WOOD AND LURIN RESIDENTIAL PROJECT

NOISE IMPACT ANALYSIS

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1 INTRODUCTION

This Noise Impact Analysis evaluates the potential noise and vibration related impacts that would be generated by the proposed Wood and Lurin residential project (proposed project). The project site is located northeast of the intersection of Lurin Avenue and Wood Road in the City of Riverside. The project would consist of the construction of 96 single-family dwelling units on approximately 18.9 acres. The project includes the construction of a 6-foot CMU perimeter wall, 5-to-6-foot interior CMU walls, and 5- to 6-foot-high privacy fencing between each yard. The regional location and site plan can be found in Figure 1 and Figure 2, respectively.

1.1 Purpose of the Report

To support the CEQA document for the proposed project, this Noise Impact Analysis has been prepared in order to determine the potential offsite and onsite noise and vibration impacts that could be generated from construction and operation of the proposed project. The following is provided in this report:

- A description of the study area and the proposed project.
- Information regarding the fundamentals of noise.
- Information regarding the fundamentals of vibration.
- A description of the local noise guidelines and standards.
- An evaluation of the current noise environment.
- An analysis of the potential short-term construction-related noise and vibration impacts from the proposed project.
- An analysis of long-term operations-related noise and vibration impacts from the proposed project.

1.2 Conclusions

The conclusions for the noise and vibration analysis are as follows:

Construction Noise:

Construction noise sources are regulated within the City of Riverside under Section 7.35.020(G) of the City's Municipal Code which prohibits construction activities between the hours of 7:00 PM and 7:00 AM on weekdays, between the hours of 5:00 PM and 8:00 AM on Saturdays, or at any time on Sunday or a federal holiday.

Modeled construction noise levels would reach a maximum of 74.3 dBA at the closest sensitive receptors during construction of the project. Per the FTA, construction noise levels should not exceed 80 dBA L_{eq} for an 8-hour period at residential uses. Therefore, project construction is not anticipated to exceed the FTA thresholds and impacts are considered less than significant. However, recommended BMPs to reduce construction noise further can be found in Section 7 of this report.

Vibration Impacts: Construction activities can produce vibration that may be felt by adjacent uses. As the nearest existing structures (residential uses located adjacent to the northern portion of the site, south of Krameria Avenue) are approximately 5 feet from the project site boundary. At a distance of 110 feet, use of a vibratory roller would be expected to generate 74.7 VdB and at a distance of 63 feet use of a bulldozer would be expected to generate 74.96 VdB. At a distance of 5 feet, use of a vibratory roller would be expected to generate a PPV of 2.348 in/sec. At a distance of 5 feet, the vibration level from a large bulldozer is 0.995 in/sec PPV. Therefore, Mitigation Measure, NOI-1 requires bulldozers to be operated at least 68 feet and vibratory rollers be operated at least 120 feet from the façades of the homes located adjacent to the project boundary.

Construction activity that must occur within 120 feet of the homes' façades would need to be performed with smaller equipment types that do not exceed the vibration thresholds applied herein. The estimated maximum vibration levels for the construction of the proposed project with the use of required setback distance Mitigation Measure NOI-1 would be less than significant. Furthermore, the compliance with the setback distance detailed in Mitigation Measure NOI-1 will also reduce the potential for annoyance-related vibration impacts to adjacent residential uses from construction-related vibration, as the buffer distances required to reduce architectural damage-related vibration impacts are greater than the buffer distance needed to reduce annoyance-related vibration impacts. In summary, during the construction of the proposed project, setback distance attenuation during construction would reduce the vibration levels to a less than significant level with the incorporation of Mitigation Measure NOI-1 (see Section 7.3 the report for details).

Off-Site Vehicular Noise: The proposed project would not result in a perceptible increase in noise due to the increase of project-related traffic on roadways in the project vicinity. The calculated noise levels show that the project would contribute a maximum of 0.2 dBA to existing traffic noise levels. As the project-related increase in traffic noise does not exceed the 5 dBA threshold, the project would not contribute to a substantial permanent increase in ambient noise levels in the project vicinity. Impacts are considered less than significant.

On-Site Operational Noise/Vibration: The project is a proposed residential use and would not be a significant source of operational noise or vibration. Impacts are less than significant.

Airport Noise: The nearest airport is March Air Reserve Base/Inland Port Airport (March ARB/IPA), located approximately 3.5 miles northeast of the project site. The project site falls well outside the 60 dBA noise contour. Therefore, the proposed project would not expose people residing or working in the project area to excessive noise levels from airports. Impacts are considered to be less than significant.

Aerial View

Krameria Avenue
Wood Road
Lurin Avenue
Maxar
Project Site
N


KRAMERIA AVE.
WOOD ROAD
DANT ST.
LURIN AVE
EX. RESIDENTIAL
EX. RESIDENTIAL
EX. RESIDENTIAL
(61,909 SF)
N

2 NOISE FUNDAMENTALS

Noise is defined as unwanted sound. Sound becomes unwanted when it interferes with normal activities, when it causes actual physical harm or when it has adverse effects on health. Sound is produced by the vibration of sound pressure waves in the air. Sound pressure levels are used to measure the intensity of sound and are described in terms of decibels. The decibel (dB) is a logarithmic unit, which expresses the ratio of the sound pressure level being measured to a standard reference level. A-weighted decibels (dBA) approximate the subjective response of the human ear to a broad frequency noise source by discriminating against very low and very high frequencies of the audible spectrum. They are adjusted to reflect only those frequencies that are audible to the human ear.

2.1 Noise Descriptors

Noise equivalent sound levels are not measured directly but are calculated from sound pressure levels typically measured in dBA. The equivalent sound level (L_{eq}) represents a steady state sound level containing the same total energy as a time varying signal over a given sample period. The peak traffic hour L_{eq} is the noise metric used by the California Department of Transportation (Caltrans) for all traffic noise impact analyses.

The Day-Night Average Sound Level (L_{dn}) is the weighted average of the intensity of a sound, with corrections for time of day, and averaged over 24 hours. The time of day corrections require the addition of ten decibels to sound levels at night between 10 PM and 7 AM While the Community Noise Equivalent Level (CNEL) is similar to the L_{dn}, except that it has another addition of 4.77 dB to sound levels during the evening hours between 7 PM and 10 PM These additions are made to the sound levels at these times because during the evening and nighttime hours, when compared to daytime hours, there is a decrease in the ambient noise levels, which creates an increased sensitivity to sounds. For this reason, the sound is perceived to be louder in the evening and nighttime hours and is weighted accordingly. Many cities rely on the CNEL noise standard to assess transportation-related impacts on noise sensitive land uses.

Another noise descriptor that is used primarily for the assessment of aircraft noise impacts is the Sound Exposure Level, which is also called the Single Event Level (SEL). The SEL descriptor represents the acoustic energy of a single event (i.e., an aircraft overflight) normalized to one-second event duration. This is useful for comparing the acoustical energy of different events involving different durations of the noise sources. The SEL is based on an integration of the noise during the period when the noise first rises within 10 dBA of its maximum value and last falls below 10 dBA of its maximum value. The SEL is often 10 dBA greater, or more, than the L_{MAX} since the SEL logarithmetically adds the L_{eq} for each second of the duration of the noise.

2.2 Tone Noise

A pure tone noise is a noise produced at a single frequency and laboratory tests have shown the humans are more perceptible to changes in noise levels of a pure tone (Caltrans 1998). For a noise source to contain a “pure tone,” there must be a significantly higher A-weighted sound energy in a given frequency band than in the neighboring bands, thereby causing the noise source to “stand out” against other noise sources. A pure tone occurs if the sound pressure level in the one-third octave band with the tone exceeds the average of the sound pressure levels of the two contagious one-third octave bands by: 5 dB for center frequencies of 500 Hertz (Hz) and above; by 8 dB for center frequencies between 160 and 400 Hz; and by 15 dB for center frequencies of 125 Hz or less (Department of Health Services 1977).

2.3 Ground Absorption

The sound drop-off rate is highly dependent on the conditions of the land between the noise source and receiver. To account for this ground-effect attenuation (absorption), two types of site conditions are commonly used in traffic noise models: soft-site and hard-site conditions. Soft-site conditions account for the sound propagation loss over natural surfaces such as normal earth and ground vegetation. For point sources, a drop-off rate of 7.5 dBA/DD is typically observed over soft ground with landscaping, as compared with a 6.0 dBA/DD drop-off rate over hard ground such as asphalt, concrete, stone and very hard packed earth. For line sources a 4.5 dBA/DD is typically observed for soft-site conditions compared to the 3.0 dBA/DD drop-off rate for hard-site conditions. To be conservative, hard-site conditions were used in this analysis.

2.4 Traffic Noise Prediction

The level of traffic noise depends on the three primary factors: (1) the volume of the traffic, (2) the speed of the traffic, and (3) the number of trucks in the flow of traffic. Generally, the loudness of traffic noise is increased by heavier traffic volumes, higher speeds, and greater number of trucks. Vehicle noise is a combination of the noise produced by the engine, exhaust, and tires. Because of the logarithmic nature of traffic noise levels, a doubling of the traffic volume (assuming that the speed and truck mix do not change) results in a noise level increase of 3 dBA. Based on the FHWA community noise assessment criteria, this change is “barely perceptible,” for reference a doubling of perceived noise levels would require an increase of approximately 10 dBA. However, the 1992 findings of Federal Interagency Committee on Noise (FICON), which assessed changes in ambient noise levels resulting from aircraft operations, found that noise increases as low as 1.5 dB can cause annoyance, when the existing noise levels are already greater than 65 dB. The truck mix on a given roadway also has an effect on community noise levels. As the number of heavy trucks increases and becomes a larger percentage of the vehicle mix, adjacent noise levels increase.

