Appendix G:
Noise and Supporting Information

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Memorandum

Date: June 25, 2024

To: City of San José Planning Division
Cort Hitchens, Planner III

From: Philip Ault, Director of Noise and Air Quality, FirstCarbon Solutions

Subject: Noise Impact Analysis for the Proposed Camden Avenue Residential Project, City of San José, California

On behalf of Mana Camden Fund, LLC (project applicant), FirstCarbon Solutions (FCS), prepared this memorandum to evaluate noise impacts that could result from construction and operations of the proposed Camden Avenue Residential Project (proposed project). Supporting documents, such as calculation worksheets and other modeling outputs, are included as attachments to this memorandum.

PROJECT DESCRIPTION

The project site is located at 5670 Camden Avenue in the City of San José, California. It is bounded by Beacon School and Delight Montessori School San José along Camden Avenue to the west; residential uses and a utilities easement to the east and north; an electricity production and distribution substation south on Singletree Way; and more residential uses to the southwest. Guadalupe Creek is located south of the substation, approximately 400 feet south of the project site.

The project applicant proposes to remove the existing sports fields, associated structures, and improvements and to then develop 108 townhouse units spread over 32 buildings. The proposed project would also include 243 parking spaces composed of 216 garage spaces and 27 guest spaces. Twenty-eight bicycle parking spaces would be provided, along with seven bicycle lockers. Open space would include approximately 101,370 square feet of common open space and approximately 6,500 square feet of private open space (for a total of 107,870 square feet).

The project site is designated as “Public/Quasi-Public” and is zoned Multiple Residence District (R-M) by the Envision San José 2040 General Plan.

NOISE AND VIBRATION FUNDAMENTALS

A summary of the fundamentals of noise and vibration are provided as an attachment to this document.

REGULATORY SETTING

Federal Regulations

Currently, no federal noise standards regulate environmental noise associated with temporary construction activities or the long-term operations of development projects. As such, both temporary and long-term noise impacts resulting from the proposed project would be largely regulated or otherwise evaluated by State and City of Berkeley standards designed to protect public well-being and health.

Federal Transit Administration

Though not regulatory in nature, vibration impact criteria for buildings and other structures have been established by the Federal Transit Authority (FTA), as building and structural damages are generally the foremost concern when evaluating the impacts of construction-related vibrations. For the evaluation of the proposed project's construction-related vibration impacts, the following FTA vibration impact criteria, shown in Table 1, are used given the absence of applicable federal, State, and City standards specific to temporary construction activities and their potential to result in building and structural damages.[1]

Table 1: Federal Transit Administration Construction Vibration Impact Criteria

Building Category	PPV (in/sec)
I. Reinforced—Concrete, Steel or Timber (no plaster)	0.5
II. Engineered Concrete and Masonry (no plaster)	0.3
III. Nonengineered Timber and Masonry Buildings	0.2
IV. Buildings Extremely Susceptible to Vibration Damage	0.12

Notes:
PPV = peak particle velocity
VdB = vibration measured as root mean square (rms) velocity in decibels of 1 microinch per second
Source: Federal Transit Administration (FTA). 2018. Transit Noise and Vibration Impact Assessment Manual.

State Regulations

2017 General Plan Guidelines

The State of California's 2017 General Plan Guidelines propose county and city standards for acceptable exterior noise levels based on land use. These standards are incorporated into land use planning

[1] Federal Transit Administration (FTA). 2018. Transit Noise and Vibration Impact Assessment Manual.

processes to prevent or reduce noise and land use incompatibilities. The State's suggested compatibility considerations between various land uses and exterior noise levels are not regulatory in nature but are recommendations intended to aid communities in determining their own noise-acceptability standards.

California Building Standards Code

The State of California has established noise insulation standards for new hotels, motels, apartment houses, and dwellings (other than single-family detached housing). These requirements are provided in the 2022 California Building Standards Code (CBC) (California Code of Regulations [CCR] Title 24). As provided in the CBC, the noise insulation standards set forth a Community Noise Equivalent Level (CNEL) of 45 A-weighted decibel (dBA) as measured from within the structure's interior. Title 24 standards are typically enforced by local jurisdictions through the building permit application process.

Assembly Bill 1307

Assembly Bill (AB) 1307 went into effect January 1, 2024. This bill clarifies that "for residential projects, the effects of noise generated by project occupants and their guests on human beings is not a significant effect on the environment." Therefore, this analysis does not address potential noise impacts from future occupants and their guests on sensitive receptors in the project vicinity.

