New Hilmar Unified Elementary School Project
Initial Study

(State Clearinghouse No. 2019110288)

Appendix 3:

Noise & Groundborne Vibration Impact Analysis

NOISE & GROUNDBORNE VIBRATION IMPACT ANALYSIS

FOR

NEW ELEMENTARY SCHOOL PROJECT

HILMAR UNIFIED SCHOOL DISTRICT
HILMAR, CA

DECEMBER 2020

PREPARED FOR:

ODELL PLANNING & RESEARCH, INC.
49346 ROAD 426, SUITE 2
OAKHURST, CA 93644

PREPARED BY:

AMBIENT
AIR QUALITY & NOISE CONSULTING

612 12TH STREET, SUITE 201
PASO ROBLES, CA 93446

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

LIST OF COMMON TERMS AND ACRONYMS

ANSI	Acoustical National Standards Institute, Inc.
Caltrans	California Department of Transportation
CEQA	California Environmental Quality Act
CNEL	Community Noise Equivalent Level
dB	Decibels
dBA	A-Weighted Decibels
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
Hz	Hertz
HVAC	Heating Ventilation & Air Conditioning
in/sec	Inches per Second
L_{dn}	Day-Night Level
L_{eq}	Equivalent Sound Level
L_{max}	Maximum Sound Level
ppv	Peak Particle Velocity
U.S. EPA	United States Environmental Protection Agency

INTRODUCTION

This report discusses the existing setting, identifies potential noise impacts associated with implementation of the proposed project. Noise mitigation measures are recommended where the predicted noise levels would exceed applicable noise standards.

PROPOSED PROJECT SUMMARY

The new elementary school campus will provide instruction for Pre-K through 2nd grades and will serve approximately 600 students. Buildout of the new campus will include six classroom buildings housing 25 classrooms; one building housing a library and administrative office; a multipurpose building with an outdoor amphitheater area; and recreational areas including hardcourts, play structures, and turfed athletic fields. At the Elim Elementary campus, the "front" of Elim will be reoriented from facing Lander Avenue (State Route 165) to facing a new interior access area, where a new administration building will be constructed for the Elim campus. New driveways from Geer Avenue will serve as the main access to both elementary schools. A parking area with approximately 58 spaces is proposed to be developed along the eastern portion of the new elementary school campus. The project will also include designated vehicle and bus drop-off areas for each campus.

As part of the project's operation, Pre K through 2nd grades will relocate from Elim Elementary to the new elementary school, leaving Elim with 3rd through 5th grades. Elim's current student population will be reduced from approximately 1,000 to 500 students, and 24 classrooms (all portables) will be removed from its current total of 50 classrooms, leaving the Elim campus with approximately 26 classrooms. The project will increase overall student capacity from approximately 1,000 to 1,200 total students in Pre-K through 5th grades. While each campus is anticipated to have a maximum of 60 staff, it is anticipated that some staff will be shared given the proximity of the schools.

EXISTING SETTING

CONCEPTS AND TERMINOLOGY

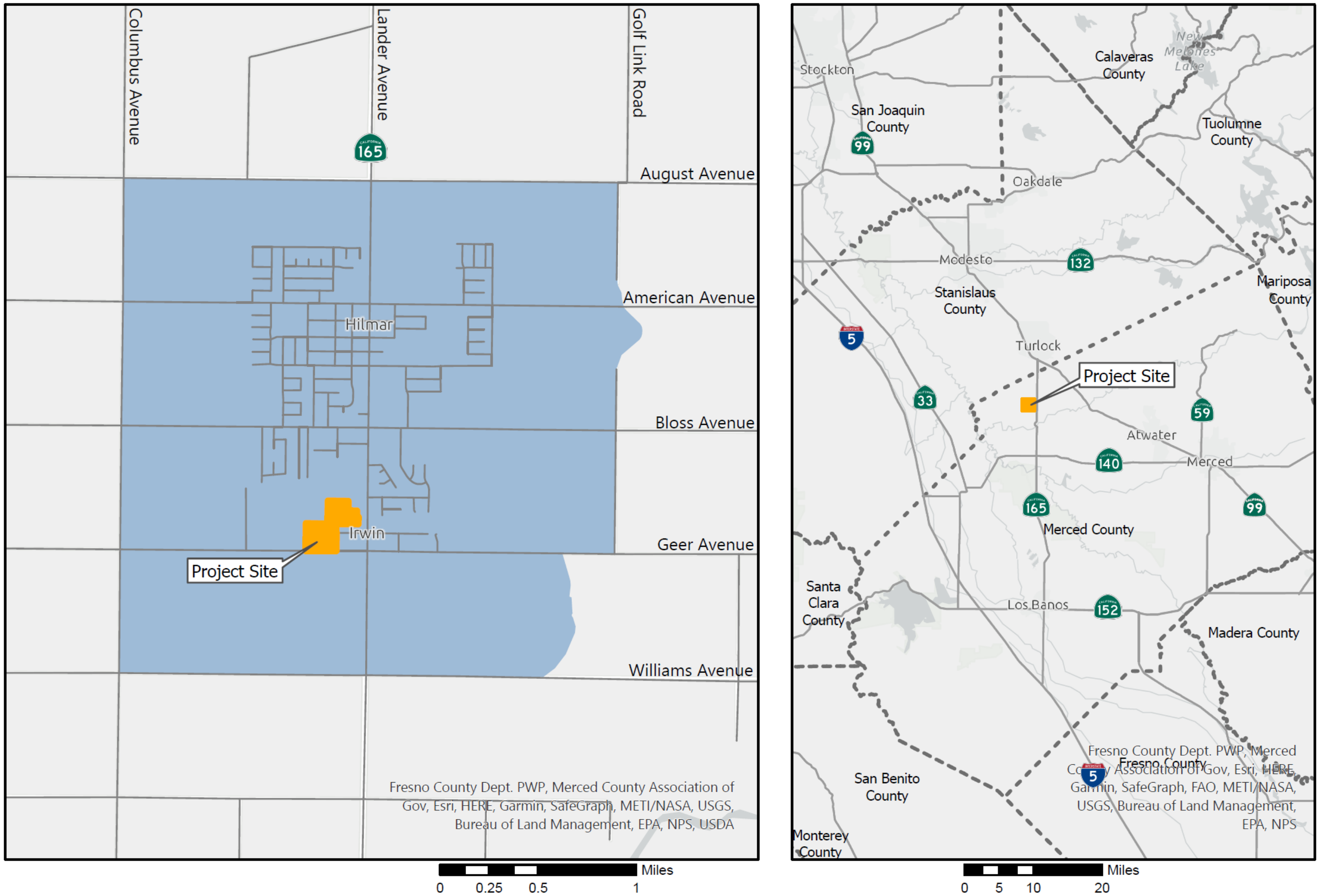
ACOUSTIC FUNDAMENTALS

Noise is generally defined as sound that is loud, disagreeable, or unexpected. Sound is mechanical energy transmitted in the form of a wave because of a disturbance or vibration. Sound levels are described in terms of both amplitude and frequency.

Amplitude

Amplitude is defined as the difference between ambient air pressure and the peak pressure of the sound wave. Amplitude is measured in decibels (dB) on a logarithmic scale. For example, a 65-dB source of sound, such as a truck, when joined by another 65 dB source results in a sound amplitude of 68 dB, not 130 dB (i.e., doubling the source strength increases the sound pressure by 3 dB). Amplitude is interpreted by the ear as corresponding to different degrees of loudness. Laboratory measurements correlate a 10 dB increase in amplitude with a perceived doubling of loudness and establish a 3-dB change in amplitude as the minimum audible difference perceptible to the average person.

