3.11 NOISE AND VIBRATION

This section includes a summary of applicable regulations related to noise and vibration, a description of ambient-noise conditions, and an analysis of potential short-term construction and long-term operational-source noise impacts associated with the New Zoo at Elk Grove.

Scoping comments received regarding noise and vibration in response to the notice of preparation (NOP) stated that the EIR should address noise from humans and animals at nearby residents. These issues are addressed in the impacts analysis below. See Appendix A for all NOP comments received.

Before discussing the regulatory and environmental setting, the following definitions of commonly used noise terms throughout this section are provided.

- **Equivalent Continuous Sound Level (L_{eq}):** L_{eq} represents an average of the sound energy occurring over a specified period. In effect, L_{eq} is the steady-state sound level containing the same acoustical energy as the time-varying sound level that occurs during the same period (California Department of Transportation [Caltrans] 2013:2-48). For instance, the 1-hour equivalent sound level, also referred to as the hourly L_{eq}, is the energy average of sound levels occurring during a 1-hour period and is the basis for noise abatement criteria used by Caltrans and Federal Transit Administration (FTA) (Caltrans 2013:2-47; FTA 2018: Table 3-1).
- **Maximum Sound Level (L_{max}):** L_{max} is the highest instantaneous sound level measured during a specified period (Caltrans 2013:2-48; FTA 2018: Table 3-1).
- **Day-Night Level (L_{dn}):** L_{dn} is the energy average of A-weighted sound levels occurring over a 24-hour period, with a 10-dB "penalty" applied to sound levels occurring during nighttime hours between 10 p.m. and 7 a.m. (Caltrans 2013:2-48; FTA 2018:Table 3-1).
- **Community Noise Equivalent Level (CNEL):** CNEL is the energy average of the A-weighted sound levels occurring over a 24-hour period, with a 10-dB penalty applied to sound levels occurring during the nighttime hours between 10 p.m. and 7 a.m. and a 5-dB penalty applied to the sound levels occurring during evening hours between 7 p.m. and 10 p.m. (Caltrans 2013:2-48).
- **Vibration Decibels (VdB):** VdB is the vibration velocity level in decibel scale (FTA 2018:Table 5-1).
- **Peak Particle Velocity (PPV):** PPV is the peak signal value of an oscillating vibration waveform. Usually expressed in inches/second (in/sec) (FTA 2018:Table 5-1).

3.11.1 Regulatory Setting

FEDERAL

U.S. Environmental Protection Agency Office of Noise Abatement and Control

The U.S. Environmental Protection Agency (EPA) Office of Noise Abatement and Control was originally established to coordinate Federal noise control activities. In 1981, EPA administrators determined that subjective issues such as noise would be better addressed at more local levels of government. Consequently, in 1982 responsibilities for regulating noise control policies were transferred to state and local governments. However, documents and research completed by the EPA Office of Noise Abatement and Control continue to provide value in the analysis of noise effects.

Federal Transit Administration

To address the human response to ground vibration, the Federal Transit Administration (FTA) has set forth guidelines for maximum-acceptable vibration criteria for different types of land uses. These guidelines are presented in Table 3.11-1.

Table 3.11-1 Ground-Borne Vibration (GBV) Impact Criteria for General Assessment

Land Use Category	GVB Impact Levels (VdB re 1 micro-inch/second)		
	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]
Category 1: Buildings where vibration would interfere with interior operations.	65 [4]	65 [4]	65 [4]
Category 2: Residences and buildings where people normally sleep.	72	75	80
Category 3: Institutional land uses with primarily daytime uses.	75	78	83

Notes: VdB = vibration decibels referenced to 1 µ inch/second and based on the root mean square (RMS) velocity amplitude.

[1] "Frequent Events" is defined as more than 70 vibration events of the same source per day.

[2] "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day.

[3] "Infrequent Events" is defined as fewer than 30 vibration events of the same source per day.

[4] This criterion is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research would require detailed evaluation to define acceptable vibration levels.

Source: FTA 2018.

STATE

California Building Code Sound Transmission Standards

Noise within habitable units that is attributable to external sources is regulated by the California Building Standards codified in the California Code of Regulations, Title 24, Part 2, Section 1207. These standards are enforceable at the time of construction or during occupancy and apply to habitable units with common interior walls, partitions, and ceilings or those adjacent to public areas, such as halls, corridors, stairways, and service areas. Under these standards, the interior noise levels attributable to exterior sources shall not exceed 45 decibels (dB) in any habitable room. The noise metrics used to measure these levels can be day-night average sound level (L_{dn}) or CNEL, consistent with the local general plan. An acoustical analysis documenting compliance with the interior sound level standards shall be prepared for structures containing habitable rooms. Under Public Resources Code Section 25402.1(g), all cities and counties in the State are required to enforce the adopted California Building Code, including these standards for noise in interior environments.

California Department of Transportation

In 2013, Caltrans published the Transportation and Construction Vibration Manual (Caltrans 2013). The manual provides general guidance on vibration issues associated with construction and operation of projects in relation to human perception and structural damage. Table 3.11-2 presents recommendations for levels of vibration that could result in damage to structures exposed to continuous vibration.

Table 3.11-2 Caltrans Recommendations Regarding Levels of Vibration Exposure

PPV (in/sec)	Effect on Buildings
0.4-0.6	Architectural damage and possible minor structural damage
0.2	Risk of architectural damage to normal dwelling houses
0.1	Virtually no risk of architectural damage to normal buildings
0.08	Recommended upper limit of vibration to which ruins and ancient monuments should be subjected
0.006-0.019	Vibration unlikely to cause damage of any type

Notes: PPV= Peak Particle Velocity; in/sec = inches per second

Source: Caltrans 2020.