Local Regulations

Envision San José 2040 General Plan

The project site is located within the City of San José and this analysis was performed using the City's noise regulations. The City of San José addresses noise in the Noise Element of the Envision San José 2040 General Plan (General Plan) and in the City of San José Municipal Code (Municipal Code).

Envision San José 2040 Relevant Noise and Vibration Policies

Policies	Description
Policy ES-1.1	Locate new development in areas where noise levels are appropriate for the proposed uses. Consider federal, State and City noise standards and guidelines as a part of new development review. Applicable standards and guidelines for land uses in San José include: **Interior Noise Levels** • The City's standard for interior noise levels in residences, hotels, motels, residential care facilities, and hospitals is 45 dBA DNL. Include appropriate site and building design, building construction and noise attenuation techniques in new development to meet this standard. For sites with exterior noise levels of 60 dBA DNL or more, an acoustical analysis following protocols in the City-adopted California Building Code is required to demonstrate that development projects can meet this standard. The acoustical analysis shall base required noise attenuation techniques on expected *Envision San José 2040 General Plan* traffic volumes to ensure land use compatibility and General Plan consistency over the life of this plan.

Envision San José 2040 Relevant Noise and Vibration Policies

Policies	Description
	Exterior Noise Levels • The City's acceptable exterior noise level objective is 60 dBA DNL or less for residential and most institutional land uses (refer to Table EC-1 in the General Plan or Table 4.12-1 in this Initial Study). Residential uses are considered "normally acceptable" with exterior noise exposures of up to 60 dBA DNL and "conditionally compatible" where the exterior noise exposure is between 60 and 75 dBA DNL such that the specified land use may be permitted only after detailed analysis of the noise reduction requirements and needed noise insulation features are included in the design.
Policy EC-1.2	Minimize the noise impacts of new development on land uses sensitive to increased noise levels (Land Use Categories 1, 2, 3 and 6 in Table EC-1 in the General Plan or Table 4.12-1 in this Initial Study) by limiting noise generation and by requiring use of noise attenuation measures such as acoustical enclosures and sound barriers, where feasible. The City considers significant noise impacts to occur if a project would: • Cause the DNL at noise-sensitive receptors to increase by five dBA DNL or more where the noise levels would remain "Normally Acceptable." • Cause the DNL at noise-sensitive receptors to increase by three dBA DNL or more where noise levels would equal or exceed the "Normally Acceptable" level.
Policy EC-1.7	Require construction operations within San José to use best available noise suppression devices and techniques and limit construction hours near residential uses per the City's Municipal Code. The City considers significant construction noise impacts to occur if a project located within 500 feet of residential uses or 200 feet of commercial or office uses would: • Involve substantial noise generating activities (such as building demolition, grading, excavation, pile driving, use of impact equipment, or building framing) continuing for more than 12 months. For such large or complex projects, a construction noise logistics plan that specifies hours of construction, noise and vibration minimization measures, posting or notification of construction schedules, and designation of a noise disturbance coordinator who would respond to neighborhood complaints will be required to be in place prior to the start of construction and implemented during construction to reduce noise impacts on neighboring residents and other uses.
Policy EC-2.3	Require new development to minimize vibration impacts to adjacent uses during demolition and construction. For sensitive historic structures, a vibration limit of 0.08 in/sec PPV (peak particle velocity) will be used to minimize the potential for cosmetic damage to a building. A vibration limit of 0.20 in/sec PPV will be used to minimize the potential for cosmetic damage at buildings of normal conventional construction.

City of San José Municipal Code

The Municipal Code restricts construction hours within 500 feet of a residential unit to between 7:00 a.m. and 7:00 p.m. Monday through Friday, unless otherwise expressly allowed in a Development Permit or other planning approval. No construction activities are permitted on the weekends at sites within 500 feet of a residence.

The Zoning Ordinance limits noise levels to 55 dBA maximum (L_{max}) at any residential property line and 60 dBA L_{max} at commercial property lines, unless otherwise expressly allowed in a Development Permit or other planning approval. The Zoning Ordinance also limits noise emitted by stand-by/backup and emergency generators to 55 dBA at the property line of residential properties. The testing of generators is limited to between 7:00 a.m. and 7:00 p.m., Monday through Friday.

