NOISE AND VIBRATION IMPACT ANALYSIS

COTTONWOOD COLLECTION RESIDENTIAL PROJECT

MORENO VALLEY, CALIFORNIA

LSA

June 2022

NOISE AND VIBRATION IMPACT ANALYSIS

COTTONWOOD COLLECTION RESIDENTIAL PROJECT

MORENO VALLEY, CALIFORNIA

Submitted to:

EPD Solutions, Inc.
2355 Main Street, Suite 100
Irvine, California 92614

Prepared by:

LSA
20 Executive Park, Suite 200
Irvine, California 92614
(949) 553-0666

Project No. ESL2201.08

LSA

June 2022

TABLE OF CONTENTS

APPENDICES

FIGURES AND TABLES

FIGURES

TABLES

LIST OF ABBREVIATIONS AND ACRONYMS

ADT	average daily trips
ALUC	Airport Land Use Compatibility
CEQA	California Environmental Quality Act
City	City of Moreno Valley
CNEL	Community Noise Equivalent Level
dBA	A-weighted decibel(s)
FHWA	Federal Highway Administration
ft	foot/feet
FTA	Federal Transit Administration
FTA Manual	FTA *Transit Noise and Vibration Impact Assessment Manual*
in/sec	inch/inches per second
L_{dn}	day-night average noise level
L_{eq}	equivalent continuous sound level
L_{max}	maximum instantaneous sound level
mi	mile/miles
Noise Element	City of Moreno Valley General Plan Noise Element
PPV	peak particle velocity
project	Cottonwood Collection Residential Project
RIV	March Air Reserve Base
RMS	root-mean-square
STC	Sound Transmission Class
VdB	vibration velocity decibels

INTRODUCTION

This noise and vibration impact analysis has been prepared to evaluate the potential noise and vibration impacts and reduction measures associated with the proposed Cottonwood Collection Residential Project (project) in Moreno Valley, California. This report is intended to satisfy the City of Moreno Valley's (City) requirement for a project-specific noise impact analysis by examining the impacts of the project site and evaluating noise reduction measures that the project may require.

PROJECT LOCATION AND DESCRIPTION

The proposed project is located at the southeast corner of Cottonwood Avenue and Quincy Street in Moreno Valley, California.

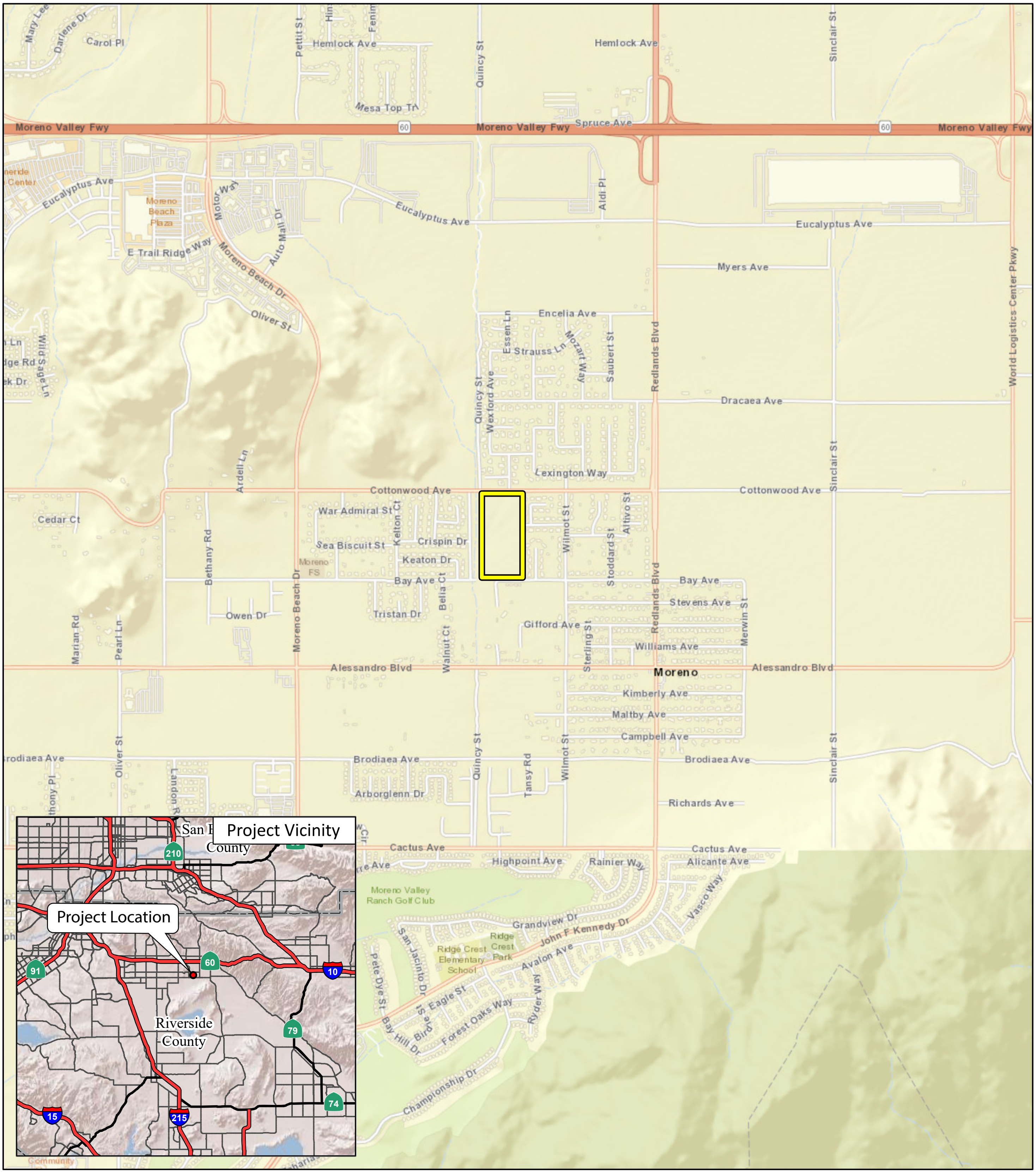
The project consists of 60 single-family detached units on a 20.04-acre site. The site is currently vacant. The project site is surrounded by existing single-family homes to the east, to the south opposite Bay Avenue, to the west opposite Quincy Street, and to the north opposite Cottonwood Avenue.

The project's main entry will be from Cottonwood Avenue. A secondary entry will be from Bay Avenue, completing the existing partially built street section. Figures 1 and 2 show the project location and site plan, respectively.

EXISTING LAND USES IN THE PROJECT AREA

The project site is surrounded primarily by residential uses and vacant parcels. The areas adjacent to the project site include the following uses:

- **North:** Existing single-family residences opposite Cottonwood Avenue;
- **East:** Existing single-family residences;
- **South:** Existing single-family residences opposite Bay Avenue and vacant land; and
- **West:** Existing single-family residences opposite Quincy Street.



LEGEND

Project Location

N

0 1000 2000

FEET

SOURCE: USGS The National Map (2018)

