Appendix E

Noise & Groundborne Vibration Impact Assessment

NOISE & GROUNDBORNE VIBRATION IMPACT ANALYSIS

FOR

FRESNO CITY COLLEGE SOFTBALL FIELD IMPROVEMENT PROJECT

STATE CENTER COMMUNITY
COLLEGE DISTRICT
FRESNO, CA

JULY 2022

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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 proposed project includes improvement to existing softball facilities at Fresno City College. The project location is depicted in Figures 1 and 2. The following facilities and activities are planned as part of the project. Development of the facilities would occur over the next year.

- Demolition of existing dugout, bullpen, and announcer booth, approximately 2,050 square feet.
- Replacement of the existing bleacher seating with a new 200 person seating capacity.
- Construction of an announcer's booth, in-ground dugout enclosure, batting cage area, two pitching warm-up areas, back stop fencing, and field lighting.
- Construction of a field house that contains a team room, coach's office, restrooms, snack bar. And storage areas.
- The addition of 3 ADA parking spaces along an existing access road.

EXISTING SETTING

CONCEPTS AND TERMINOLOGY

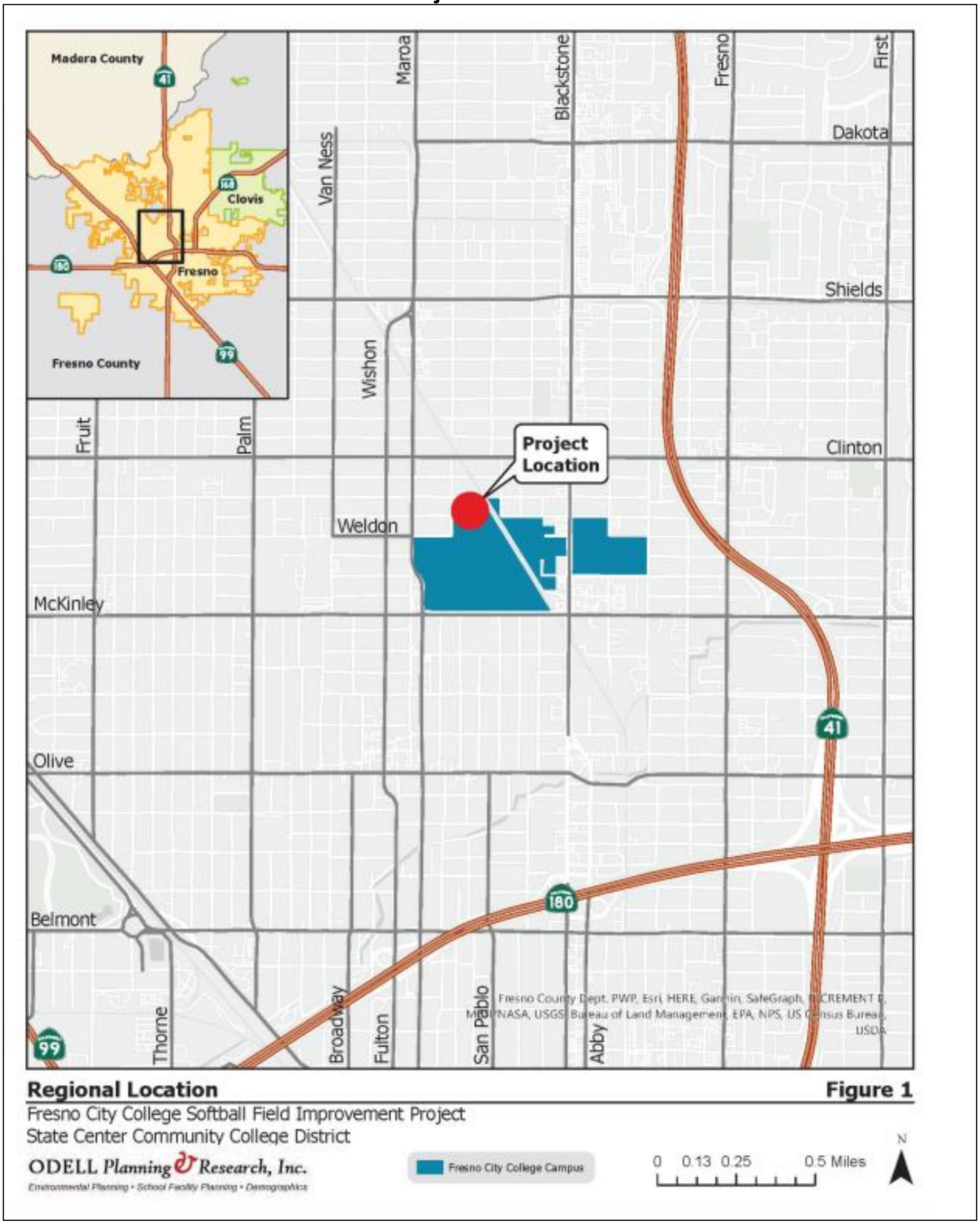
ACOUSTIC FUNDAMENTALS

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
Project Location

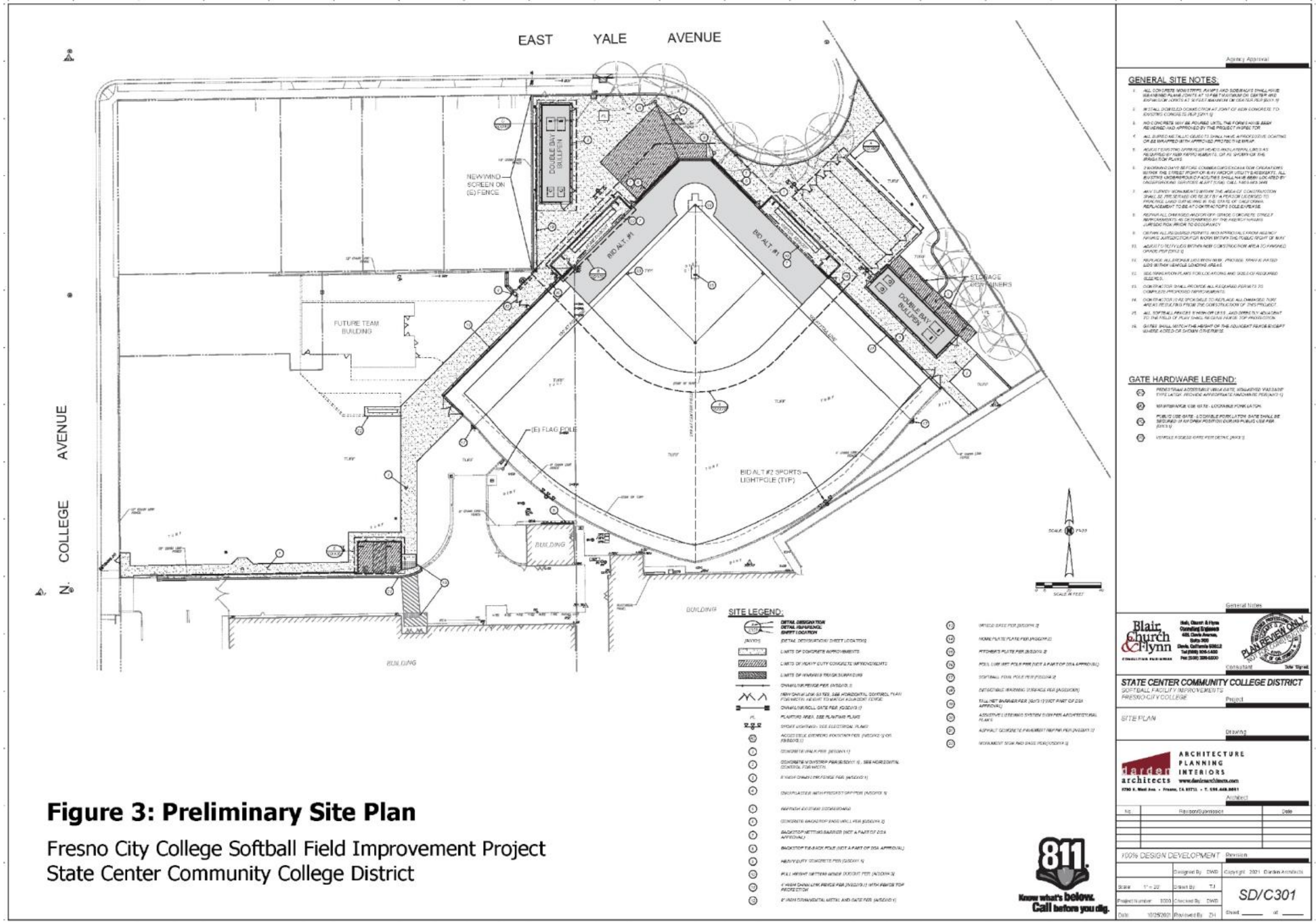


Source: OPR 2022

Figure 2
Project Site Boundaries & Noise Monitoring Locations

Source: OPR 2022

Figure 3
Preliminary Site Plan



Source: Darden Architects 2021

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 3.

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.