Figure 1. Local and Regional Project Location



Local and Regional Location **Figure 1**

New Elementary School Project
Hilmar Unified School District

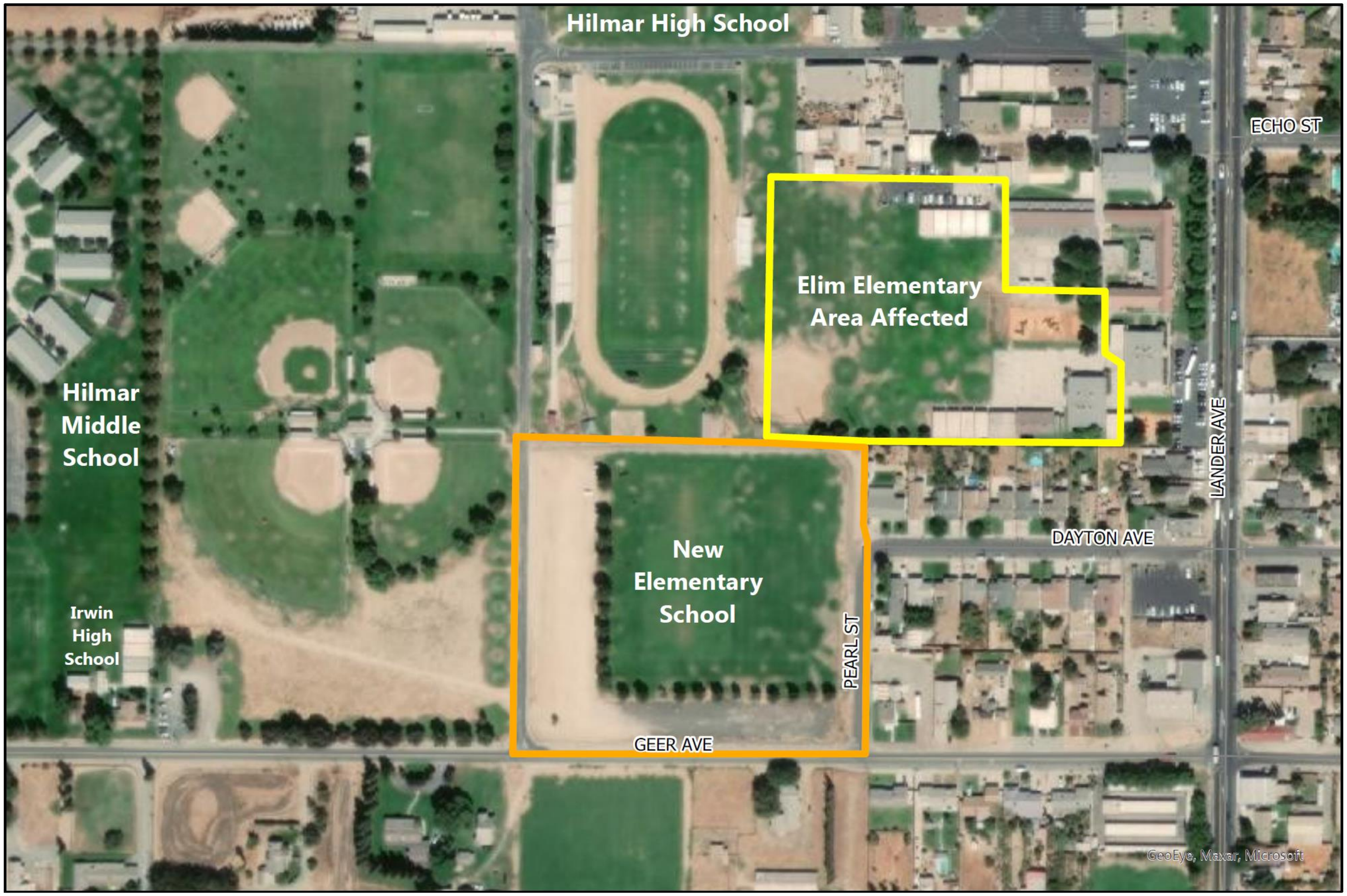
ODELL Planning & Research, Inc.
Environmental Planning • School Facility Planning • Demographics

Project Site
Hilmar Census Designated Place

N

Source: OPR 2020

Figure 2. Project Site



Project Site **Figure 2**

New Elementary School Project
Hilmar Unified School District

ODELL Planning & Research, Inc.
Environmental Planning • School Facility Planning • Demographics

0 125 250 500 Feet N

Source: OPR 2020

Figure 3. Project Site Plan

Source: OPR 2020

Frequency

The frequency of a sound is defined as the number of fluctuations of the pressure wave per second. The unit of frequency is the Hertz (Hz). One Hz equals one cycle per second. The human ear is not equally sensitive to sound of different frequencies. For instance, the human ear is more sensitive to sound in the higher portion of this range than in the lower and sound waves below 16 Hz or above 20,000 Hz cannot be heard at all. To approximate the sensitivity of the human ear to changes in frequency, environmental sound is usually measured in what is referred to as "A-weighted decibels" (dBA). On this scale, the normal range of human hearing extends from about 10 dBA to about 140 dBA (U.S. EPA 1971). Common community noise sources and associated noise levels, in dBA, are depicted in Figure 4.

Addition of Decibels

Because decibels are logarithmic units, sound levels cannot be added or subtracted through ordinary arithmetic. Under the decibel scale, a doubling of sound energy corresponds to a 3-dB increase. In other words, when two identical sources are each producing sound of the same loudness, the resulting sound level at a given distance would be 3 dB higher than one source under the same conditions. For example, if one automobile produces a sound level of 70 dB when it passes an observer, two cars passing simultaneously would not produce 140 dB; rather, they would combine to produce 73 dB. Under the decibel scale, three sources of equal loudness together would produce an increase of 5 dB.