City of San José Standard Permit Conditions

The City has established the following Standard Permit Conditions that it imposes on projects and which would apply to construction of the proposed project:

> **Construction-related Noise.** Noise minimization measures include, but are not limited to, the following:
>
> i. Pile Driving is prohibited.
>
> ii. Limit construction to the hours of 7:00 a.m. to 7:00 p.m. Monday through Friday for any on-site or off-site work within 500 feet of any residential unit. Construction outside of these hours may be approved through a Development Permit based on a site-specific "construction noise mitigation plan" and a finding by the Director of Planning, Building and Code Enforcement that the construction noise mitigation plan is adequate to prevent noise disturbance of affected residential use.
>
> iii. Construct solid plywood fences around ground level construction sites adjacent to operational businesses, residences, or other noise-sensitive land uses.
>
> iv. Equip all internal combustion engine-driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment.
>
> v. Prohibit unnecessary idling of internal combustion engines.
>
> vi. Locate stationary noise generating equipment such as air compressors or portable power generators as far as possible from sensitive receptors. Construct temporary noise barriers to screen stationary noise generating equipment when located near adjoining sensitive land uses.
>
> vii. Utilize "quiet" air compressors and other stationary noise sources where technology exists.
>
> viii. Control noise from construction workers' radios to a point where they are not audible at existing residences bordering the project site.

ix. Notify all adjacent business, residences, and other noise-sensitive land uses of the construction schedule, in writing, and provide a written schedule of "noisy" construction activities to the adjacent land uses and nearby residences.

x. If complaints are received or excessive noise levels cannot be reduced using the measures above, erect a temporary noise control blanket barrier along surrounding building façades that face the construction sites.

xi. Designate a "disturbance coordinator" who shall be responsible for responding to any complaints about construction noise. The disturbance coordinator shall determine the cause of the noise complaint (e.g., bad muffler, etc.) and shall require that reasonable measures be implemented to correct the problem. Conspicuously post a telephone number for the disturbance coordinator at the construction site and include it in the notice sent to neighbors regarding the construction schedule.

Operations-related Noise.

i. Interior Noise Standard for Residential Development. The project applicant shall prepare final design plans that incorporate building design and acoustical treatments to ensure compliance with State Building Codes and City noise standards. A project-specific acoustical analysis shall be prepared to ensure that the design incorporates controls to reduce interior noise levels to 45 dBA DNL or lower within the residential unit. The project applicant shall conform with any special building construction techniques requested by the City's Building Department, which may include sound-rated windows and doors, sound-rated wall constructions, and acoustical caulking.

EXISTING NOISE CONDITIONS

FCS Noise Study

On January 11, 2024, noise measurements were obtained at multiple locations near the project site to further aid in the characterization of daytime ambient noise conditions surrounding the proposed project and nearby sensitive receptors. The measurements ranged between 52.6 and 70.2 dBA equivalent sound level (L_{eq}) as shown in Table 2. Noise sources were primarily vehicle traffic along Camden Avenue and Blossom Hill Road, as well as continuous noise from an electric substation adjacent to the project site. These ambient noise measurements correlate well with the General Plan's 75 dBA day/night average noise level (DNL) estimate for the project site. Noise measurement data sheets are included in Attachment B.

Table 2: FCS Noise Measurements

#	Time	Location	Primary Noise Sources	Noise Level (dBA L_{eq})
1.	1:55 p.m.–2:10 p.m.	10 feet off Singletree Way, 40 feet east of SW corner of project site.	Singletree Way traffic, continuous noise from adjacent electric substation, school parking traffic.	52.6
2.	2:14 p.m.–2:29 p.m.	10 feet off Singletree Way, 50 feet west of SE corner of project site.	Adjacent electrical substation (continuous), Singletree Way traffic.	55.9
3.	2:35 p.m.–2:50 p.m.	15 feet off Camden Avenue, adjacent to NW corner of project site.	Camden Avenue and Blossom Hill Road traffic.	70.2

Notes:
dBA = A-weighted decibel
L_{eq} = equivalent sound level

THRESHOLDS OF SIGNIFICANCE AND IMPACT ANALYSIS

Thresholds of Significance

According to the California Environmental Quality Act (CEQA) Guidelines, Appendix G, to determine whether impacts related to noise and vibration are significant environmental effects, the following questions are analyzed and evaluated.

Would the proposed project:

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

b) Generate excessive groundborne vibration or groundborne noise levels?

c) For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?

Substantial Noise Increase in Excess of Standards

Construction Noise Impacts

For purposes of this analysis, a significant impact would occur if construction activities would result in a substantial temporary increase in ambient noise levels outside of the City's permissible hours for construction that would result in annoyance or sleep disturbance of nearby sensitive receptors. The

City's permissible hours for construction activity are between the hours of 7:00 a.m. and 7:00 p.m. Monday through Friday. No construction is permitted on Saturdays, Sundays, or federal holidays.

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. Typical operating cycles for these types of construction equipment may involve 1 or 2 minutes of full-power operation followed by 3 or 4 minutes at lower power settings. Impact equipment, such as impact pile drivers, are not expected to be used during construction of this proposed project.