2.5 Noise Barrier Attenuation

Effective noise barriers can reduce noise levels by 10 to 15 dBA, cutting the loudness of traffic noise in half. For a noise barrier to work, it must be high enough and long enough to block the view of a road. A noise barrier is most effective when placed close to the noise source or receiver. A noise barrier can achieve a 5-dBA noise level reduction when it is tall enough to break the line-of-sight. When the noise barrier is a berm instead of a wall, the noise attenuation can be increased by another 3 dBA.

3 GROUNDBORNE VIBRATION FUNDAMENTALS

Groundborne vibrations consist of rapidly fluctuating motions within the ground that have an average motion of zero. The effects of groundborne vibrations typically only cause a nuisance to people, but at extreme vibration levels, damage to buildings may occur. Although groundborne 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. Groundborne noise is an effect of groundborne 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.

3.1 Vibration Descriptors

Several different methods are used to quantify vibration amplitude such as the maximum instantaneous peak in the vibrations velocity, which is known as the peak particle velocity (PPV) or the root mean square (RMS) amplitude of the vibration velocity. Because of the typically small amplitudes of vibrations, vibration velocity is often expressed in decibels and is denoted as L_V and is based on the RMS velocity amplitude. A commonly used abbreviation is VdB, which in this text, is when vibration level (L_V) is based on the reference quantity of 1 microinch per second.

3.2 Vibration Perception

The background vibration velocity level in residential areas is usually around 50 VdB[1]. The vibration velocity level threshold of perception for humans is approximately 65 VdB. A vibration velocity level of 75 VdB is the approximate dividing line between barely perceptible and distinctly perceptible levels for many people. Most perceptible indoor vibration is caused by sources within buildings, such as the operation of mechanical equipment, movement of people, or slamming of doors. Typical outdoor sources of perceptible groundborne vibration are construction equipment, steel-wheeled trains, and traffic on rough roads. If a roadway is smooth, the groundborne vibration from traffic is rarely perceptible. According to the Federal Transit Administration (FTA), the range of interest is from approximately 50 VdB, which is the typical background vibration velocity level, to 100 VdB, which is the general threshold where minor damage can occur in fragile buildings.[2]

The effects of groundborne vibration include movement of the building floors, rattling of windows, shaking of items on shelves or hanging on walls, and rumbling sounds. In extreme cases, the vibration can cause damage to buildings. Building damage is not a factor for most projects, with the occasional exception of blasting and pile-driving during construction. Annoyance from vibration often occurs when the vibration levels exceed the threshold of perception by only a small margin. A vibration level that causes annoyance will be well below the damage threshold for normal buildings.[3]

The general human response to different levels of groundborne vibration velocity levels is described in Table 1, Human Response to Different Levels of Groundborne Vibration. Groundborne vibration becomes unwanted when it interferes with normal activities, causes actual physical harm, or results

1 FTA, Transit Noise and Vibration Impact Assessment Manual, September 2018.
2 Federal Transit Administration, Transit Noise and Vibration Impact Assessment, September 2018.
3 Wood, cement, aggregates, metals, bricks, concrete, clay are the most common type of building material used in construction.

in adverse health effects including: fatigue from lack of sleep, sleep disturbances, to more serious issues such as cardiovascular disease, and cognitive impairment.

Table 1. Human Response to Different Levels of Groundborne Vibration

Vibration Velocity Level	Human Perception
65 VdB	Approximate threshold of perception for many people.
75 VdB	Approximate dividing line between barely perceptible and distinctly perceptible. Many people find that transportation-related vibration at this level is unacceptable.
85 VdB	Vibration acceptable only if there are an infrequent number of events per day.
Source: Federal Transit Administration (FTA), Transit Noise and Vibration Impact Assessment, September 2018.	

3.3 Vibration Propagation

The propagation of groundborne vibration is not as simple to model as airborne noise. This is because noise in the air travels through a relatively uniform median, while groundborne vibrations travel through the earth, which may contain significant geological differences. 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 wave front, 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 wave front. 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 wave front. 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.

3.4 Construction-Related Vibration Level Prediction

Construction activity can result in varying degrees of ground vibration, depending on the equipment used on the site. Operation of construction equipment causes ground vibrations that spread through the ground and diminish in strength with distance. Buildings in the vicinity of the construction site respond to these vibrations with varying results ranging from no perceptible effects at the low levels to slight damage at the highest levels. Table 2 gives approximate vibration levels for particular construction activities. The data in Table 2 provides a reasonable estimate for a wide range of soil conditions.

Table 2. Vibration Source Levels for Construction Equipment

Equipment	Peak Particle Velocity (inches/second) at 25 feet	Approximate Vibration Level (Lv) at 25 feet
Pile driver (impact)	1.518 (upper range)	112
	0.644 (typical)	104
Pile driver (sonic)	0.734 (upper range)	105
	0.170 (typical	93
Clam shovel drop (slurry wall)	0.202	94
Hydromill (slurry wall)	0.008 in soil	66
	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
Source: Transit Noise and Vibration Impact Assessment, Federal Transit Administration, 2018.		

4 REGULATORY SETTING

The proposed project is located in the City of Riverside and noise regulations are addressed through various federal, State, and local government regulations as discussed below.

4.1 Federal Regulations

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

- Promulgating noise emission standards for interstate commerce
- Assisting state and local abatement efforts
- Promoting noise education and research

The Federal Office of Noise Abatement and Control (ONAC) was initially tasked with implementing the Noise Control Act. However, the ONAC has since been eliminated, leaving the development of federal noise policies and programs to other federal agencies and interagency committees. For example, the Occupational Safety and Health Administration (OSHA) agency limits noise exposure of workers to 90 dB L_{eq} or less for 8 continuous hours or 105 dB L_{eq} or less for 1 continuous hour. The Department of Transportation (DOT) assumed a significant role in noise control through its various operating agencies. The Federal Aviation Administration (FAA) regulates noise of aircraft and airports. Surface transportation system noise is regulated by a host of agencies, including the Federal Transit Administration (FTA). Transit noise is regulated by the federal Urban Mass Transit Administration (UMTA), while freeways that are part of the interstate highway system are regulated by the Federal Highway Administration (FHWA). Finally, the federal government actively advocates that local jurisdictions use their land use regulatory authority to arrange new development in such a way that "noise sensitive" uses are either prohibited from being sited adjacent to a highway or, alternately that the developments are planned and constructed in such a manner that potential noise impacts are minimized.

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

4.2 State Regulations

Though not adopted by law, the State of California General Plan Guidelines 2017, published by the California Governor's Office of Planning and Research (OPR) (OPR Guidelines), provides guidance for the compatibility of projects within areas of specific noise exposure. The OPR Guidelines identify the suitability of various types of construction relative to a range of outdoor noise levels and provide each local community some flexibility in setting local noise standards that allow for the variability in community preferences. Findings presented in the Levels of Environmental Noise Document (EPA 1974) influenced the recommendations of the OPR Guidelines, most importantly in the choice of noise exposure metrics (i.e., Ldn or CNEL) and in the upper limits for the normally acceptable outdoor exposure of noise-sensitive uses.

The OPR Guidelines include a Noise and Land Use Compatibility Matrix which identifies acceptable and unacceptable community noise exposure limits for various land use categories. Where the "normally acceptable" range is used, it any special acoustical is defined as the highest noise level that should be considered for the construction of the buildings which do not incorporate treatment or noise mitigation. The "conditionally acceptable" or "normally unacceptable" ranges include conditions calling for detailed acoustical study prior to the construction or operation of the proposed project. The City of Riverside has adopted their own version of the State Land Use Compatibility Guidelines for land use planning and to assess potential transportation noise impacts to proposed land uses (see Table 2).

Title 24, Chapter 1, Article 4 of the California Administrative Code (California Noise Insulation Standards) requires noise insulation in new hotels, motels, apartment houses, and dwellings (other than single-family detached housing) that provides an annual average noise level of no more than 45 dBA CNEL. When such structures are located within a 60-dBA CNEL (or greater) noise contour, an acoustical analysis is required to ensure that interior levels do not exceed the 45-dBA CNEL annual threshold. In addition, Title 21, Chapter 6, Article 1 of the California Administrative Code requires that all habitable rooms, hospitals, convalescent homes, and places of worship shall have an interior CNEL of 45 dB or less due to aircraft noise.

4.3 Local Regulations

The City of Riverside General Plan and Municipal Code establish the following applicable goals policies related to noise and vibration.

City of Riverside General Plan

The City of Riverside General Plan Noise Element was adopted November 2007 (amended February 2018) and includes modified version of the State of California Noise Land Use Compatibility Matrix (see Table 3). This Matrix establishes standards for outdoor noise levels that are normally acceptable, conditionally acceptable, normally unacceptable, and clearly unacceptable for a variety of land uses. For example, noise levels of up to 60 dBA CNEL are "normally acceptable" and levels up to 65 dBA CNEL are "conditionally acceptable" for single-family uses, noise levels of up to 65 dBA CNEL are "normally acceptable." Additional City of Riverside General Plan Noise Element objectives and policies which may apply to the proposed project are presented below.

Objective N-1 Minimize noise levels from point sources throughout the community and, wherever possible, mitigate the effects of noise to provide a safe and healthful environment.

Policies

N-1.1 Continue to enforce noise abatement and control measures particularly within residential neighborhoods.

N-1.2 Require the inclusion of noise-reducing design features in development consistent with standards in Figure N–10 (Noise/Land Use Compatibility Criteria), Title 24 California Code of Regulations and Title 7 of the Municipal Code.

N-1.3 Enforce the City of Riverside Noise Control Code to ensure that stationary noise and noise emanating from construction activities, private developments/residences and special events are minimized.

N-1.4 Incorporate noise considerations into the site plan review process, particularly with regard to parking and loading areas, ingress/egress points and refuse collection areas.

N-1.5 Avoid locating noise-sensitive land uses in existing and anticipated noise-impacted areas.

N-1.8 Continue to consider noise concerns in evaluating all proposed development decisions and roadway projects.

Objective N-2 Minimize the adverse effects of airport related noise through proper land use planning.