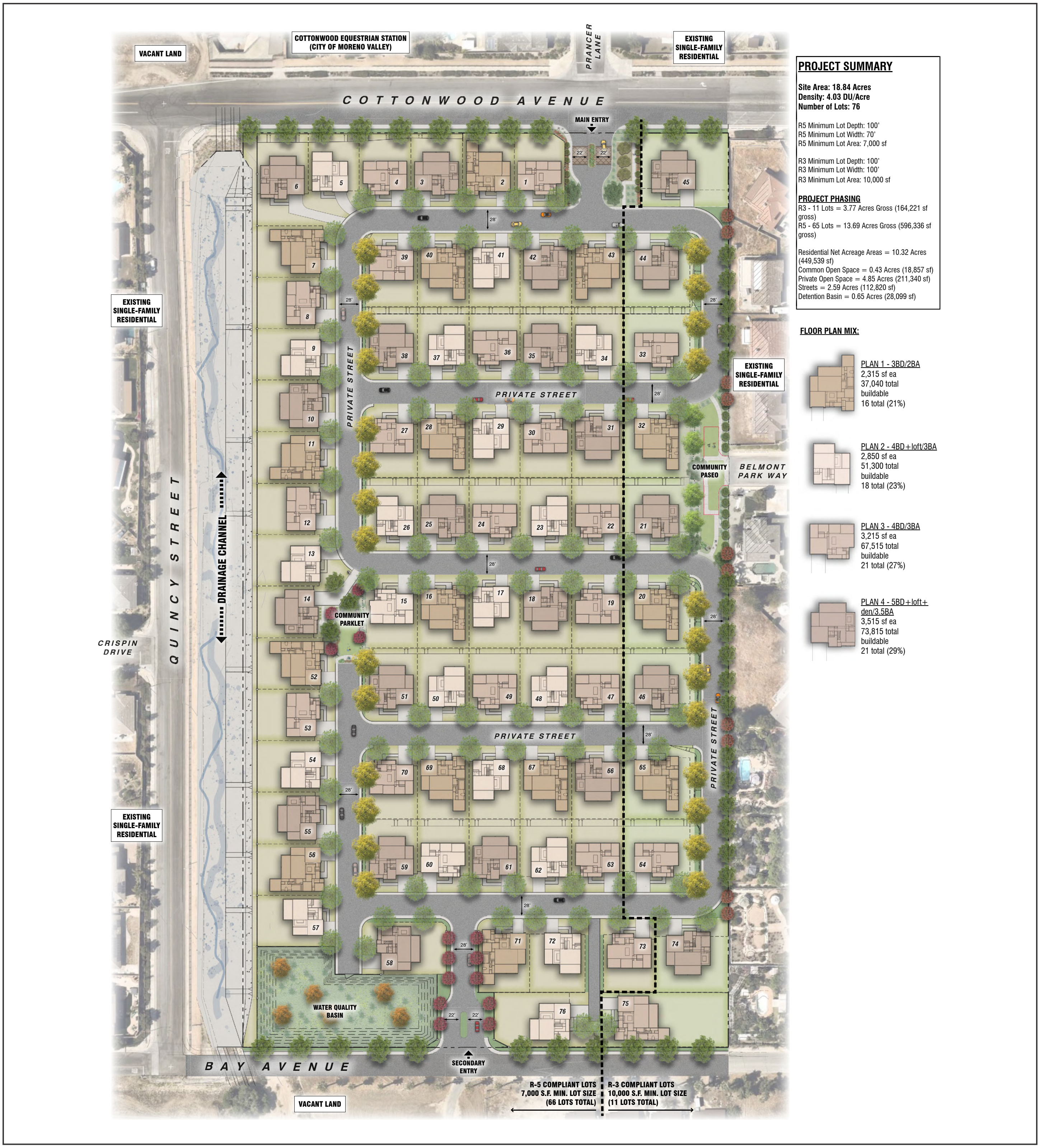
I:\ESL2201.08\G\Project_Location.ai (6/1/2022)

LSA

FIGURE 1

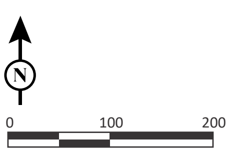
Cottonwood Collection Residential

Project Location



LSA

FIGURE 2



SOURCE: Canyon Park Studio Landscape Architecture

Cottonwood Collection Residential

Site Plan

I:\ESL2201.08\G\Site_Plan.ai (6/1/2022)

NOISE AND VIBRATION FUNDAMENTALS

CHARACTERISTICS OF SOUND

Noise is usually defined as unwanted sound. Noise consists of any sound that may produce physiological or psychological damage and/or interfere with communication, work, rest, recreation, and sleep.

To the human ear, sound has two significant characteristics: pitch and loudness. Pitch is generally an annoyance, while loudness can affect the ability to hear. Pitch is the number of complete vibrations, or cycles per second, of a sound wave, which results in the tone's range from high to low. Loudness is the strength of a sound, and it describes a noisy or quiet environment; it is measured by the amplitude of the sound wave. Loudness is determined by the intensity of the sound waves combined with the reception characteristics of the human ear. Sound intensity is the average rate of sound energy transmitted through a unit area perpendicular to the direction in which the sound waves are traveling. This characteristic of sound can be precisely measured with instruments. The analysis of a project defines the noise environment of the project area in terms of sound intensity and its effect on adjacent sensitive land uses.

MEASUREMENT OF SOUND

Sound intensity is measured with the A-weighted decibel (dBA) scale to correct for the relative frequency response of the human ear. That is, an A-weighted noise level de-emphasizes low and very high frequencies of sound, similar to the human ear's de-emphasis of these frequencies. Decibels (dB), unlike the linear scale (e.g., inches or pounds), are measured on a logarithmic scale representing points on a sharply rising curve.

For example, 10 dB is 10 times more intense than 0 dB, 20 dB is 100 times more intense than 0 dB, and 30 dB is 1,000 times more intense than 0 dB. Thirty decibels (30 dB) represents 1,000 times as much acoustic energy as 0 dB. The decibel scale increases as the square of the change, representing the sound pressure energy. A sound as soft as human breathing is about 10 times greater than 0 dB. The decibel system of measuring sound gives a rough connection between the physical intensity of sound and its perceived loudness to the human ear. A 10 dB increase in sound level is perceived by the human ear as only a doubling of the sound's loudness. Ambient sounds generally range from 30 dB (very quiet) to 100 dB (very loud).

Sound levels are generated from a source, and their decibel level decreases as the distance from that source increases. Sound levels dissipate exponentially with distance from their noise sources. For a single point source, sound levels decrease approximately 6 dB for each doubling of distance from the source. This drop-off rate is appropriate for noise generated by stationary equipment. If noise is produced by a line source (e.g., highway traffic or railroad operations), the sound decreases 3 dB for each doubling of distance in a hard site environment. Line-source sound levels decrease 4.5 dB for each doubling of distance in a relatively flat environment with absorptive vegetation.

There are many ways to rate noise for various time periods, but an appropriate rating of ambient noise affecting humans also accounts for the annoying effects of sound. The equivalent continuous sound level (L_{eq}) is the total sound energy of time-varying noise over a sample period. However, the predominant rating scales for human communities in the State of California are the L_{eq} and Community Noise Equivalent Level (CNEL) or the day-night average noise level (L_{dn}) based on A-weighted decibels. CNEL is the time-weighted average noise over a 24-hour period, with a 5 dBA weighting factor applied to the hourly L_{eq} for noises occurring from 7:00 p.m. to 10:00 p.m. (defined as relaxation hours) and a 10 dBA weighting factor applied to noises occurring from 10:00 p.m. to 7:00 a.m. (defined as sleeping hours). L_{dn} is similar to the CNEL scale but without the adjustment for events occurring during relaxation hours. CNEL and L_{dn} are within 1 dBA of each other and are normally interchangeable. The City uses the CNEL noise scale for long-term traffic noise impact assessment.

Other noise rating scales of importance when assessing the annoyance factor include the maximum instantaneous noise level (L_{max}), which is the highest sound level that occurs during a stated time period. The noise environments discussed in this analysis for short-term noise impacts are specified in terms of maximum levels denoted by L_{max}, which reflects peak operating conditions and addresses the annoying aspects of intermittent noise. It is often used together with another noise scale, or noise standards in terms of percentile noise levels, in noise ordinances for enforcement purposes. For example, the L_{10} noise level represents the noise level exceeded 10 percent of the time during a stated period. The L_{50} noise level represents the median noise level. Half the time the noise level exceeds this level, and half the time it is less than this level. The L_{90} noise level represents the noise level exceeded 90 percent of the time and is considered the background noise level during a monitoring period. For a relatively constant noise source, the L_{eq} and L_{50} are approximately the same.

Noise impacts can be described in three categories. The first category includes audible impacts, which are increases in noise levels noticeable to humans. Audible increases in noise levels generally refer to a change of 3 dB or greater because this level has been found to be barely perceptible in exterior environments. The second category, potentially audible, refers to a change in the noise level between 1 dB and 3 dB. This range of noise levels has been found to be noticeable only in laboratory environments. The last category includes changes in noise levels of less than 1 dB, which are inaudible to the human ear. Only audible changes in existing ambient or background noise levels are considered potentially significant.

Physiological Effects of Noise

Physical damage to human hearing begins at prolonged exposure to sound levels higher than 85 dBA. Exposure to high sound levels affects the entire system, with prolonged sound exposure in excess of 75 dBA increasing body tensions, thereby affecting blood pressure and functions of the heart and the nervous system. In comparison, extended periods of sound exposure above 90 dBA would result in permanent cell damage. When the sound level reaches 120 dBA, a tickling sensation occurs in the human ear, even with short-term exposure. This level of sound is called the threshold of feeling. As the sound reaches 140 dBA, the tickling sensation is replaced by a feeling of pain in the ear (i.e., the threshold of pain). A sound level of 160–165 dBA will result in dizziness or a loss of equilibrium. The ambient or background noise problem is widespread and generally more concentrated in urban areas than in outlying, less developed areas.

Table A lists definitions of acoustical terms, and Table B shows common sound levels and their sources.