LOCAL

City of Elk Grove General Plan

Chapter 8 of the *City of Elk Grove General Plan* (City of Elk Grove 2019) includes noise policies that are applicable to the Project:

- **Policy N-1-1:** New development of the uses listed in Table 8-3 [presented as Table 3.11-3 of this EIR] shall conform with the noise levels contained in the table. All indoor and outdoor areas shall be located, constructed, and/or shielded from noise sources in order to achieve compliance with the City's noise standards.
- **Policy N-1-2:** Where noise mitigation measures are required to achieve the standards of Tables 8-3 and 8-4 [presented as Tables 3.11-3 and 3.11-4, respectively, in this EIR], the emphasis of such measures shall be placed upon site planning and project design. The use of noise barriers shall be considered a means of achieving the noise standards only after all other practical design-related noise mitigation measures, including the use of distance from noise sources, have been integrated into the project.
- **Policy N-1-4:** Protect noise-sensitive land uses, identified in Table 8-3 [presented as Table 3.11-3 in this EIR], from noise impacts.
- **Policy N-2-1:** Noise created by new proposed non-transportation noise sources shall be mitigated so as not to exceed the noise level standards of Table 8-4 [presented as Table 3.11-4 in this EIR], as measured immediately within the property line of lands designated for noise-sensitive uses.
- **Policy N-2-2:** The following criteria shall be used as CEQA significance thresholds for transportation and stationary noise sources:
  - Where existing ambient noise levels are less than 60 dB L_{dn} at the outdoor activity areas of noise-sensitive uses, a +5 dB L_{dn} increase in noise levels shall be considered significant; and
  - Where existing ambient noise levels range between 60 and 65 dB L_{dn} at the outdoor activity areas of noise-sensitive uses, a +3 dB L_{dn} increase in noise levels shall be considered significant; and
  - Where existing ambient noise levels are greater than 65 dB L_{dn} at the outdoor activity areas of noise-sensitive uses, a +1.5 dB L_{dn} increase in noise levels shall be considered significant. Public roadway improvements to alleviate traffic congestion and safety hazards shall utilize FHWA [Federal Highway Administration] noise standards to allow a reasonable dollar threshold per dwelling to be used in the evaluation and abatement of impacts.
  - The standards outlined in Table 8-4 [presented as Table 3.11-4 in this EIR] shall not apply to public projects to alleviate traffic congestion and safety hazards.
- **Policy N-2-4:** Where sound walls or noise barriers are constructed, strongly encourage and consider requiring a combination of berms and walls to reduce the apparent height of the wall and produce a more aesthetically appealing streetscape.

Table 3.11-3 Maximum Allowable Noise Exposure, Transportation Noise Sources

Land Use	Outdoor Activity Areas[a, b] L_{dn}	Interior Spaces	
		L_{dn}	L_{eq}[c]
Residential	60[d,g]	45	-
Residential subject to noise from railroad tracks, aircraft overflights, or similar noise sources which produce clearly identifiable, discrete noise events (the passing of a single train, as opposed to relatively steady noise sources as roadways)	60[d,g]	40[f]	-
Transient Lodging	60[e,g]	45	-
Hospitals, Nursing Homes	60[d,g]	45	-
Theaters, Auditoriums, Music Halls	-	-	35
Churches, Meeting Halls	60[d,g]	-	40
Office Buildings	-	-	45
Schools, Libraries, Museums	-	-	45

[a] Where the location of outdoor activity areas is unknown, the exterior noise level standards shall be applied to the property line of the receiving land use. Where it is not practical to mitigate exterior noise levels at patios or balconies of apartment complexes, a common area such as a pool or recreation area may be designated as the outdoor activity area.

[b] Transportation projects subject to California Department of Transportation review or approval shall comply with the Federal Highway Administration noise standards for evaluation and abatement of noise impacts.

[c] As determined for a typical worst-case hour during periods of use.

[d] Where it is not possible to reduce noise in outdoor activity areas to 60 dB L_{dn} or less using a practical application of the best available noise reduction measures, an exterior noise level of up to 65 dB L_{dn} may be allowed provided that available exterior noise level reduction measures have been implemented and interior noise levels are in compliance with this table.

[e] In the case of hotel/motel facilities or other transient lodging, outdoor activity areas such as pool areas may not be included in the project design. In these cases, only the interior noise level criterion will apply.

[f] The intent of this noise standard is to provide increased protection against sleep disturbance for residences located near railroad tracks.

[g] In cases where the existing ambient noise level exceeds 60 dB, the maximum allowable project-related permanent increase in ambient noise levels shall be 3 dB L_{dn}.

Source: City of Elk Grove 2019:8-57.

Table 3.11-4 Noise Level Performance Standards for New Projects Affected by or Including Nontransportation Noise Sources*

Performance Standards for Stationary Sources	Noise Level Descriptor	Daytime (7 a.m. to 10 p.m.)	Nighttime (10 p.m. to 7 a.m.)
Performance Standards for Typical Stationary Noise Sources[a]	Hourly L_{eq}, dB	55[c,d]	45[c,d]
Performance Standards for Stationary Noise Sources Which Are Tonal, Impulsive, Repetitive, or Consist Primarily of Speech or Music[b]	Hourly L_{eq}, dB	50[c,d]	40[c,d]

* Applies to noise-sensitive land uses only.

[a] These standards will apply generally to noise sources that are not tonal, impulsive, or repetitive in nature. Typical noise sources in this category would include HVAC systems, cooling towers, fans, and blowers.

[b] These standards apply to noises which are tonal in nature, impulsive, repetitive, or which consist primarily of speech or music (e.g., humming sounds, outdoor speaker systems). Typical noise sources in this category include pile drivers, drive-through speaker boxes, punch presses, steam valves, and transformer stations. HVAC/pool equipment are exempt from these standards.

[c] These noise levels do not apply to residential units established in conjunction with industrial or commercial uses (e.g., caretaker dwelling). HVAC/pool equipment are exempt from these standards.

[d] The City may impose noise level standards which are more or less restrictive based upon determination of existing low or high ambient noise levels.

Source: City of Elk Grove 2019:8-58.

City of Elk Grove Municipal Code

Chapter 6.32 of the Elk Grove Municipal Code (EGMC) addresses noise generation in the City. Section 6.32.080 of the EGMC contains exterior noise standards for sensitive receivers, outlined in Table 6.32-1 [presented as Table 3.11-5 in this EIR]. The metric of these standards is L_{eq} because they are identical to the noise level performance standards included in the General Plan presented in Table 3.11-4.

Table 3.11-5 Exterior Noise Standards for Sensitive Receivers[1]

	7:00 am to 10:00 pm	10:00 pm to 7:00 am
Stationary noise sources, generally	55 dB	45 dB
Stationary noise sources which are tonal, impulsive, repetitive, or consist primarily of speech or music	50 dB	40 dB

Source: Section 6.32.080 of the Elk Grove Municipal Code.

[1] Sensitive receivers are defined as receiving premises used for residential purposes and for nonresidential purposes that are sensitive to noise, including, but not limited to, residential dwellings, schools, hospitals, hotels, and community care facilities.