N-2.1 Ensure that new development can be made compatible with the noise environment by using noise/land use compatibility standards (Figure N–10 – Noise/Land Use Noise Compatibility Criteria) and the airport noise contour maps (found in the Riverside County Airport Land Use Compatibility Plans) as guides to future planning and development decisions.

N-2.2 Avoid placing noise-sensitive land uses (e.g., residential uses, hospitals, assisted living facilities, group homes, schools, day care centers, etc.) within the high noise impact areas (over 60 dB CNEL) for Riverside Municipal Airport and Flabob Airport in accordance with the Riverside County Airport Land Use Compatibility Plan.

N-2.4 Work with the Federal Aviation Administration and neighboring airport authorities to minimize the noise impacts of air routes through residential neighborhoods within the City.

N-2.5 Utilize the Airport Protection Overlay Zone, as appropriate, to advise landowners of special noise considerations associated with their development.

Objective N-3 Ensure the viability of March Air Reserve Base/March Inland Port.

N-3.1 Avoid placing noise-sensitive land uses (e.g., residential uses, hospitals, assisted living facilities, group homes, schools, day care centers, etc.) within the high noise impact areas (over 65 dB CNEL) for March Air Reserve Base/March Inland Port in accordance with the Riverside County 2014 March Air Reserve Base/Inland Port Airport Land Use Compatibility Plan.

Objective N-4 Minimize ground transportation-related noise impacts.

N-4.1 Ensure that noise impacts generated by vehicular sources are minimized through the use of noise reduction features (e.g., earthen berms, landscaped walls, lowered streets, improved technology).

City of Riverside Municipal Code

In addition to any measures to reduce noise levels recommended in this report, project operations will be subject to the following noise related Municipal Code requirements.

Municipal Code Section 7.25.010 Exterior sound level limits

A. Unless a variance has been granted as provided in this title, it shall be unlawful for any person to cause or allow the creation of any noise which exceeds the following:

1. The exterior noise standard of the applicable land use category, up to five decibels, for a cumulative period of more than 30 minutes in any hour; or
2. The exterior noise standard of the applicable land use category, plus five decibels, for a cumulative period of more than 15 minutes in any hour; or
3. The exterior noise standard of the applicable land use category, plus ten decibels, for a cumulative period of more than five minutes in any hour; or
4. The exterior noise standard of the applicable land use category, plus 15 decibels, for the cumulative period of more than one minute in any hour; or
5. The exterior noise standard for the applicable land use category, plus 20 decibels or the maximum measured ambient noise level, for any period of time.

B. If the measured ambient noise level exceeds that permissible within any of the first four noise limit categories, the allowable noise exposure standard shall be increased in five decibel increments in each category as appropriate to encompass the ambient noise level. In the event the ambient noise level exceeds the fifth noise limit category, the maximum allowable noise level under said category shall be increased to reflect the maximum ambient noise level.

C. If possible, the ambient noise level shall be measured at the same location along the property line with the alleged offending noise source inoperative. If for any reason the alleged offending noise source cannot be shut down, then the ambient noise must be estimated by performing a measurement in the same general area of the source but at a sufficient distance that the offending noise is inaudible. If the measurement location is on the boundary between two different districts, the noise shall be the arithmetic mean of the two districts.

D. Where the intruding noise source is an air-conditioning unit or refrigeration system which was installed prior to the effective date of this title, the exterior noise level when measured at the property line shall not exceed 60 dBA for units installed before 1-1-80 and 55 dBA for units installed after 1-1-80.

Exterior Noise Standards		
Land Use Category	Time Period	Noise Level
Residential	Night (10:00 PM - 7:00 AM)	45 dBA
	Day (7:00 AM - 10:00 PM)	55 dBA
Office/Commercial	Any time	65 dBA
Industrial	Any time	70 dBA
Community Support	Any time	60 dBA
Public Recreation Facility	Any time	65 dBA
Nonurban	Any time	70 dBA

Land Use Category/Zoning Matrix	
Land Use Category	Underlying Zone
Residential	RE, RA-5, RR, RC, R-1-1/2 acre, R-1-13000, R-1-10500, R-1-8500, R-1-7000, R-3-25000, R-3-4000, R-3-3000, R-3-2000, R-3-1500, R-4
Office/Commercial	O, CRC, CR-NC, CR, CG
Industrial	BMP, I, AIR
Community Support	Any permitted zone
Nonurban	Any permitted zone

Municipal Code Section 7.30.015 Interior sound level limits

A. No person shall operate or cause to be operated, any source of sound indoors which causes the noise level, when measured inside another dwelling unit, school or hospital, to exceed:

1. The interior noise standard for the applicable land category area, up to five decibels, for a cumulative period of more than five minutes in any hour;
2. The interior noise standard for the applicable land use category, plus five decibels, for a cumulative period of more than one minute in any hour;
3. The interior noise standard for the applicable land use category, plus ten decibels or the maximum measured ambient noise level, for any period of time.

B. If the measured interior ambient noise level exceeds that permissible within the first two noise limit categories in this section, the allowable noise exposure standard shall be increased in five decibel increments in each category as appropriate to reflect the interior ambient noise level. In the event the interior ambient noise level exceeds the third noise limit category, the maximum allowable interior noise level under said category shall be increased to reflect the maximum interior ambient noise level.

C. The interior noise standard for various land use districts shall apply, unless otherwise specifically indicated, within structures located in designated zones with windows opened or closed as is typical of the season.

Interior Noise Standard		
Land Use Category	Time Period	Noise Level
Residential	Night (10:00 PM - 7:00 AM)	35 dBA
	Day (7:00 AM - 10:00 PM)	45 dBA
School	7:00 AM – 10:00 PM (while school is in session)	45 dBA
Hospital	Any time	45 dBA

Municipal Code Section 7.35.020 Exemptions

The following activities shall be exempt from the provisions of Title 7 Noise Control of the City of Riverside Municipal Code:

C*onstruction*. Noise sources associated with construction, repair, remodeling, or grading of any real property; provided a permit has been obtained from the City as required; and provided said activities do not take place between the hours of 7:00 PM and 7:00 AM on weekdays, between the hours of 5:00 PM and 8:00 AM on Saturdays, or at any time on Sunday or a federal holiday.

Table 3. City of Riverside General Plan Noise Compatibility Guidelines

Land Use Category	Exterior Noise Level (CNEL)							
	55	60	65	70	75	80	85	
Single Family Residential	Acceptable	Acceptable	Conditionally Acceptable	Normally Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable
Infill Single Family Residential	Acceptable	Acceptable	Acceptable	Conditionally Acceptable	Conditionally Acceptable	Normally Unacceptable	Unacceptable	Unacceptable
Commercial - Motels, Hotels, Transient Lodging	Acceptable	Acceptable	Conditionally Acceptable	Conditionally Acceptable	Normally Unacceptable	Normally Unacceptable	Unacceptable	Unacceptable
Schools, Libraries, Churches, Hospitals, Nursing Homes	Acceptable	Acceptable	Conditionally Acceptable	Conditionally Acceptable	Normally Unacceptable	Normally Unacceptable	Unacceptable	Unacceptable
Auditoriums, Concert Halls, Amphitheaters, Meeting Halls	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable
Sports Arena, Outdoor Spectator Sports	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable
Playgrounds, Neighborhood Parks	Acceptable	Acceptable	Acceptable	Acceptable	Normally Unacceptable	Unacceptable	Unacceptable	Unacceptable
Golf Courses, Riding Stables, Water Recreation, Cemeteries	Acceptable	Acceptable	Acceptable	Acceptable	Normally Unacceptable	Normally Unacceptable	Unacceptable	Unacceptable
Office Buildings, Business Commercial and Professional, and Mixed-Use Developments	Acceptable	Acceptable	Acceptable	Conditionally Acceptable	Conditionally Acceptable	Normally Unacceptable	Normally Unacceptable	Normally Unacceptable
Industrial, Manufacturing Utilities, Agriculture	Acceptable	Acceptable	Acceptable	Acceptable	Conditionally Acceptable	Conditionally Acceptable	Normally Unacceptable	Normally Unacceptable
Freeway Adjacent Commercial Office, and Industrial Uses.	Acceptable	Acceptable	Acceptable	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Normally Unacceptable	Normally Unacceptable

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

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

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

Unacceptable: New construction or development should generally not be undertaken.

5 EXISTING NOISE CONIDTIONS

To determine the existing noise level environment, short-term noise measurements were taken at four locations in the project study area on April 27, 2021. The field survey noted that noise within the proposed project area is generally characterized by traffic noise. The nearest airport is March Air Reserve Base/Inland Port Airport (March ARB/IPA), which is located approximately 3.5 miles northeast of the project site. The project site is located outside of the 60 dBA noise contour; therefore, MARCH ARB is not considered as a source that contributes to the ambient noise levels on the project site.

The following describes the measurement procedures, measurement locations, and the noise measurement results.

5.1 Noise Measurement Procedure and Criteria

Noise Measurement Equipment

Noise monitoring was performed using American National Standards Institute (ANSI Section SI4 1979, Type 1) Larson Davis model Sound Track LxT2 sound level meter. The sound level meter was programmed in "slow" mode to record the sound pressure level at one second- and one-minute intervals for in A-weighted form. The sound level meter and microphone were mounted approximately five feet above the ground and equipped with a windscreen during all measurements. The sound level meter was calibrated before monitoring. The noise level measurement equipment meets American National Standards Institute (ANSI) specifications for sound level meters (S1.4-1983 identified in Chapter 19.68.020.AA).

Noise Measurement Locations

The noise monitoring locations were selected in order to obtain noise measurements of the current noise sources impacting the vicinity of the project site and to provide a baseline for any potential noise impacts that may be created by development of the proposed project. The sites are shown in Figure 3 on the following page. Appendix A includes a photographic index of the study area and noise measurement data.