Table A: Definitions of Acoustical Terms

Term	Definitions
Decibel, dB	A unit of sound measurement that denotes the ratio between two quantities that are proportional to power; the number of decibels is 10 times the logarithm (to the base 10) of this ratio.
Frequency, Hz	Of a function periodic in time, the number of times that the quantity repeats itself in 1 second (i.e., the number of cycles per second).
A-Weighted Sound Level, dBA	The sound level obtained by use of A-weighting. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. (All sound levels in this report are A-weighted unless reported otherwise.)
L_{01}, L_{10}, L_{50}, L_{90}	The fast A-weighted noise levels that are equaled or exceeded by a fluctuating sound level 1%, 10%, 50%, and 90% of a stated time period, respectively.
Equivalent Continuous Noise Level, L_{eq}	The level of a steady sound that, in a stated time period and at a stated location, has the same A-weighted sound energy as the time-varying sound.
Community Noise Equivalent Level, CNEL	The 24-hour A-weighted average sound level from midnight to midnight, obtained after the addition of 5 dBA to sound levels occurring in the evening from 7:00 p.m. to 10:00 p.m. and after the addition of 10 dBA to sound levels occurring in the night between 10:00 p.m. and 7:00 a.m.
Day/Night Noise Level, L_{dn}	The 24-hour A-weighted average sound level from midnight to midnight, obtained after the addition of 10 dBA to sound levels occurring in the night between 10:00 p.m. and 7:00 a.m.
L_{max}, L_{min}	The maximum and minimum A-weighted sound levels measured on a sound level meter, during a designated time interval, using fast time averaging.
Ambient Noise Level	The all-encompassing noise associated with a given environment at a specified time. Usually a composite of sound from many sources from many directions, near and far; no particular sound is dominant.
Intrusive	The noise that intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, time of occurrence, and tonal or informational content, as well as the prevailing ambient noise level.

Source: *Handbook of Acoustical Measurements and Noise Control* (Harris 1991).

Table B: Common Sound Levels and Their Noise Sources

Noise Source	A-Weighted Sound Level in Decibels	Noise Environments	Subjective Evaluations
Near Jet Engine	140	Deafening	128 times as loud
Civil Defense Siren	130	Threshold of Pain	64 times as loud
Hard Rock Band	120	Threshold of Feeling	32 times as loud
Accelerating Motorcycle at a Few Feet Away	110	Very Loud	16 times as loud
Pile Driver; Noisy Urban Street/Heavy City Traffic	100	Very Loud	8 times as loud
Ambulance Siren; Food Blender	95	Very Loud	—
Garbage Disposal	90	Very Loud	4 times as loud
Freight Cars; Living Room Music	85	Loud	—
Pneumatic Drill; Vacuum Cleaner	80	Loud	2 times as loud
Busy Restaurant	75	Moderately Loud	—
Near Freeway Auto Traffic	70	Moderately Loud	Reference level
Average Office	60	Quiet	One-half as loud
Suburban Street	55	Quiet	—
Light Traffic; Soft Radio Music in Apartment	50	Quiet	One-quarter as loud
Large Transformer	45	Quiet	—
Average Residence without Stereo Playing	40	Faint	One-eighth as loud
Soft Whisper	30	Faint	—
Rustling Leaves	20	Very Faint	—
Human Breathing	10	Very Faint	Threshold of Hearing
—	0	Very Faint	—

Source: Compiled by LSA (2022).

FUNDAMENTALS OF VIBRATION

Vibration refers to ground-borne noise and perceptible motion. Ground-borne vibration is almost exclusively a concern inside buildings and is rarely perceived as a problem outdoors, where the motion may be discernible, but without the effects associated with the shaking of a building there is less adverse reaction. Vibration energy propagates from a source through intervening soil and rock layers to the foundations of nearby buildings. The vibration then propagates from the foundation throughout the remainder of the structure. Building vibration may be perceived by occupants as the motion of building surfaces, the rattling of items sitting on shelves or hanging on walls, or a low-frequency rumbling noise. The rumbling noise is caused by the vibration of walls, floors, and ceilings that radiate sound waves. Annoyance from vibration often occurs when the vibration exceeds the threshold of perception by 10 dB or less. This is an order of magnitude below the damage threshold for normal buildings.

Typical sources of ground-borne vibration are construction activities (e.g., blasting, pile-driving, and operating heavy-duty earthmoving equipment), steel-wheeled trains, and occasional traffic on rough roads. Problems with both ground-borne vibration and noise from these sources are usually localized to areas within approximately 100 feet (ft) from the vibration source, although there are examples of ground-borne vibration causing interference out to distances greater than 200 ft . When roadways are smooth, vibration from traffic, even heavy trucks, is rarely perceptible. It is assumed for most projects that the roadway surface will be smooth enough that ground-borne vibration from street traffic will not exceed the impact criteria; however, construction of the project could result in ground-borne vibration that may be perceptible and annoying.

Ground-borne noise is not likely to be a problem because noise arriving via the normal airborne path will usually be greater than ground-borne noise.

Ground-borne vibration has the potential to disturb people and damage buildings. Although it is very rare for train-induced ground-borne vibration to cause even cosmetic building damage, it is not uncommon for construction processes such as blasting and pile-driving to cause vibration of sufficient amplitudes to damage nearby buildings. Ground-borne vibration is usually measured in terms of vibration velocity, either the root-mean-square (RMS) velocity or peak particle velocity (PPV). The RMS is best for characterizing human response to building vibration, and PPV is used to characterize the potential for damage. Decibel notation acts to compress the range of numbers required to describe vibration. Vibration velocity level in decibels is defined as:

$$L_v = 20 \log_{10} [V/V_{ref}]$$

where "L_v" is the vibration velocity in decibels (VdB), "V" is the RMS velocity amplitude, and "V_{ref}" is the reference velocity amplitude, or 1×10^{-6} inches/second (in/sec) used in the United States.

REGULATORY SETTING

APPLICABLE NOISE STANDARDS

The applicable noise standards governing the project site include the criteria in the California Code of Regulations, the Noise Element of the City's General Plan (Noise Element), and the City of Moreno Valley Municipal Code.

California Code of Regulations

Interior noise levels for residential habitable rooms are regulated by Title 24 of the California Code of Regulations California Noise Insulation Standards. Title 24, Chapter 12, Section 1206.4, of the 2019 California Building Code requires that interior noise levels attributable to exterior sources not exceed 45 CNEL in any habitable room. A habitable room is a room used for living, sleeping, eating, or cooking. Bathrooms, closets, hallways, utility spaces, and similar areas are not considered habitable rooms for this regulation (Title 24 California Code of Regulations, Chapter 12, Section 1206.4).

City of Moreno Valley

Noise Element of the General Plan

The goals, objectives, and policies in the City's General Plan Noise Element are designed to provide noise-compatible land use relationships by establishing noise standards utilized for design and siting purposes and minimize noise impacts from significant noise generators. The following goals and policies are applicable to the proposed project:

- **Goal N-1: Design for a pleasant, healthy sound environment conducive to living and working.**
  - **Policy N.1-1:** Protect occupants of existing and new buildings from exposure to excessive noise, particularly adjacent to freeways, major roadways, the railroad, and within areas of aircraft overflight.
  - **Policy N.1-3:** Apply the community noise compatibility standards (Table N-1 within the Noise Element) to all new development and major redevelopment projects outside the noise and safety compatibility zones established in the March Air Reserve Base/Inland Port Airport Land Use Compatibility (ALUC) Plan in order to protect against the adverse effects of noise exposure. Projects within the noise and safety compatibility zones are subject to the standards contained in the ALUC Plan.
  - **Policy N.1-4:** Require a noise study and/or mitigation measures if applicable for all projects that would expose people to noise levels greater than the "normally acceptable" standard and for any other projects that are likely to generate noise in excess of these standards.
  - **Policy N.1-5:** Noise impacts should be controlled at the noise source where feasible, as opposed to at receptor end with measures to buffer, dampen, or actively cancel noise sources. Site design, building orientation, building design, hours of operation, and other

techniques, for new developments deemed to be noise generators shall be used to control noise sources.

- **Policy N.1-6:** Require noise buffering, dampening, or active cancellation, on rooftop or other outdoor mechanical equipment located near residences, parks, and other noise sensitive land uses.

- **Policy N.1-7:** Developers shall reduce the noise impacts on new development through appropriate means (e.g., double-paned or soundproof windows, setbacks, berming, and screening). Noise attenuation methods should avoid the use of visible sound walls where possible.

- **Goal N-2: Ensure that noise does not have a substantial, adverse effect on the quality of life in the community.**

  - **Policy N.2-1:** Use the development review process to proactively identify and address potential noise compatibility issues.

  - **Policy N.2-1:** Limit the potential noise impacts of construction activities on surrounding land uses through noise regulations in the Municipal Code that address allowed days and hours of construction, types of work, construction equipment, and sound attenuation devices.