In the case that the measured ambient noise level exceeds the noise levels identified in Table 6.32-1 of the EGMC (presented as Table 3.11-5 in this EIR), a maximum increase of 5-dBA is allowed where the ambient noise level is above that shown in the table but less than 60 dB. Where the ambient noise level is between sixty (60) dB and sixty-five (65) dB, inclusive, a maximum increase of three (3) dB above the ambient noise level is allowed. Finally, where the ambient noise level is greater than sixty-five (65) dB, a maximum increase of one and one-half (1.5) dB above the ambient noise level is allowed.

Section 6.32.100 of the EGMC provides the several exemptions to all noise regulations specified within Chapter 6.32.100 of the Code. Relevant to the Project, the exemption includes:

- activities conducted on parks, public playgrounds and school grounds, provided such parks, playgrounds and school grounds are owned and operated by a public entity or private school;
- any mechanical device, apparatus or equipment related to or connected with emergency activities or emergency work; the exemption does not include permanently installed emergency generators;
- noise sources associated with construction, repair, remodeling, demolition, paving, or grading of any real property, provided said activities only occur between the hours of 7:00 a.m. and 7:00 p.m. when located in close proximity to residential uses. Noise associated with these activities not located in close proximity to residential uses may occur between the hours of 6:00 a.m. and 8:00 p.m. However, when an unforeseen or unavoidable condition occurs during a construction project and the nature of the project necessitates that work in process be continued until a specific phase is completed, the contractor or owner shall be allowed to continue work after 7:00 p.m. and to operate machinery and equipment necessary until completion of the specific work in progress can be brought to conclusion under conditions which will not jeopardize inspection acceptance or create undue financial hardships for the contractor or owner;
- all transportation, flood control, and utility company maintenance and construction operation at any time on public rights-of-way, and those situations that may occur on private property deemed necessary to serve the best interest of the public and to protect the public's health and well-being, including debris and limb removal, removal of damaged poles and vehicles, removal of downed wires, repairing traffic signals, repair of water hydrants and mains, gas lines, oil lines, and sewers, restoring electrical service, street sweeping, unplugging sewers, vacuuming catch basins, etc. The regular testing of motorized equipment and pumps shall not be exempt;
- noise sources associated with the authorized collection of solid waste (e.g., refuse and garbage); and

Section 6.32.110 of the EGMC pertains to the operation of machinery, equipment, fans, and air conditioning.

- Except as otherwise provided, it is unlawful for any person to operate any mechanical equipment, pump, fan, air conditioning apparatus, stationary pumps, stationary cooling towers, stationary compressors, similar mechanical

devices, or any combination thereof in any manner so as to create any noise which would cause the maximum noise level to exceed a maximum limit of fifty-five (55) dBA.

Section 6.32.140 of the EGMC prohibits the following activities which are relevant to the Project:

- operating or causing the operation of tools or equipment on private property used in alteration, construction, demolition, drilling or repair work daily between the hours of 7:00 p.m. and 7:00 a.m. when located in close proximity to residential uses, or between the hours of 8:00 p.m. and 6:00 a.m. when not located in close proximity to residential uses, so that the sound creates a noise disturbance across a residential property line, except for emergency work of public service utilities. However, when an unforeseen or unavoidable condition occurs during a construction project and the nature of the project necessitates that work in process be continued until a specific phase is completed, the contractor or owner shall be allowed to continue work after 8:00 p.m. and to operate machinery and equipment necessary until completion of the specific work in progress can be brought to conclusion under conditions which will not jeopardize inspection acceptance or create undue financial hardships for the contractor or owner.
- loading, unloading, opening, closing or other handling of boxes, crates, containers, building materials, garbage cans, or similar objects on private property between the hours of 10:00 p.m. and 7:00 a.m. in a manner to cause a noise disturbance.

City of Elk Grove Construction Specifications Manual

The Elk Grove Construction Specifications Manual (City of Elk Grove 2022) includes the following standards that are applicable to the Project:

- Section 7-8.01: Allowable Times and Hours of Work. Unless otherwise noted in the Special Provisions or approved by the City, no work shall be done between the hours of 6 p.m. and 7 a.m., or on Saturdays, Sundays, or legal holidays.
- Section 7-8.02: Off-Period Work. A written request to work between 6 p.m. and 7 a.m. or on Saturdays, Sundays, or legal holidays, or to close a lane of traffic during peak hours must be submitted at least two (2) Working Days in advance of the intended work. The City will evaluate the Contractor's request to determine if there is a benefit to the City, a nuisance or a hazard to the public, the project, or the area surrounding the site, and if the Contractor should pay any City overtime costs related to the off-period work. The City may place conditions on any approval of off-period work based on this analysis.
- Section 7-8.03: Emergency Repairs. Work done at night, on Saturdays, Sundays, or legal holidays will be exempt for emergency repairs that pose a danger to the public or jeopardizes the integrity of the work.
- Section 10-6: Noise Control. The Contractor shall comply with all local noise control and noise level rules, regulations, and ordinances that apply to the Work. The Special Provisions may contain specific or additional requirements. Internal combustion engines used for any purpose on the Work must be equipped with a muffler recommended by the manufacturer.

3.11.2 Environmental Setting

ACOUSTIC FUNDAMENTALS

Before discussing the noise setting for the Project, background information about sound, noise, vibration, and common noise descriptors is needed to provide context and a better understanding of the technical terms referenced throughout this section.

Sound, Noise, and Acoustics

Sound can be described as the mechanical energy of a vibrating object transmitted by pressure waves through a liquid or gaseous medium (e.g., air) to a human ear. Noise is defined as loud, unexpected, annoying, or unwanted sound.

In the science of acoustics, the fundamental model consists of a sound (or noise) source, a receiver, and the propagation path between the two. The loudness of the noise source and obstructions or atmospheric factors affecting the propagation path to the receiver determines the sound level and characteristics of the noise perceived by the receiver. The field of acoustics deals primarily with the propagation and control of sound.

Frequency

Continuous sound can be described by frequency (pitch) and amplitude (loudness). A low-frequency sound is perceived as low in pitch. Frequency is expressed in terms of cycles per second, or hertz (Hz) (e.g., a frequency of 250 cycles per second is referred to as 250 Hz). High frequencies are sometimes more conveniently expressed in kilohertz, or thousands of hertz. The audible frequency range for humans is generally between 20 Hz and 20,000 Hz.

