8	39.2	39.2
HVAC-1	-	-2.0	-2.0	-2.4	-2.4
HVAC-2	-	-4.1	-4.1	-4.1	-4.1
HVAC-3	-	-5.7	-5.7	-5.7	-5.7
HVAC-4	-	-2.2	-2.2	-2.8	-2.8
HVAC-5	-	-2.2	-2.2	-3.1	-3.1
HVAC-6	-	-6.0	-6.0	-6.0	-6.0
HVAC-7	-	13.1	13.1	2.4	2.4
HVAC-8	-	18.3	18.3	13.9	13.9
HVAC-9	-	-0.2	-0.2	-0.2	-0.2
HVAC-10	-	-0.5	-0.5	-0.5	-0.5
HVAC-11	-	-0.8	-0.8	-0.8	-0.8
HVAC-12	-	0.0	0.0	-0.1	-0.1
HVAC-13	-	-1.0	-1.0	-1.2	-1.2
HVAC-14	-	-0.8	-0.8	-0.9	-0.9
HVAC-15	-	-0.1	-0.1	-0.4	-0.4
HVAC-16	-	0.7	0.7	0.5	0.5
HVAC-17	-	1.5	1.5	1.4	1.4
HVAC-18	-	1.2	1.2	1.0	1.0
HVAC-19	-	1.4	1.4	1.4	1.4
HVAC-20	-	23.5	23.5	17.2	17.2
HVAC-21	-	4.8	4.8	4.8	4.8
HVAC-22	-	3.5	3.5	3.5	3.5
HVAC-23	-	3.2	3.2	3.2	3.2
HVAC-24	-	3.8	3.8	3.8	3.8
HVAC-25	-	3.1	3.1	3.1	3.1
HVAC-26	-	3.8	3.8	3.8	3.8
HVAC-27	-	21.7	21.7	17.3	17.3
HVAC-28	-	33.4	33.4	28.8	28.8
HVAC-29	-	33.4	33.4	28.6	28.6
HVAC-30	-	32.5	32.5	28.1	28.1
HVAC-31	-	32.3	32.3	27.9	27.9
HVAC-32	-	33.1	33.1	29.0	29.0
HVAC-33	-	33.9	33.9	29.5	29.5
HVAC-34	-	35.8	35.8	31.0	31.0
HVAC-35	-	38.5	38.5	33.5	33.5
HVAC-36	-	3.3	3.3	2.9	2.9
HVAC-37	-	2.1	2.1	1.7	1.7
HVAC-38	-	1.9	1.9	1.9	1.9
HVAC-39	-	2.1	2.1	2.1	2.1
HVAC-40	-	2.5	2.5	2.5	2.5
HVAC-41	-	3.9	3.9	3.6	3.6
HVAC-42	-	4.2	4.2	3.9	3.9
HVAC-43	-	3.7	3.7	3.3	3.3
HVAC-44	-	4.8	4.8	4.7	4.7
HVAC-45	-	4.5	4.5	4.5	4.5
HVAC-46	-	3.2	3.2	3.2	3.2
HVAC-47	-	2.5	2.5	2.5	2.5
HVAC-48	-	2.0	2.0	2.0	2.0
HVAC-49	-	1.6	1.6	1.6	1.6
HVAC-50	-	1.4	1.4	1.4	1.4
HVAC-51	-	2.6	2.6	2.6	2.6