The loudest phase of construction is typically the site preparation and grading phase, as that is when the loudest pieces of heavy construction equipment would operate. For example, the maximum noise level generated by each grader is assumed to be 85 dBA L_{max} at 50 feet from this equipment. Each front-end loader would also generate 80 dBA L_{max} at 50 feet. The maximum noise level generated by each backhoe is approximately 80 dBA L_{max} at 50 feet.

A conservative but reasonable assumption is that this equipment would operate simultaneously and continuously over at least a 1-hour period in the vicinity of the closest existing residential receptors but would move linearly over the project site as they perform their earthmoving operations, spending a relatively short amount of time adjacent to any one receptor. A characteristic of sound is that each doubling of sound sources with equal strength increases a sound level by 3 dBA. Assuming that each piece of construction equipment operates at some distance from the other equipment, a reasonable worst-case combined noise level during this phase of construction would be 91 dBA L_{max} at a distance of 50 feet from the acoustic center of a construction area. The acoustical center reference is used because construction equipment must operate at some distance from one another on a project site, and the combined noise level as measured at a point equidistant from the sources (acoustic center) would be the worst-case maximum noise level. These operations would be expected to result in a reasonable worst-case hourly average of 90 dBA L_{eq} at a distance of 50 feet from the acoustic center of a construction area. These worst-case construction noise levels would only occur during the site preparation phase of development.

The closest noise-sensitive receptors to the proposed project site are multi-family residences located directly east of the project site. The closest residence would be located approximately 25 feet from the acoustic center of construction activity where multiple pieces of heavy construction equipment would potentially operate at the project site. At this distance, and assuming minimal shielding from existing fencing, worst-case construction noise levels could range up to approximately 88 dBA L_{max}, intermittently, and could have an hourly average of up to 87 dBA L_{eq} at the façade of the nearest multi-family residential home.

The proposed project would be required to comply with the Municipal Code, which limits noise generating construction activities to daytime hours and requires the implementation of measures that avoid or minimize significant noise impacts from construction activities.

Although there could be a relatively high single-event noise exposure potential causing an intermittent noise nuisance, the effect of construction activities on longer-term (hourly or daily) ambient noise levels would be small. However, construction activities could result in a temporary increase in ambient noise levels in the project vicinity that could result in annoyance or sleep disturbance of nearby sensitive receptors. Therefore, limiting construction activities to the daytime hours would reduce the effects of noise levels produced by these activities on longer-term (hourly or daily) ambient noise levels and would reduce the potential for noise-related annoyance or sleep disturbances at nearby sensitive receptors. The Municipal Code limits construction activities to between the hours of 7:00 a.m. and 7:00 p.m. Monday through Friday. The proposed project would be required to adhere to Standard Permit Condition NOI No. 1. With implementation of the Municipal Code and adherence to Standard Permit Condition NOI No. 1, the proposed project would not result in substantial temporary increases at the off-site sensitive receptors above standards established in the General Plan, and construction noise impacts on sensitive receptors in the project vicinity would be **less than significant**.

Mobile Source Operational Noise Impacts

A significant impact would occur if project-generated traffic would result in a substantial increase in ambient noise levels compared with those that would exist without the proposed project. The City considers a significant noise impact to occur if a project would cause the day-night average sound level (DNL) at noise-sensitive receptors to increase by 5 dBA DNL or more where the noise levels would remain “normally acceptable”; or where it would cause the DNL at noise-sensitive receptors to increase by 3 dBA DNL or more where noise levels would equal or exceed the “normally acceptable” level.

Typically, a doubling of the average daily traffic (ADT) hourly volumes on a roadway segment is required in order to result in an increase of 3 dBA in traffic noise levels, which, as discussed in the characteristics of noise discussion above, is the lowest change that can be perceptible to the human ear in outdoor environments. Therefore, for the purposes of this analysis, a doubling of the existing ADT volumes would result in a substantial permanent increase in traffic noise levels.

Based on the traffic analysis prepared for the project by Hexagon Transportation Consultants, Inc.,[2] existing traffic conditions on Camden Ave and Singletree Way is 306 AM peak-hour trips and 2,169 PM peak-hour trips. The proposed project is calculated to generate 704 new daily vehicle trips, with 47 new trips (14 inbound and 33 outbound) occurring during the AM peak-hour and 56 new trips (32 inbound and 24 outbound) occurring during the PM peak-hour. These net new trips would not double existing traffic trips on any roadway segment in the project vicinity. Furthermore, this increase in trips would result in a less than 1 dBA increase in traffic noise levels along any roadway segment in the project vicinity. This increase is below a level that would be a perceptible increase and well below a level that would be

[2] Hexagon Transportation Consultants, Inc.2024. 5670 Camden Avenue Residential Draft Transportation Analysis. May 14.

considered a substantial increase in traffic noise levels. Therefore, implementation of the proposed project would not result in a substantial increase in traffic noise levels compared with traffic noise levels existing without the project.