Sound Pressure Levels and Decibels

The amplitude of pressure waves generated by a sound source determines the loudness of that source. Sound pressure amplitude is measured in micro-Pascals (mPa). One mPa is approximately one hundred billionth (0.00000000001) of normal atmospheric pressure. Sound pressure amplitudes for different kinds of noise environments can range from less than 100 to 100,000,000 mPa. Because of this large range of values, sound is rarely expressed in terms of mPa. Instead, a logarithmic scale is used to describe sound pressure level (SPL) in terms of decibels (dB).

Addition of Decibels

Because decibels are logarithmic units, SPLs 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 at the same time, the resulting sound level at a given distance would be 3 dB higher than if only one of the sound sources was producing sound under the same conditions. For example, if one idling truck generates an SPL of 70 dB, two trucks idling simultaneously would not produce 140 dB; rather, they would combine to produce 73 dB. Under the decibel scale, three sources of equal loudness together produce a sound level approximately 5 dB louder than one source.

A-Weighted Decibels

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 SPL in that range. In general, people are most sensitive to the frequency range of 1,000–8,000 Hz and perceive sounds within this range better than sounds of the same amplitude with frequencies outside of this range. To approximate the response of the human ear, sound levels of individual frequency bands are weighted, depending on the human sensitivity to those frequencies. Then, an "A-weighted" sound level (expressed in units of A-weighted decibels) can be computed based on this information.

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 judgment correlates well with the A-scale sound levels of those sounds. Thus, noise levels are typically reported in terms of A-weighted decibels. All sound levels discussed in this section are expressed in A-weighted decibels. Table 3.11-6 describes typical A-weighted noise levels for various noise sources.

Table 3.11-6 Typical A-Weighted Noise Levels

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	— 110 —	Rock band
Jet fly-over at 1,000 feet	— 100 —	
Gas lawn mower at 3 feet	— 90 —	
Diesel truck at 50 feet at 50 miles per hour	— 80 —	Food blender at 3 feet, Garbage disposal at 3 feet
Noisy urban area, daytime, Gas lawn mower at 100 feet	— 70 —	Vacuum cleaner at 10 feet, Normal speech at 3 feet
Commercial area, Heavy traffic at 300 feet	— 60 —	
Quiet urban daytime	— 50 —	Large business office, Dishwasher next room
Quiet urban nighttime	— 40 —	Theater, large conference room (background)
Quiet suburban nighttime	— 30 —	Library, Bedroom at night
Quiet rural nighttime	— 20 —	
	— 10 —	Broadcast/recording studio
Lowest threshold of human hearing	— 0 —	Lowest threshold of human hearing

Source: Caltrans 2013: Table 2-5.

Human Response to Changes in Noise Levels

The doubling of sound energy results in a 3-dB increase in the sound level. However, given a sound level change measured with precise instrumentation, the subjective human perception of a doubling of loudness will usually be different from what is measured.

Under controlled conditions in an acoustical laboratory, the trained, healthy human ear can discern 1-dB changes in sound levels when exposed to steady, single-frequency ("pure-tone") signals in the mid-frequency (1,000–8,000 Hz) range. In general, the healthy human ear is most sensitive to sounds between 1,000 and 5,000 Hz and perceives both higher and lower frequency sounds of the same magnitude with less intensity (Caltrans 2013b:2-18). In typical noisy environments, changes in noise of 1–2 dB are generally not perceptible. However, it is widely accepted that people can begin to detect sound level increases of 3 dB in typical noisy environments. Further, a 5-dB increase is generally perceived as a distinctly noticeable increase, and a 10-dB increase is generally perceived as a doubling of loudness (Caltrans 2013b:2-10). Therefore, a doubling of sound energy (e.g., doubling the volume of traffic on a highway) that would result in a 3-dB increase in sound would generally be perceived as barely detectable.

Vibration

Vibration is the periodic oscillation of a medium or object with respect to a given reference point. Sources of vibration include natural phenomena (e.g., earthquakes, volcanic eruptions, sea waves, landslides) and those introduced by human activity (e.g., explosions, machinery, traffic, trains, construction equipment). Vibration sources may be continuous, (e.g., operating factory machinery) or transient in nature (e.g., explosions). Vibration levels can be depicted in terms of amplitude and frequency, relative to displacement, velocity, or acceleration.

Vibration amplitudes are commonly expressed in peak particle velocity (PPV) or root-mean-square (RMS) vibration velocity. PPV and RMS vibration velocity are normally described in inches per second (in/sec) or in millimeters per second. PPV is defined as the maximum instantaneous positive or negative peak of a vibration signal. PPV is typically used in the monitoring of transient and impact vibration and has been found to correlate well to the stresses experienced by buildings (FTA 2018: 110, Caltrans 2013: 6].

Although PPV is appropriate for evaluating the potential for building damage, it is not always suitable for evaluating human response. It takes some time for the human body to respond to vibration signals. In a sense, the human body responds to average vibration amplitude. The RMS of a signal is the average of the squared amplitude of the signal, typically calculated over a 1-second period. As with airborne sound, the RMS velocity is often expressed in decibel

notation as vibration decibels (VdB), which serves to compress the range of numbers required to describe vibration (FTA 2018: 7-4; Caltrans 2020: 7). This is based on a reference value of 1 micro inch per second.

The typical background vibration-velocity level in residential areas is approximately 50 VdB. Ground vibration is normally perceptible to humans at approximately 65 VdB. For most people, a vibration-velocity level of 75 VdB is the approximate dividing line between barely perceptible and distinctly perceptible levels (FTA 2018: 7-8; Caltrans 2020: 27).

Typical outdoor sources of perceptible ground vibration are construction equipment, steel-wheeled trains, and traffic on rough roads. If a roadway is smooth, the ground vibration is rarely perceptible. The range of interest is from approximately 50 VdB, which is the typical background vibration-velocity level, to 100 VdB, which is the general threshold where minor damage can occur to fragile buildings. Construction activities can generate sufficient ground vibrations to pose a risk to nearby structures. Constant or transient vibrations can weaken structures, crack facades, and disturb occupants (FTA 2018: 7-5).

Vibrations generated by construction activity can be transient, random, or continuous. Transient construction vibrations are generated by blasting, impact pile driving, and wrecking balls. Continuous vibrations are generated by vibratory pile drivers, large pumps, and compressors. Random vibration can result from jackhammers, pavement breakers, and heavy construction equipment.