Sound Propagation & Attenuation

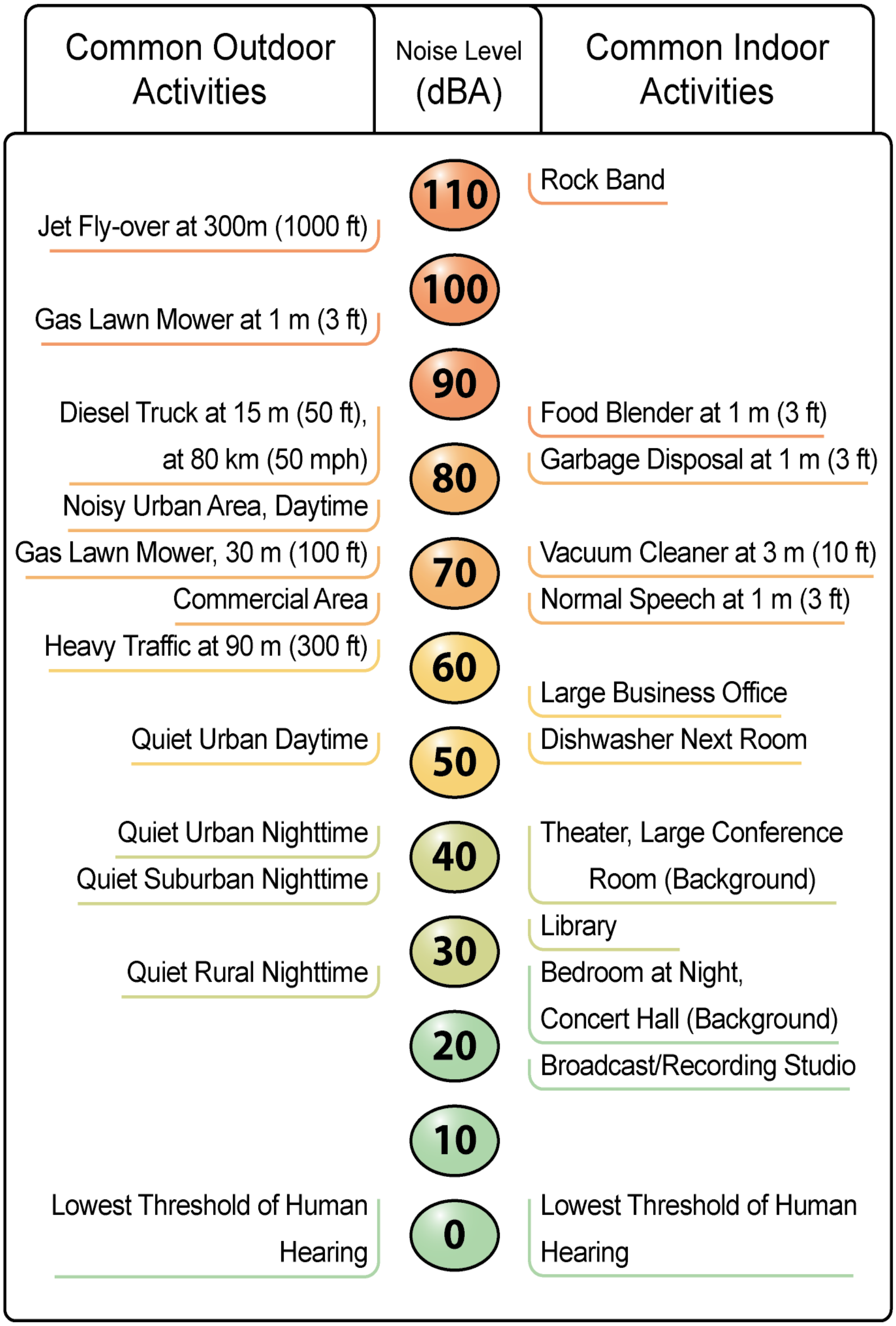
Geometric Spreading

Sound from a localized source (i.e., a point source) propagates uniformly outward in a spherical pattern. The sound level decreases (attenuates) at a rate of approximately 6 decibels for each doubling of distance from a point source. Highways consist of several localized noise sources on a defined path, and hence can be treated as a line source, which approximates the effect of several point sources. Noise from a line source propagates outward in a cylindrical pattern, often referred to as cylindrical spreading. Sound levels attenuate at a rate of approximately 3 decibels for each doubling of distance from a line source, depending on ground surface characteristics. For acoustically hard sites (i.e., sites with a reflective surface between the source and the receiver, such as a parking lot or body of water,), no excess ground attenuation is assumed. For acoustically absorptive or soft sites (i.e., those sites with an absorptive ground surface between the source and the receiver, such as soft dirt, grass, or scattered bushes and trees), an excess ground-attenuation value of 1.5 decibels per doubling of distance is normally assumed. When added to the cylindrical spreading, the excess ground attenuation for soft surfaces results in an overall attenuation rate of 4.5 decibels per doubling of distance from the source.

Atmospheric Effects

Receptors located downwind from a source can be exposed to increased noise levels relative to calm conditions, whereas locations upwind can have lowered noise levels. Sound levels can be increased at large distances (e.g., more than 500 feet) from the highway due to atmospheric temperature inversion (i.e., increasing temperature with elevation). Other factors such as air temperature, humidity, and turbulence can also have significant effects.

Figure 4
Common Community Noise Sources & Noise Levels



Source: Caltrans 2020a

Shielding by Natural or Human-Made Features

A large object or barrier in the path between a noise source and a receiver can substantially attenuate noise levels at the receiver. The amount of attenuation provided by shielding depends on the size of the object and the frequency content of the noise source. Natural terrain features (e.g., hills and dense woods) and human-made features (e.g., buildings and walls) can substantially reduce noise levels. Walls are often constructed between a source and a receiver specifically to reduce noise. A barrier that breaks the line of sight between a source and a receiver will typically result in minimum 5 dB of noise reduction. Taller barriers provide increased noise reduction.

Noise reductions afforded by building construction can vary depending on construction materials and techniques. Standard construction practices typically provide approximately 15 dBA exterior-to-interior noise reductions for building facades, with windows open, and approximately 25-30 dBA, with windows closed. With compliance with current Title 24 energy efficiency standards, which require increased building insulation and inclusion of an interior air ventilation system to allow windows on noise-impacted façades to remain closed, exterior-to-interior noise reductions typically average approximately 25 dBA. The absorptive characteristics of interior rooms, such as carpeted floors, draperies and furniture, can result in further reductions in interior noise.

NOISE DESCRIPTORS

The decibel scale alone does not adequately characterize how humans perceive noise. The dominant frequencies of a sound have a substantial effect on the human response to that sound. Although the intensity (energy per unit area) of the sound is a purely physical quantity, the loudness or human response is determined by the characteristics of the human ear.

Human hearing is limited in the range of audible frequencies as well as in the way it perceives the sound-pressure level in that range. In general, people are most sensitive to the frequency range of 1,000–8,000 Hz, and perceive sounds within that range better than sounds of the same amplitude in higher or lower frequencies. To approximate the response of the human ear, sound levels of individual frequency bands are weighted, depending on the human sensitivity to those frequencies, which is referred to as the "A-weighted" sound level (expressed in units of dBA). The A-weighting network approximates the frequency response of the average young ear when listening to most ordinary sounds. When people make judgments of the relative loudness or annoyance of a sound, their judgments correlate well with the A-scale sound levels of those sounds. Other weighting networks have been devised to address high noise levels or other special problems (e.g., B-, C-, and D-scales), but these scales are rarely used in conjunction with environmental noise.

The intensity of environmental noise fluctuates over time, and several descriptors of time-averaged noise levels are typically used. For the evaluation of environmental noise, the most commonly used descriptors are L_{eq}, L_{dn}, CNEL and SEL. The energy-equivalent noise level, L_{eq}, is a measure of the average energy content (intensity) of noise over any given period. Many communities use 24-hour descriptors of noise levels to regulate noise. The day-night average noise level, L_{dn}, is the 24-hour average of the noise intensity, with a 10-dBA "penalty" added for nighttime noise (10 p.m. to 7 a.m.) to account for the greater sensitivity to noise during this period. CNEL, the community equivalent noise level, is similar to L_{dn} but adds an additional 5-dBA penalty for evening noise (7 p.m. to 10 p.m.) Another descriptor that is commonly discussed is the single-event noise exposure level, also referred to as the sound-exposure level, expressed as SEL. The SEL describes a receiver's cumulative noise exposure from a single noise event, which is defined as an acoustical event of short duration (0.5 second), such as a backup beeper, the sound of an airplane traveling overhead, or a train whistle. Common noise level descriptors are summarized in Table 1.

HUMAN RESPONSE TO NOISE

The human response to environmental noise is subjective and varies considerably from individual to individual. Noise in the community has often been cited as a health problem, not in terms of actual physiological damage, such as hearing impairment, but in terms of inhibiting general well-being and contributing to undue stress and annoyance. The health effects of noise in the community arise from interference with human activities, including sleep, speech, recreation, and tasks that demand concentration or coordination. Hearing loss can occur at the highest noise intensity levels. When community noise interferes with human activities or contributes to stress, public annoyance with the noise source increases. The acceptability of noise and the threat to public well-being are the basis for land use planning policies preventing exposure to excessive community noise levels.

Table 1. Common Acoustical Descriptors

Descriptor	Definition
Energy Equivalent Noise Level (L_{eq})	The energy mean (average) noise level. The instantaneous noise levels during a specific period of time in dBA are converted to relative energy values. From the sum of the relative energy values, an average energy value (in dBA) is calculated.
Statistical Descriptor (L_x)	The noise level exceeded a percentage of time during a measurement period. For instance, L_{50} is a statistical descriptor of the nosie level exceeded 50% of the time during the measurement period. Over a one-hour period the L_{50} noise level is roughly equivalent to the L_{eq} noise level.
Minimum Noise Level (L_{min})	The minimum instantaneous noise level during a specific period of time.
Maximum Noise Level (L_{max})	The maximum instantaneous noise level during a specific period of time.
Day-Night Average Noise Level (DNL or L_{dn})	The DNL was first recommended by the U.S. EPA in 1974 as a "simple, uniform and appropriate way" of measuring long term environmental noise. DNL takes into account both the frequency of occurrence and duration of all noise events during a 24-hour period with a 10 dBA "penalty" for noise events that occur between the more noise-sensitive hours of 10:00 p.m. and 7:00 a.m. In other words, 10 dBA is "added" to noise events that occur in the nighttime hours to account for increases sensitivity to noise during these hours.
Community Noise Equivalent Level (CNEL)	The CNEL is similar to the L_{dn} described above, but with an additional 5 dBA "penalty" added to noise events that occur between the hours of 7:00 p.m. to 10:00 p.m. The calculated CNEL is typically approximately 0.5 dBA higher than the calculated L_{dn}.
Sound Exposure Level (SEL)	The level of sound accumulated over a given time interval or event. Technically, the sound exposure level is the level of the time-integrated mean square A-weighted sound for a stated time interval or event, with a reference time of one second.