Noise Measurement Timing and Climate

The short-term (15 minute) noise measurements were recorded between 12:06 PM and 1:58 PM on April 27, 2021. At the start of the noise monitoring, the temperature was 58°F, 46% humidity, sky was relatively clear with patchy clouds and calm wind conditions (~6 mph).

Noise Measurement Locations

5.2 Noise Measurement and Analysis Results

The short-term noise measurements were taken for a duration of 15 minutes each at four locations surrounding the project site. Both Caltrans and the FTA recognize that it is not reasonable to collect noise level measurements that can fully represent every part of a private yard, patio, deck, or balcony normally used for human activity when estimating impacts for new development projects. This is demonstrated in the Caltrans general site location guidelines which indicate that, *sites* "must be free of noise contamination by sources other than sources of interest. Avoid sites located near sources such as barking dogs, lawnmowers, pool pumps, and air conditioners unless it is the express intent of the analyst to measure these sources."[4] Furthermore, FTA guidance states, "that it is not necessary nor recommended that existing noise exposure be determined by measuring at every noise-sensitive location in the project area. Rather, the recommended approach is to characterize the noise environment for clusters of sites based on measurements or estimates at representative locations in the community."[5]

Based on recommendations of Caltrans and the FTA, it is not necessary to collect measurements at each individual building or residence, because each receiver measurement represents a group of buildings that share acoustical equivalence.[6] Collecting reference ambient noise level measurements at the nearby sensitive receiver locations allows for a comparison of the before and after project noise levels and is necessary to assess potential noise impacts due to the project's contribution to the ambient noise levels.

The results of the short-term noise level measurements are provided below in Table 3. The dominant noise source in the area is vehicular traffic from Lurin Avenue, Wood Road, and Krameria Avenue. Earth moving equipment was in use south of Lurin Avenue.

Table 4. Short-Term Noise Measurement Summary (dBA)[1,2]

Site Location	Time Started	Leq	Lmax	Lmin	L(2)	L(8)	L(25)	L(50)
NM 1	12:06 PM	58.7	72.9	40.1	68.8	64.4	55.1	49.8
NM 2	12:40 PM	69.3	80.8	45.2	77.2	74.8	70.3	62.0
NM 3	1:17 PM	46.6	55.1	39.2	51.3	49.9	47.8	45.7
NM 4	1:43 PM	62.6	77.5	49.5	70.2	67.0	62.4	58.9

[1] See Figure 3 for noise measurement locations. Each noise measurement was performed over a 15-minute duration.
[2] Noise measurements performed on April 27, 2021.

5.3 Existing Traffic Noise

The existing ambient noise from vehicular traffic was modeled using the Federal Highway Administration (FHWA) Traffic Noise Prediction Model (FHWA-RD-77-108), as modified for CNEL and the "Calveno" energy curves. Site-specific information is entered, such as roadway traffic volumes, roadway active width, source-to-receiver distances, travel speed, noise source and receiver heights, and the percentages of automobiles, medium trucks, and heavy trucks that the traffic is made up of throughout the day, amongst other variables.

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[4] California Department of Transportation Environmental Program. *Technical Noise Supplement – A Technical Supplement to the Traffic Noise Analysis Protocol*. Sacramento, CA : s.n., September 2013

[5] U.S. Department of Transportation, Federal Transit Administration. *Transit Noise and Vibration Impact Assessment Manual*. September 2018

[6] Ibid.

The FHWA Traffic Noise Prediction Model arrives at a predicted noise level through a series of adjustments to the Reference Energy Mean Emission Level (REMEL). Adjustments are then made to the REMEL to account for: total average daily traffic volumes, roadway classification, width, speed and truck mix, roadway grade and site conditions (hard or soft ground surface). All modeled roadways were assumed to have a "hard site" to predict worst-case, conservative noise levels. A hard site, such as pavement, is highly reflective and does not attenuate noise as quickly as grass or other soft sites. Any reductions in noise levels due to intervening topography and buildings were not accounted for in this analysis. Existing daily traffic (ADT) were calculated and provided by EPD traffic analysts (see Appendix B).

The calculated noise levels in Table 5 show that the existing traffic noise in the area is as high as 73.9 dBA at a distance of 50 feet from the centerline.

Table 5. Existing Traffic Noise Levels

Road Segments	Existing ADT	dB CNEL
Van Buren Boulevard		
w/o Wood St	42,054	73.9
e/o Wood St	40,117	73.7
at Trautwein-Cole Ave	41,461	73.9
Cole Avenue		
s/o Van Buren Blvd	6,934	66.1
Krameria Avenue		
w/o Cole Ave	2,752	62.1
e/o Cole Ave	1,870	60.4

5.4 Existing Sensitive Receptors

The State of California defines sensitive receptors as those land uses that require serenity or are otherwise adversely affected by noise events or conditions. Schools, libraries, churches, hospitals, single and multiple-family residential, including transient lodging, motels and hotel uses make up the majority of these areas. The closest receptors to the project site include: the single-family residential uses located adjacent to the east and west of the site, the single-family residential uses located approximately 90 feet north of the site, north of Krameria Avenue; approximately 40 feet east of the site, east of Dant Street; and approximately 60 feet to the west, west of Wood Road (see Figure 4).

Sensitive Receptor Locations

6 NOISE AND VIBRATION THRESHOLDS

Consistent with the California Environmental Quality Act (CEQA) and the CEQA Guidelines, a significant impact related to noise or vibration would occur if a proposed project is determined to result in:

- Generation of a substantial temporary or permanent increase in ambient noise levels in excess of standards established in the local General Plan or noise ordinance, or applicable standards of other agencies.
- Generation of excessive groundborne vibration or groundborne noise levels.
- Exposure of persons residing or working in the project area to excessive noise levels from aircraft.

7 Noise and Vibration Impacts

This impact discussion analyzes the potential for project construction and operational noise to cause an exposure of persons to or generation of noise levels in excess of established City of Riverside noise standards listed previously in Section 4.

7.1 Construction Noise

Construction noise sources are regulated within the City of Riverside under Section 7.35.020(G) of the City's Municipal Code which prohibits construction activities between the hours of 7:00 PM and 7:00 AM on weekdays, between the hours of 5:00 PM and 8:00 AM on Saturdays, or at any time on Sunday or a federal holiday.

Although construction activity may be exempt from the noise standards in the City's Municipal Code, CEQA requires that potential noise impacts still be evaluated for significance.

The City of Riverside has not adopted a numerical threshold that identifies what a substantial increase would be. For purposes of this analysis, the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment (2018) criteria will be used to establish significance thresholds. The FTA provides reasonable criteria for assessing construction noise impacts based on the potential for adverse community reaction. For residential uses, the daytime noise threshold is 80 dBA L_{eq} averaged over an 8-hour period ($L_{eq\ (8\text{-hr})}$; and the nighttime noise threshold is 70 dBA $L_{eq\ (8\text{-hr})}$. In compliance with the City's Code, it is assumed that construction would not occur during the nighttime hours.

Construction noise levels will vary significantly based upon the size and topographical features of the active construction zone, duration of the workday, and types of equipment employed. As shown on Table 6, construction equipment used for the Project generates noise up to 89.6 dBA at a distance of 50 feet from the noise source. However, typical operating cycles for construction equipment involves one or two minutes of full power operation followed by three to four minutes at lower power settings. Thus, construction equipment noise is not continuous. A summary of noise level data for a variety of construction equipment is listed in Table 6.

Table 6. Construction Equipment Noise Emissions and Acoustical Usage Factor

Equipment Description	Impact Device?	Acoustical use Factor (%)	Spec. Lmax @ 50ft (dBA, slow)	Actual Measured Lmax @ 50ft (dBA, slow)	No. of Actual Data Samples (Count)
Compressor (air)	No	40	80	78	18
Concrete Mixer Truck	No	40	85	79	40
Concrete Saw	No	20	90	89.6	55
Crane	No	16	85	81	405
Dozer	No	40	85	82	55
Excavator	No	40	85	81	170
Forklift[1,2]	No	50	n/a	61	n/a
Front End Loader	No	40	80	79	96
Generator	No	50	82	81	19
Grader	No	40	85	-N/A-	0
Paver	No	50	85	77	9
Pickup Truck	No	50	85	77	9
Paving Equipment	No	20	90	-N/A-	9
Roller	No	20	85	80	16
Scraper	No	40	85	84	12
Tractor/Loader/Backhoe	No	25	80	-N/A-	0
Welder/Torch	No	40	73	74	5

Source: FHWA RCNM User's Guide, 2006

[1] Warehouse & Forklift Noise Exposure - NoiseTesting.info Carl Stautins, November 4, 2014 http://www.noisetesting.info/blog/carl-strautins/page-3/

[2] Data provided Leq as measured at the operator. Sound Level at 50 feet is estimated.

Construction noise associated with the project was calculated utilizing methodology from FTA Transit Noise and Vibration Impact Assessment Manual (2018) together with several key construction parameters including: distance to each sensitive receiver, equipment usage, percent usage factor, and baseline parameters for the project site (see Appendix C for details). The equipment used to calculate the construction noise levels for each phase were based on the assumptions provided in the CalEEMod Emission Summary prepared for the proposed project (April 2021). Distances to receptors were based on the acoustical center of the proposed construction activity. Therefore, the distance to each receptor used in the modeling was the estimated distance from the acoustical center of the project site to the receptor. Construction noise levels were calculated for each phase. To be conservative, the noise generated by each piece of equipment was added together for each phase of construction; however, it is unlikely (and unrealistic) that every piece of equipment will be used at the same time, at the same distance from the receptor, for each phase of construction.

As shown in Table 7, the noisiest construction phase is anticipated to occur during grading, where the highest modeled construction noise levels could reach up to 74.3 dBA L_{eq} at the façade of the closest residential receptors located northwest of the site (in the vicinity of STNM2). Other receptors located further from the center of construction activity would experience lower noise levels.