Stationary Source Operational Noise Impacts

A significant impact would occur if operational noise levels generated by stationary noise sources at the proposed project site would result in a substantial permanent increase in ambient noise levels in excess of any of the noise performance thresholds established by the City of San José. The Zoning Ordinance limits operational noise levels to 55 dBA L_{max} as measured at any receiving residential property.

The primary new stationary noise source associated with implementation of the proposed project would be the new mechanical ventilation systems associated with the proposed residential uses. Potential impacts associated with this new noise source are analyzed below.

Mechanical Ventilation Equipment

Reference noise levels for typical residential mechanical ventilation equipment range up to approximately 70 dBA L_{eq} at a distance of 3 feet. Proposed mechanical ventilation systems could be located as close as approximately 35 feet from the nearest off-site receptor, the multi-family residence located along the northeast corner of the project site. At this distance, and assuming minimal shielding, noise generated by mechanical ventilation equipment would attenuate to below 37 dBA L_{max} at the nearest off-site residential receptors.

These operational noise levels would not exceed the City's noise performance thresholds of 55 dBA L_{max} as measured at the nearest receiving residential property. Therefore, mechanical ventilation system operational noise levels would not result in a substantial permanent increase in noise levels in excess of established standards. The impact of mechanical ventilation equipment operational noise levels on sensitive off-site receptors would be **less than significant**.

Groundborne Vibration/Noise Levels

This section analyzes both construction and operational groundborne vibration and noise impacts. Groundborne vibrations consist of rapidly fluctuating motions within the ground that have an average motion of zero. Vibrating objects in contact with the ground radiate vibration waves through various soil and rock strata to the foundations of nearby buildings. Groundborne noise is generated when vibrating building components radiate sound, or noise, generated by groundborne vibration. In general, if groundborne vibration levels do not exceed levels considered to be perceptible, then groundborne noise levels would not be perceptible in most interior environments. Therefore, this analysis focuses on determining exceedances of groundborne vibration levels.

The City Municipal Code states that, "No ground vibration shall be generated that is perceptible without instruments by a reasonable person at the property lines of the site, except for vibrations from

temporary construction or demolition activities, and motor vehicle operations." For purposes of this analysis, the FTA guidelines for construction vibration impacts are used to determine potential significant construction-related impacts.

Short-term Construction Vibration Impacts

A significant impact would occur if the proposed project would generate excessive groundborne vibration or groundborne noise levels. According to Policy EC-2.3 of the General Plan, a vibration limit of 0.08 inches per second (in/sec) peak particle velocity (PPV) shall be used to minimize the potential for cosmetic damage to sensitive historical structures, and a vibration limit of 0.20 in/sec PPV shall be used to minimize damage at buildings of normal conventional construction.

Of the variety of equipment used during construction, the small vibratory rollers anticipated to be used in the site preparation phase of construction would produce the greatest groundborne vibration levels. Small vibratory rollers produce groundborne vibration levels ranging up to 0.101 in/sec PPV at 25 feet from the operating equipment.

The nearest off-site structure is a multi-family residential building located east of the project site, approximately 25 feet from the nearest construction footprint where small vibratory rollers would potentially operate. At this distance, groundborne vibration levels could range up to 0.101 PPV from operation of a small vibratory roller. This is well below the FTA Construction Vibration Impact Criteria[3] of 0.2 in/sec PPV for this type of structure, a building of nonengineered timber and masonry construction, and the vibration limit of 0.08 in/sec PPV that would cause cosmetic damage to sensitive historic structures.

Therefore, construction-related groundborne vibration would not continually disturb adjacent properties or impact the general public's health, comfort, and convenience, nor would these vibration levels exceed the FTA's Construction Vibration Impact Criteria as measured at the nearest receiving structures in the project vicinity. Project construction-related groundborne vibration impacts would be **less than significant**.

Operational Vibration Impacts

A significant impact would occur if the proposed project would generate excessive groundborne vibration or groundborne noise levels. The Municipal Code states there shall be no activity on any site that causes ground vibration that is perceptible without instruments at the property line of the site.