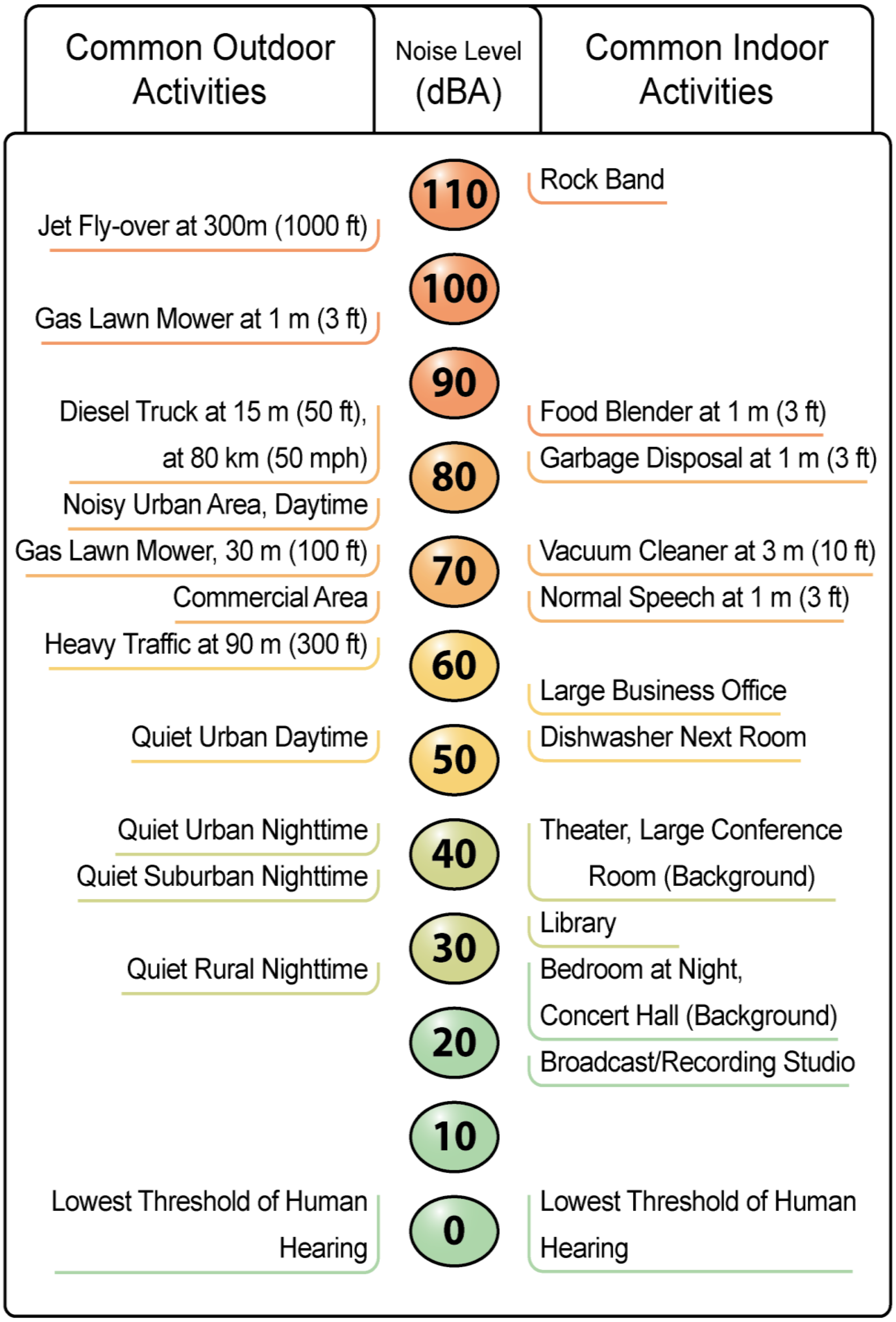
Atmospheric Effects

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.

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

Figure 4
Common Community Noise Sources & Noise Levels



Source: Caltrans 2018

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 20-30 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.
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 north of the project site, east of N. College Avenue and north and south of E. Yale Avenue.

AMBIENT NOISE ENVIRONMENT

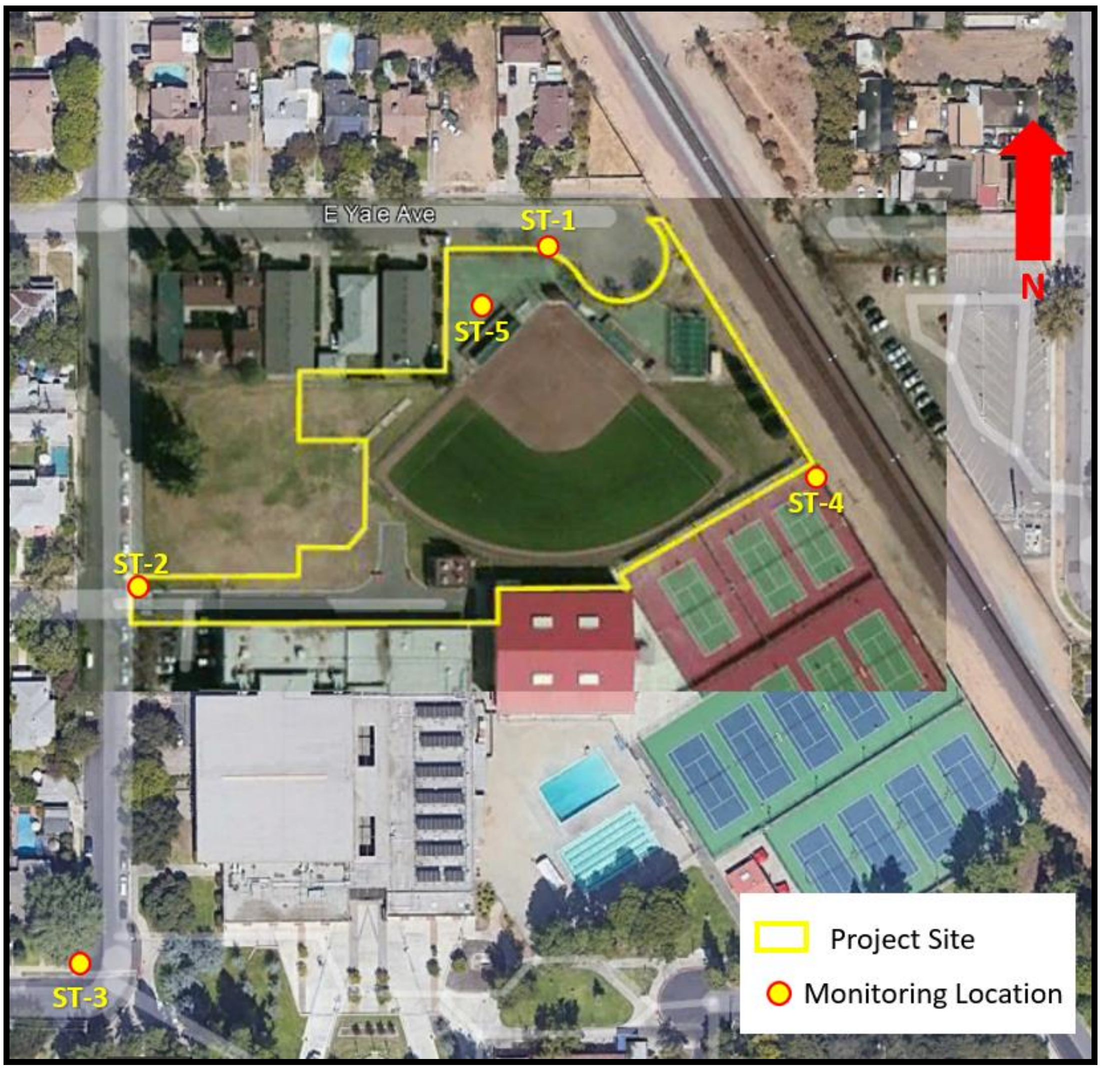
To document existing ambient noise levels in the project area, short-term ambient noise measurements were conducted on June 14, 2022 using a Larson Davis Laboratories, Type I, Model 820 integrating sound-level meter. The meter was calibrated before use and is certified to be in compliance with ANSI specifications. Measured ambient noise levels are summarized in Table 2 and measurement location are shown in Figure 5.