Unfortunately, there is no completely satisfactory way to measure the subjective effects of noise or of the corresponding reactions of annoyance and dissatisfaction. This is primarily because of the wide variation in individual thresholds of annoyance and habituation to noise over differing individual experiences with noise. Thus, an important way of determining a person's subjective reaction to a new noise is the comparison of it to the existing environment to which one has adapted: the so-called "ambient" environment. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be judged. Regarding increases in A-weighted noise levels, knowledge of the following relationships will be helpful in understanding this analysis:

- Except in carefully controlled laboratory experiments, a change of 1 dB cannot be perceived by humans;
- Outside of the laboratory, a 3-dB change is considered a just-perceivable difference;
- A change in level of at least 5 dB is required before any noticeable change in community response would be expected. An increase of 5 dB is typically considered substantial;
- A 10-dB change is subjectively heard as an approximate doubling in loudness and would almost certainly cause an adverse change in community response.

Effects of Noise on Human Activities

The extent to which environmental noise is deemed to result in increased levels of annoyance, activity interference, and sleep disruption varies greatly from individual to individual depending on various factors, including the loudness or suddenness of the noise, the information value of the noise (e.g., aircraft overflights, child crying, fire alarm), and an individual's sleep state and sleep habits. Over time, adaptation to noise events and increased levels of noise may also occur. In terms of land use compatibility, environmental noise is often evaluated in terms of the potential for noise events to result in increased levels of annoyance, sleep disruption, or interference with speech communication, activities, and learning. Noise-related effects on human activities are discussed in more detail, as follows:

Speech Communication

For most noise-sensitive land uses, an interior noise level of 45 dB L_{eq} is typically identified for the protection of speech communication in order to provide for 100-percent intelligibility of speech sounds. Assuming a minimum 20-dB reduction in sound level between outdoors and indoors, with windows closed, this interior noise level of 45 dB L_{eq} would equate to an exterior noise level of 65 dBA L_{eq}. For outdoor voice communication, an exterior noise level of 60 dBA L_{eq} allows normal conversation at distances up to 2 meters with 95 percent sentence intelligibility (U.S. EPA 1974.) Based on this information, speech interference begins to become a problem when steady noise levels reach approximately 60 to 65 dBA. Within interior noise environments, an average-hourly background noise level of 45 dBA L_{eq} is typically recommended for noise-sensitive land uses, such as educational facilities (Caltrans 2002).

Learning

Closely related to speech interference are the effects of noise on learning and, more broadly, on cognitive tasks. Recent studies have shown a strong relationship between noise and children's reading ability. Children's attention spans also appear to be adversely affected by noise. Adults are affected as well. Some studies indicate that, in a noisy environment, adults have increased difficulty accomplishing complex tasks. One of the issues associated with assessment of these effects is which noise metric correlates most closely with the impacts. For example, the average-daily noise level (i.e., CNEL/L_{dn}), which incorporates a nighttime weighting, may not be the best measure of noise impacts on schools given that operational activities are often limited to the daytime hours (Caltrans 2002).

Various standards and recommended criteria have been developed to specifically address classroom noise. For instance, with regard to transportation sources, the California Department of Transportation has adopted abatement criteria that limit the maximum interior average-hourly noise level within classrooms and other noise-sensitive interior uses, to 52 dBA L_{eq}. In June 2002, the American National Standards Institute, Inc. (ANSI) released a new classroom acoustics standard entitled Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools" (ANSI S12.60-2002). For schools exposed to intermittent background noise sources, such as airport and other transportation noise, the ANSI standards recommend that interior noise levels not exceed 40 dBA L_{eq} during the noisiest hour of the day. At present complying with the ANSI-recommended standard is voluntary in most locations.

Annoyance & Sleep Disruption

With regard to potential increases in annoyance, activity interference, and sleep disruption, land use compatibility determinations are typically based on the use of the cumulative noise exposure metrics (i.e., CNEL or L_{dn}). Perhaps the most comprehensive and widely accepted evaluation of the relationship between noise exposure and the extent of annoyance was one originally developed by Theodore J. Schultz in 1978. In 1978 the research findings of Theodore J. Schultz provided support for L_{dn} as the descriptor for environmental noise. Research conducted by Schultz identified a correlation between the cumulative noise exposure metric and individuals who were highly annoyed by transportation noise. The Schultz curve, expressing this correlation, became a basis for noise standards. When expressed graphically, this relationship is typically referred to as the Schultz curve. The Schultz curve indicates that approximately 13 percent of the population is highly annoyed at a noise level of 65 dBA L_{dn}. It also indicates that the percent of people describing themselves as being highly annoyed accelerates smoothly between 55 and 70 dBA L_{dn}. A noise level of 65 dBA L_{dn} is a commonly referenced dividing point between lower and higher rates of people describing themselves as being highly annoyed (Caltrans 2002).

The Schultz curve and associated research became the basis for many of the noise criteria subsequently established for federal, state, and local entities. Most federal and state of California regulations and policies related to transportation noise sources establish a noise level of 65 dBA CNEL/L_{dn} as the basic limit of acceptable noise exposure for residential and other noise-sensitive land uses. For instance, with respect to aircraft noise, both the Federal Aviation Administration (FAA) and the State of California have identified a noise level of 65 dBA L_{dn} as the dividing point between normally compatible and normally incompatible residential land use generally applied for determination of land use compatibility. For noise-sensitive land uses exposed to aircraft noise, noise levels in excess of 65 dBA CNEL/L_{dn} are typically considered to result in a potentially significant increase in levels of annoyance (Caltrans 2002).

Allowing for an average exterior-to-interior noise reduction of 20 dB, an exterior noise level of 65 dBA CNEL/L_{dn} would equate to an interior noise level of 45 dBA CNEL/L_{dn}. An interior noise level of 45 dB CNEL/L_{dn} is generally considered sufficient to protect against activity interference at most noise-sensitive land uses, including residential dwellings, and would also be sufficient to protect against sleep interference (U.S. EPA 1974.) Within California, the California Building Code establishes a noise level of 45 dBA CNEL as the maximum acceptable interior noise level for residential uses (other than detached single-family dwellings). Use of the 45 dBA CNEL threshold is further supported by recommendations provided in the State of California Office of Planning and Research's *General Plan Guidelines*, which recommend an interior noise level of 45 dB CNEL/L_{dn} as the maximum allowable interior noise level sufficient to permit "normal residential activity."

The cumulative noise exposure metric is currently the only noise metric for which there is a substantial body of research data and regulatory guidance defining the relationship between noise exposure, people's reactions, and land use compatibility. However, when evaluating environmental noise impacts involving intermittent noise events, such as aircraft overflights and train passbys, the use of cumulative noise metrics may not provide a thorough understanding of the resultant impact. The general public often finds it difficult to understand the relationship between intermittent noise events and cumulative noise exposure metrics. In such instances, supplemental use of other noise metrics, such as the L_{eq} or L_{max} descriptor, may be helpful as a means of increasing public understanding regarding the relationship between these metrics and the extent of the resultant noise impact (Caltrans 2002).

AFFECTED ENVIRONMENT

NOISE-SENSITIVE LAND USES

Noise-sensitive land uses are generally considered to include those uses where noise exposure could result in health-related risks to individuals, as well as places where quiet is an essential element of their intended purpose. Residential dwellings are of primary concern because of the potential for increased and prolonged exposure of individuals to both interior and exterior noise levels. Additional land uses such as parks, historic sites, cemeteries, and recreation areas are also considered sensitive to increases in exterior noise levels. Schools, churches, hotels, libraries, and other places where low interior noise levels are essential are also considered noise-sensitive land uses.

Sensitive land uses located in the vicinity of the proposed project site consist predominantly of residential land uses. The nearest residential land uses are generally located to the south and east of the project site along Geer Avenue and Pearl Street, respectively.