Contribution levels of the receivers

Source name	Traffic lane	Level w/o NP		Level w NP	
		Day	Night	Day	Night
		dB(A)		dB(A)	
HVAC-52	-	4.1	4.1	4.1	4.1
HVAC-53	-	5.1	5.1	5.0	5.0
HVAC-54	-	15.6	15.6	6.5	6.5
HVAC-55	-	8.8	8.8	8.8	8.8
HVAC-56	-	7.7	7.7	7.7	7.7
HVAC-57	-	7.5	7.5	7.5	7.5
HVAC-58	-	26.4	26.4	17.6	17.6
HVAC-59	-	10.7	10.7	10.7	10.7
HVAC-60	-	8.4	8.4	8.4	8.4
HVAC-61	-	7.8	7.8	7.8	7.8
HVAC-62	-	0.4	0.4	0.4	0.4
HVAC-63	-	-0.2	-0.2	-0.2	-0.2
HVAC-64	-	1.7	1.7	1.6	1.6
HVAC-65	-	2.0	2.0	2.0	2.0
HVAC-66	-	2.2	2.2	2.2	2.2
HVAC-67	-	3.0	3.0	1.5	1.5
HVAC-68	-	6.4	6.4	1.6	1.6
HVAC-69	-	0.3	0.3	0.3	0.3
Receptor at PL-4	GF	50.7	50.7	40.6	40.6
HVAC-1	-	-6.0	-6.0	-6.0	-6.0
HVAC-2	-	-6.8	-6.8	-6.8	-6.8
HVAC-3	-	-7.0	-7.0	-7.0	-7.0
HVAC-4	-	-5.6	-5.6	-5.7	-5.7
HVAC-5	-	-6.0	-6.0	-6.0	-6.0
HVAC-6	-	-6.0	-6.0	-6.0	-6.0
HVAC-7	-	-8.1	-8.1	-8.1	-8.1
HVAC-8	-	-4.8	-4.8	-4.9	-4.9
HVAC-9	-	-4.7	-4.7	-4.8	-4.8
HVAC-10	-	-3.8	-3.8	-3.9	-3.9
HVAC-11	-	-4.3	-4.3	-4.4	-4.4
HVAC-12	-	-5.5	-5.5	-5.5	-5.5
HVAC-13	-	-5.4	-5.4	-5.4	-5.4
HVAC-14	-	-5.2	-5.2	-5.2	-5.2
HVAC-15	-	-4.2	-4.2	-4.2	-4.2
HVAC-16	-	-4.0	-4.0	-4.0	-4.0
HVAC-17	-	-4.3	-4.3	-4.3	-4.3
HVAC-18	-	-3.8	-3.8	-3.8	-3.8
HVAC-19	-	-3.5	-3.5	-3.5	-3.5
HVAC-20	-	-2.1	-2.1	-2.1	-2.1
HVAC-21	-	-2.6	-2.6	-2.8	-2.8
HVAC-22	-	-2.6	-2.6	-2.7	-2.7
HVAC-23	-	-2.7	-2.7	-2.9	-2.9
HVAC-24	-	-3.2	-3.2	-3.4	-3.4
HVAC-25	-	-2.6	-2.6	-2.7	-2.7
HVAC-26	-	-2.6	-2.6	-2.8	-2.8
HVAC-27	-	-2.6	-2.6	-2.8	-2.8
HVAC-28	-	0.7	0.7	0.5	0.5
HVAC-29	-	0.7	0.7	0.5	0.5
HVAC-30	-	1.4	1.4	1.3	1.3
HVAC-31	-	1.2	1.2	1.1	1.1
HVAC-32	-	-0.5	-0.5	-0.7	-0.7
HVAC-33	-	0.3	0.3	0.1	0.1
HVAC-34	-	0.4	0.4	0.2	0.2
HVAC-35	-	0.3	0.3	0.1	0.1
HVAC-36	-	-2.0	-2.0	-2.0	-2.0
HVAC-37	-	-1.9	-1.9	-1.9	-1.9
HVAC-38	-	-1.3	-1.3	-1.6	-1.6
HVAC-39	-	-1.5	-1.5	-2.2	-2.2
HVAC-40	-	-1.3	-1.3	-2.0	-2.0
HVAC-41	-	-1.6	-1.6	-2.4	-2.4
HVAC-42	-	-1.1	-1.1	-1.9	-1.9
HVAC-43	-	-0.5	-0.5	-1.4	-1.4
HVAC-44	-	0.0	0.0	-0.9	-0.9
HVAC-45	-	0.7	0.7	-0.2	-0.2