City of Moreno Valley Municipal Code

Section 8.14.040(E) states that grading and equipment operations shall only be completed between the hours of 7:00 a.m. to 7:00 p.m. Monday through Friday, excluding holidays and from 8:00 a.m. to 4:00 p.m. on Saturday.

Section 11.80.030(C) of the City's Municipal Code establishes limits on non-impulsive noise where no person shall maintain, create, operate, or cause noise on private property to not exceed the noise standards shown in Table C. The standards are applicable for each source land use category when measured at a distance of 200 ft from the property line of the source of the noise, if the noise occurs on privately owned property. If the sound occurs on public right-of-way, public space, or other publicly owned property the measurement shall occur from the source of the sound. Noise levels that exceed the noise standards in Table C shall be deemed to be a noise disturbance.

Table C: Maximum Sound Levels for Source Land Uses

Residential		Commercial	
Daytime[1]	Nighttime[2]	Daytime[1]	Nighttime[2]
60 dBA	55 dBA	65 dBA	60 dBA

Source: Section 11.80.030(C) of the City of Moreno Valley *Municipal Code.*
[1] Daytime means 8:00 a.m. to 10:00 p.m.
[2] Nighttime means 10:01 p.m. to 7:59 a.m.
dBA = A-weighted decibels
L_{eq} = equivalent continuous sound level

Section 11.80.030(D)(7) of the City's Municipal Code limits construction and demolition activities to between the hours of 7:00 a.m. and 8:00 p.m. every day. No person shall operate or allow the operation of any tools or equipment used in construction, drilling, repair, or alteration or demolition work outside of these hours to prevent noise disturbances.

Section 9.10.170 of the Municipal Code prohibits vibration that can be felt at or beyond the property line. However, construction activity is exempt from Section 9.10.170 pursuant to Section 9.10.030, which states that temporary construction, maintenance, or demolition activities between the hours of 7:00 a.m. and 7:00 p.m. are exempt from the provisions of Chapter 9.10 (Performance Standards) of the City Municipal Code.

Federal Transit Administration

Although the City does not have daytime construction noise level limits for activities that occur within the specified hours in Section 11.80.030(D)(7) to determine potential California Environmental Quality Act (CEQA) noise impacts, construction noise was assessed using criteria from the *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018) (FTA Manual). Table D shows the Federal Transit Administration's (FTA) Detailed Assessment Construction Noise Criteria based on the composite noise levels per construction phase.

Table D: Detailed Assessment Daytime Construction Noise Criteria

Land Use	Daytime 8-hour L_{eq} (dBA)
Residential	80
Commercial	85
Industrial	90

Source: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).
dBA = A-weighted decibels
L_{eq} = equivalent continuous sound level

APPLICABLE VIBRATION STANDARDS

Federal Transit Administration

Vibration standards included in the FTA Manual are used in this analysis for ground-borne vibration impacts on human annoyance. The criteria for environmental impact from ground-borne vibration and noise are based on the maximum levels for a single event. Table E provides the criteria for assessing the potential for interference or annoyance from vibration levels in a building.

Table F lists the potential vibration building damage criteria associated with construction activities, as suggested in the FTA Manual. FTA guidelines show that a vibration level of up to 0.5 in/sec in PPV is considered safe for buildings consisting of reinforced concrete, steel, or timber (no plaster) and would not result in any construction vibration damage. For non-engineered timber and masonry buildings, the construction building vibration damage criterion is 0.2 in/sec in PPV.

Table E: Interpretation of Vibration Criteria for Detailed Analysis

Land Use	Max L_v (VdB)[1]	Description of Use
Workshop	90	Vibration that is distinctly felt. Appropriate for workshops and similar areas not as sensitive to vibration.
Office	84	Vibration that can be felt. Appropriate for offices and similar areas not as sensitive to vibration.
Residential Day	78	Vibration that is barely felt. Adequate for computer equipment and low-power optical microscopes (up to 20×).
Residential Night and Operating Rooms	72	Vibration is not felt, but ground-borne noise may be audible inside quiet rooms. Suitable for medium-power microscopes (100×) and other equipment of low sensitivity.

Source: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).
[1] As measured in 1/3-octave bands of frequency over a frequency range of 8 to 80 Hertz.
FTA = Federal Transit Administration
Max = maximum
L_V = velocity in decibels
VdB = vibration velocity decibels

Table F: Construction Vibration Damage Criteria

Building Category	PPV (in/sec)
Reinforced concrete, steel, or timber (no plaster)	0.50
Engineered concrete and masonry (no plaster)	0.30
Non-engineered timber and masonry buildings	0.20
Buildings extremely susceptible to vibration damage	0.12

Source: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).
FTA = Federal Transit Administration
PPV = peak particle velocity
in/sec = inch/inches per second

OVERVIEW OF THE EXISTING NOISE ENVIRONMENT

The primary existing noise sources in the project area are transportation facilities. Traffic on Cottonwood Avenue is a steady source of ambient noise.

AMBIENT NOISE MEASUREMENTS

Long-Term Noise Measurements

Long-term (24-hour) noise level measurements were conducted on April 6 and 7, 2022, using two Larson Davis Spark 706RC Dosimeters. Table G provides a summary of the measured hourly noise levels from the long-term noise level measurements. Hourly noise levels at surrounding sensitive uses are as low as 44.8 dBA L_{eq} during nighttime hours and 51.9 dBA L_{eq} during daytime hours. Long-term noise monitoring data results are provided in Appendix A. Figure 3 shows the long-term monitoring locations.

Table G: Long-Term Ambient Noise Level Measurements

Location		Daytime Noise Levels[1] (dBA L_{eq})	Nighttime Noise Levels[2] (dBA L_{eq})
LT-1	Near the northwest corner of the project site, southeast corner of Cottonwood Avenue and Quincy Street, on third palm tree south of Cottonwood Avenue. Approximately 125 ft south of Cottonwood Avenue centerline and 130 ft east of Quincy Street.	57.1–74.3	50.7–70.9
LT-2	Near the southeast corner of the project site. Across the street from 28611 Bay Avenue, on a power pole. Approximately 20 ft north of Bay Avenue centerline.	51.9–58.5	44.8–56.0

Source: Compiled by LSA (2022).
Note: Noise measurements were conducted from April 6 to April 7, 2022, starting at 12:00 p.m.
[1] Daytime Noise Levels = Noise levels during the hours from 8:00 a.m. to 10:00 p.m.
[2] Nighttime Noise Levels = Noise levels during the hours from 10:01 p.m. to 7:59 a.m.
dBA = A-weighted decibels
L_{eq} = equivalent continuous sound level

EXISTING AIRCRAFT NOISE

Airport-related noise levels are primarily associated with aircraft engine noise made while aircraft are taking off, landing, or running their engines while still on the ground. The closest airport to the proposed project site is March Air Reserve Base (RIV) located approximately 5.6 miles (mi) southwest of the project site. Based on the Riverside County Airport Land Use Compatibility Plan (County of Riverside 2014) the project is located outside of the 60 dBA CNEL noise contour of the airport. In addition, the heliport at the Riverside University Health System Medical Center is located approximately 1.9 mi southwest of the project site. Based on previous analyses completed by LSA, assuming a conservative scenario in which three helipad activities occur in the same day, including one during evening hours and one during nighttime hours, the 60 dBA CNEL noise contour is approximately 600 ft from the center of the helipad. At a distance of approximately 1,850 ft from the existing helipad, the proposed project is located well outside of the 60 dBA CNEL noise contour.

LSA

LEGEND

- Project Site Boundary
LT-1 - Long-term Noise Monitoring Location

N

0 250 500
FEET

SOURCE: Google Earth, 2021

FIGURE 3

Cottonwood Collection Residential

Noise Monitor Locations

I:\ESL2201.08\G\Noise_Monitor_Locs.ai (6/1/2022)

PROJECT IMPACT ANALYSIS

SHORT-TERM CONSTRUCTION NOISE IMPACTS

Two types of short-term noise impacts could occur during the construction of the proposed project. First, construction crew commutes and the transport of construction equipment and materials to the site for the proposed project would incrementally increase noise levels on access roads leading to the site. Although there would be a relatively high single-event noise-exposure potential causing intermittent noise nuisance (passing trucks at 50 ft would generate up to 84 dBA L_{max}), the effect on longer-term ambient noise levels would be small when compared to existing daily traffic volumes on Cottonwood Avenue. Because construction-related vehicle trips would not approach existing daily traffic volumes, traffic noise would not increase by 3 dBA CNEL. A noise level increase of less than 3 dBA would not be perceptible to the human ear in an outdoor environment. Therefore, short-term, construction-related impacts associated with worker commute and equipment transport to the project site would be less than significant.