AMBIENT NOISE ENVIRONMENT

To document existing ambient noise levels in the project area, short-term ambient noise measurements were conducted on September 18, 2019 using a Larson Davis Laboratories, Type I, Model 820 integrating sound-level meter. The meter was calibrated before use and is certified to be in compliance with ANSI specifications. Measured ambient noise levels are summarized in Table 2.

As indicated in Table 2, measured ambient noise levels in the project area ranged from approximately 48.9 to 71.3 dBA L_{eq}. Ambient noise levels within the project area are predominantly influenced by vehicle traffic on area roadways. Ambient noise levels during the evening and nighttime hours are generally 5 to 10 dB lower than daytime noise levels.

Table 2. Summary of Measured Ambient Noise Levels

Location	Monitoring Period	Noise Levels (dBA)	
		L_{eq}	L_{max}
1. Approximately 185 feet North of Pearl St and Geer Ave intersection on West side of Pearl St	10:56-11:06	48.9	64.5
2. Approximately 500 feet West of Pearl St and Geer Ave intersection on North side of Geer Ave	11:15-11:26	53.3	71.4
3. Approximately 200 feet North of Scholar Way and Geer Ave intersection on West side of Scholar Way	11:31-11:41	49.8	68.0
4. Lander Ave, approximately 100 feet North of Echo St	11:52-12:02	71.3	83.9
Ambient noise measurements were conducted on September 18, 2019 using a Larson Davis Laboratories, Type I, Model 820 integrating sound-level meter.			

REGULATORY FRAMEWORK

NOISE

State of California

The State of California regulates vehicular and freeway noise affecting classrooms, sets standards for sound transmission and occupational noise control, and identifies noise insulation standards and airport noise/land-use compatibility criteria.

California General Plan Guidelines

The *State of California General Plan Guidelines*, published by the Governor's Office of Planning and Research (GOPR 2017), also provides guidance for the acceptability of projects within specific CNEL/L_{dn} contours. The guidelines also present adjustment factors that may be used in order to arrive at noise acceptability standards that reflect the noise control goals of the community, the particular community's sensitivity to noise, and the community's assessment of the relative importance of noise pollution. For school land uses, the *State of California General Plan Guidelines* identify a "normally acceptable" exterior noise level of up to 70 dBA CNEL/L_{dn}. Schools are considered "conditionally acceptable" within noise environments of 60 to 70 dBA CNEL/L_{dn} and "normally unacceptable" within exterior noise environments of 70 to 80 CNEL/L_{dn} and "clearly unacceptable" within exterior noise environments in excess of 80 dBA CNEL/L_{dn}. Assuming a minimum exterior-to-interior noise reduction of 20 dB, an exterior noise environment of 65 dBA CNEL/L_{dn} would allow for a normally acceptable interior noise level of 45 dBA CNEL/L_{dn}.

County of Merced

The *Merced County General Plan Health and Safety Element* includes noise standards for both non-transportation (stationary) and transportation noise sources for determination of land use compatibility. In accordance with General Plan policies, new projects within sensitive areas include measures to mitigate noise levels to comply with standards. (County of Merced 2013). The County's noise standards for non-transportation and transportation noise sources are summarized in Tables 3 and 4, respectively.

The County's General Plan also includes Policy HS-7.5, which limits noise generating activities, such as construction, to normal business hours of operation. The County typically limits noise-generating construction activities to between the daytime hours of 7:00 a.m. and 6:00 p.m.

As depicted in Table 3, non-transportation noise exposure at schools is limited to daytime noise levels of 55 dBA L_{50}/75 dBA L_{max} at outdoor activity areas and 35 dBA L_{50}/60 dBA L_{max} within interior areas. Non-transportation noise exposure at residential land uses is limited to a daytime noise level of 55 dBA L_{50}/75 dBA L_{max} in outdoor activity areas and 35 dBA L_{50}/55 dBA L_{max} within interior areas. As noted in Table 4, exterior exposure to transportation noise levels is limited to an average-daily exterior noise level of 65 dBA L_{dn}/CNEL for both schools and residential land uses. Interior exposure to transportation noise levels is limited to an average-daily noise level of 40 dBA L_{dn}/CNEL for schools and 45 dBA L_{dn}/CNEL for residential land uses.

Table 3. County of Merced General Plan Noise Standards - Non-Transportation (Stationary) Noise Sources

Land Use	Notes	Outdoor[2] Daytime (L_{50}/L_{Max}[1])	Outdoor[2] Nighttime (L_{50}/L_{Max}[1])	Interior[3] Daytime or Nighttime (L_{50}/L_{Max}[1])
All Residential		55/75	50/70	35/55
Transient Lodging	4	55/75	--	35/55
Hospitals and Nursing Homes	5,6	55/75	--	35/55
Theaters and Auditoriums	6	--	--	30/50
Churches, Meeting Halls, Schools, Libraries, etc.	6	55/75	--	35/60
Office Buildings	6	60/75	--	45/65
Commercial Buildings	6	55/75	--	45/65
Playgrounds, Parks, etc.	6	65/75	--	--
Industry	6	60/80	--	50/70

Notes:

1. *These standards shall be reduced by 5 dB for sounds consisting primarily of speech or music, and for recurring impulsive sounds. If the existing ambient noise level exceeds the standards in this table, then the noise level standards shall be increased at 5 dB increments to encompass the ambient.*
2. *Sensitive Outdoor Areas include primary outdoor activity areas associated with any given land use at which noise-sensitivity exists and the location at which the County's exterior noise level standards are applied.*
3. *Sensitive Interior Areas includes any interior area associated with any given land use at which noise sensitivity exists and the location at which the County's interior noise level standards are applied. Examples of sensitive interior spaces include, but are not limited to, all habitable rooms of residential and transient lodging facilities, hospital rooms, classrooms, library interiors, offices, worship spaces, theaters. Interior noise level standards are applied within noise-sensitive areas of the various land uses with windows and doors in the closed positions.*
4. *Outdoor activity areas of transient lodging facilities are not commonly used during nighttime hours.*
5. *Since hospitals are often noise-generating uses, the exterior noise level standards are applicable only to clearly identified areas designated for outdoor relaxation by either hospital staff or patients.*
6. *The outdoor activity areas of these uses (if any) are not typically used during nighttime hours.*
7. *Where median (L_{50}) noise level data is not available for a particular noise source, average (Leq) values may be substituted for the standards of this table provided the noise source operates for at least 30 minutes. If the source operates less than 30 minutes the maximum noise level standards shown shall apply.*

Source: County of Merced 2013

Table 4. County of Merced General Plan Noise Standards - Transportation Noise Sources

Land Use	Notes	Sensitive Outdoor Area[1] (L_{dn})	Sensitive Indoor Area[2] (L_{dn})
All Residential	3	65	45
Transient Lodging	3,4	65	45
Hospitals and Nursing Homes	3,4,5	65	45
Theaters and Auditoriums	4	--	35
Churches, Meeting Halls, Schools, Libraries, etc.	4	65	40
Office Buildings	4	65	45
Commercial Buildings	4	--	50
Playgrounds, Parks, etc.		70	--
Industry	4	65	50

Notes:

1. Sensitive Outdoor Areas include primary outdoor activity areas associated with any given land use at which noise-sensitivity exists and the location at which the County's exterior noise level standards are applied.

2. Sensitive Interior Areas includes any interior area associated with any given land use at which noisesensitivity exists and the location at which the County's interior noise level standards are applied. Examples of sensitive interior spaces include, but are not limited to, all habitable rooms of residential and transient lodging facilities, hospital rooms, classrooms, library interiors, offices, worship spaces, theaters. Interior noise level standards are applied within noise-sensitive areas of the various land uses with windows and doors in the closed positions.

3. Railroad warning horn usage shall not be included in the computation of L_{dn}.

4. Only the interior noise level standard shall apply if there are no sensitive exterior spaces proposed for these uses.

5. Since hospitals are often noise-generating uses, the exterior noise level standards are applicable only to clearly identified areas designated for outdoor relaxation by either hospital staff or patients.