Contribution levels of the receivers

Source name	Traffic lane	Level w/o NP		Level w NP	
		Day	Night	Day	Night
		dB(A)		dB(A)	
HVAC-46	-	3.0	3.0	2.2	2.2
HVAC-47	-	3.7	3.7	2.9	2.9
HVAC-48	-	4.7	4.7	3.7	3.7
HVAC-49	-	4.6	4.6	4.8	4.8
HVAC-50	-	5.8	5.8	4.1	4.1
HVAC-51	-	7.6	7.6	5.5	5.5
HVAC-52	-	2.6	2.6	1.9	1.9
HVAC-53	-	2.5	2.5	1.8	1.8
HVAC-54	-	5.8	5.8	5.7	5.7
HVAC-55	-	6.0	6.0	5.9	5.9
HVAC-56	-	5.1	5.1	5.0	5.0
HVAC-57	-	5.5	5.5	5.4	5.4
HVAC-58	-	5.8	5.8	5.6	5.6
HVAC-59	-	5.8	5.8	5.6	5.6
HVAC-60	-	5.8	5.8	5.7	5.7
HVAC-61	-	5.6	5.6	5.4	5.4
HVAC-62	-	37.8	37.8	30.0	30.0
HVAC-63	-	40.9	40.9	31.5	31.5
HVAC-64	-	45.9	45.9	34.6	34.6
HVAC-65	-	45.3	45.3	34.1	34.1
HVAC-66	-	40.5	40.5	31.1	31.1
HVAC-67	-	37.0	37.0	28.6	28.6
HVAC-68	-	34.9	34.9	27.0	27.0
HVAC-69	-	38.0	38.0	29.7	29.7
Receptor at PL-5	GF	45.3	45.3	39.2	39.2
HVAC-1	-	-5.4	-5.4	-6.5	-6.5
HVAC-2	-	-3.9	-3.9	-4.7	-4.7
HVAC-3	-	-4.4	-4.4	-5.2	-5.2
HVAC-4	-	-8.8	-8.8	-8.8	-8.8
HVAC-5	-	-5.2	-5.2	-5.9	-5.9
HVAC-6	-	-5.4	-5.4	-6.0	-6.0
HVAC-7	-	-5.6	-5.6	-6.2	-6.2
HVAC-8	-	-5.4	-5.4	-5.4	-5.4
HVAC-9	-	-5.3	-5.3	-5.3	-5.3
HVAC-10	-	-5.2	-5.2	-5.2	-5.2
HVAC-11	-	-3.6	-3.6	-3.6	-3.6
HVAC-12	-	12.8	12.8	14.3	14.3
HVAC-13	-	12.9	12.9	13.9	13.9
HVAC-14	-	13.3	13.3	14.5	14.5
HVAC-15	-	16.1	16.1	14.7	14.7
HVAC-16	-	16.5	16.5	15.0	15.0
HVAC-17	-	17.0	17.0	15.4	15.4
HVAC-18	-	14.9	14.9	13.0	13.0
HVAC-19	-	17.8	17.8	15.9	15.9
HVAC-20	-	-2.3	-2.3	-2.3	-2.3
HVAC-21	-	-2.2	-2.2	-2.2	-2.2
HVAC-22	-	-2.9	-2.9	-2.9	-2.9
HVAC-23	-	-0.9	-0.9	-0.9	-0.9
HVAC-24	-	-2.8	-2.8	-2.8	-2.8
HVAC-25	-	-1.7	-1.7	-1.7	-1.7
HVAC-26	-	-2.1	-2.1	-2.1	-2.1
HVAC-27	-	-2.3	-2.3	-2.3	-2.3
HVAC-28	-	1.4	1.4	1.4	1.4
HVAC-29	-	2.9	2.9	2.9	2.9
HVAC-30	-	2.0	2.0	2.0	2.0
HVAC-31	-	1.8	1.8	1.8	1.8
HVAC-32	-	3.9	3.9	2.7	2.7
HVAC-33	-	1.3	1.3	0.8	0.8
HVAC-34	-	0.5	0.5	0.3	0.3
HVAC-35	-	2.7	2.7	2.6	2.6
HVAC-36	-	18.8	18.8	16.9	16.9
HVAC-37	-	19.0	19.0	17.1	17.1
HVAC-38	-	24.2	24.2	18.0	18.0
HVAC-39	-	24.7	24.7	18.3	18.3