Table 7. Estimated Construction Noise Levels at Sensitive Receptors

Construction Phase	Receptor Location	Existing Ambient Noise Levels (dBA Leq)	Construction Noise Levels at Receptor Locations (dBA Leq)
Demolition	Northwest (STNM2)	69.3	73.6
	Northeast (STNM3)	46.6	68.6
	East (STNM 4)	62.6	65.9
	West (STNM2)	69.3	65.0
	North (STNM1)	58.7	61.2
Site Preparation	Northwest (STNM2)	69.3	72.4
	Northeast (STNM3)	46.6	67.4
	East (STNM 4)	62.6	64.7
	West (STNM2)	69.3	63.9
	North (STNM1)	58.7	58.5
Grading	Northwest (STNM2)	69.3	74.3
	Northeast (STNM3)	46.6	69.3
	East (STNM 4)	62.6	66.6
	West (STNM2)	69.3	65.8
	North (STNM1)	58.7	60.6
Building Construction	Northwest (STNM2)	69.3	68.9
	Northeast (STNM3)	46.6	64.0
	East (STNM 4)	62.6	61.2
	West (STNM2)	69.3	60.4
	North (STNM1)	58.7	56.7
Paving	Northwest (STNM2)	69.3	70.3
	Northeast (STNM3)	46.6	65.4
	East (STNM 4)	62.6	62.6
	West (STNM2)	69.3	61.8
	North (STNM1)	58.7	58.8
Architectural Coating	Northwest (STNM2)	69.3	61.0
	Northeast (STNM3)	46.6	56.0
	East (STNM 4)	62.6	53.3
	West (STNM2)	69.3	52.4
	North (STNM1)	58.7	47.1

As discussed earlier, construction noise sources are regulated within the City of Riverside under Section 7.35.020(G) of the City's Municipal Code which prohibits construction activities between the hours of 7:00 PM and 7:00 AM on weekdays, between the hours of 5:00 PM and 8:00 AM on Saturdays, or at any time on Sunday or a federal holiday.

Furthermore, per FTA, daytime construction noise levels should not exceed 80 dBA L_{eq} for an 8-hour period at residential uses. Therefore, as the highest construction noise levels are less than 80 dBA, project construction would not be anticipated to exceed FTA thresholds. Impacts are less than significant.

In addition to adherence to the City of Riverside Municipal Code which limits the construction hours, the following best management practices (BMPs) are recommended that would further reduce noise levels associated with the construction of the proposed project:

1. During all project site excavation and grading on-site, construction contractors shall equip all construction equipment, fixed or mobile, with properly operating and maintained mufflers, consistent with manufacturer standards.

2. The contractor shall place all stationary construction equipment so that emitted noise is directed away from noise sensitive receptors nearest the project site.

3. As applicable, all equipment shall be shut off and not left to idle when not in use.

4. The contractor shall locate equipment staging in areas that will create the greatest distance between construction-related noise/vibration sources and sensitive receptors nearest the project site during all project construction.

5. Jackhammers, pneumatic equipment and all other portable stationary noise sources shall be shielded and noise shall be directed away from sensitive receptors.

6. The project proponent shall mandate that the construction contractor prohibit the use of music or sound amplification on the project site during construction.

7. The construction contractor shall limit haul truck deliveries to the same hours specified for construction equipment.

7.2 Operational Noise

Potential noise impacts associated with increases in ambient noise from operation of stationary noise sources are based on the following criteria. Noise level increases below 3 dBA would not be perceptible to the human ear in an outdoor environment, and an increase or decrease in noise level of at least 5 dBA is required before any noticeable change in community response would be expected.[7] Therefore, the City's ambient noise threshold for stationary sources is a clearly perceptible increase of 5 dBA in for ambient noise increases to be considered significant.[8]

The following section provides an analysis of potential long-term offsite and onsite noise impacts associated with the ongoing operations of the proposed project.

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[7] Section 5.11 – Noise of the General Plan and Supporting Documents Environmental Impact Report. Page 5.11-26. Albert A. Webb Associates. Certified November 2007.

[8] Ibid.

Potential On-Site Noise Impacts

Parking Noise
Noise would be generated by parking activities along the street, in drive-ways, and in private garages. Sources of noise associated with parking would include engines accelerating, doors slamming, car alarms, and people talking. Noise levels associated with parking would fluctuate with the amount of automobile and human activity. It is anticipated that the types of parking related noise would be substantially similar to the noise generated by the existing street parking and roadway activity in the vicinity of the project site. Therefore, noise impacts associated with parking would be less than significant and no mitigation measures are required.

Stationary Noise Sources
The proposed project includes on-site ground-floor HVAC units for each residential unit that could potentially operate 24 hours per day and would generate noise levels of 66.5 dBA Leq at 5 feet. At a distance of 20 feet, the noise levels from the HVAC units would be reduced to 54.5 dBA, and further reduced by 5 dBA by shielding from the proposed 6-foot-high perimeter wall, which would reduce noise volumes at 20 feet to approximately 4.9.5 dBA. Although the operation of this equipment would generate noise, the location of all mechanical equipment would be reviewed during the City's permitting process and would be required to comply with the regulations under Section 7.25.010 of the Municipal Code. Therefore, impacts related to stationary noise sources would be less than significant with compliance with existing regulations. No mitigation measures are required.

Potential Off-Site Vehicular Noise Impacts

The Existing Plus Project average daily traffic (ADT) were calculated by EPD for road segments within the project's vicinity. Please see Appendix B for details.

Noise impacts related to vehicular traffic were modeled using a version of the Federal Highway Administration (FHWA) Traffic Noise Prediction Model (FHWA-RD-77-108), as modified for CNEL and the "Calveno" energy curves. Roadway parameters utilized to model future traffic noise levels to the project include location, traffic volume, speed and vehicle mix (autos, medium trucks, and heavy trucks). The various scenarios that are described above were modeled to determine project-specific increases in noise levels at an arbitrary distance of 50 feet from roadway centerline. The uniform distance allows for direct comparisons of potential increases or decreases in noise levels based upon various traffic scenarios; however, at this distance, no specific noise standard necessarily applies. Therefore, the change in a noise level between scenarios is the focus of this portion of the analysis, rather than the resulting independent noise level for any one segment. FHWA calculation spreadsheets are included in Appendix B.

The calculated noise levels in Table 8 show that the project would contribute a maximum of 0.3 dBA to existing noise levels along Krameria Avenue west of Cole Avenue. The project-related increase in traffic noise does not exceed the 5 dBA threshold. Therefore, the project would not contribute to a substantial permanent increase in ambient noise levels in the project vicinity.

Table 8. Project Traffic Noise Contributions to Existing Scenario

Road Segments	Existing		Existing Plus Project			Is the Increase Significant?
	ADT	dB CNEL	ADT	Total	Project Increase	
Van Buren Boulevard						
w/o Wood St	42,054	73.9	42,493	74.0	0.1	**No**
e/o Wood St	40,117	73.7	40,293	73.8	0.1	**No**
at Trautwein-Cole Ave	41,461	73.9	41,637	73.9	0.0	**No**
Cole Avenue						
s/o Van Buren Blvd	6,934	66.1	7,241	66.3	0.2	**No**
Krameria Avenue						
w/o Cole Ave	2,752	62.1	2,928	62.4	0.3	**No**
e/o Cole Ave	1,870	60.4	1,914	60.5	0.1	**No**

7.3 Groundborne Vibration

This impact discussion analyzes the potential for construction and operational activities of the proposed project to generate excessive groundborne vibration or groundborne noise levels.

The City currently does not have any adopted standards, guidelines, or thresholds relative to ground-borne vibration. Ground-borne noise refers to the noise generated by ground-borne vibration. Ground-borne noise that accompanies the building vibration is usually perceptible only inside buildings and typically is only an issue at locations with subway or tunnel operations where there is no airborne noise path or for buildings with substantial sound insulation such as a recording studio.[9] As such, available guidelines from the Federal Transit Administration (FTA) are utilized to assess impacts due to ground-borne vibration. The FTA has adopted vibration standards that are used to evaluate potential building damage impacts related to construction activities.

Table 9. Construction Vibration Damage Criteria

Building Category	PPV (in/sec)
I. Reinforced-concrete, steel or timber (no plaster)	0.50
II. Engineered concrete and masonry (no plaster)	0.30
III. Non-engineered timber and masonry buildings	0.20
IV. Buildings extremely susceptible to vibration damage	0.12
Source: Federal Transit Administration, Transit Noise and Vibration Impact Assessment, September 2018.	

9 Federal Transit Administration, Transit Noise and Vibration Impact Assessment, May 2018, pp 108, 112.

As shown in Table 9, the threshold at which there is a risk to "architectural" damage to residential structures (non-engineered timber and masonry buildings) is a PPV of 0.2.

The FTA has also adopted standards associated with human annoyance for groundborne vibration impacts for the following three land-use categories:

(1) Vibration Category 1 – High Sensitivity,

(2) Vibration Category 2 – Residential, and

(3) Vibration Category 3 – Institutional.

The FTA defines Category 1 as buildings where vibration would interfere with operations within the building, including vibration-sensitive research and manufacturing facilities, hospitals with vibration-sensitive equipment, and university research operations. Vibration-sensitive equipment includes, but is not limited to, electron microscopes, high-resolution lithographic equipment, and normal optical microscopes. Category 2 refers to all residential land uses and any buildings where people sleep, such as hotels and hospitals. Category 3 refers to institutional land uses such as schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment, but still have the potential for activity interference. The vibration criteria associated with human annoyance for these three land-use categories are shown in Table 1. Table 1 shows that 75 VdB is the threshold for annoyance from groundborne vibration at sensitive receptors.

Therefore, impacts would be significant if construction activities result in groundborne vibration of 0.2 PPV or higher at residential structures or 75 VdB.

Construction Vibration

The types of construction vibration impact include human annoyance and building damage. Human annoyance occurs when construction vibration rises significantly above the threshold of human perception for extended periods of time. Building damage can be cosmetic or structural.