Source: County of Merced 2013

GROUNDBORNE VIBRATION

Vibration is like noise in that it involves a source, a transmission path, and a receiver. While vibration is related to noise, it differs in that noise is generally considered to be pressure waves transmitted through air, whereas vibration usually consists of the excitation of a structure or surface. As with noise, vibration consists of amplitude and frequency. A person's perception of the vibration will depend on their individual sensitivity to vibration, as well as the amplitude and frequency of the source and the response of the system which is vibrating. Vibration can be measured in terms of acceleration, velocity, or displacement.

The effects of groundborne vibration levels, with regard to human annoyance and structural damage, is influenced by various factors, including ground type, the distance between source and receptor, and duration. Overall effects are also influenced by the type of the vibration event, defined as either continuous or transient. Continuous vibration events would include most construction equipment, including pile drivers, and compactors; whereas, transient sources of vibration create single isolated vibration events, such as demolition ball drops and blasting. The threshold criteria for continuous and transient events are summarized in Table 5.

As indicated in Table 5, the threshold at which there is a risk to normal structures from continuous events is 0.5 in/sec ppv for newer building construction. A threshold of 0.5 in/sec ppv also represents the structural damage threshold applied to older structures for transient vibration sources. With regard to human perception (refer to Table 5), vibration levels would begin to become distinctly perceptible at levels of 0.04 in/sec ppv for continuous events and 0.25 in/sec ppv for transient events. Continuous vibration levels are considered annoying for people in buildings at levels of 0.2 in/sec ppv.

Table 5
Summary of Groundborne Vibration Levels and Potential Effects

Vibration Level (in/sec ppv)	Human Reaction	Effect on Buildings
0.006 - 0.019	Threshold of perception; possibility of intrusion.	Vibrations unlikely to cause damage of any type.
0.08	Vibrations readily perceptible.	Recommended upper level of the vibration to which ruins and ancient monuments should be subjected.
0.10	Level at which continuous vibrations begin to annoy people.	Virtually no risk of "architectural" damage to normal buildings.
0.20	Vibrations annoying to people in buildings (this agrees with the levels established for people standing on bridges and subjected to relatively short periods of vibrations).	Threshold at which there is a risk of "architectural" damage to fragile buildings.
0.3 - 0.6	Vibrations become distinctly perceptible at 0.04 in/sec ppv and considered unpleasant by people subjected to continuous vibrations and unacceptable to some people walking on bridges.	Potential risk of "architectural" damage may occur at levels above 0.3 in/sec ppv for older residential structures and above 0.5 in/sec ppv for newer structures.

The vibration levels are based on peak particle velocity in the vertical direction for continuous vibration sources, which includes most construction activities.
Source: Caltrans 2020b

IMPACTS AND MITIGATION MEASURES

METHODOLOGY

Short-Term Construction Noise

Short-term noise impacts associated with construction activities were analyzed based on typical construction equipment noise levels and distances to the nearest noise-sensitive land uses. Noise levels were predicted based on an average noise-attenuation rate of 6 dB per doubling of distance from the source.

Long-term Operational Noise

Roadway Traffic Noise

Traffic noise levels were calculated using the Federal Highway Administration (FHWA) roadway noise prediction model (FHWA-RD-77-108) based on California vehicle reference noise levels and traffic data obtained from the traffic analysis prepared for this project. Additional input data included day/night percentages of autos, medium and heavy trucks, vehicle speeds, ground attenuation factors, and roadway widths. The project's contribution to traffic noise levels along area roadways was determined by comparing the predicted noise levels with and without project-generated traffic. The compatibility of the proposed land uses were evaluated based on predicted future on-site noise conditions and in comparison to the County of Merced's interior noise standard of 40 dBA L_{dn}/CNEL for school uses (refer to Table 4).

Non-Transportation Noise

Noise levels associated with vehicle parking areas were calculated in accordance with FHWA's *Transit Noise and Vibration Impact Assessment Guidelines* (2006) assuming a reference noise level of 92 dBA SEL. Average-hourly noise levels associated with vehicle parking-related activities were calculated based on the conservative assumption that all parking spaces would be accessed over a one-hour period. Noise levels generated by other on-site noise sources, including on-site building mechanical equipment and recreational uses were assessed based on representative noise data obtained from similar land uses.

THRESHOLDS OF SIGNIFICANCE

In accordance with Appendix G of the CEQA Guidelines Initial Study Checklist, a project would be considered to have a significant impact to climate change if it would:

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

b) 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 two miles of a public airport or public use airport, the project would expose people residing or working in the project area to excessive noise levels.

Noise

Predicted non-transportation and transportation noise levels that exceed the County noise standards would be considered a potentially significant impact (refer Table 3 and Table 4, respectively). As depicted in Table 3, non-transportation noise exposure at schools is limited to daytime noise levels of 55 dBA L_{50}/75 dBA L_{max} at outdoor activity areas and 35 dBA L_{50}/60 dBA L_{max} within interior areas. Non-transportation noise exposure at residential land uses is limited to a daytime noise level of 55 dBA L_{50}/75 dBA L_{max} in outdoor activity areas and 35 dBA L_{50}/55 dBA L_{max} within interior areas. As noted in Table 4, exterior exposure to transportation noise levels is limited to an average-daily exterior noise level of 65 dBA CNEL for both schools and residential land uses. Interior exposure to transportation noise levels is limited to an average-daily noise level of 40 dBA CNEL for schools and 45 dBA CNEL for residential land uses. Construction activities occurring during the daytime hours of between 7:00 a.m. and 6:00 p.m. are exempt from County noise standards.

The *CEQA Guidelines* do not define the levels at which temporary and permanent increases in ambient noise are considered “substantial.” As discussed previously in this section, a noise level increase of 3 dBA is barely perceptible to most people, a 5 dBA increase is readily noticeable, and a difference of 10 dBA would be perceived as a doubling of loudness. For purposes of this analysis, a significant increase in ambient noise levels would be defined as an increase of 5 dBA, or greater. Significant increases in ambient noise levels that would exceed applicable noise standards would be considered to have a potentially significant impact.

Groundborne Vibration

The *CEQA Guidelines* also do not define the levels at which groundborne vibration levels would be considered excessive. For this reason, Caltrans’ recommended groundborne vibration thresholds were used for the evaluation of impacts based on increased potential for structural damage and human annoyance, as identified in Table 5. Based on these levels, groundborne vibration levels would be considered to have a potentially significant impact with regard to potential structural damage if levels would exceed a 0.5 in/sec ppv.

PROJECT IMPACTS

Impact Noise-A:	***Would the project result in the generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?***

Noise generated by the proposed project would occur during short-term construction and long-term operation. Noise-related impacts associated with short-term construction and long-term operations of the proposed project are discussed separately, as follows:

Short-term Construction Noise Levels

Construction noise typically occurs intermittently and varies depending upon the nature or phase of construction (e.g., land clearing, grading, building construction). Noise generated by construction equipment, including earth movers, material handlers, and portable generators, can reach high levels. Although noise ranges were found to be similar for all construction phases, the initial site preparation phases, including demolition and grading/excavation activities, tend to involve the most equipment and result in the highest average-hourly noise levels.

Noise levels commonly associated with construction equipment are summarized in Table 6. As noted in Table 6, instantaneous noise levels (in dBA L_{max}) generated by individual pieces of construction equipment typically range from approximately 80 dBA to 85 dBA L_{max} at 50 feet (FTA 2018). Typical operating cycles may involve 2 minutes of full power, followed by 3 or 4 minutes at lower settings. Average-hourly noise levels for individual equipment generally range from approximately 73 to 82 dBA L_{eq}. Based on typical off-road equipment usage rates and assuming multiple pieces of equipment operating simultaneously within a localized area, such as soil excavation activities, average-hourly noise levels could reach levels of approximately 80 dBA L_{eq} at roughly 100 feet.