As indicated in Table 2, measured ambient noise levels in the project area ranged from approximately 55.4 to 57.9 dBA L_{eq}. Ambient noise levels within the project area are predominantly influenced by vehicle traffic on area roadways and mechanical equipment on campus buildings. 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	Measurement Period	Noise Levels (dBA)	
		L_{eq}	L_{max}
ST-1: E. Yale Avenue. Approximately 45 feet north of the fields backstop.	1301-1311	45.4	53.5
ST-2: N. College Avenue. Entrance of staff Parking Lot L.	1317-1327	54.5	70.1
ST-3: NW Corner of N. College Avenue and E. Weldon Avenue.	1334-1344	53.6	65.1
ST-4: NE Corner of FCC Tennis Courts.	1349-1359	57.9	68.2
ST-5: Approximately 7 feet west of home team bullpen and dug out.	1403-1413	46.7	57.9
Ambient noise measurements were conducted on June 14, 2022 using a Larson Davis Laboratories, Type I, Model 820 integrating sound-level meter.			

Figure 5
Noise Measurement Locations



Refer to Figure1 & 2 for Project location boundaries.
Source: GoogleEarth 2022, OPR 2021

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 (OPR 2003), 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}.

City of Fresno

The *Fresno General Plan Noise and Safety Element* includes noise standards for both stationary and transportation noise sources for determination of land use compatibility. In accordance with General Plan policies, new noise-sensitive land uses impacted by existing or projected future transportation or stationary noise sources shall include mitigation measures so that resulting noise levels do not exceed these standards (City of Fresno 2014). The land use compatibility noise standards for non-transportation (stationary) and transportation noise sources are summarized in Tables 3 and 4, respectively. In addition, Policy NS-1-a of the *Fresno General Plan Noise and Safety Element* also establishes an exterior noise standard of 60 dBA CNEL/L_{dn} for new non-transportation noise sources that impinge on noise-sensitive land uses, such as residential dwellings. This noise standard is applied at the property line of the noise-sensitive land use.

The City of Fresno has also adopted a noise ordinance that contains additional limitations intended to prevent noise which may create dangerous, injurious, noxious, or otherwise objectionable conditions. As opposed to the City's General Plan noise standards, the City's noise ordinance is primarily used for the regulation of existing uses and activities, including construction activities, and are not typically used as a basis for land use planning. Construction activities occurring during the daytime hours of 7:00 a.m. to 10:00 p.m., Monday through Saturday, are typically considered exempt from the City's noise ordinance requirements (City of Fresno 2016). In accordance with Section 15-2506(H) of the City's noise ordinance, the sounding of school bells and school-sanctioned outdoor activities such as pep rallies, sports games, and band practices are exempt from the City's noise ordinance standards.

Table 3
City of Fresno General Plan Noise Standards - Stationary Noise Sources

Noise Descriptor	Noise Level Standards (dBA)[1]	
	Daytime (7 am - 10 pm)	Nighttime (10 pm – 7 am)
Hourly Equivalent Sound Level (L_{eq})	50	45
Maximum Sound Level (L_{max})	70	65

Notes:

1. The Department of Development and Resource Management Director, on a case-by-case basis, may designate land uses other than those shown in this table to be noise-sensitive, and may require appropriate noise mitigation measures.