Contribution levels of the receivers

Source name	Traffic lane	Level w/o NP		Level w NP	
		Day	Night	Day	Night
		dB(A)		dB(A)	
HVAC-40	-	23.2	23.2	17.4	17.4
HVAC-41	-	21.1	21.1	17.5	17.5
HVAC-42	-	21.9	21.9	20.0	20.0
HVAC-43	-	22.8	22.8	21.4	21.4
HVAC-44	-	23.6	23.6	22.2	22.2
HVAC-45	-	21.9	21.9	16.2	16.2
HVAC-46	-	32.1	32.1	21.0	21.0
HVAC-47	-	33.6	33.6	21.9	21.9
HVAC-48	-	35.3	35.3	22.8	22.8
HVAC-49	-	34.8	34.8	23.9	23.9
HVAC-50	-	36.4	36.4	26.8	26.8
HVAC-51	-	37.2	37.2	37.2	37.2
HVAC-52	-	26.3	26.3	20.2	20.2
HVAC-53	-	25.9	25.9	20.0	20.0
HVAC-54	-	6.3	6.3	6.3	6.3
HVAC-55	-	6.3	6.3	6.3	6.3
HVAC-56	-	9.0	9.0	9.0	9.0
HVAC-57	-	10.2	10.2	10.2	10.2
HVAC-58	-	6.0	6.0	6.0	6.0
HVAC-59	-	5.6	5.6	5.6	5.6
HVAC-60	-	4.9	4.9	4.9	4.9
HVAC-61	-	11.1	11.1	11.1	11.1
HVAC-62	-	37.3	37.3	23.6	23.6
HVAC-63	-	19.0	19.0	13.8	13.8
HVAC-64	-	15.1	15.1	8.4	8.4
HVAC-65	-	7.1	7.1	7.1	7.1
HVAC-66	-	7.7	7.7	7.7	7.7
HVAC-67	-	7.7	7.7	7.7	7.7
HVAC-68	-	7.3	7.3	7.3	7.3
HVAC-69	-	37.2	37.2	23.6	23.6
Receptor at PL-6	GF	46.4	46.4	38.6	38.6
HVAC-1	-	1.9	1.9	1.9	1.9
HVAC-2	-	0.4	0.4	0.4	0.4
HVAC-3	-	0.2	0.2	0.2	0.2
HVAC-4	-	-1.3	-1.3	-1.3	-1.3
HVAC-5	-	-0.4	-0.4	-0.4	-0.4
HVAC-6	-	-0.7	-0.7	-0.7	-0.7
HVAC-7	-	-0.5	-0.5	-0.5	-0.5
HVAC-8	-	3.5	3.5	3.5	3.5
HVAC-9	-	2.3	2.3	2.3	2.3
HVAC-10	-	2.7	2.7	2.7	2.7
HVAC-11	-	3.0	3.0	3.0	3.0
HVAC-12	-	5.6	5.6	5.6	5.6
HVAC-13	-	6.7	6.7	6.7	6.7
HVAC-14	-	7.7	7.7	7.7	7.7
HVAC-15	-	8.7	8.7	8.7	8.7
HVAC-16	-	9.7	9.7	9.7	9.7
HVAC-17	-	11.5	11.5	11.5	11.5
HVAC-18	-	29.8	29.8	29.8	29.8
HVAC-19	-	31.2	31.2	31.2	31.2
HVAC-20	-	8.5	8.5	8.5	8.5
HVAC-21	-	9.0	9.0	9.0	9.0
HVAC-22	-	8.3	8.3	8.3	8.3
HVAC-23	-	5.8	5.8	5.8	5.8
HVAC-24	-	25.1	25.1	19.5	19.5
HVAC-25	-	6.2	6.2	6.2	6.2
HVAC-26	-	4.6	4.6	4.6	4.6
HVAC-27	-	5.9	5.9	5.9	5.9
HVAC-28	-	4.5	4.5	4.5	4.5
HVAC-29	-	5.8	5.8	5.8	5.8
HVAC-30	-	5.3	5.3	5.3	5.3
HVAC-31	-	5.8	5.8	5.8	5.8
HVAC-32	-	7.1	7.1	7.1	7.1
HVAC-33	-	6.7	6.7	6.7	6.7