Table 6. Typical Construction Equipment Noise Levels

Equipment	Typical Noise Level (dBA) at 50 feet from Source	
	L_{max}	L_{eq}
Compactor, Concrete Vibratory Mixer	80	73
Backhoe/Front-End Loader, Air Compressor	80	76
Generator	82	79
Crane, Mobile	85	77
Jack Hammer, Roller	85	78
Dozer, Excavator, Grader, Concrete Mixer Truck	85	81
Paver, Pneumatic Tools	85	82
Sources: FTA 2018		

Depending on the location and types of activities conducted (e.g., building demolition, soil excavation, grading), predicted noise levels at the nearest residences, which are generally located to the east and south of the project site, could potentially exceed 75 dBA L_{eq}/L_{max}. Construction-generated noise levels could potentially exceed the County's noise standards. Furthermore, with regard to residential land uses, activities occurring during the more noise-sensitive evening and nighttime hours could result in increased levels of annoyance and potential sleep disruption. For these reasons, noise-generating construction activities would be considered to have a ***potentially significant*** short-term noise impact.

Mitigation Measure Noise-1: The following measures shall be implemented to reduce construction-generated noise levels:

a. Construction activities (excluding activities that would result in a safety concern to the public or construction workers) shall be limited to between the hours of 7:00 a.m. and 6:00 p.m. Construction activities shall be prohibited on Sundays and legal holidays.

b. Construction truck trips shall be scheduled, to the extent feasible, to occur during non-peak hours and truck haul routes shall be selected to minimize impacts to nearby residential dwellings.

c. Construction equipment shall be properly maintained and equipped with noise-reduction intake and exhaust mufflers and engine shrouds, in accordance with manufacturers' recommendations. Equipment engine shrouds shall be closed during equipment operation.

d. Stationary construction equipment (e.g., portable power generators) should be located at the furthest distance possible from nearby residences. If deemed necessary, portable noise barriers shall be erected sufficient to shield nearby residences from direct line-of-sight of stationary construction equipment.

e. When not in use, all equipment shall be turned off and shall not be allowed to idle. Provide clear signage that posts this requirement for workers at the entrances to the site.

Significance After Mitigation: Use of mufflers would reduce individual equipment noise levels by approximately 10 dBA. Implementation of the above mitigation measures would limit construction activities to the less noise-sensitive periods of the day. With implementation of the above mitigation measures and because activities would be short-term, this impact would be considered ***less than significant***.

Long-term Operational Noise Levels

Potential long-term increases in noise associated with the proposed project would be primarily associated with the operation of building equipment, such as heating, ventilation, and air conditioning (HVAC) units, outdoor recreational activities, and vehicle use within onsite parking lots.

Building Mechanical Equipment

The operation of the proposed elementary school would be predominantly limited to daytime hours. Proposed onsite structures would be anticipated to include the use of building mechanical equipment, such as air conditioning units and exhaust fans. The specific building mechanical equipment to be installed and the locations of such equipment have not yet been identified. Building mechanical equipment (e.g., air conditioning units, exhaust fans) would typically be located within the structures, enclosed, or placed on rooftop areas away from direct public exposure. Exterior air conditioning units would be anticipated to generate the loudest noise levels at exterior locations. Exterior air conditioning units can generate noise levels up to approximately 65 dBA L_{50}/L_{eq} at 10 feet. Based on this noise level and assuming a noise-attenuation rate of 6 dB/doubling of distance from the source, predicted noise levels at the nearest residential land uses would be 44 dBA L_{50}/L_{eq}, or less. Predicted operational noise levels at nearby residential land uses would not exceed the County's applicable exterior daytime noise standard of 55 dBA L_{50}/L_{eq} (refer to Table 3). Noise generated by building mechanical equipment would be considered to have a less-than-significant impact.

Recreational Facilities

The proposed project includes the construction of play courts and structures. Based on measurement data obtained from similar uses, noise levels associated with small playgrounds, courts, and ball fields can generate noise levels of approximately 55-60 dBA L_{50}/L_{eq} at 50 feet. Assuming a maximum noise level of 60 dBA L_{50}/L_{eq}, predicted noise levels at the nearest residential land uses would be approximately 44 dBA L_{50}/L_{eq}, or less. Predicted operational noise levels at nearby residential land uses would not exceed the County's applicable exterior daytime noise standard of 55 dBA L_{50}/L_{eq} (refer to Table 3). Noise generated by recreational facilities would be considered to have a less-than-significant impact.

Vehicle Parking Areas

The proposed project includes the construction of various surface parking lots, including an approximate 22-space staff parking lot located near the northeastern boundary of the project site. Staff and visitor parking lots are also located near the eastern boundary of the project site with a combined parking area of 36 spaces. Based on a conservative assumption that all parking spaces within the parking areas were to be accessed over a one-hour period, predicted noise levels at the nearest residential dwellings would be approximately 44 dBA L_{50}/L_{eq}, or less. Predicted operational noise levels at nearby residential land uses would not exceed the County's applicable exterior daytime noise standard of 55 dBA L_{50}/L_{eq} (refer to Table 3). Noise generated by vehicle parking areas would be considered to have a less-than-significant impact.

Roadway Traffic

Predicted existing traffic noise levels, with and without implementation of proposed project, are summarized in Table 7. In comparison to existing traffic noise levels, the proposed project would result in a predicted increase in traffic noise levels of 0.1 to 4.8 dBA along area roadways.

Predicted increases in future cumulative traffic noise levels along nearby roadways are summarized in Table 8. In future years, the project's contribution to cumulative traffic noise levels would be anticipated to decline slightly as increases in vehicle traffic due to surrounding development increases. Under future cumulative conditions, the proposed project would result in predicted increases in traffic noise levels of 0.1 to 4.4 dBA along area roadways.

As noted earlier in this report, changes in ambient noise levels of approximately 3 dBA, or less, are typically not discernible to the human ear and would not be considered to result in a significant impact. Implementation of the proposed project would result in a significant increase (i.e., 5 dBA, or greater) in existing and projected future traffic noise levels along area roadways. This highest predicted increase in traffic noise levels is projected to occur along Geer Avenue, west of Lander Avenue. However, predicted traffic noise levels along this roadway segment would not be projected to exceed the County's exterior noise standard of 65 dBA L_{dn}/CNEL at adjacent residential land uses. As a result, this impact would be considered less than significant.

Table 7. Predicted Increases in Existing Traffic Noise Levels

Roadway Segment	Predicted Noise Level at 50 feet from Centerline of Near Travel Lane (dBA L_{dn}/CNEL)[1]			
	Existing Without Project	Existing With Project	Difference[2]	Significant Impact?[3]
Lander Ave., Dayton Ave. to Echo St.	61.5	62.1	0.6	No
Dayton Ave., West of Lander Av Ave.	46.0	46.0	0.0	No
Geer Ave., West of Lander Ave.	56.6	61.4	4.8	No
Geer Ave., East of Lander Ave.	54.2	54.4	0.1	No
Lander Ave., Geer Ave. to Dayton Ave.	61.3	61.9	0.6	No

1. Traffic noise levels were calculated using the FHWA roadway noise prediction model (FHWA-RD-77-108), based on data obtained from the traffic analysis prepared for this project.
2. Difference in noise levels reflects the incremental increase attributable to the proposed project.
3. Defined as a substantial increase (i.e., 5 dBA, or greater) in ambient noise levels in excess of the County's exterior noise standard of 65 dBA CNEL.

Table 8. Predicted Increases in Future Traffic Noise Levels

Roadway Segment	Predicted Noise Level at 50 feet from Centerline of Near Travel Lane (dBA L_{dn}/CNEL)[1]			
	Future Without Project	Future With Project	Difference[2]	Significant Impact?[3]
Lander Ave., Dayton Ave. to Echo St.	61.8	62.4	0.6	No
Dayton Ave., West of Lander Av Ave.	46.4	46.4	0.0	No
Geer Ave., West of Lander Ave.	57.1	61.5	4.4	No
Geer Ave., East of Lander Ave.	54.6	54.7	0.1	No
Lander Ave., Geer Ave. to Dayton Ave.	61.7	62.2	0.6	No

1. Traffic noise levels were calculated using the FHWA roadway noise prediction model (FHWA-RD-77-108), based on data obtained from the traffic analysis prepared for this project.
2. Difference in noise levels reflects the incremental increase attributable to the proposed project.
3. Defined as a substantial increase (i.e., 5 dBA, or greater) in ambient noise levels in excess of the County's exterior noise standard of 65 dBA CNEL.