Implementation of the proposed project would not include any permanent sources that would expose persons in the project vicinity to groundborne vibration levels that could be noticeable without instruments at the lot line of the project. In addition, there are no existing significant permanent sources of groundborne vibration in the project vicinity. Therefore, project operations would not generate

[3] Federal Transit Administration (FTA). 2018. Transit Noise and Vibration Impact Assessment Manual. September.

excessive groundborne vibration levels or expose proposed uses to excessive groundborne vibration levels, and groundborne vibration impacts would be **less than significant**.

Noise Levels from Airport Activity

A significant impact would occur if the proposed project would expose people residing or working in the project area to excessive noise levels for a project located within the vicinity of a private airstrip or an Airport Land Use Compatibility Plan or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport.

The nearest airports to the project site are the Reid-Hillview County Airport, located approximately 8 miles northeast of the project site, and the San José International Airport, located approximately 8 miles north of the project site. Because of the distance from and orientation of the airport runways, the project site is located well outside of the 65 dBA CNEL airport noise contours. While aircraft noise is occasionally audible on the project site from aircraft flyovers, aircraft noise associated with nearby airport activity would not expose people residing or working near the project site to excessive noise levels. Therefore, implementation of the proposed project would not expose persons residing or working in the project vicinity to noise levels from airport activity that would be in excess of normally acceptable standards for residential land use development, the project would result in **no impact** associated with airport noise.

CONCLUSION

The proposed project would restrict the hours of construction activity in accordance with the City's standard conditions of approval and implement best practices noted in COA-1, which would ensure that noise impacts from construction are less than significant. Furthermore, the proposed project would have less than significant impacts related to mobile source operational noise, stationary source operational noise, construction-related groundborne vibration, and operational groundborne vibration. There would be no impact from airport noise.

Sincerely,

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Attachment A: Fundamentals of Noise
Attachment B: Noise Monitoring and Modeling Data

Attachment A:
Fundamentals of Noise

NOISE AND VIBRATION FUNDAMENTALS

Characteristics of Noise and Descriptors

Sound can be described in terms of its loudness (amplitude) and frequency (pitch). The standard unit of measurement for sound is the decibel, abbreviated dB. Because the human ear is not equally sensitive to sound at all frequencies, the A-weighted scale (dBA) is used to reflect the normal hearing sensitivity range of the human ear. Table 1 provides examples of A-weighted noise levels from common sources. Although the terms "sound" and "noise" are often used synonymously, noise is commonly defined as sound that is either loud, unpleasant, unexpected, or undesired.[1] Because decibels are logarithmic units, they cannot be simply added or subtracted. For example, two cars each producing 60 dBA of noise would not produce a combined 120 dBA.

Table 1: A-Weighted Decibel Scale

Common Noise Sources	Sound Level, dBA
Near Jet Engine	130
Rock and Roll Band	110
Jet Flyover at 1,000 feet	100
Power Motor	90
Food Blender	80
Living Room Music	70
Human Voice at 3 feet	60
Residential Air Conditioner at 50 feet	50
Bird Calls	40
Quiet Living Room	30
Average Whisper	20
Rustling Leaves	10
Notes: These noise levels are approximations intended for general reference and information use. They do not meet the standard required for detailed noise analysis but are provided for the reader to gain a rudimentary concept of various noise levels. Source: Cowan, James P. 1993. Handbook of Environmental Acoustics.	

Table 2 briefly defines common noise measurement descriptors and other sound terminology used in this memorandum.

[1] California Department of Transportation (Caltrans). 2013. Technical Noise Supplement to the Traffic Noise Analysis Protocol.

Table 2: Sound Terminology

Term	Definition
Sound	A vibratory disturbance created by a vibrating object which, when transmitted by pressure waves through a medium such as air, can be detected by a receiving mechanism such as the human ear or a microphone.
Noise	Sound that is loud, unpleasant, unexpected, or otherwise undesirable.
Ambient Noise	The composite of noise from all sources near and far in a given environment.
Decibel (dB)	A unitless measure of sound on a logarithmic scale which represents the squared ratio of sound pressure amplitude to a reference sound pressure. The reference pressure is 20 micropascals, representing the threshold of human hearing (0 dB).
A-Weighted Decibel (dBA)	An overall frequency-weighted sound level that approximates the frequency response of the human ear.
Equivalent Noise Level (L_{eq})	The average sound energy occurring over a specified time period. In effect, L_{eq} is the steady-state sound level that in a stated period would contain the same acoustical energy as the time-varying sound that actually occurs during the same period.
Maximum and Minimum Noise Levels (L_{max} and L_{min})	The maximum or minimum instantaneous sound level measured during a measurement period.
Day-Night Level (DNL or L_{dn})	The energy average of the A-weighted sound levels occurring during a 24-hour period, with 10 dB added to the A-weighted sound levels occurring between 10:00 p.m. and 7:00 a.m. (nighttime).
Community Noise Equivalent Level (CNEL)	The energy average of the A-weighted sound levels occurring during a 24-hour period, with 5 dB added to the A-weighted sound levels occurring between 7:00 p.m. and 10:00 p.m. and 10 dB added to the A-weighted sound levels occurring between 10:00 p.m. and 7:00 a.m.
Statistical Descriptor (L_X)	L_X is used to represent the noise level exceeded X% of a specified time period. For example, L_{90} represents the noise level that is exceeded 90% of a specified time period. L_{90} is commonly used to represent ambient or background steady-state noise levels.