Table 3.11-7 summarizes the general human response to different ground vibration-velocity levels.

Table 3.11-7 Human Response to Different Levels of Ground Noise and Vibration

Vibration-Velocity Level	Human Reaction
65 VdB	Approximate threshold of perception.
75 VdB	Approximate dividing line between barely perceptible and distinctly perceptible. Many people find that transportation-related vibration at this level is unacceptable.
85 VdB	Vibration acceptable only if there are an infrequent number of events per day.

Notes: VdB = vibration decibels referenced to 1 µ inch/second and based on the root mean square (RMS) velocity amplitude.

Source: FTA 2018:7-8.

Sound Propagation

When sound propagates over a distance, it changes in level and frequency content. The manner in which a noise level decreases with distance depends on the following factors:

Geometric Spreading

Sound from a localized source (i.e., a point source) propagates uniformly outward in a spherical pattern. The sound level attenuates (or decreases) at a rate of 6 dB for each doubling of distance from a point source. Roads and 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, thus propagating at a slower rate in comparison to a point source. Noise from a line source propagates outward in a cylindrical pattern, often referred to as cylindrical spreading. Sound levels attenuate at a rate of 3 dB for each doubling of distance from a line source.

Ground Absorption

The propagation path of noise from a source to a receiver is usually very close to the ground. Noise attenuation from ground absorption and reflective-wave canceling provides additional attenuation associated with geometric spreading. Traditionally, this additional attenuation has also been expressed in terms of attenuation per doubling of distance. This approximation is usually sufficiently accurate for distances of less than 200 feet. 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), additional ground-attenuation value of 1.5 dB per doubling of distance is normally assumed. When added to the attenuate rate associated with cylindrical spreading, the additional ground attenuation results in an overall drop-off

rate of 4.5 dB per doubling of distance. This would hold true for point sources, resulting in an overall drop-off rate of up to 7.5 dB per doubling of distance.

Atmospheric Effects

Receivers located downwind from a source can be exposed to increased noise levels relative to calm conditions, whereas locations upwind can have lowered noise levels, as wind can carry sound. Sound levels can be increased over large distances (e.g., more than 500 feet) from the source because of atmospheric temperature inversion (i.e., increasing temperature with elevation). Other factors such as air temperature, humidity, and turbulence can also affect sound attenuation.

Shielding by Natural or Human-Made Features

A large object or barrier in the path between a noise source and a receiver 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. A barrier that breaks the line of sight between a source and a receiver will typically result in at least 5 dB of noise reduction (Caltrans 2013: 2-41; FTA 2018: 42). Barriers higher than the line of sight provide increased noise reduction (FTA 2018: 2-12). Vegetation between the source and receiver is rarely effective in reducing noise because it does not create a solid barrier unless there are multiple rows of vegetation (FTA 2018: 15, 104, 106).

EXISTING NOISE ENVIRONMENT

Existing Noise- and Vibration-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 uses are of primary concern because of the potential for increased and prolonged exposure of individuals to both interior and exterior noise levels, and because these land uses are places of rest and sleep for City residents. Additionally, the City of Elk Grove defines sensitive receivers as "receiving premises used for residential purposes and for nonresidential purposes that are sensitive to noise, including, but not limited to, residential dwellings, schools, hospitals, hotels, and community care facilities as those uses are defined in [EGMC] Title 23 (Zoning)." 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. The City includes many of these types of noise-sensitive land uses including residential, hotel/motel, parks and recreational facilities, religious institutions, and schools (City of Elk Grove 2019). These land uses are given priority in assessing and addressing noise exposure given the noise-sensitive nature of the land uses and activities occurring in these locations.

The noise-sensitive receivers nearest to the Project site are single-family residences located east of the Project site along the eastern side of Lotz Parkway. An approximately 8-foot concrete masonry wall parallels Lotz Parkway along the single-family residences and blocks the line of site for the residential units. The next nearest sensitive receivers are single-family residences located across Lotz Parkway northeast of the Project site's northern boundary. The parcels north of the Project site across Shed C channel are currently being developed with single-family residential uses. This analysis conservatively analyzes noise levels at the single-family residences east of the site across Lotz Parkway to determine the greatest noise impacts. Noise levels at nearby sensitive receivers further from the site would experience noise levels below those included in this analysis.

Existing Noise Sources and Ambient Levels

Noise measurements were taken on the Project site to characterize the existing ambient noise environment. Noise measurements were also taken at the existing Sacramento Zoo to characterize noise from zoo operations. A Larson Davis LxT precision integrating sound level meter was used for the ambient noise level measurement surveys. The meter was calibrated before use with a Larson Davis Laboratories Model CAL200 acoustical calibrator to ensure

measurement accuracy. The measurement equipment meets all pertinent specifications of the American National Standards Institute.

Noise Measurements at the Sacramento Zoo included four short-term measurements that were conducted on June 2 and June 15, 2023, and a long-term (24-hour continuous) ambient noise level measurement was conducted on June 2, 2023. The locations of the monitoring sites are shown in Figure 3.11-1 and measurement results are summarized in Table 3.11-8 as measurement numbers 1 through 4. Daytime noise levels at the Sacramento Zoo range from approximately 62 to 80 dBA L_{eq}. Noise measurement short-term (ST) ST-1 was taken near the entrance of the Sacramento Zoo, noise measurement ST-2 was taken near the parrot exhibit, noise measurement ST-3 was taken near the Kampala Café, and noise measurement ST-4 was taken at the northern portion of the Sacramento Zoo to capture event noise. As recorded during the long-term measurement at the Sacramento Zoo ambient noise is approximately 57 dBA CNEL. The long-term measurement was taken near the lion exhibit to capture nighttime noise from lions roaring, which was determined to be the loudest nighttime noise source at the Sacramento Zoo.

Noise measurements on the Project site included four short term and one long term measurement conducted on July 13, 2023. The locations of the monitoring sites are shown in Figure 3.11-2 and measurement results are summarized in Table 3.11-8 as measurement numbers 5 through 8. Daytime noise levels on the Project site range from approximately 48 to 62 dBA L_{eq}. As recorded during the long-term measurement on the site ambient noise is approximately 71 dBA CNEL.