The nearest existing structures to the project boundary are the residential structures located adjacent to the northern portion of the project site, approximately 5 feet from the project site boundary. To be conservative, this distance represents the closest a piece of equipment could come to the building façade of the sensitive receptors as the equipment passes by the project boundary. Other vibration sensitive land uses are located further from the project site and would experience lower impacts.

7.3.1.1.1.1 Architectural Damage

Vibration generated by construction activity generally has the potential to damage structures. This damage could be structural damage, such as cracking of floor slabs, foundations, columns, beams, or wells, or cosmetic architectural damage, such as cracked plaster, stucco, or tile.

Construction of the proposed project would not require the use of equipment such as pile drivers, which are known to generate substantial construction vibration levels. The highest degree of groundborne vibration that would be generated during construction would be from operation of a vibratory roller and large bulldozer. At a distance of 5 feet vibratory roller operations are estimated to be approximately 2.348 inch-per-second PPV and large bulldozer operations are estimated to be 0.995 inch-per-second PPV, which exceeds the FTA significance thresholds (i.e., 0.2 inch-per-second PPV for potential structural damage to non-engineered timber and masonry buildings).

However, at a distance of 120 feet, the vibration level from a vibratory roller is 0.02 in/sec PPV, and at a distance of 68 feet, the vibration level from a large bulldozer is 0.02 in/sec PPV, which meets the criteria to reduce potential structural damage to a less than significant level (vibration calculations provided in Appendix D). Therefore, to avoid the potential for any structural damage to the adjacent buildings during construction, Mitigation Measure NOI-1 has been included to restrict use of a vibratory roller within 120 feet of the existing offsite buildings and restrict use of a large bulldozer within 68 feet of the existing offsite buildings. With the implementation of Mitigation Measure NOI-1, construction impacts from groundborne vibration would be reduced to a level of less than significant.

7.3.1.1.1.2 Annoyance to Persons

At a distance of 5 feet, use of a vibratory roller would be expected to generate 114.97 VdB[10] and use of a bulldozer would be expected to generate 107.97 VdB,[7][11] which would exceed 75 VdB. Therefore, annoyance-based vibration impacts to the closest residential uses, located within 5 feet of the site), would be considered potentially significant.

At a distance of 110 feet, use of a vibratory roller would be expected to generate 74.7 VdB and at a distance of 63 feet use of a bulldozer would be expected to generate 74.96 VdB (vibration calculations provided in Appendix D). At these distances, annoyance-based impacts from groundborne vibration would be less than significant. As described previously, Mitigation Measure NOI-1 has been included to restrict use of a vibratory roller within 120 feet of the existing offsite buildings and restrict use of a large bulldozer within 68 feet of the existing offsite buildings. At the distances required by Mitigation Measure NOI-1, impacts related to human annoyance would be less than the 75 VdB threshold significant, and less than significant.

Mitigation

The following mitigation measure is recommended to reduce construction-related vibration annoyance impacts to nearby residential receptors to the maximum extent feasible.

Mitigation Measure NOI-1: The construction contractor shall avoid using vibratory rollers within 120 feet, and bulldozers within 68 feet of the residential uses directly adjacent to the project boundary.

Mitigation Measure NOI-1 requires bulldozers to be operated at least 68 feet and vibratory rollers be operated at least 120 feet from the façades of the residences located adjacent to the project boundary. Construction activity that must occur within 120 feet of the residential façades would

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[10] Based on the 2018 FTA Transit Noise and Vibration Impact Assessment Manual vibration equation 7-3: $L_{v.distance} = L_{vref} - 30 \log (D/25)$, where $L_{v \cdot distance}$ is the vibration level adjusted for distance, VdB; L_{vref} is the source reference vibration level at 25 feet, VdB; and D = distance from the equipment to the receiver. Page 185.

[11] Ibid.

need to be performed with smaller equipment types that do not exceed the vibration thresholds applied herein. Compliance with the setback distance detailed in Mitigation Measure NOI-1 will reduce the potential for architectural damage and annoyance-related vibration impacts to adjacent residential uses from construction-related vibration to a less than significant level. See Appendix D for Vibration Worksheets.

Operational Vibration

As the proposed project consists of residential uses, the project does not include any sources of operational vibration and no impacts are anticipated.

7.4 Airport Noise

This impact discussion analyzes the potential for nearby airports or private airstrips to expose people residing or working in the project area to excessive noise levels.

The nearest airport is March Air Reserve Base/Inland Port Airport (March ARB/IPA), located approximately 3.5 miles northeast of the project site. The project site falls well outside the 60 dBA noise contour. Therefore, the proposed project would not expose people residing or working in the project area to excessive noise levels from airports. Impacts are considered to be less than significant.

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APPENDIX A – FIELD NOISE MEASUREMENT PRINT-OUTS

KWAQN

Office
7404 Kingsley Way,
Riverside, CA

15-Minute Noise Measurement Datasheet

Project: Wood Road & Lurin Avenue Project.
Site Address/Location: Between N-S: Krameria Ave & Lurin Ave, E-W: Wood Rd & Dant St.
Date: 4/27/2021
Field Tech/Engineer: Ian Edward Gallagher

General Location: Between NS: Krameria Ave & Lurin Ave, EW: Wood Rd & Dant St.
Sound Meter: Larson Davis Sound Track LxT2 **SN:** 1152
Settings: A-weighted, slow, 1-min, 15-minute interval
Meteorological Con.: 58 deg F, 6 mph wind, 46% humidity, ~40% cloud, patchy sunshine.
Site ID: NM-1 2 3 & 4

Site Observations: Main noise sources are from vehicular traffic travelling along Lurin Ave, Wood Rd, Krameria Ave & other surrounding roads . The local buildings reflect much of the sound. Other noise sources include bird song, occasional low altitude aircraft (propeller, jet, and helicopter). Residential ambiance, distant dogs barking. Road works in operation just N of Wood St & Krameria Ave intersection. Earth moving equipment in use S of Lurin Ave. Leaf rustle from 6mph breeze.

Site Topo: Suburbia/open land trees & grass. Residential off site in all directions.
Ground Type: Medium site conditions,reflective,refractive, some absorption.

NM locations, lat , long :

NM1 Meter: 33°52'47.94"N 117°19'47.99"W
NM2 Meter: 33°52'41.50"N 117°19'52.60"W
NM3 Meter: 33°52'41.56"N 117°19'41.36"W
NM4 Meter: 33°52'35.24"N 117°19'42.33"W

Figure 1: Monitoring Locations

Office
7404 Kingsley Way,
Riverside, CA

15-Minute Noise Measurement Datasheet - Cont.

Project: Wood Road & Lurin Avenue Project.
Site Address/Location: Between N-S: Krameria Ave & Lurin Ave, E-W: Wood Rd & Dant St.
Site ID: NM-1 2 3 & 4

Figure 2: STNM1 Photo

NM1 looking N across Krameria Avenue & Meadow Lane intersection. Residence on the left across Krameria Avenue is 19068 Krameria Ave, Riverside.

Figure 3: STNM2 Photo

NM2 looking N up Wood Road towards Krameria Avenue intersection (220 yards), road works in operation just beyond intersection. Residence 16588 Wood Road, Riverside on the right of photo.

Office
7404 Kingsley Way,
Riverside, CA

15-Minute Noise Measurement Datasheet - Cont.

Project: Wood Road & Lurin Avenue Project.
Site Address/Location: Between N-S: Krameria Ave & Lurin Ave, E-W: Wood Rd & Dant St.
Site ID: NM-1 2 3 & 4

Figure 4: STNM3 Photo

NM3 looking NE past SW corner of property & into front yard of residence 16611 Dant Street, Riverside.

Figure 5: STNM4 Photo

NM4 looking from Lurin Avenue past microphone into yard of residence 16723 Dant Street, Riverside.A114:N126

KWAQN

Office
7404 Kingsley Way,
Riverside, CA

15-Minute Noise Measurement Datasheet - Cont.

Project: Wood Road & Lurin Avenue Project.
Site Address/Location: Between N-S: Krameria Ave & Lurin Ave, E-W: Wood Rd & Dant St.
Site ID: NM-1 2 3 & 4

Table 1: Noise Measurement Summary

Location	Start	Stop	Leq/ dB	Lmax/ dB	Lmin/ dB	L2/ dB	L8/ dB	L25/ dB	L50/ dB	L90/ dB
NM 1	12:06 PM	12:21 PM	58.7	72.9	40.1	68.8	64.4	55.1	49.8	44.0
NM 2	12:40 PM	12:55 PM	69.3	80.8	45.2	77.2	74.8	70.3	62.0	48.8
NM 3	1:17 PM	1:32 PM	46.6	55.1	39.2	51.3	49.9	47.8	45.7	41.1
NM 4	1:43 PM	1:58 PM	62.6	77.5	49.5	70.2	67.0	62.4	58.9	54.0

APPENDIX B – FHWA MODEL ANALYSIS CALCULATIONS

Project Traffic Noise Contributions to Existing Scenario

Road Segments	Existing		Existing Plus Project			Is the Increase Significant ?
	ADT	dB CNEL	ADT	Total	Project Increase	
Van Buren Boulevard						
w/o Wood St	42,054	73.9	42,493	74.0	0.1	**No**
e/o Wood St	40,117	73.7	40,293	73.8	0.1	**No**
at Trautwein-Cole Ave	41,461	73.9	41,637	73.9	0.0	**No**
Cole Avenue						
s/o Van Buren Blvd	6,934	66.1	7,241	66.3	0.2	**No**
Krameria Avenue						
w/o Cole Ave	2,752	62.1	2,928	62.4	0.3	**No**
e/o Cole Ave	1,870	60.4	1,914	60.5	0.1	**No**

*The uniform distance of 50 feet from centerline allows for direct comparisons of potential increases or decreases in noise levels based upon various traffic scenarios; however, at this distance, no specific noise standard necessarily applies