Source: Data compiled by FirstCarbon Solutions (FCS) 2024.

Effects of Environmental Noise

The degree to which noise can impact an environment ranges from levels that interfere with speech and sleep to levels that can cause adverse health effects. Most human response to noise is subjective. Factors that influence individual responses may include the intensity, frequency, and pattern of noise;

the amount of background or existing noise present; and the nature of work or human activity that is exposed to intruding noise.

According to the National Institute of Health (NIH), extended or repeated exposure to sounds at or above 85 dB can cause hearing loss. Sounds of 75 dBA or less, even after continuous and repeated exposure, are unlikely to cause hearing loss.[2] The World Health Organization (WHO) reports that adults should not be exposed to sudden "impulse" noise events of 140 dB or greater. For children, this limit is 120 dB.[3]

Exposure to elevated nighttime noise levels can disrupt sleep, leading to increased levels of fatigue and decreased work or school performance. For the preservation of healthy sleeping environments, the WHO recommends that continuous interior noise levels should not exceed 30 dBA L_{eq} and that individual noise events of 45 dBA or higher be limited.[4]

Some epidemiological studies have shown a weak association between long-term exposure to noise levels of 65 to 70 dBA L_{eq} or greater and cardiovascular effects, including ischemic heart disease and hypertension. However, at this time, the relationship is largely inconclusive.

It is generally accepted that people with normal hearing sensitivity can barely perceive a 3 dBA change in noise levels, though if changes occur to the character of a sound (i.e., changes to the frequency content), then changes less than 3 dBA may be more noticeable.[5] Changes of 5 dBA may be readily perceptible, and changes of 10 dBA are perceived as a doubling in loudness.[6] However, few people are highly annoyed by daytime noise levels below 55 dBA.[7]

Loud noises, such as those from construction activities, can interfere with peoples' abilities to effectively communicate via speech, as well as other activities, resulting in annoyance or inconvenience. The EPA has found that a home interior noise level of 45 dBA L_{eq} generally protects speech and communication by providing 100 percent intelligibility of speech sounds.[8] Other common daily activities that may be disrupted by elevated interior noise levels include watching television, listening to music, or activities requiring concentration (such as reading). The EPA has determined that, given the preservation of an indoor noise level associated with 100 percent speech intelligibility (i.e., 45 dBA L_{eq}), the average community reaction is not evident and "7 dBA below levels associated with significant complaints and threats of legal action." Any complaints and annoyance are dependent on "attitude and other non-level related factors."

Noise Attenuation

Generally speaking, noise levels decrease, or "attenuate," as distances from noise sources to receivers increases. For each doubling of distance, noise from stationary or small, localized sources, commonly

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2 National Institute of Health (NIH), National Institute on Deafness and Other Communication. www.nidcd.nih.gov/health/noise-induced-hearing-loss.
3 World Health Organization (WHO). 1999. Guidelines for Community Noise.
4 Ibid.
5 California Department of Transportation (Caltrans). 2013. Technical Noise Supplement to the Traffic Noise Analysis Protocol.
6 Ibid.
7 World Health Organization (WHO). 1999. Guidelines for Community Noise.
8 United States Environmental Protection Agency (EPA). 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety.

referred to as “point sources,” may attenuate at a rate of 6 dBA for each doubling of distance. This attenuation is referred to as the inverse square law. For example, if a point source emits a noise level of 80 dBA at a reference distance of 50 feet, its noise level would be approximately 74 dBA at a distance of 100 feet, 68 dBA at a distance of 200 feet, etc. Noise emitted by “line” sources, such as highways, attenuates at the rate of 3 dBA for each doubling of distance.[9]

Factors such as ground absorption and atmospheric effects may also affect the propagation of noise. In particular, ground attenuation by non-reflective surfaces, such as soft dirt or grass, may contribute to increased attenuation rates of up to an additional 8-10 dBA per doubling of distance.[10]