Table 3.11-8 Summary of Existing Ambient Noise Measurements

Location[1]	Date and Time	A-Weighted Sound Level (dB)		
		L_{eq}	L_{max}	L_{min}
Sacramento Zoo				
ST-1	June 2, 2023, 9:35 a.m. to 9:50 a.m.	62.4	72.9	55.0
ST-2	June 2, 2023, 9:55 a.m. to 10:11 a.m.	77.8	93.8	55.6
ST-3	June 2, 2023, 10:26 a.m. to 10:41 a.m.	66.4	78.7	56.9
ST-4	June 15, 2023, 5:46 p.m. to 6:08 p.m.	80.3	91.9	55.7
LT-1	June 2, 2023/10:00 a.m. to June 3, 2023/10:00 a.m.	57.4[2]	87.0	40.5
Project Site[3]				
ST-5	July 13, 2023, 9:09 a.m. to 9:31 a.m.	61.3	78.2	36.2
ST-6	July 13, 2023, 10:29 a.m. to 10:51 a.m.	61.4	77.6	37.2
ST-7	July 13, 2023, 11:04 a.m. to 11:29 a.m.	61.9	79.7	42.2
ST-8	July 13, 2023, 11:56 a.m. to 12:15 p.m.	47.8	62.3	40.9
LT-2	July 13, 2023/10:10 a.m. to July 14, 2023/10:10 a.m.	71.3[2]	96.9	31.9

1 Refer to Figures 3.11-1 and 3.11-2 for ambient noise level measurement locations; ST = short-term measurement; LT = long-term measurement

2 Noise level represents CNEL

3 Construction was occurring periodically on Kyler Road north of the Project site during noise measurements.

Source: Data collected by Ascent Environmental in 2023.

Source: adapted by Ascent in 2023.

Figure 3.11-1 Sacramento Zoo Noise Measurement Locations

Source: adapted by Ascent in 2023.

Figure 3.11-2 Project Site Noise Measurement Locations

3.11.3 Impacts and Mitigation Measures

METHODOLOGY

Construction Noise and Vibration

To assess potential short-term (construction-related) noise and vibration impacts, sensitive receivers and their relative exposure were identified. Project-generated construction source noise and vibration levels were determined based on methodologies, reference emission levels, and usage factors from FTA's *Guide on Transit Noise and Vibration Impact Assessment* methodology (FTA 2018) and FHWA's *Roadway Construction Noise Model User's Guide* (FHWA 2006). Reference levels for noise and vibration emissions for specific equipment or activity types are well documented and the usage thereof common practice in the field of acoustics.

Operational Noise and Vibration

Non-transportation Noise

With respect to non-transportation (i.e., stationary) noise sources associated with Project implementation, long-term (operation-related) impacts were assessed using reconnaissance data, reference noise emission levels, measured noise levels for activities and equipment associated with Project operation (e.g., heating, ventilation, and air conditioning [HVAC] units, delivery docks), and standard attenuation rates and modeling techniques. Animal noise impacts were assessed using reference noise levels measured near animal enclosures at the Sacramento Zoo, as shown in Table 3.11-8 and Figure 3.11-1.

Transportation Noise

To assess potential long-term (operational) noise impacts from Project-generated increases in traffic, noise levels were calculated based on methods and formulas from the FHWA roadway noise prediction model using California vehicle reference noise emission factors (FHWA 2006). The analysis is based on the reference noise emission levels for automobiles, medium trucks, and heavy trucks, with consideration given to vehicle volume, vehicle speed, roadway configuration, distance to the receiver, and ground attenuation factors. Truck use and vehicle speeds on area roadways were estimated from field observations and the Project-specific traffic report (Appendix H). Modeling does not account for any natural or human-made shielding (e.g., the presence of walls or buildings) or reflection off building surfaces and thus represents a conservative estimation of traffic noise.

Increases in traffic noise levels attributable to the Project were analyzed using roadway traffic data (i.e., baseline), as well as Plus Project roadway traffic data provided in the Project traffic study. New vehicle trips generated by the Project were added to traffic volumes modeled as part of the Project to analyze the roadway traffic noise level increases on roadways that would be affected by the Project. Projected traffic noise level increases were then compared to the City's transportation noise standards (see Section 3.11.1) to identify whether any standards were exceeded and whether any new or substantially more severe impacts would result from the Project.

THRESHOLDS OF SIGNIFICANCE

For projects undertaken by the City of Elk Grove, City noise standards are reasonable and appropriate thresholds for determination of significance under CEQA. Therefore, a noise impact would be significant if implementation of the Project would result in any of the following:

- construction noise levels that exceed an adopted local or other applicable noise standard or a substantial temporary increase in noise that has the potential to cause an adverse effect to a sensitive receiver; based on the City's adopted municipal code, this criterion is applied in the following manner:
  - construction-generated noise occurring during non-exempt nighttime hours from 7:00 p.m. to 7:00 a.m., Monday through Saturday, as defined in the City's Municipal Code;
  - an increase by 5 dBA or more over existing ambient noise levels (FTA 2018); and

  - construction-generated noise that would exceed 90 dBA L_{eq} for residential receivers for daytime construction as established by FTA (2018);

- construction-generated or operational vibration levels exceeding Caltrans's recommended standards (2013) with respect to the prevention of structural building damage (0.2 PPV in/sec) or FTA's human response (80 VdB) at nearby vibration-sensitive land uses (FTA 2018);
- long-term traffic-generated noise levels exceeding the outdoor and interior noise standards for transportation noise sources as specified in Table 3.11-3;
- long-term noise levels generated by stationary or area sources that exceed City standards of 55 dBA L_{eq} during daytime hours from 7:00 a.m. to 10:00 p.m. and 45 dBA L_{eq} during nighttime hours from 10:00 p.m. to 7:00 a.m. for fixed noise sources, shown in Table 3.11-5, at existing noise-sensitive land uses;
- for a project located within 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, expose people residing or working in the project area to excessive noise levels; or
- for a project within the vicinity of a private airstrip, expose people residing or working in the project area to excessive noise levels.

IMPACTS NOT DISCUSSED FURTHER

Airport Noise

The Franklin Field, Sacramento Executive, and Sacramento International Airport noise contours do not extend into the City of Elk Grove, and noise generation from Borges-Clarksburg Airport and Sky Way Estates Airport within the City of Elk Grove is minimal (City of Elk Grove 2019). The Borges-Clarksburg Airport is a small private airport located approximately 6 miles northwest of the Project site. The Sky Way Estates Airport is a small private airport located approximately 8 miles east of the Project site. Therefore, Implementing the Project would not result in the exposure of people to excessive noise levels associated with airport activity. The issue of noise levels associated with airport activity is not discussed further.