Contribution levels of the receivers

Source name	Traffic lane	Level w/o NP		Level w NP	
		Day	Night	Day	Night
		dB(A)		dB(A)	
HVAC-34	-	5.1	5.1	5.1	5.1
HVAC-35	-	4.7	4.7	4.7	4.7
HVAC-36	-	36.1	36.1	27.7	27.7
HVAC-37	-	36.5	36.5	28.0	28.0
HVAC-38	-	40.7	40.7	27.5	27.5
HVAC-39	-	39.8	39.8	27.7	27.7
HVAC-40	-	36.4	36.4	26.7	26.7
HVAC-41	-	34.4	34.4	25.5	25.5
HVAC-42	-	30.2	30.2	24.4	24.4
HVAC-43	-	28.5	28.5	23.3	23.3
HVAC-44	-	27.2	27.2	22.1	22.1
HVAC-45	-	26.2	26.2	21.3	21.3
HVAC-46	-	24.6	24.6	22.4	22.4
HVAC-47	-	23.7	23.7	22.8	22.8
HVAC-48	-	22.9	22.9	20.1	20.1
HVAC-49	-	22.2	22.2	19.4	19.4
HVAC-50	-	21.7	21.7	17.5	17.5
HVAC-51	-	21.5	21.5	17.4	17.4
HVAC-52	-	21.8	21.8	18.2	18.2
HVAC-53	-	22.1	22.1	18.4	18.4
HVAC-54	-	2.4	2.4	2.4	2.4
HVAC-55	-	1.8	1.8	1.8	1.8
HVAC-56	-	1.8	1.8	1.8	1.8
HVAC-57	-	2.4	2.4	2.4	2.4
HVAC-58	-	2.2	2.2	2.2	2.2
HVAC-59	-	2.3	2.3	2.3	2.3
HVAC-60	-	1.9	1.9	1.9	1.9
HVAC-61	-	2.9	2.9	2.9	2.9
HVAC-62	-	-0.2	-0.2	-0.2	-0.2
HVAC-63	-	-0.1	-0.1	-0.1	-0.1
HVAC-64	-	-1.2	-1.2	-1.2	-1.2
HVAC-65	-	-0.1	-0.1	-0.2	-0.2
HVAC-66	-	-0.3	-0.3	-0.3	-0.3
HVAC-67	-	-0.6	-0.6	-0.6	-0.6
HVAC-68	-	-0.7	-0.7	-0.7	-0.7
HVAC-69	-	-0.3	-0.3	-0.3	-0.3

Spectra of the receivers

No.	Name	Floor	Time slice	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
1	Receptor at PL-1	GF	Day	12.1	22.2	27.6	30.4	25.4	20.0	5.4
			Night	12.1	22.2	27.6	30.4	25.4	20.0	5.4
2	Receptor at PL-2	GF	Day	9.8	20.8	27.5	31.8	28.0	23.4	8.4
			Night	9.8	20.8	27.5	31.8	28.0	23.4	8.4
3	Receptor at PL-3	GF	Day	11.6	23.1	30.4	35.5	33.2	30.8	18.6
			Night	11.6	23.1	30.4	35.5	33.2	30.8	18.6
4	Receptor at PL-4	GF	Day	17.4	27.9	33.9	37.5	33.1	28.2	13.8
			Night	17.4	27.9	33.9	37.5	33.1	28.2	13.8
5	Receptor at PL-5	GF	Day	14.1	24.7	31.3	35.8	32.7	29.4	16.8
			Night	14.1	24.7	31.3	35.8	32.7	29.4	16.8
6	Receptor at PL-6	GF	Day	15.5	25.9	31.8	35.4	31.4	27.2	13.4
			Night	15.5	25.9	31.8	35.4	31.4	27.2	13.4