2. As determined at outdoor activity areas. Where the location of outdoor activity areas is unknown or not applicable, the noise exposure standard shall be applied at the property line of the receiving land use. When ambient noise levels exceed or equal the levels in this table, mitigation shall only be required to limit noise to the ambient plus five dB.

Source: City of Fresno 2014

Table 4
City of Fresno General Plan Noise Standards - Transportation Noise Sources

Land Use[1]	Outdoor Activity Areas[2,3] (CNEL/L_{dn} dBA)	Interior Spaces (dBA)[3]	
		Average Daily (CNEL/L_{dn})	Average Hourly (L_{eq}) [2]
Residential	65	45	--
Transient Lodging	65	45	--
Hospitals, Nursing Homes	65	45	--
Theaters, Auditoriums, Music Halls	--	--	35
Churches, Meeting Halls	65	--	45
Office Buildings	--	--	45
Schools, Libraries, Museums	--	--	45

1. Where the location of outdoor activity areas is unknown or is not applicable, the exterior noise level standard shall be applied to the property line of the receiving land use.

2. As determined for a typical worst-case hour during periods of use.

3. Noise standards do not apply to aircraft noise.

Source: City of Fresno 2014

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 an amplitude and frequency. A person's perception to 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, 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. Threshold criteria for continuous and transient events are summarized in Tables 5.

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 relative short periods of vibrations).	Threshold at which there is a risk of "architectural" damage to fragile buildings.
0.4-0.6	Vibrations 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 2020

As shown in Table 5, the threshold for architectural damage commonly applied to construction activities is a peak particle velocity (ppv) of 0.20 inches per second (in/sec) for fragile structures and 0.50 in/sec ppv for newer structures. Levels above 0.20 in/sec ppv may result in increased levels of annoyance for people in buildings (Caltrans 2020).

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

The *CEQA Guidelines* do not define the levels at which temporary and permanent increases in ambient noise are considered "substantial." 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 3 dBA, or greater. Significant increases in ambient noise levels that would exceed applicable noise standards would be considered to have a potentially significant impact.

Transportation Noise

The proposed project would construct new team facilities and seating at the existing softball field. The new seating will be approximately the same size as the existing bleachers. The proposed project would not result in a substantial change in the softball field's current capacity, nor an increase in vehicle traffic. As a result, traffic noise impacts are considered less than significant and are not discussed further in this report.

Non-Transportation Noise

New non-transportation noise sources associated with operation of the proposed project include batting cages, relocation of bullpens, three additional ADA parking spaces, and a team building that potentially includes a HVAC system. While the project will include new seating the capacity will not increase from existing seating and so crowd noise was considered less than significant and not discussed further in this report. Non-transportation noise impacts were evaluated based on representative noise levels obtained from similar sources/activities and assuming an average noise-attenuation rate of 6 dB per doubling of distance from the sources. Noise levels associated with vehicle parking areas were calculated in accordance with FHWA's *Transit Noise and Vibration Impact Assessment Guidelines* (2006) assuming that all parking spaces would be accessed over a one-hour period.

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 (e.g., demolition/land clearing, grading and excavation, erection) of 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 the mid-70's to the low 90's dBA L_{max} at 50 feet (FTA 2006). 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	Noise Level (dBA at 50 feet)	
	L_{max}	L_{eq}
Backhoes	78	74
Bulldozers	82	78
Compressors	78	74
Concrete Pump Truck	81	74
Dump Trucks	77	73
Front End Loaders	79	75
Pneumatic Tools	85	82
Rollers	80	73
Based on measured instantaneous noise levels (L_{max}), average equipment usage rates, and calculated average-hourly (L_{eq}) noise levels derived from the FHWA Road Construction Noise Model (FHWA 2008)		

The City has not adopted noise standards that apply to short-term construction activities. However, based on screening noise criteria commonly recommended by federal agencies, construction activities would generally be considered to have a potentially significant impact if average-hourly daytime noise levels would exceed 80 dBA L_{eq} at noise-sensitive land uses, such as residential land uses (FTA 2006). Depending on the location and types of activities conducted (e.g., demolition, site prep, grading, construction, and architectural coating), predicted noise levels at the nearest residences, which are located adjacent to and west of the project site, could potentially exceed 80 dBA L_{eq}. 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 10:00 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, this impact would be considered ***less than significant***.

Long-term Operational Noise Levels

The proposed project includes the installation of field lighting that would allow for some games to be held in the evening hours. However, event noise levels during the evening hours (e.g., 7:00 p.m. to 10:00 p.m.) would be similar to daytime noise levels associated with existing events. The proposed project would not result in nighttime events that occur beyond 10:00 p.m.

Under current conditions on the project site the seating for attendees is spread around the field. The majority of seating is located along the west side approximately 25 feet from the nearest residence. Under the proposed project, seating would become consolidated behind home plate and located approximately 40 feet from the nearest residence. As a result of the increased distance from the nearest sensitive land use and no change in seating capacity, crowed noise at the nearest residential land use would be anticipated to decrease slightly in comparison to existing conditions and was not analyzed. Additionally, no changes to the existing amplified sound system are proposed and so no further analysis was conducted.