NOISE CONTOUR WORKSHEET

(calculations based on the FHWA-RD-77-108 Highway Noise Prediction Model)

PROJECT INFORMATION

Project:	- -	**W.O. #:**	- -
City/County:	- -	**Date Entered:**	
Comments:	- -	**Entered By:**	- -

SITE INFORMATION

Planning Area(s):	- -	**Land Use(s):**	- -
Obs. Location:	(see below)	**Scenario:**	LOS 'C' Volumes

ROADWAY SEGMENT, VEHICULAR AND OBSERVER CHARACTERISTICS

Roadway:	"standard roadway"	**Roadway Class:**	- -
Segment:	- -	**Right of Way:**	- -
ADT:	10,000	**Travel Speed:**	40 MPH
Pad Elev. (opt.):	0.0 feet	**Obs. Height:**	5.0 feet
Roadway Elev.:	0.0 feet	**Roadway Grade:**	0.1%

	Required	Type	Height
Ext. Mitigation:	- -	- -	- -

	Autos	Med Trucks	Heavy Trucks
Noise Height: (above roadway)	0.00 feet	2.30 feet	8.01 feet

	Left	Right	Total
Exposure:	90º	90º	180º

	Autos	Med Trucks	Heavy Trucks
Hard/Soft Site:	Hard	Hard	Hard

Veh. Distribution	Daytime	Evening	Nighttime	Daily
Automobiles	77.50%	12.90%	9.59%	97.42%
Medium Trucks	84.78%	4.89%	10.33%	1.84%
Heavy Trucks	86.49%	2.70%	10.81%	0.74%

Notes: Standard Road at 50 feet from the centerline

CALCULATED CNEL NOISE IMPACTS

Noise impact under various scenarios:	67.7 Exterior Umitigated

Noise is a function of both speed and ADTs.
Since speed is assumed constant at 40 mph for this analysis, noise is a function of ADT only, and can be calculated by the following equation:

CNEL (dB) = 67.7 + 10 x log (ADT/10,000)

Project ADT 878

Street	Cross Streets	Existing ADT	Date	Project %	Project ADT	Existing + Proj ADT
Van Buren	w/o Wood	42,054	Sept 03	50%	439	42,493
Van Buren	w/o Wood	39,887	Oct 07	50%	439	40,326
Van Buren	e/o Wood	40,117	Apr 06	20%	176	40,293
Van Buren	@ Trautwein-Cole	41,461	Jun 06	20%	176	41,637
Cole	s/o Van Buren	6,934	May 04	35%	307	7,241
Krameria	w/o Cole	2,752	Jun 07	20%	176	2,928
Krameria	e/o Cole	1,870	Nov 05	5%	44	1,914

APPENDIX C – CONSTRUCTION NOISE WORKSHEETS

Table A
Construction Noise by Phase - Receptor Northwest of the Project Site (STNM2)

A	B	C	D	E	F	G	H	I	J
Equipment Type	# of Equipment	Equipment Lmax at 50 feet, dBA[1, 2]	Distance to Receptor[3]	Equipment Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Noise Level Leq (dBA) at Receptor	Noise Level (dBA Lmax) at Receptor
Demolition									
Concrete/Industrial Saw	1	89.6	225	20	0.20	-13.1	-7.0	69.5	69.3
Rubber Tired Dozers	2	82	225	40	0.80	-13.1	-1.0	68.0	64.8
Excavators	3	81	225	40	1.20	-13.1	0.8	68.7	65.5
							Log Sum	73.6	71.8
Site Preparation									
Rubber Tired Dozers	3	82	225	40	1.20	-13.1	0.8	69.7	66.5
Tractors/Loaders/Backhoes	4	80	225	40	1.60	-13.1	2.0	69.0	65.8
							Log Sum	72.4	69.2
Grading									
Excavators	2	81	225	40	0.80	-13.1	-1.0	67.0	63.8
Graders	1	85	225	40	0.40	-13.1	-4.0	68.0	64.7
Rubber Tired Dozers	1	82	225	40	0.40	-13.1	-4.0	65.0	61.7
Scrapers	2	84	225	40	0.80	-13.1	-1.0	70.0	66.4
Tractors/Loaders/Backhoes	2	80	225	25	0.50	-13.1	-3.0	63.9	62.8
							Log Sum	74.3	71.2
Building Construction									
Cranes	1	81	225	16	0.16	-13.1	-8.0	60.0	60.7
Forklifts	3	64	225	50	1.50	-13.1	1.8	52.7	48.5
Generator Sets	1	81	225	40	0.40	-13.1	-4.0	64.0	60.7
Welders	1	73	225	40	0.40	-13.1	-4.0	56.0	52.7
Tractors/Loaders/Backhoes	3	80	225	25	0.75	-13.1	-1.2	65.7	64.5
							Log Sum	68.9	67.4
Paving									
Pavers	2	77	225	50	1.00	-13.1	0.0	63.9	59.8
Paving Equipment	2	85	225	20	0.40	-13.1	-4.0	68.0	67.8
Rollers	2	80	225	20	0.40	-13.1	-4.0	63.0	62.8
							Log Sum	70.3	69.5
Architectural Coating									
Air Compressors	1	78	225	40	0.40	-13.1	-4.0	61.0	57.7
							Log Sum	61.0	57.7

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018).

(2) Source: https://www.google.com/url?q=http://www.noisetesting.info/blog/warehouse-forklift-workplace-noise-levels/&sa=D&source=hangouts&ust=1545259247311000&usg=AFQjCNHFcKKoEKUjv5VZMOtw_KO977Em1A

(3) Distance to receptor calculated from center of site. Construction noise projected from the center of the project site to the structural facade of the nearest sensitive use.

Table B
Construction Noise by Phase - Receptors Northeast of the Project Site (STNM3)

A	B	C	D	E	F	G	H	I	J
Equipment Type	# of Equipment	Equipment Lmax at 50 feet, dBA[1, 2]	Distance to Receptor[3]	Equipment Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Noise Level Leq (dBA) at Receptor	Noise Level (dBA Lmax) at Receptor
Demolition									
Concrete/Industrial Saw	1	89.6	397	20	0.20	-18.0	-7.0	64.6	66.1
Rubber Tired Dozers	2	82	397	40	0.80	-18.0	-1.0	63.0	61.5
Excavators	3	81	397	40	1.20	-18.0	0.8	63.8	62.3
							Log Sum	68.6	68.6
Site Preparation									
Rubber Tired Dozers	3	82	397	40	1.20	-18.0	0.8	64.8	63.3
Tractors/Loaders/Backhoes	4	80	397	40	1.60	-18.0	2.0	64.0	62.5
							Log Sum	67.4	65.9
Grading									
Excavators	2	81	397	40	0.80	-18.0	-1.0	62.0	60.5
Graders	1	85	397	40	0.40	-18.0	-4.0	63.0	61.5
Rubber Tired Dozers	1	82	397	40	0.40	-18.0	-4.0	60.0	58.5
Scrapers	2	84	397	40	0.80	-18.0	-1.0	65.0	63.5
Tractors/Loaders/Backhoes	2	80	397	25	0.50	-18.0	-3.0	59.0	59.5
							Log Sum	69.3	68.0
Building Construction									
Cranes	1	81	397	16	0.16	-18.0	-8.0	55.0	57.5
Forklifts	3	64	397	50	1.50	-18.0	1.8	47.8	45.3
Generator Sets	1	81	397	40	0.40	-18.0	-4.0	59.0	57.5
Welders	1	73	397	40	0.40	-18.0	-4.0	51.0	49.5
Tractors/Loaders/Backhoes	3	80	397	25	0.75	-18.0	-1.2	60.8	61.3
							Log Sum	64.0	64.1
Paving									
Pavers	2	77	397	50	1.00	-18.0	0.0	59.0	56.5
Paving Equipment	2	85	397	20	0.40	-18.0	-4.0	63.0	64.5
Rollers	2	80	397	20	0.40	-18.0	-4.0	58.0	59.5
							Log Sum	65.4	66.2
Architectural Coating									
Air Compressors	1	78	397	40	0.40	-18.0	-4.0	56.0	54.5
							Log Sum	56.0	54.5

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018).

(2) Source: https://www.google.com/url?q=http://www.noisetesting.info/blog/warehouse-forklift-workplace-noise-levels/&sa=D&source=hangouts&ust=1545259247311000&usg=AFQjCNHFcKKoEKUjv5VZMOtw_KO977Em1A

(3) Distance to receptor calculated from center of site. Construction noise projected from the center of the project site to the structural façade of the nearest sensitive use.

Table C
Construction Noise by Phase - Receptors East of the Project Site (STNM4)

A	B	C	D	E	F	G	H	I	J
Equipment Type	# of Equipment	Equipment Lmax at 50 feet, dBA[1, 2]	Distance to Receptor[3]	Equipment Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Noise Level Leq (dBA) at Receptor	Noise Level (dBA Lmax) at Receptor
Demolition									
Concrete/Industrial Saw	1	89.6	546	20	0.20	-20.8	-7.0	61.8	59.1
Rubber Tired Dozers	2	82	546	40	0.80	-20.8	-1.0	60.3	54.5
Excavators	3	81	546	40	1.20	-20.8	0.8	61.0	55.3
							Log Sum	65.9	61.6
Site Preparation									
Rubber Tired Dozers	3	82	546	40	1.20	-20.8	0.8	62.0	56.3
Tractors/Loaders/Backhoes	4	80	546	40	1.60	-20.8	2.0	61.3	55.5
							Log Sum	64.7	58.9
Grading									
Excavators	2	81	546	40	0.80	-20.8	-1.0	59.3	53.5
Graders	1	85	546	40	0.40	-20.8	-4.0	60.3	54.5
Rubber Tired Dozers	1	82	546	40	0.40	-20.8	-4.0	57.3	51.5
Scrapers	2	84	546	40	0.80	-20.8	-1.0	62.3	56.5
Tractors/Loaders/Backhoes	2	80	546	25	0.50	-20.8	-3.0	56.2	52.5
							Log Sum	66.6	61.1
Building Construction									
Cranes	1	81	546	16	0.16	-20.8	-8.0	52.3	50.5
Forklifts	3	64	546	50	1.50	-20.8	1.8	45.0	38.3
Generator Sets	1	81	546	40	0.40	-20.8	-4.0	56.3	50.5
Welders	1	73	546	40	0.40	-20.8	-4.0	48.3	42.5
Tractors/Loaders/Backhoes	3	80	546	25	0.75	-20.8	-1.2	58.0	54.3
							Log Sum	61.2	57.2
Paving									
Pavers	2	77	546	50	1.00	-20.8	0.0	56.2	49.5
Paving Equipment	2	85	546	20	0.40	-20.8	-4.0	60.3	57.5
Rollers	2	80	546	20	0.40	-20.8	-4.0	55.3	52.5
							Log Sum	62.6	59.2
Architectural Coating									
Air Compressors	1	78	546	40	0.40	-20.8	-4.0	53.3	47.5
							Log Sum	53.3	47.5

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018).