Appendix F

Construction Noise and Vibration Worksheets

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 12/28/2020
Case Description: Vivian Residential Development Noise Impact Study

				---- Receptor #1 ----
		Baselines (dBA)		
Description	Land Use	Daytime	Evening	Night
Demolition	Residential	90	90	90

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Saw	No	20		89.6	50	0
Dozer	No	40		81.7	50	0
Tractor	No	40	84		50	0
Tractor	No	40	84		50	0
Tractor	No	40	84		50	0

Results

		Calculated (dBA)	
Equipment		*Lmax	Leq
Concrete Saw		89.6	82.6
Dozer		81.7	77.7
Tractor		84	80
Tractor		84	80
Tractor		84	80
	Total	89.6	87.3

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 12/28/2020
Case Description: Vivian Residential Development Noise Impact Study

				---- Receptor #1 ----			
		Baselines (dBA)					
Description	Land Use	Daytime	Evening	Night			
Site Preparation	Residential	90	90	90			

			Equipment			
			Spec	Actual	Receptor	Estimated
	Impact		Lmax	Lmax	Distance	Shielding
Description	Device	Usage(%)	(dBA)	(dBA)	(feet)	(dBA)
Grader	No	40	85		50	0
Scraper	No	40		83.6	50	0
Tractor	No	40	84		50	0

Results

	Calculated (dBA)	
Equipment	*Lmax	Leq
Grader	85	81
Scraper	83.6	79.6
Tractor	84	80
Total	85	85

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 12/28/2020
Case Description: Vivian Residential Development Noise Impact Study

		Baselines (dBA)		---- Receptor #1 ----
Description	Land Use	Daytime	Evening	Night
Grading	Residential	90	90	90

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85		50	0
Dozer	No	40		81.7	50	0
Tractor	No	40	84		50	0
Tractor	No	40	84		50	0

Results

Calculated (dBA)

Equipment		*Lmax	Leq
Grader		85	81
Dozer		81.7	77.7
Tractor		84	80
Tractor		84	80
	Total	85	85.9

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 12/28/2020
Case Description: Vivian Residential Development Noise Impact Study

		Baselines (dBA)		---- Receptor #1 ----
Description	Land Use	Daytime	Evening	Night
Building Construction	Residential	90	90	90

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Crane	No	16		80.6	50	0
Pickup Truck	No	40		75	50	0
Generator	No	50		80.6	50	0
Tractor	No	40	84		50	0
Welder / Torch	No	40		74	50	0
Welder / Torch	No	40		74	50	0
Welder / Torch	No	40		74	50	0

Results

		Calculated (dBA)	
Equipment		*Lmax	Leq
Crane		80.6	72.6
Pickup Truck		75	71
Generator		80.6	77.6
Tractor		84	80
Welder / Torch		74	70
Welder / Torch		74	70
Welder / Torch		74	70
	Total	84	83.4

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 12/28/2020
Case Description: Vivian Residential Development Noise Impact Study

		Baselines (dBA)		---- Receptor #1 ----
Description	Land Use	Daytime	Evening	Night
Paving	Residential	90	90	90

Description	Impact Device	Usage(%)	Equipment Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	50	0
Paver	No	50		77.2	50	0
Roller	No	20		80	50	0
Roller	No	20		80	50	0
Tractor	No	40	84		50	0
Roller	No	20		80	50	0

Results

Calculated (dBA)

Equipment	*Lmax	Leq
Concrete Mixer Truck	78.8	74.8
Paver	77.2	74.2
Roller	80	73
Roller	80	73
Tractor	84	80
Roller	80	73
Total	84	83.4

*Calculated Lmax is the Loudest value.