Land Use Compatibility

The County of Merced General Plan Noise Element includes noise standards for determination of land use compatibility for new land uses. As previously discussed, the County's "normally acceptable" exterior noise standards for schools is 65 dBA L_{dn}/CNEL.

As noted earlier in this report, ambient noise levels in the project area are largely influenced by traffic noise on area roadways. Under future cumulative conditions, predicted traffic noise levels for the adjacent segment of Geer Avenue would be approximately 62 dBA L_{dn}/CNEL at 50 feet from the near-travel-lane centerline (refer to Table 8). Based on preliminary site plans, the nearest proposed structures/outdoor activity areas would be located in excess of 80 feet from the from the near-travel-lane centerline of Geer Avenue. Based on this distance, predicted exterior noise levels at the nearest proposed structure/outdoor activity area would be approximately 58 dBA L_{dn}/CNEL, or less. Based on this exterior noise level and assuming an average exterior-to-interior noise reduction of 25 dBA, which is typical for new building construction, predicted interior noise levels at the nearest proposed structure would be approximately 33 dBA L_{dn}/CNEL, or less. Predicted exterior and interior noise levels would not exceed the County's applicable noise standard of 65 and 40 dBA L_{dn}/CNEL, respectively. As a result, this impact would be considered less than significant.

Impact Noise-B. Would the project result in the generation of excessive groundborne vibration or groundborne noise levels?

Long-term operational activities associated with the proposed project would not involve the use of any equipment or processes that would result in potentially significant levels of ground vibration. Increases in groundborne vibration levels attributable to the proposed project would be primarily associated with short-term construction-related activities. Construction activities associated with the proposed improvements would likely require the use of various off-road equipment, such as tractors, concrete mixers, and haul trucks. The use of major groundborne vibration-generating construction equipment, such as pile drivers, would not be required for this project.

Groundborne vibration levels associated with representative construction equipment are summarized in Table 9. As depicted, ground vibration generated by construction equipment would be approximately 0.089 in/sec ppv, or less, at 25 feet (Caltrans 2020). Predicted vibration levels at the nearest existing structures would not be anticipated to exceed commonly applied criteria for structural damage or human annoyance (i.e., 0.5 and 0.2 in/sec ppv, respectively). In addition, no fragile or historic structures have been identified in the project area. As a result, this impact would be considered less than significant.

Table 9. Representative Vibration Source Levels for Construction Equipment

Equipment	Peak Particle Velocity at 25 Feet (In/Sec)
Large Bulldozer	0.089
Loaded Truck	0.076
Jackhammer	0.035
Small Bulldozer	0.003
Source: Caltrans 2020	

Impact Noise-C. ***For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?***

The nearest airport in the project vicinity is the Turlock Airpark, which are located approximately 4.5 miles to the north of the project site. The nearest airstrip is airstrip, which is located approximately 3.7 miles west of the project site. The project site is not located within two miles of a public airport or private airstrip. The proposed project site is not located within the projected noise contours of major airports within the County (Merced County 2012). Implementation of the proposed project would not result in the exposure of sensitive receptors to aircraft noise levels nor would the proposed project affect airport operations. This impact is considered less than significant.

REFERENCES

California Department of Transportation (Caltrans). 2020a. *EIR/EA Annotated Outline*. Available at website url: https://dot.ca.gov/programs/environmental-analysis/standard-environmental-reference-ser/forms-templates.

California Department of Transportation (Caltrans). 2020b. *Transportation and Construction Vibration Guidance Manual.*

California Department of Transportation (Caltrans). August 2006. *Traffic Noise Analysis Protocol*.

California Department of Transportation (Caltrans). 2002. *Caltrans Airport Land Use Planning Handbook.*

California, Department of Transportation (Caltrans). 1998. *California Department of Transportation (Caltrans). Technical Noise Supplement.*

California, Governor's Office of Planning and Research (GOPR). 2017. *State of* California *General Plan Guidelines*.

County of Merced, Airport Land Use Commission. June 2012. Merced County Airport Land Use Compatibility Plan. Available at website url: https://www.co.merced.ca.us/406/Airport-Land-Use-Commission.

Federal Register Vol 65, No 136, July 14, 2000. *FAA Aviation Noise Abatement Policy*. Available at Website url: www.transource.org/shared_files/noisepol.pdf.

JLB Traffic Engineering, Inc. November 10, 2020. *Draft Traffic Impact Analysis: Hilmar Unified School District Elementary School Project.*

Odell Planning & Research (OPR). 2020. E-mail correspondence between Daniel Brannick, Project Planner and Kurt Legleiter, Principal, AMBIENT Air Quality & Noise Consulting.

United States Department of Transportation, Federal Transit Administration (FTA). April 2018. *Transit Noise and Vibration Impact Assessment Manual. Website url: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123_0.pdf.*

U.S. Environmental Protection Agency (U.S. EPA). December 31, 1971. *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances*.

U.S. Environmental Protection Agency (U.S. EPA). 1974. *Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*.

APPENDIX A

Noise Prediction Modeling & Supportive Documentation

PREDICTED TRAFFIC NOISE LEVELS

ROADWAY SEGMENT	LANES	SPEED (MPH)	PEAK-HOUR VOLUMES				ADT VOLUMES			
			EXISTING	EX+PROJ	CUM	CUM+PROJ	EXISTING	EX+PROJ	CUM	CUM+PROJ
LANDER AVE, DAYTON AVE TO ECHO ST	2	30	994	1139	1076	1221	9940	11390	10760	12210
DAYTON AVE, WEST OF LANDER AVE	2	25	34	34	37	37	340	340	370	370
GEER AVENUE, WEST OF LANDER AVE	2	35	172	521	194	534	1720	5210	1940	5340
GEER AVENUE, EAST OF LANDER AVE	2	35	101	104	109	112	1010	1040	1090	1120
LANDER AVE, GEER AVENUE TO DAYTON AVE	2	30	955	1100	1034	1179	9550	11000	10340	11790

ROADWAY SEGMENT	CNEL AT 50' FROM NTLCL					
	EXISTING	EX+PROJ	INCREASE	CUM	CUM+PROJ	INCREASE
LANDER AVE, DAYTON AVE TO ECHO ST	61.5	62.1	0.6	61.8	62.4	0.6
DAYTON AVE, WEST OF LANDER AVE	46.0	46.0	0.0	46.4	46.4	0.0
GEER AVENUE, WEST OF LANDER AVE	56.6	61.4	4.8	57.1	61.5	4.4
GEER AVENUE, EAST OF LANDER AVE	54.2	54.4	0.1	54.6	54.7	0.1
LANDER AVE, GEER AVENUE TO DAYTON AVE	61.3	61.9	0.6	61.7	62.2	0.6

NTLCL=Near travel lane centerline

ROADWAY SEGMENT	DISTANCE TO CNEL CONTOURS (FEET) - CUMULATIVE+PROJECT				
	70	65	60	55	
LANDER AVE, DAYTON AVE TO ECHO ST	WR	WR	96	204	
DAYTON AVE, WEST OF LANDER AVE	WR	WR	WR	WR	
GEER AVENUE, WEST OF LANDER AVE	WR	WR	70	150	
GEER AVENUE, EAST OF LANDER AVE	WR	WR	WR	53	
LANDER AVE, GEER AVENUE TO DAYTON AVE	WR	WR	94	200	

PREDICTED STATIONARY SOURCE NOISE LEVELS

NOISE SOURCE	REFERENCE NOISE LEVEL	DISTANCE FROM SOURCE CENTER TO NEAREST RESIDENCE (FEET)	SHIELDING	PREDICTED NOISE LEVEL (dBA Leq)
PARKING LOT - STAFF (22 SPACES)	92 SEL	115	0	44
PARKING LOT - VISITOR/STAFF (36 SPACES)	92 SEL	115	0	44
PLAY COURTS	60 dBA Leq at 50 ft	300	0	44
EXTERIOR AC UNITS-NEW ADMIN BUILDING	65 dBA Leq at 10 ft	115	0	44
EXTERIOR AC UNITS-NEW CLASSROOMS	65 dBA Leq at 10 ft	135	0	42