Operational Vibration

As described in Chapter 2, "Project Description," implementing the Project would result in operation of a zoological park and associated support and operational, retail, and guest services facilities on the Project site. No vibratory sources are associated with operation of the zoological park. Operational vibration impacts are not discussed further.

Off-Site Improvements

Operation of the off-site improvements would not result in a long-term change in noise level that differs from existing conditions, because the off-site improvements would not result in an increase in vehicle trips or introduce new stationary noise sources. The only potential noise impact would be construction-generated noise, which is discussed under Impact 3.11-1. Operational noise impacts from off-site improvements are not discussed further.

Sacramento Zoo Closure

With completion of Phase 1 of the New Zoo, zoo operation at the Sacramento Zoo would cease. Noise from loading and unloading to support animal care facilities and restaurants would no longer occur at the Sacramento Zoo. Traffic noise surrounding the Sacramento Zoo would similarly decrease as trips would be redistributed to the New Zoo site. See the discussion of Impact 3.11-3 for an assessment of traffic noise at the New Zoo. Noise would occur at the Sacramento Zoo from removal of the animals and facilities, such as the Okapi barn, that would be transported to the New Zoo. These noise sources would be short-term and are anticipated to be similar in operational noise levels existing at the Sacramento Zoo from maintenance and animal transfers. Noise impacts from the Sacramento Zoo closure are not discussed further.

ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Impact 3.11-1: Create Substantial Temporary (Construction) Noise

Hourly noise levels during construction activities would be as loud as 79 dBA L_{eq} and 82 dBA L_{max} at nearby residential land uses. Based on available existing noise level data for the Project site, hourly noise levels closest to the nearest sensitive receivers are approximately 61 dBA L_{eq}. Considering that noise levels at this location could reach as high as 76 dBA L_{eq} (i.e., as much as 15 dBA over existing levels), construction noise would constitute a substantial increase (perceived more than doubling of the existing noise levels) for an extended period. The requirements listed in Mitigation Measure 3.11-1 would decrease exposure of sensitive receivers to construction-generated noise and reduce the impact to **less than significant**.

The Project would include the construction of a new zoo on the Project site in four phases. Construction of Phase 1 would be initiated in fall 2025 and be completed in late 2028. However, the New Zoo may have a rolling opening with some areas open to the public while the remainder of Phase 1 is being constructed. This analysis conservatively assumes 36 months of Project construction. Operational noise impacts from the opening of the New Zoo are discussed under Impact 3.11-4. Construction of Phases 2–4 would occur in the future as funding allows. Consistent with the hour limits established by Sections 6.32.100.F and 6.32.140.A of the EGMC, construction activities would occur between the hours of 7:00 a.m. and 7:00 p.m., Monday through Saturday. Construction activities would be prohibited on Sundays and legal holidays.

The types of heavy equipment used during Project construction for all phases would include dozers, backhoes, excavators, scrapers, cranes, concrete trucks, generators, compressors, and haul trucks. Construction activity would not involve pile driving or blasting. Reference noise levels of heavy equipment likely to be used in demolition and construction activities are summarized in Table 3.11-9.

Table 3.11-9 Noise Emission Levels from Construction Equipment

Equipment Type	Typical Noise Level (L_{eq} dBA) at 50 feet
Backhoe	80
Concrete Mixer	85
Concrete Pump	82
Compactor	82
Crane/Lift, Mobile	83
Dozer	85
Dump Truck	84
Excavator	85
Flat Bed Truck	84
Loader	80
Generator	82
Grader	85
Paver	85
Roller	85
Pickup Trucks	54
Scraper	85
Tractor	84

Notes: dBA = A-weighted decibels; L_{max} = maximum instantaneous noise levels.

Assumes all equipment is fitted with a properly maintained and operational noise control device, per manufacturer specifications. Noise levels listed are manufacture-specified noise levels for each piece of heavy construction equipment.

Source: FTA 2018: 176.

Construction noise can be characterized based on the type of activity and associated equipment needed and, in this analysis, is evaluated by considering noise levels associated with the likely combination of construction equipment required for each phase of Project construction. The combined noise levels generated by construction activity would fluctuate depending on the type, number, and duration of use of vehicles and equipment. The effects of construction noise largely depend on the type of construction activities occurring on any given day; the noise levels generated by those activities; distances to noise-sensitive receivers; the presence of any noise-attenuating features, such as topography, vegetation, and existing structures; and existing ambient noise levels.

The noise-sensitive receivers nearest to the Project site are single-family residences located on the eastern side of Lotz Parkway. Because construction activity would occur throughout the Project site over the anticipated construction period, the levels of noise exposure at individual receivers would vary substantially throughout different phases of construction depending on the type of construction activity and the distance from the construction activity to each receiver. Table 3.11-10 summarizes the noise exposure levels at these residences from different construction activities during Phases 1–4 of the New Zoo. Detailed calculations are provided in Appendix H.

Table 3.11-10 Construction Noise Estimates

Construction Phase	Construction Equipment	Modeled Noise Level (dBA L_{eq}) at Nearest Receiver[1]	Modeled Noise Level (dBA L_{max}) at Nearest Receiver
Phase 1[2]		**Nearest Receiver 150 feet**	**Nearest Receiver 150 feet**
Demolition	Rubber-tired dozers, excavators, concrete saw	77.0	80.8
Site Preparation (utilities, grading)	Rubber-tired dozers, backhoes	75.0	79.0
Grading	Grader, excavators, backhoes, scrapers, rubber-tired dozer	77.1	81.1
Building Construction	Forklifts, generator, crane, welder, backhoes	72.3	77.1
Architectural Coating	Air compressor	67.4	70.5
Paving	Pavers, paving equipment, rollers	78.5	82.4
Phase 2		**Nearest Receiver 230 feet**	**Nearest Receiver 230 feet**
Site Preparation (utilities, grading)	Rubber-tired dozers, backhoes	71.1	75.0
Grading	Grader, excavator, backhoes, rubber-tired dozer	71.8	75.8
Building Construction	Crane, forklifts, generator, welder, backhoes	70.7	75.4
Architectural Coating	backhoe, cement and mortar mixers, paver, paving equipment, rollers	63.7	66.7
Paving	air compressor	74.8	78.7
Phase 3		**Nearest Receiver 515 feet**	**Nearest Receiver 515 feet**
Demolition	Backhoes, rubber-tired dozer, concrete saw	63.4	67.2
Site Preparation (utilities, grading)	Grader, backhoe	62.0	65.9
Grading	Grader, rubber-tired dozer, backhoe	63.4	67.3
Building Construction	Crane, forklifts, backhoes	63.0	68.5
Architectural Coating	Air compressor	56.7	59.7