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 12/28/2020
Case Description: Vivian Residential Development Noise Impact Study

				---- Receptor #1 ----			
		Baselines (dBA)					
Description	Land Use	Daytime	Evening	Night			
Architectural Coating	Residential	90	90	90			

			Equipment			
			Spec	Actual	Receptor	Estimated
	Impact		Lmax	Lmax	Distance	Shielding
Description	Device	Usage(%)	(dBA)	(dBA)	(feet)	(dBA)
Compressor (air)	No	40		77.7	50	0

Results

Calculated (dBA)

Equipment		*Lmax	Leq
Compressor (air)		77.7	73.7
	Total	77.7	73.7

*Calculated Lmax is the Loudest value.

VIBRATION IMPACTS FROM CONSTRUCTION AND OPERATIONS

PROJECT:	Vivian Residential Development	JOB #:	2948-2020-02
ACTIVITY:	Small Bulldozer	DATE:	29-Dec-20
LOCATION:	Nearest Structure	ENGINEER:	D Shivaiah

VIBRATION INPUT/OUTPUT DATA

OTHER CONSTRUCTION EQUIPMENT

$$PPV = PPV_{ref}(25/D)^{n} \text{ (in/sec)}$$

PPV =	**0.003 in/sec**

Equipment Type =	6	Small Bulldozer
PPV_{ref} =	0.003	Reference PPV at 25 ft.
D =	25.00	Distance from Equipment to receiver in ft.
n =	1.10	Vibration attenuation rate through the ground

EQUIPMENT PPV REFERENCE LEVELS

Type	Equipment	Reference PPV
1	Vibratory Roller	0.210
2	Large Bulldozer	0.089
3	Caisson Drilling	0.089
4	Loaded Trucks	0.076
5	Jackhammer	0.035
6	Small Bulldozer	0.003
7	Crack and Seat	2.400

VIBRATION IMPACTS FROM CONSTRUCTION AND OPERATIONS

PROJECT:	Vivian Residential Development	JOB #:	2948-2020-02
ACTIVITY:	Loaded Truck	DATE:	29-Dec-20
LOCATION:	Nearest Structure	ENGINEER:	D Shivaiah

VIBRATION INPUT/OUTPUT DATA

OTHER CONSTRUCTION EQUIPMENT

$$PPV = PPV_{ref}(25/D)^{n} \text{ (in/sec)}$$

PPV =	**0.076 in/sec**

Equipment Type =	4	Loaded Trucks
PPV_{ref} =	0.076	Reference PPV at 25 ft.
D =	25.00	Distance from Equipment to receiver in ft.
n =	1.10	Vibration attenuation rate through the ground

EQUIPMENT PPV REFERENCE LEVELS

Type	Equipment	Reference PPV
1	Vibratory Roller	0.210
2	Large Bulldozer	0.089
3	Caisson Drilling	0.089
4	Loaded Trucks	0.076
5	Jackhammer	0.035
6	Small Bulldozer	0.003
7	Crack and Seat	2.400

VIBRATION IMPACTS FROM CONSTRUCTION AND OPERATIONS

PROJECT:	Vivian Residential Development	JOB #:	2948-2020-02
ACTIVITY:	Vibratory Roller	DATE:	29-Dec-20
LOCATION:	Nearest Structure	ENGINEER:	D Shivaiah

VIBRATION INPUT/OUTPUT DATA

OTHER CONSTRUCTION EQUIPMENT

$$PPV = PPV_{ref}(25/D)^{n} \text{ (in/sec)}$$

PPV =	**0.210 in/sec**

Equipment Type =	1	Vibratory Roller
PPV_{ref} =	0.210	Reference PPV at 25 ft.
D =	25.00	Distance from Equipment to receiver in ft.
n =	1.10	Vibration attenuation rate through the ground

EQUIPMENT PPV REFERENCE LEVELS

Type	Equipment	Reference PPV
1	Vibratory Roller	0.210
2	Large Bulldozer	0.089
3	Caisson Drilling	0.089
4	Loaded Trucks	0.076
5	Jackhammer	0.035
6	Small Bulldozer	0.003
7	Crack and Seat	2.400