(2) Source: https://www.google.com/url?q=http://www.noisetesting.info/blog/warehouse-forklift-workplace-noise-levels/&sa=D&source=hangouts&ust=1545259247311000&usg=AFQjCNHFcKKoEKUjv5VZMOtw_KO977Em1A

(3) Distance to receptor calculated from center of site. Construction noise projected from the center of the project site to the structural façade of the nearest sensitive use.

Table D
Construction Noise by Phase - Receptors West of the Project Site (STNM2)

A	B	C	D	E	F	G	H	I	J
Equipment Type	# of Equipment	Equipment Lmax at 50 feet, dBA[1, 2]	Distance to Receptor[3]	Equipment Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Noise Level Leq (dBA) at Receptor	Noise Level (dBA Lmax) at Receptor
Demolition									
Concrete/Industrial Saw	1	89.6	600	20	0.20	-21.6	-7.0	61.0	58.7
Rubber Tired Dozers	2	82	600	40	0.80	-21.6	-1.0	59.4	54.1
Excavators	3	81	600	40	1.20	-21.6	0.8	60.2	54.9
							Log Sum	65.0	61.2
Site Preparation									
Rubber Tired Dozers	3	82	600	40	1.20	-21.6	0.8	61.2	55.9
Tractors/Loaders/Backhoes	4	80	600	40	1.60	-21.6	2.0	60.5	55.1
							Log Sum	63.9	58.5
Grading									
Excavators	2	81	600	40	0.80	-21.6	-1.0	58.4	53.1
Graders	1	85	600	40	0.40	-21.6	-4.0	59.4	54.1
Rubber Tired Dozers	1	82	600	40	0.40	-21.6	-4.0	56.4	51.1
Scrapers	2	84	600	40	0.80	-21.6	-1.0	61.4	56.1
Tractors/Loaders/Backhoes	2	80	600	25	0.50	-21.6	-3.0	55.4	52.1
							Log Sum	65.8	60.6
Building Construction									
Cranes	1	81	600	16	0.16	-21.6	-8.0	51.5	50.1
Forklifts	3	64	600	50	1.50	-21.6	1.8	44.2	37.9
Generator Sets	1	81	600	40	0.40	-21.6	-4.0	55.4	50.1
Welders	1	73	600	40	0.40	-21.6	-4.0	47.4	42.1
Tractors/Loaders/Backhoes	3	80	600	25	0.75	-21.6	-1.2	57.2	53.9
							Log Sum	60.4	56.7
Paving									
Pavers	2	77	600	50	1.00	-21.6	0.0	55.4	49.1
Paving Equipment	2	85	600	20	0.40	-21.6	-4.0	59.4	57.1
Rollers	2	80	600	20	0.40	-21.6	-4.0	54.4	52.1
							Log Sum	61.8	58.8
Architectural Coating									
Air Compressors	1	78	600	40	0.40	-21.6	-4.0	52.4	47.1
							Log Sum	52.4	47.1

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018).

(2) Source: https://www.google.com/url?q=http://www.noisetesting.info/blog/warehouse-forklift-workplace-noise-levels/&sa=D&source=hangouts&ust=1545259247311000&usg=AFQjCNHFcKKoEKUjv5VZMOtw_KO977Em1A

(3) Distance to receptor calculated from center of site. Construction noise projected from the center of the project site to the structural façade of the nearest sensitive use.

Table E
Construction Noise by Phase - Receptors North of the Project Site (STNM1)

A	B	C	D	E	F	G	H	I	J
Equipment Type	# of Equipment	Equipment Lmax at 50 feet, dBA[1, 2]	Distance to Receptor[3]	Equipment Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Noise Level Leq (dBA) at Receptor	Noise Level (dBA Lmax) at Receptor
Demolition									
Concrete/Industrial Saw	1	89.6	712	20	0.20	-23.1	-7.0	59.5	58.7
Rubber Tired Dozers	2	82	712	40	0.80	-23.1	-1.0	58.0	54.1
Excavators	3	81	712	40	1.20	-23.1	0.8	58.7	54.9
							Log Sum	63.6	61.2
Site Preparation									
Rubber Tired Dozers	3	82	712	40	1.20	-23.1	0.8	59.7	55.9
Tractors/Loaders/Backhoes	4	80	712	40	1.60	-23.1	2.0	59.0	55.1
							Log Sum	62.4	58.5
Grading									
Excavators	2	81	712	40	0.80	-23.1	-1.0	57.0	53.1
Graders	1	85	712	40	0.40	-23.1	-4.0	58.0	54.1
Rubber Tired Dozers	1	82	712	40	0.40	-23.1	-4.0	55.0	51.1
Scrapers	2	84	712	40	0.80	-23.1	-1.0	60.0	56.1
Tractors/Loaders/Backhoes	2	80	712	25	0.50	-23.1	-3.0	53.9	52.1
							Log Sum	64.3	60.6
Building Construction									
Cranes	1	81	712	16	0.16	-23.1	-8.0	50.0	50.1
Forklifts	3	64	712	50	1.50	-23.1	1.8	42.7	37.9
Generator Sets	1	81	712	40	0.40	-23.1	-4.0	54.0	50.1
Welders	1	73	712	40	0.40	-23.1	-4.0	46.0	42.1
Tractors/Loaders/Backhoes	3	80	712	25	0.75	-23.1	-1.2	55.7	53.9
							Log Sum	58.9	56.7
Paving									
Pavers	2	77	712	50	1.00	-23.1	0.0	53.9	49.1
Paving Equipment	2	85	712	20	0.40	-23.1	-4.0	58.0	57.1
Rollers	2	80	712	20	0.40	-23.1	-4.0	53.0	52.1
							Log Sum	60.3	58.8
Architectural Coating									
Air Compressors	1	78	712	40	0.40	-23.1	-4.0	51.0	47.1
							Log Sum	51.0	47.1

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018).

(2) Source: https://www.google.com/url?q=http://www.noisetesting.info/blog/warehouse-forklift-workplace-noise-levels/&sa=D&source=hangouts&ust=1545259247311000&usg=AFQjCNHFcKKoEKUjv5VZMOtw_KO977Em1A

(3) Distance to receptor calculated from center of site. Construction noise projected from the center of the project site to the structural façade of the nearest sensitive use.

APPENDIX D – VIBRATION WORKSHEETS

VdB Calculations

Lv (distance)	*=*	*Lv (ref)*	*-*	*30*log (D/25)*

roller @ 5 feet

Lv 114.97

roller @ 110 feet

Lv 74.70

large bulldozer @ 5 feet

Lv 107.97

large bulldozer @ 63 feet

Lv 74.96

GROUNDBORNE VIBRATION ANALYSIS

Project:	Wood and Lurin	Date:	5/26/21
Source:	Roller		
Scenario:	Unmitigated		
Location:	Project Site		
Address:	Residential 5 feet to west		

PPV = PPVref(25/D)^n (in/sec)

INPUT

INPUT SECTION IN GREEN

Equipment = Type	1	Vibratory Roller
PPVref =	0.21	Reference PPV (in/sec) at 25 ft.
D =	5.00	Distance from Equipment to Receiver (ft)
n =	1.50	Vibration attenuation rate through the ground

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2013, pgs 35-40.

RESULTS

PPV =	2.348	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS			
Project:	Wood and Lurin		Date: 5/26/21
Source:	Large Bulldozer		
Scenario:	Unmitigated		
Location:	Project Site		
Address:	Residential 5 feet to west		
PPV = PPVref(25/D)^n (in/sec)			
INPUT			
Equipment = Type	2	Large Bulldozer	INPUT SECTION IN GREEN
PPVref =	0.089	Reference PPV (in/sec) at 25 ft.	
D =	5.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	
Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2013, pgs 35-40.			
RESULTS			
PPV =	0.995	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project:	Wood and Lurin	Date:	5/26/21
Source:	Roller		
Scenario:	Mitigated		
Location:	Project Site		
Address:	Adjacent residential		
PPV = PPVref(25/D)^n (in/sec)			

INPUT

Equipment = Type	1	Vibratory Roller	INPUT SECTION IN GREEN
PPVref =	0.21	Reference PPV (in/sec) at 25 ft.	
D =	120.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2013, pgs 35-40.

RESULTS

PPV =	0.020	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS			
Project:	Wood and Lurin		Date: 5/26/21
Source:	Large Bulldozer		
Scenario:	Mitigated		
Location:	Project Site		
Address:	Adjacent residential		
PPV = PPVref(25/D)^n (in/sec)			
INPUT			
Equipment = Type	2	Large Bulldozer	INPUT SECTION IN GREEN
PPVref =	0.089	Reference PPV (in/sec) at 25 ft.	
D =	68.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	
Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2013, pgs 35-40.			
RESULTS			
PPV =	0.020	IN/SEC	OUTPUT IN BLUE