The second type of short-term noise impact is related to noise generated during construction, which includes site preparation, grading, building construction, paving, and architectural coating on the project site. Construction is completed in discrete steps, each of which has its own mix of equipment and, consequently, its own noise characteristics. These various sequential phases would change the character of the noise generated on the site and, therefore, the noise levels surrounding the site as construction progresses. Despite the variety in the type and size of construction equipment, similarities in the dominant noise sources and patterns of operation allow construction-related noise ranges to be categorized by work phase. Table H lists typical construction equipment noise levels recommended for noise impact assessments, based on a distance of 50 ft between the equipment and a noise receptor, taken from the Federal Highway Administration (FHWA) *Roadway Construction Noise Model* (FHWA 2006).

In addition to the reference maximum noise level, the usage factor provided in Table H is used to calculate the hourly noise level impact for each piece of equipment based on the following equation:

$$L_{eq}(equip) = E.L. + 10\log(U.F.) - 20\log\left(\frac{D}{50}\right)$$

where: *L_{eq} (equip)* = L_{eq} at a receiver resulting from the operation of a single piece of equipment over a specified time period.

E.L. = noise emission level of the particular piece of equipment at a reference distance of 50 ft.

U.F. = usage factor that accounts for the fraction of time that the equipment is in use over the specified period of time.

D = distance from the receiver to the piece of equipment.

Table H: Typical Construction Equipment Noise Levels

Equipment Description	Acoustical Usage Factor (%)[1]	Maximum Noise Level (L_{max}) at 50 Feet[2]
Auger Drill Rig	20	84
Backhoes	40	80
Compactor (ground)	20	80
Compressor	40	80
Cranes	16	85
Dozers	40	85
Dump Trucks	40	84
Excavators	40	85
Flat Bed Trucks	40	84
Forklift	20	85
Front-end Loaders	40	80
Graders	40	85
Impact Pile Drivers	20	95
Jackhammers	20	85
Paver	50	77
Pickup Truck	40	55
Pneumatic Tools	50	85
Pumps	50	77
Rock Drills	20	85
Rollers	20	85
Scrapers	40	85
Tractors	40	84
Trencher	50	80
Welder	40	73

Source: *FHWA Roadway Construction Noise Model User's Guide,* Table 1 (FHWA 2006).
Note: Noise levels reported in this table are rounded to the nearest whole number.
1 Usage factor is the percentage of time during a construction noise operation that a piece of construction equipment is operating at full power.
2 Maximum noise levels were developed based on Specification 721.560 from the Central Artery/ Tunnel program to be consistent with the City of Boston's Noise Code for the "Big Dig" project.
FHWA = Federal Highway Administration
L_{max} = maximum instantaneous sound level

Each piece of construction equipment operates as an individual point source. Using the following equation, a composite noise level can be calculated when multiple sources of noise operate simultaneously:

$$Leq\ (composite) = 10 * \log_{10}\left(\sum_{1}^{n} 10^{\frac{Ln}{10}}\right)$$

Using the equations from the methodology above, the reference information in Table H, and the construction equipment list provided, the composite noise level of each construction phase was calculated. The project construction composite noise levels at a distance of 50 feet would range from 74 dBA L_{eq} to 88 dBA L_{eq}, with the highest noise levels occurring during the site preparation and grading phases.

Once composite noise levels are calculated, reference noise levels can then be adjusted for distance using the following equation:

$$Leq\ (at\ distance\ X) = Leq\ (at\ 50\ feet) - 20 * \log_{10}\left(\frac{X}{50}\right)$$

In general, this equation shows that doubling the distance would decrease noise levels by 6 dBA, while halving the distance would increase noise levels by 6 dBA.

Table I shows the nearest sensitive uses to the project site, their distance from the center of construction activities, and composite noise levels expected during construction. These noise level projections do not consider intervening topography or barriers. Construction equipment calculations are provided in Appendix B.

Table I: Potential Construction Noise Impacts at Nearest Receptor

Receptor (Location)	Composite Noise Level (dBA L_{eq}) at 50 feet[1]	Distance (feet)	Composite Noise Level (dBA L_{eq})
Residences (East)	88	320	72
Residences (West)		510	68
Residences (North)		725	65
Residences (South)		725	65

Source: Compiled by LSA (2022).

[1] The composite construction noise level represents the grading/site preparation phases, which are expected to result in the greatest noise level as compared to other phases.

dBA = A-weighted decibels L_{eq} = equivalent continuous sound level

While construction noise will vary, it is expected that composite noise levels during construction at the nearest off-site sensitive residential use to the east would reach an average noise level of 72 dBA L_{eq} during daytime hours. The existing average noise levels during the allowable construction hours range are approximately 66 dBA L_{eq} at the residences closest to Cottonwood Avenue and approximately 55 dBA L_{eq} at the residences closest to Bay Avenue. These predicted noise levels would only occur when all construction equipment is operating simultaneously and, therefore, are assumed to be rather conservative in nature. While construction-related short-term noise levels have the potential to be higher than existing ambient noise levels in the project area under existing conditions, the noise impacts would no longer occur once project construction is completed.

As stated above, construction activities are regulated by the City's Noise Ordinance. The proposed project would comply with the construction hours specified in the City's Noise Ordinance, which states that construction activities are allowed between the hours of 7:00 a.m. to 7:00 p.m., Monday through Friday, excluding holidays, and from 8:00 a.m. to 4:00 p.m. on Saturday.

As it relates to off-site uses, construction-related noise levels would remain below the daytime 90 dBA L_{eq} 1-hour construction noise level criteria established by the FTA for residential and similar sensitive uses and, therefore, would be considered less than significant. Best construction practices presented at the end of this analysis shall be implemented to minimize noise impacts to surrounding receptors.

SHORT-TERM CONSTRUCTION VIBRATION IMPACTS

This construction vibration impact analysis discusses the level of human annoyance using vibration levels in VdB and assesses the potential for building damages using vibration levels in PPV (in/sec). This is because vibration levels calculated in RMS are best for characterizing human response to building vibration, while calculating vibration levels in PPV is best for characterizing the potential for damage.

Table J shows the PPV and VdB values at 25 ft from the construction vibration source. As shown in Table J, bulldozers and other heavy-tracked construction equipment (expected to be used for this project) generate approximately 0.089 PPV in/sec or 87 VdB of ground-borne vibration when measured at 25 ft, based on the FTA Manual. The distance to the nearest buildings for vibration impact analysis is measured between the nearest off-site buildings and the project construction boundary (assuming the construction equipment would be used at or near the project setback line).

Table J: Vibration Source Amplitudes for Construction Equipment

Equipment	Reference PPV/L_V at 25 ft	
	PPV (in/sec)	L_V (VdB)[1]
Pile Driver (Impact), Typical	0.644	104
Pile Driver (Sonic), Typical	0.170	93
Vibratory Roller	0.210	94
Hoe Ram	0.089	87
Large Bulldozer[2]	**0.089**	**87**
Caisson Drilling	0.089	87
Loaded Trucks[2]	**0.076**	**86**
Jackhammer	0.035	79
Small Bulldozer	0.003	58

Source: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).
[1] RMS vibration velocity in decibels (VdB) is 1 µin/sec.
[2] Equipment shown in **bold** is expected to be used on site.
µin/sec = microinches per second
ft = foot/feet
FTA = Federal Transit Administration
in/sec = inch/inches per second
L_V = velocity in decibels
PPV = peak particle velocity
RMS = root-mean-square
VdB = vibration velocity decibels

The formulae for vibration transmission are provided below, and Tables K and L provide a summary of off-site construction vibration levels.

$$L_v dB (D) = L_v dB (25 ft) – 30 Log (D/25)$$

$$PPV_{equip} = PPV_{ref} \times (25/D)^{1.5}$$

As shown in Table E, above, the threshold at which vibration levels would result in annoyance would be 78 VdB for daytime residential uses. As shown in Table F, the FTA guidelines indicate that for a non-engineered timber and masonry building, the construction vibration damage criterion is 0.2 in/sec in PPV.

Table K: Potential Construction Vibration Annoyance Impacts at Nearest Receptor

Receptor (Location)	Reference Vibration Level (VdB) at 25 ft[1]	Distance (ft)[2]	Vibration Level (VdB)
Residences (East)		320	54
Residences (West)	87	510	48
Residences (North)		725	43
Residences (South)		725	43

Source: Compiled by LSA (2022).
[1] The reference vibration level is associated with a large bulldozer, which is expected to be representative of the heavy equipment used during construction.
[2] The reference distance is associated with the average condition, identified by the distance from the center of construction activities to surrounding uses.
ft = foot/feet
VdB = vibration velocity decibels

Table L: Potential Construction Vibration Damage Impacts at Nearest Receptor

Receptor (Location)	Reference Vibration Level (PPV) at 25 ft[1]	Distance (ft)[2]	Vibration Level (PPV)
Residences (East)		22	0.108
Residences (West)	0.089	190	0.004
Residences (North)		80	0.016
Residences (South)		110	0.010

Source: Compiled by LSA (2022).
[1] The reference vibration level is associated with a large bulldozer, which is expected to be representative of the heavy equipment used during construction.
[2] The reference distance is associated with the peak condition, identified by the distance from the perimeter of construction activities to surrounding structures.
ft = foot/feet
PPV = peak particle velocity

Based on the information provided in Table K, vibration levels are expected to approach 54 VdB at the closest residential uses located immediately east of the project site, which is below the 78 VdB threshold for annoyance. Based on the information provided in Table L, vibration levels are expected to approach 0.108 PPV in/sec at the nearest surrounding structures and would be below the 0.2 PPV in/sec damage threshold.