Noise is most audible when traveling by direct line of sight, an unobstructed visual path between a noise source and a receiver. Barriers that break the line of sight between noise sources and receivers, such as walls and buildings, can greatly reduce source noise levels by allowing noise to reach receivers by diffraction only. Barriers can reduce source noise levels by up to 20 dBA, though it is generally infeasible for temporary barriers to reduce source noise levels by more than 15 dBA.[11] In cases where the noise path from source to receiver is direct but grazes the top of a barrier, noise attenuation of up to 5 dBA may still occur.[12]

Characteristics of Vibration and Descriptors

Vibration is an oscillatory motion that can be described in terms of displacement, velocity, and acceleration.[13] Unlike noise, vibration is not a common environmental issue, as it is unusual for vibration from vehicle sources to be perceptible. Common sources of vibration may include trains, construction activities, and certain industrial operations.

Table 3 briefly defines common vibration measurement descriptors and other terminology used in this analysis.

Table 3: Vibration Terminology

Term	Definition
Peak Particle Velocity (PPV)	PPV is commonly used to describe and quantify vibration impacts to buildings and other structures. PPV levels represent the maximum instantaneous peak of a vibration signal and are generally measured in inches per second (in/sec).
Vibration Decibels (VdB)	The vibration velocity level in decibel scale.
Source: Data compiled by FirstCarbon Solutions (FCS) 2024.	

[9] California Department of Transportation (Caltrans). 2013. Technical Noise Supplement to the Traffic Noise Analysis Protocol.
[10] Ibid.
[11] Ibid.
[12] Ibid.
[13] Federal Transit Administration (FTA). 2018. Transit Noise and Vibration Impact Assessment.

Effects of Vibration

High levels of vibration may cause damage to buildings or even physical personal injury. However, vibration levels rarely affect human health outside the personal operation of certain construction equipment or industrial tools. Instead, most people consider environmental vibration to be an annoyance that may affect concentration or disturb sleep. Background vibration in residential areas is usually not perceptible, and perceptible indoor vibrations are generally caused by sources within buildings themselves, such as slamming doors or heavy footsteps. Vibration from traffic on smooth roadways is rarely perceptible, even from larger vehicles such as buses or trucks.[14] The threshold of human perception of vibration is approximately 0.01-0.02 in/sec peak particle velocity (PPV).[15]

[14] California Department of Transportation (Caltrans). 2020. Transportation and Construction Vibration Guidance Manual.
[15] Ibid.

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Attachment B:
Noise Monitoring and Modeling Data

Mobile Construction Activity Noise Calculation

Receptor:	Receiving residential property line	Noise Level Calculation Prior to Implementation of Noise Attenuation Requirements								
		Reference (dBA) 50 ft		Usage	Distance to	Ground	Shielding	Calculated (dBA)		
No.	Equipment Description	Lmax	Quantity	factor[1]	Receptor	Effect[2]	(dBA)[3]	Lmax	Leq	Energy
1	Grader	85	1	40	25	1	3	88.0	87.1	507165821.6
2	Excavator	85	1	40	75	1	3	78.5	72.7	18783919.32
3	Dozer	85	1	40	75	1	3	78.5	72.7	18783919.32
4	Front End Loader	80	1	40	75	1	3	73.5	67.7	5939996.843
5	Backhoe	80	1	40	75	1	3	73.5	67.7	5939996.843
6										
7										
8										
9										
10										
Notes:							Lmax[4]	88	Leq	87

[1] Percentage of time activity occurs each hour

[2] Soft ground terrain between project site and receptor.

[3] Shielding due to terrain or structures

[4] Calculated Lmax is the Loudest value.

Mechanical Equipment Noise Calculation

Receptor:	Receiving residential property line	Noise Level Calculation Prior to Implementation of Noise Attenuation Requirements								
		Reference (dBA) 3 ft		Usage	Distance to	Ground	Shielding	Calculated (dBA)		
No.	Equipment Description	Lmax	Quantity	factor[1]	Receptor	Effect[2]	(dBA)[3]	Lmax	Leq	Energy
1	Commercial grade mechanical ventilation equipment	70	1	80	35	1	3	64.1	34.0	2524.931603
2	Commercial grade mechanical ventilation equipment	70	1	80	45	1	3	61.9	30.7	1187.999369
3	Commercial grade mechanical ventilation equipment	70	1	80	55	1	3	60.2	28.1	650.6773401
4	Commercial grade mechanical ventilation equipment	70	1	80	65	1	3	58.7	26.0	394.1973326
Notes:									Leq	37

[1] Percentage of time activity occurs each hou

[2] Soft ground terrain between project site and receptor

[3] Shielding due to rooftop parapet and soundwall shielding

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