Although the project may extend activity hours into the evening hours, overall average-hourly noise levels associated with onsite events are not anticipated to increase in comparison to existing conditions. However, in comparison to existing conditions, implementation of the proposed project would include the addition of some features that may result in increases in ambient noise levels at the nearest residential land uses that could exceed the City's noise standards, such as the proposed batting cage. bullpen, team building, and ADA parking spaces. Noise associated with these facilities are discussed in greater detail, as follows:

<u>Batting Cage</u>

The proposed project includes the addition of batting cages just east of the field. Noise associated with batting cages typically consist predominantly of instantaneous noise events associated with the hitting of balls. Assuming continuous use over an approximate one-hour period, noise associated with batting cages typically average approximately 64-67 dBA L_{eq} and 88-91 dBA L_{max} at 10 feet (CSUN 2019). The proposed batting cages would be located approximately 150 feet from the nearest residence. Based on this distance and assuming an average noise level of 67 dBA L_{eq} and 91 dBA L_{max} at 10 feet, predicted noise levels at the nearest residential land use would be 43 dBA $L_{eq.}$ and 67 dBA L_{max}. Predicted operational noise levels at the nearest residence would not exceed the City's daytime average-hourly or maximum instantaneous noise standards of 50 dBA $L_{eq,}$ and 70 dBA L_{max}, respectively. Predicted noise levels at other nearby noise-sensitive land uses, including residential uses located north of the project site, across E. Yale Avenue would not be projected to exceed the City's noise standards. As a result, this impact would be considered ***less-than-significant***.

<u>Bullpen</u>

The proposed project includes the relocation of pitching warm up areas, or bullpens. Noise associated with bullpens typically consist predominantly of instantaneous noise events associated with the catching of balls. Based on measurements conducted, noise levels associated with the catching of a softball typically generate noise levels up to approximately 57 dBA L_{eq} and 75 dBA L_{max} at 10 feet. The proposed bullpen would be located approximately 15 feet from the nearest residential land use, which is located adjacent to and west of the proposed bullpen. Based on this distance and the noise levels noted above, predicted noise level at the nearest residence would be 53 dBA L_{eq} and 71 dBA L_{max}. Predicted operational noise levels at the nearest residence would exceed the City's daytime average-hourly or maximum instantaneous noise standards of 50 dBA $L_{eq,}$ and 70 dBA L_{max}, respectively. Predicted noise levels at other nearby noise-sensitive land uses, including residential uses located north of the project site, across E. Yale Avenue would not be projected to exceed the City's noise standards. Because predicted noise levels at the nearest residential land use would exceed the City's noise standards, this impact would be considered ***potentially significant***.

Team Building Mechanical Equipment

The proposed team building would contain a team room, coach's office, restrooms, snack bar, and storage areas. While the site plan does not mention weather this building will be air conditioned, to be conservative it is assumed that air conditioning would be included. Air conditioning units typically average approximately 65 dBA L_{eq} at 5 feet. The operation of air conditioning units is largely limited to the warmer daytime hours. The nearest residence is located approximately 23 feet north of the proposed building. Based on this distance and assuming an average noise level of 65 dBA at 5 feet, predicted operational noise levels at the nearest residential property line would be 52 dBA L_{eq}. Predicted operational noise levels at the property line of the nearest residential land use would exceed the City's daytime and nighttime noise standard (i.e., 50 and 45 dBA L_{eq}). As a result, this impact would be considered ***potentially significant***.

Vehicle Parking Areas

The proposed project includes the construction of three ADA surface parking spaces. Based on a conservative assumption that all three parking spaces were to be accessed over a one-hour period, predicted daytime noise levels at the property line of the nearest residential dwellings, which are located 175 feet north on E. Yale Avenue, would be 20.6 dBA L_{eq}. Predicted noise levels would not exceed the City's daytime noise standard of 50 dBA L_{eq}. As a result, this impact is considered a ***less than significant***.

Mitigation Measure Noise-2: The following measures shall be implemented to reduce long-term operational noise impacts:

- The scheduled operation of the proposed softball field and related facilities shall be limited to between the hours of 7:00 a.m. to 10:00 p.m.
- Building mechanical equipment (e.g., HVAC units) associated with the proposed team building shall be shielded from direct line-of-sight of nearby residential land uses. It is recommended that air conditioning units be located on roof-top areas and shielded from line of sight of nearby residential land uses by incorporation of shielding or building parapets along the perimeter of the roof.
- Building mechanical equipment (e.g., HVAC units) associated with the proposed team building shall comply with the City of Fresno's daytime and nighttime noise standards of 50 and 45 dBA L_{eq}, respectively, when measured at the property line of the nearest residential land use.
- The proposed bullpen shall be shielded from line of sight of the nearest residential land use located adjacent to and west of the bullpen. Shielding may include construction of a solid barrier located along the eastern property line of the residential land use and/or enclosure of the bullpens western and southern walls. The barrier shall be constructed of material having a Sound Transmission Class (STC) rating of 20, or greater. Example materials include masonry block, wood, or exterior sound insulation blankets. Barrier shielding shall be constructed to a minimum height of six feet above ground level with no visible air gaps between barrier components or at the base of the barrier.