Because construction activities are regulated by the City's Municipal Code, which states that temporary construction, maintenance, or demolition activities are allowed between the hours of 7:00 a.m. and 7:00 p.m., Monday through Friday, excluding holidays, and from 8:00 a.m. to 4:00 p.m. on Saturday, vibration impacts would not occur during the more sensitive nighttime hours.

LONG-TERM OFF-SITE TRAFFIC NOISE IMPACTS

In order to assess the potential traffic impacts related to the proposed project, a *Vehicle Miles Traveled (VMT) Screening Analysis* (EPD Solutions, Inc. 2022) has been prepared. Based on the analysis results, it was determined that a net additional 566 average daily trips (ADT) would be generated by the proposed project. The existing (2017) traffic volume on the adjacent segment of Cottonwood Avenue is 3,300 (City of Moreno Valley Public Works 2021). The following equation was used to determine the potential impacts of the project:

Change in CNEL = $10\ log_{10}\left[V_{e+p}/V_{existing}\right]$

where: $V_{existing}$ = existing daily volumes
V_{e+p} = existing daily volumes plus project
Change in CNEL = increase in noise level due to the project

The results of the calculations show that an increase of approximately 0.7 dBA CNEL is expected along the streets adjacent to the project site. A noise level increase of less than 1 dBA would not be perceptible to the human ear; therefore, the traffic noise increase in the vicinity of the project site resulting from the proposed project would be less than significant. No mitigation is required.

LONG-TERM TRAFFIC-RELATED VIBRATION IMPACTS

The proposed project would not generate vibration levels related to on-site operations. In addition, vibration levels generated from project-related traffic on the adjacent roadways are unusual for on-road vehicles because the rubber tires and suspension systems of on-road vehicles provide vibration isolation. Vibration levels generated from project-related traffic on the adjacent roadways would be less than significant, and no mitigation measures are required.

BEST CONSTRUCTION PRACTICES

In addition to compliance with the City's Municipal Code allowed hours of construction of 7:00 a.m. to 7:00 p.m., Monday through Friday, excluding holidays, and from 8:00 a.m. to 4:00 p.m. on Saturday, the following recommendations would reduce construction noise to the extent feasible:

- The project construction contractor should equip all construction equipment, fixed or mobile, with properly operating and maintained noise mufflers, consistent with manufacturer's standards.

- The project construction contractor should locate staging areas away from off-site sensitive uses during the later phases of project development.

- The project construction contractor should place all stationary construction equipment so that emitted noise is directed away from sensitive receptors nearest the project site whenever feasible.

LAND USE COMPATIBILITY

The dominant source of noise in the project vicinity is traffic noise from roadways in the vicinity of the project.

EXTERIOR NOISE ASSESSMENT

To assess exterior noise levels at the proposed residential uses, the future noise levels were modeled based on the buildout traffic volume of 30,000 ADT, consistent with the desired capacity volume for a minor arterial as described in the City's General Plan Circulation Element. Due to the project design, as shown on the Site Plan in Figure 2, the nearest single-family homes with private rear yards would be units 1–6 and 45, located approximately 55 ft from the Cottonwood Avenue centerline. The exterior noise levels at the closest residences to Cottonwood Avenue in the private rear-yard areas were modeled to be 72.9 dBA CNEL.

As specified above, Policy N.1-4 of the General Plan Noise Element requires mitigation measures for all projects that would expose people to noise levels greater than "normally acceptable." Table N-1 of the City's General Plan Noise Element shows that below 65 dBA CNEL for residential uses is "normally acceptable." To reduce the noise levels below or at the normally acceptable noise level of 65 dBA CNEL at the private rear yards, a minimum 7 ft noise barrier would be required at the project's boundary along Cottonwood Avenue to shielding lots 1–6 and 45. The results of the on-site exterior noise model runs are shown in Appendix C.

INTERIOR NOISE ASSESSMENT

As discussed above, per the California Code of Regulations, an interior noise level standard of 45 dBA CNEL or less is required for all noise-sensitive rooms. Based on the expected future exterior noise levels at the second-floor façades of the lots closest to Cottonwood Avenue (lots 1–6 and 45) approaching 73 dBA CNEL, a minimum noise reduction of 28 dBA would be required.

A sample interior noise calculation was completed for a typical bedroom, as shown in Appendix D, that assumes standard building construction and upgraded window assemblies. Based on reference information from transmission loss test reports for various Milgard windows (Milgard 2008), the necessary reduction can be achieved with standard building construction and upgraded windows with Sound Transmission Class (STC) ratings of 30–35, depending on the window-to-glass ratio, at lots 1–6 and 45 for the second floor, which would not be shielded by a noise barrier. For the first floor at lots 1–6 and 45 and all other lots, with standard building construction along with standard windows (typically in the STC 25–28 range), interior noise levels of 45 dBA CNEL or less would be achieved.

Once final plans are available to detail the exterior wall construction and a window manufacturer has been chosen, a Final Acoustical Report (FAR) would be required to confirm the reduction capability of the exterior façades and to identify any specific upgrades necessary to achieve an interior noise level of 45 dBA CNEL or below.

REFERENCES

City of Moreno Valley. 2021a. *General Plan Noise Element*. June 15.

———. 2022. *Municipal Code*. Website: https://library.qcode.us/lib/moreno_valley_ca/pub/municipal_code (accessed June 2022).

City of Moreno Valley Public Works. 2021b. *Traffic Counts*. Website: https://moval.gov/departments/public-works/transportation/pdfs/traffic-counts.pdf (accessed June 2022).

County of Riverside. 2014. Riverside County Airport Land Use Compatibility Plan. November.

EPD Solutions, Inc. 2022. *SEC of Cottonwood Avenue and Quincy Street – Vehicle Miles Traveled (VMT) Screening Analysis*. May 20.

Federal Highway Administration (FHWA). 2006. *Roadway Construction Noise Model User's Guide.* January. Washington, D.C. Website: www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/rcnm.pdf (accessed March 2022).

Federal Transit Administration (FTA). 2018. *Transit Noise and Vibration Impact Assessment Manual*. Office of Planning and Environment. Report No. 0123. September.

Harris, Cyril M., editor. 1991. *Handbook of Acoustical Measurements and Noise Control*. Third Edition.

Milgard. 2008. Various Transmission Loss Reports.

State of California. 2020. *2019 California Green Building Standards Code.*

United States Environmental Protection Agency. 1978. *Protective Noise Levels, Condensed Version of EPA Levels Document*, EPA 550/9-79-100. November.

APPENDIX A

NOISE MONITORING DATA

Noise Measurement Survey – 24 HR

Project Number: ESL2208

Project Name: Cottonwood

Test Personnel: Kevin Nguyendo

Equipment: Spark 706RC (SN:18907)

Site Number: LT-1 Date: 4/6/22

Time: From 12:00 p.m. To 12:00 p.m.