Significance After Mitigation

Implementation of Mitigation Measure Noise-2 would limit scheduled activities associated with the proposed facilities to the daytime hours of 7:00 a.m. to 10:00 p.m. In addition, building mechanical equipment (e.g., exhaust fans, air conditioning units) would be shielded from direct line of sight of nearby residential land uses, which would reduce predicted operational noise levels by a minimum of 5 dBA L_{eq}. With mitigation, operation of onsite building mechanical equipment would be reduced by approximately 5 dB. Shielding of the proposed bullpen would, likewise, reduce operational noise levels by approximately 5 dBA. With mitigation, predicted noise levels at nearby residential land uses would not exceed the City's noise standards. Furthermore, as previously noted and in accordance with Section 15-2506(H) of the City's noise ordinance, school-sanctioned outdoor activities including sports games, are exempt from the City's noise ordinance standards. For this reason and with mitigation, 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 7. As depicted, ground vibration generated by construction equipment would be approximately 0.089 in/sec ppv, or less, at 25 feet. Predicted vibration levels at the nearest existing structures would be approximately 0.119 in/sec ppv and is not 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 structures have been identified in the project area. As a result, this impact would be considered ***less than significant.***

Table 7
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: FTA 2006, 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 airports in the project vicinity include the Fresno Yosemite International Airport and the Fresno Chandler Downtown Airport, which are located approximately 3.6 and 2.8 miles to the east and southwest, respectively. The proposed project is not located within the projected 60 dBA CNEL/L_{dn} noise contours of these airports (City of Fresno 2014). No private airstrips were identified within two miles of the project site. 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.***

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

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APPENDIX A

Noise Prediction Modeling & Supportive Documentation

Predicted On-Site Noise levels

Source	Reference Noise Level	Reference Distance (feet)	Distance to Receiver (feet)	Predicted Noise Level (dBA)
Bullpen	57 dBA Leq	10	15	53
	75 dBA Lmax	10	15	71
Batting Cage	67 dBA Leq	10	150	43
	91 dBA Lmax	10	150	67
Exterior AC Unit	65 dBA Leq	5	23	52 dBA Leq

Predicted Noise Level from Parking Spaces

Number of Parking Spaces: 3

Number of Vehicles/Hour: 6 (Assumes 3 vehicles; access and departure within a one-hour period)

Distance from Source to Receiver (ft): 175

Number of Intervening Rows of Buildings: 0

Noise Barrier? No

Predicted Noise Level: 20.6 dBA

Source: FTA 2018. FTA Noise Impact Assessment Worksheet.

Predicted Vibration Levels from Construction

REFERENCE VIBRATION LEVELS	
HOE RAM	0.089
LARGE BULLDOZER	0.089
CAISSON DRILLING	0.089
LOADED TRUCKS	0.076
JACKHAMMER	0.035
SMALL BULLDOZER	0.003

SOURCE:	PAVEMENT DEMO
REFERENCE LEVEL:	0.089
ATTENUATION RATE*:	1.3
DISTANCE	20
PREDICTED GROUND-BORNE VIBRATION LEVEL:	0.119

SOURCE:	EARTHWORK
REFERENCE LEVEL:	0.089
ATTENUATION RATE*:	1.3
DISTANCE	20
PREDICTED GROUND-BORNE VIBRATION LEVEL:	0.119

SOURCE:	DRAINAGE/UTILITIES/SUBGRADE
REFERENCE LEVEL:	0.089
ATTENUATION RATE*:	1.3
DISTANCE	20
PREDICTED GROUND-BORNE VIBRATION LEVEL:	0.119

SOURCE:	PAVING
REFERENCE LEVEL:	0.089
ATTENUATION RATE*:	1.3
DISTANCE	20
PREDICTED GROUND-BORNE VIBRATION LEVEL:	0.119

Caltrans 2020

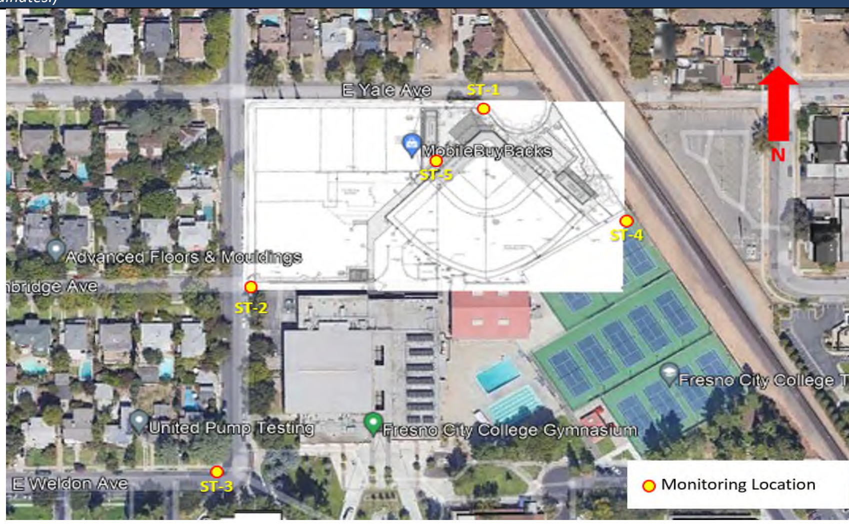
NOISE MEASUREMENT SURVEY FORM

AMBIENT AIR QUALITY & NOISE CONSULTING

SHEET	1	OF	2

DATE:	6/14/2022
PROJECT:	Fresno City College Softball Field Project
LOCATION:	Fresno, CA
MONITORING STAFF:	Trevor Burmester

LOCATION MAP: *(Include a map of noise measurement locations AND photographs for measurement locations on attached worksheet. Include additional sheets as necessary. Where possible include GPS coordinates.)*



SITE PHOTO(S):

NOISE MEASUREMENT CONDITIONS & EQUIPMENT

MET CONDITIONS & MONITORING EQUIPMENT:	TEMP: 80 - 88 F. | HUMIDITY: 16-17% | WIND SPEED: 1 - 3 MPH | WIND DIR: WNW | GROUND: Dry				
	CLOUD COVER BY CLASS (OC=OVERCAST):	3	(1. HEAVY OC, 2. LIGHT OC, 3. SUNNY, 4. CLEAR NIGHT, 5. OC NIGHT)		
	MET. METER:				
NOISE MONITORING EQUIPMENT:	LARSON DAVIS SLM MODEL:	LxT	S/N:	4526	
	MICROPHONE:		S/N:		
	CALIBRATOR:	CAL200	S/N:	2744	
NOISE MONITORING SETUP:	WITHIN 10 FT OF REFLECTIVE SURFACE?:	NO	MICROPHONE HEIGHT AGL (FT):	5	
	CALIBRATED PRIOR TO AND UPON COMPLETION OF MEASUREMENTS:	YES	METER SETTINGS:	A-WHT	SLOW

NOISE & TRAFFIC MEASUREMENTS

MEASUREMENT LOCATION	MEASUREMENT DATE/TIME	DURATION (Minutes)	MEASUREMENT LOCATION	PRIMARY NOISE SOURCES NOTED	MEASURED NOISE LEVELS LEQ
ST1	6/14/2022 13:01	10	Yale Ave. Behind Homeplate	Birds, Traffic in Distance	45.4
ST2	6/14/2022 13:17	10	College Ave. Staff Parking lot L	HVAC System, Traffic, Kids Playing	54.5
ST3	6/14/2022 13:34	10	NW Corner of Cllege Ave & Weldon Ave.	Birds, Traffic, Car Alarm in Distance	53.6
ST4	6/14/2022 13:49	10	Tennis courts, south of softball field	HVAC System, Plane, Birds, Train	57.9
ST5	6/14/2022 14:03	10	West of Home dugout	Birds, Sprinklers in Distance, Power tools in Distance	46.7

TRAFFIC COUNTS LOCATION	TRAFFIC COUNTS DATE/TIME	DURATION (Minutes)	TRAFFIC DIRECTION/ LANE ASSIGNMENT	VEHICLE CLASSIFICATION LDV	MDV	HDV	BUS	AVG. VEHICLE SPEEDS

VEHICLE COUNTS:	☐	MANUALLY	☐	VIDEO
VEHICLE SPEEDS:	☐	IN TRAFFIC	☐	RADAR

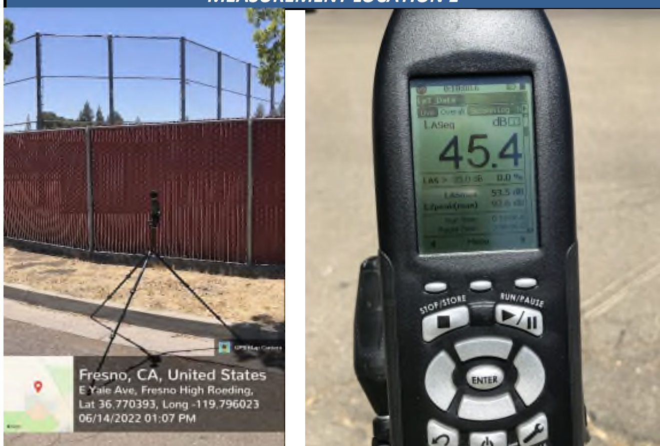
AMBIENT
AIR QUALITY & NOISE CONSULTING

NOISE MEASUREMENT SURVEY FORM

SHEET	2 OF 2
DATE:	6/14/2022
PROJECT:	Fresno City College Softball Field Project
LOCATION:	Fresno, CA
MONITORING STAFF:	Trevor Burmester

SITE PHOTO(S): (Refer to data sheets for noise measurement locations)

MEASUREMENT LOCATION 1



MEASUREMENT LOCATION 2

MEASUREMENT LOCATION 3

MEASUREMENT LOCATION 4

MEASUREMENT LOCATION 5

MEASUREMENT LOCATION 6