Site Location: Near northwest corner of project site. Near the southeast corner of Cottonwood Avenue and Quincy Street, on 3rd palm tree south of Cottonwood Avenue

Primary Noise Sources: Traffic on Cottonwood Avenue

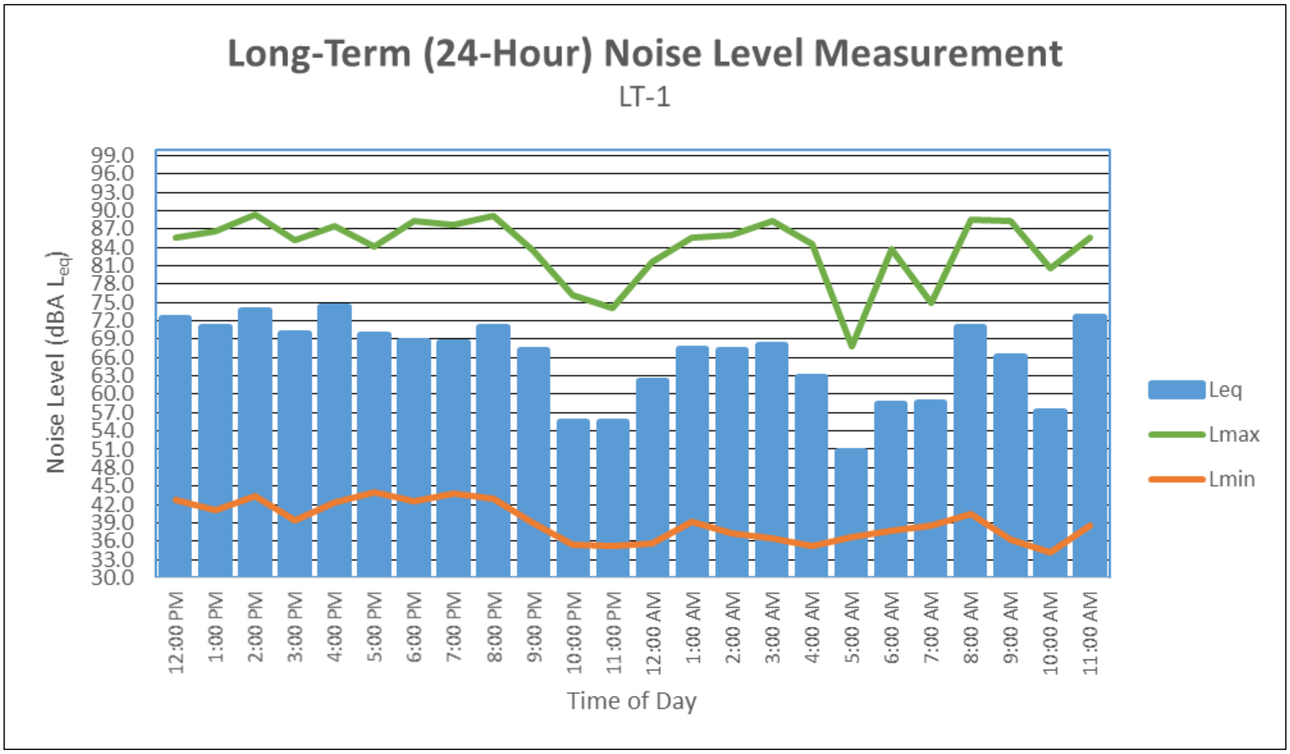
Comments: Higher winds averaging 5 mph with gusts up to 15 mph

Photo:

Long-Term (24-Hour) Noise Level Measurement Results at LT-1

Start Time	Date	Noise Level (dBA)		
		L_{eq}	L_{max}	L_{min}
12:00 PM	4/6/22	72.5	85.7	42.8
1:00 PM	4/6/22	71.0	86.6	41.1
2:00 PM	4/6/22	73.6	89.3	43.4
3:00 PM	4/6/22	70.0	85.1	39.3
4:00 PM	4/6/22	74.3	87.4	42.4
5:00 PM	4/6/22	69.7	84.2	44.0
6:00 PM	4/6/22	68.6	88.4	42.6
7:00 PM	4/6/22	68.5	87.7	43.8
8:00 PM	4/6/22	70.9	89.2	42.9
9:00 PM	4/6/22	67.1	83.6	38.9
10:00 PM	4/6/22	55.4	76.2	35.5
11:00 PM	4/6/22	55.6	74.2	35.3
12:00 AM	4/7/22	62.2	81.6	35.6
1:00 AM	4/7/22	67.5	85.6	39.2
2:00 AM	4/7/22	67.2	86.0	37.4
3:00 AM	4/7/22	68.1	88.4	36.5
4:00 AM	4/7/22	62.9	84.5	35.3
5:00 AM	4/7/22	50.7	67.8	36.6
6:00 AM	4/7/22	58.5	83.7	37.7
7:00 AM	4/7/22	58.6	74.9	38.5
8:00 AM	4/7/22	71.0	88.5	40.5
9:00 AM	4/7/22	66.2	88.3	36.2
10:00 AM	4/7/22	57.1	80.5	34.1
11:00 AM	4/7/22	72.6	85.7	38.5

Source: Compiled by LSA Associates, Inc. (2022).
dBA = A-weighted decibel
L_{eq} = equivalent continuous sound level
L_{max} = maximum instantaneous noise level
L_{min} = minimum measured sound level


Long-Term (24-Hour) Noise Level Measurement
LT-1
Noise Level (dBA Leq)
99.0
96.0
93.0
90.0
87.0
84.0
81.0
78.0
75.0
72.0
69.0
66.0
63.0
60.0
57.0
54.0
51.0
48.0
45.0
42.0
39.0
36.0
33.0
30.0
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
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
Time of Day
Leq
Lmax
Lmin

Project Number: ESL2208

Project Name: Cottonwood

Test Personnel: Corey Knips

Equipment: Spark 706RC (SN:18908)

Site Number: LT-2 Date: 4/6/22

Time: From 12:00 p.m. To 12:00 p.m.

Site Location: Near southeast corner of project site, across the street from 28611 Bay Avenue

Primary Noise Sources: (Quiet) some dogs barking

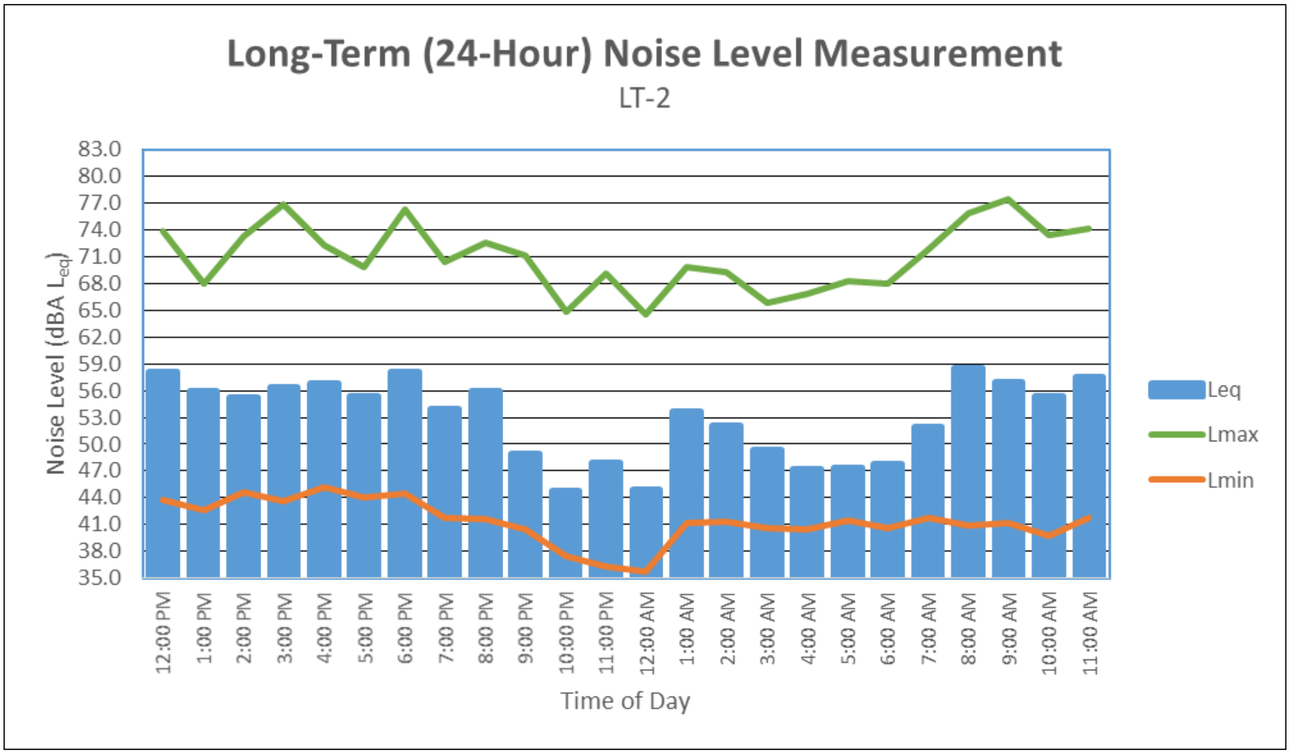
Comments:

Photo:

Long-Term (24-Hour) Noise Level Measurement Results at LT-2

Start Time	Date	Noise Level (dBA)		
		L_{eq}	L_{max}	L_{min}
12:00 PM	4/6/22	58.1	73.8	43.8
1:00 PM	4/6/22	55.9	68.0	42.6
2:00 PM	4/6/22	55.2	73.3	44.6
3:00 PM	4/6/22	56.3	76.9	43.6
4:00 PM	4/6/22	56.9	72.3	45.2
5:00 PM	4/6/22	55.4	69.9	44.1
6:00 PM	4/6/22	58.1	76.3	44.5
7:00 PM	4/6/22	53.9	70.4	41.8
8:00 PM	4/6/22	56.0	72.6	41.6
9:00 PM	4/6/22	49.0	71.2	40.5
10:00 PM	4/6/22	44.8	64.8	37.5
11:00 PM	4/6/22	47.9	69.2	36.3
12:00 AM	4/7/22	44.9	64.6	35.7
1:00 AM	4/7/22	53.7	69.8	41.2
2:00 AM	4/7/22	52.0	69.3	41.3
3:00 AM	4/7/22	49.4	65.8	40.6
4:00 AM	4/7/22	47.1	66.9	40.5
5:00 AM	4/7/22	47.4	68.2	41.5
6:00 AM	4/7/22	47.7	68.0	40.6
7:00 AM	4/7/22	51.9	71.8	41.8
8:00 AM	4/7/22	58.5	75.8	40.9
9:00 AM	4/7/22	56.9	77.5	41.2
10:00 AM	4/7/22	55.4	73.4	39.8
11:00 AM	4/7/22	57.5	74.1	41.8

Source: Compiled by LSA Associates, Inc. (2022).
dBA = A-weighted decibel
L_{eq} = equivalent continuous sound level
L_{max} = maximum instantaneous noise level
L_{min} = minimum measured sound level



Long-Term (24-Hour) Noise Level Measurement
LT-2
Noise Level (dBA Leq)
83.0
80.0
77.0
74.0
71.0
68.0
65.0
62.0
59.0
56.0
53.0
50.0
47.0
44.0
41.0
38.0
35.0
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
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
Time of Day
Leq
Lmax
Lmin

APPENDIX B

CONSTRUCTION NOISE CALCULATIONS

Construction Calculations

Phase: Site Preparation

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA)	
						Lmax	Leq
Tractor	4	84	40	50	0.5	84	86
Dozer	3	82	40	50	0.5	82	83
					Combined at 50 feet	**86**	**88**
					Combined at Receptor 320 feet	**70**	**72**
					Combined at Receptor 510 feet	**66**	**68**
					Combined at Receptor 725 feet	**63**	**64**

Phase: Grading

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA)	
						Lmax	Leq
Tractor	2	84	40	50	0.5	84	83
Excavator	2	81	40	50	0.5	81	80
Grader	1	85	40	50	0.5	85	81
Dozer	1	82	40	50	0.5	82	78
Scraper	2	84	40	50	0.5	84	83
					Combined at 50 feet	**90**	**88**
					Combined at Receptor 320 feet	**74**	**72**
					Combined at Receptor 510 feet	**70**	**68**
					Combined at Receptor 725 feet	**67**	**65**

Phase:Building Construstion

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA)	
						Lmax	Leq
Crane	1	81	16	50	0.5	81	73
Man Lift	3	75	20	50	0.5	75	73
Generator	1	81	50	50	0.5	81	78
Tractor	3	84	40	50	0.5	84	85
Welder / Torch	1	74	40	50	0.5	74	70
					Combined at 50 feet	**87**	**86**
					Combined at Receptor 320 feet	**71**	**70**
					Combined at Receptor 510 feet	**67**	**66**
					Combined at Receptor 725 feet	**64**	**63**

Phase: Paving

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA)	
						Lmax	Leq
Paver	2	77	50	50	0.5	77	77
All Other Equipment > 5 HP	2	85	50	50	0.5	85	85
Roller	2	80	20	50	0.5	80	76
					Combined at 50 feet	**87**	**86**
					Combined at Receptor 320 feet	**71**	**70**
					Combined at Receptor 510 feet	**67**	**66**
					Combined at Receptor 725 feet	**63**	**63**

Phase:Architectural Coating

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA)	
						Lmax	Leq
Compressor (air)	1	78	40	50	0.5	78	74
					Combined at 50 feet	**78**	**74**
					Combined at Receptor 320 feet	**62**	**58**
					Combined at Receptor 510 feet	**58**	**54**
					Combined at Receptor 725 feet	**55**	**51**

Sources: RCNM

[1]- Percentage of time that a piece of equipment is operating at full power.

dBA – A-weighted Decibels
Lmax- Maximum Level
Leq- Equivalent Level

APPENDIX C
ON-SITE TRAFFIC NOISE CALCULATIONS

TABLE 0 -01
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 05/26/2022
ROADWAY SEGMENT: Cottonwood Avenue - East of Quincy
NOTES: Cottonwood - 0

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 30000 SPEED (MPH): 45 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 30 SITE CHARACTERISTICS: SOFT

ELEVATION AT ROAD SURFACE: 0
ELEVATION AT BARRIER BASE: 0
BARRIER HEIGHT (FT): 0
BARRIER TYPE: WALL
ELEVATION AT RECEPTOR BASE: 0
RECEPTOR HEIGHT (FT): 5

ROADWAY CENTERLINE TO RECEPTOR DISTANCE (FT): 55
BARRIER TO RECEPTOR DISTANCE (FT): 10

---

* * CALCULATED NOISE LEVELS * *

CNEL WITHOUT BARRIER (dB)= 72.89

BARRIER ATTENUATION (dB):
Autos: + 0.00
Med. Trucks: + 0.00
Hvy. Trucks: + 0.00

CNEL WITH BARRIER (dB)= 72.89

TABLE Existing with 7 ft barrier-01
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 05/26/2022
ROADWAY SEGMENT: Cottonwood Avenue - East of Quincy
NOTES: Cottonwood - Existing with 7 ft barrier

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 30000 SPEED (MPH): 45 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	EVENING	NIGHT
AUTOS	75.51	12.57	9.34
M-TRUCKS	1.56	0.09	0.19
H-TRUCKS	0.64	0.02	0.08

ACTIVE HALF-WIDTH (FT): 30 SITE CHARACTERISTICS: SOFT

ELEVATION AT ROAD SURFACE: 0
ELEVATION AT BARRIER BASE: 0
BARRIER HEIGHT (FT): 7
BARRIER TYPE: WALL
ELEVATION AT RECEPTOR BASE: 0
RECEPTOR HEIGHT (FT): 5

ROADWAY CENTERLINE TO RECEPTOR DISTANCE (FT): 55
BARRIER TO RECEPTOR DISTANCE (FT): 10

---

* * CALCULATED NOISE LEVELS * *

CNEL WITHOUT BARRIER (dB)= 72.89

BARRIER ATTENUATION (dB):
Autos: - 8.89
Med. Trucks: - 8.11
Hvy. Trucks: - 6.12

CNEL WITH BARRIER (dB)= 64.77

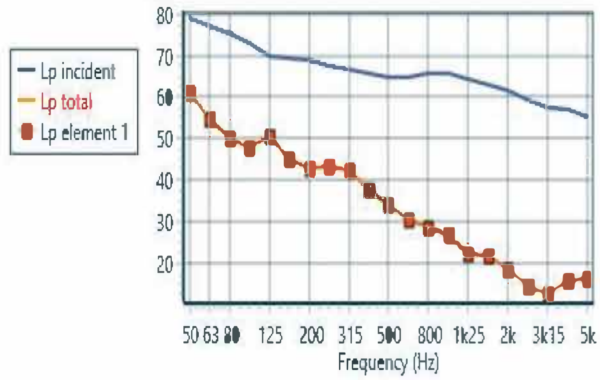
APPENDIX D

SAMPLE INTERIOR NOISE CALCULATIONS

Outdoor To Indoor Sound Transmission (v9.0.23)

Margin of error is generally within ±3 dB
 - Key No. 4862
Job Name:
Job No.: Initials:JStephens
Date:5/10/2022
File Name:INSUL Calc.inz

Comment: Sample Room with STC 31



	Octave Band Centre Frequency (Hz)																					
Source		63			125			250			500			1k			2k			4k		Overall dBA
Incident sound level (freefield)	79.0	77.0	75.3	72.9	69.9	69.2	68.7	67.4	66.4	65.6	65.0	64.7	65.6	65.8	64.2	62.8	61.6	59.5	57.6	56.8	55.3	74
Path																						
Element 1 , STL	-18	-22	-25	-25	-19	-24	-26	-24	-24	-28	-31	-34	-37	-39	-42	-41	-43	-45	-45	-41	-39	
Facade Shape factor Level diff.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Insertion Loss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Area(+10LogA) [96 ft2]	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	
Element sound level contribution	61	55	50	48	51	45	43	43	42	37	34	31	28	27	22	22	18	14	12	16	16	43
Receiver																						
Room volume(-10LogV) [1205 ft3]	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	
Reverberation time (s)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
RT (+10LogT)	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	
Equation Constant	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	
Room sound level	61	55	50	48	51	45	43	43	42	37	34	31	28	27	22	22	18	14	12	16	16	43