Construction Phase	Construction Equipment	Modeled Noise Level (dBA L_{eq}) at Nearest Receiver[1]	Modeled Noise Level (dBA L_{max}) at Nearest Receiver
Paving	Backhoe, cement mixers, paver, roller	67.8	71.7
Phase 4		**Nearest Receiver 560 feet**	**Nearest Receiver 560 feet**
Site Preparation (utilities, grading)	Rubber-tired dozers, backhoes	63.3	67.3
Grading	Grader, excavator, backhoes, rubber-tired dozer	64.1	68.0
Building Construction	Forklifts, generator, crane, welder, backhoe	62.9	67.7
Architectural Coating	Air compressor	56.0	59.0
Paving	Pavers, paving equipment, rollers	67.0	71.0

Notes: dBA = A-weighted decibels; L_{eq} = hourly-average noise level; L_{max} = maximum instantaneous noise levels.

[1] Nearest sensitive receivers are single-family residences along Lotz Parkway east of the Project site.

[2] Equipment list for Phase 1 represents equipment from Phase 1A, which would be closest to the nearest receivers along Lotz Parkway.

Source: Modeled by Ascent Environmental in 2023. Refer to Appendix G.

As shown in Table 3.11-10, noise from construction would expose residences along Lotz Parkway to noise levels as high as 79 dBA L_{eq} and 82 dBA L_{max}. However, there is an 8-foot-tall concrete masonry wall along Lotz Parkway that blocks the line of sight between the residences and construction on the Project site. A barrier that breaks the line of sight between a source and a receiver will typically reduce noise levels by at least 5 dBA (Caltrans 2013: 2-41; FTA 2018: 42). Therefore, exterior construction noise levels for residences along Lotz Parkway would be as high as 74 dBA L_{eq} and 77 dBA L_{max}.

Consistent with the EGMC and Construction Specifications Manual, Project construction would occur Monday through Saturday from 7:00 a.m. to 7:00 p.m. Although Section 6.32.100 of the EGMC provides an exemption for construction-generated noise provided that construction occurs between 7:00 a.m. and 7:00 p.m., the City has not adopted construction-related numerical noise limits. FTA has established noise criteria for the purpose of conducting construction noise assessments, which includes 90 dBA L_{eq} for residential receivers for daytime construction. Based on the modeling conducted, this level would not be exceeded at nearby sensitive land uses during any phase of construction. However, in addition to maximum noise exposure, the duration of noise exposure and the perceived increase in noise over existing ambient levels are important when considering impacts from construction noise. Regarding duration of noise exposure, FTA evaluates long-term construction noise impacts using a 30-day average noise standard, and other jurisdictions (e.g., City of San Jose) have identified an extended period of construction as a 12-month period. Project construction is anticipated to occur over 36 months, which would be considered an extended period to be exposed to increased noise levels. Further, based on available existing noise conditions on the Project site, the daytime hourly noise levels on the Project site near sensitive receivers along Lotz Parkway would be approximately 61 dBA L_{eq} (Table 3.11-8). Considering that noise levels at this location could reach as high as 74 dBA L_{eq} (i.e., 13 dBA over existing daytime lowest levels, which would be perceived as a more than doubling of the existing noise levels), construction noise would result in a substantial increase (i.e., 5 dBA) for an extended period. Therefore, Mitigation Measure 3.11-1 would be required to reduce construction noise levels by at least 8 dBA. Implementing Mitigation Measure 3.11-1 would reduce noise by locating equipment as far away from receivers as possible; requiring the proper use of available noise-reduction equipment, including alternatively powered equipment, exhaust mufflers, engine shrouds, and equipment enclosures; and requiring designation of a disturbance coordinator for any construction noise complaints. Implementation of these noise-reduction features can reduce construction noise levels by approximately 10 dBA, or more (NCHRP 1999, EPA 1971). With mitigation, construction-generated noise levels would be substantially reduced. Construction noise levels would exceed ambient levels by up to 3 dBA, which is not considered a perceivable increase in noise. This impact would be reduced to **less than significant**.

Construction Noise Impacts on Zoo Animals

Construction of Phase 1A of the Project would not affect animals housed at the New Zoo, because there would not be any animals on the site until the completion of Phase 1. Construction noise during Phases 1B, 1C, 2, 3, and4, however, has the potential to disrupt animals housed at the New Zoo. Additionally, should Phase 1A be opened on a rolling basis, animals brought in for initial occupancy would be subjected to construction noises while the remainder of Phase 1A is completed. Construction noise can impact animals wellbeing. The New Zoo would follow Association of Zoo and Aquariums (AZA) standards and United States Department of Agriculture (USDA) Guidelines for animal noise exposure in accordance with the Animal Welfare Act. The AZA standards and USDA Guidelines provide guidance for planning for, monitoring, and mitigating noise impacts to animals. Methods include but are not limited to: acclimating sensitive/impacted animals to diverse sounds and stimuli; temporarily relocating animals within the zoo; temporarily relocating animals to another zoo facility; and implementing construction barriers that reduce the noise impact to animals. Because the New Zoo would be AZA accredited zookeepers and animal caretakers at the New Zoo would be trained in how to monitor animals' welfare and would implement measures appropriate for each species. This would ensure animal safety and well-being in accordance with the Animal Welfare Act and AZA standards. During construction, measures to protect animals would be implemented as needed by the zookeepers. Because noise sensitivity varies by animal species, accommodations for specific animals would be developed before construction of Phases 2–4. If construction noise impacts on animals cannot be avoided, the New Zoo, as an AZA-accredited zoo, would be part of a large consortium of accredited zoos that could provide temporary alternative accommodations for animals during construction if necessary. Compliance with the Animal Welfare Act and AZA standards would ensure that there would be no adverse effects on animals at the New Zoo during construction of Phases 2–4. The construction noise impact on zoo animals would be **less than significant**.

Mitigation Measures

Mitigation Measure 3.11-1: Implement Measures to Reduce Exposure of Noise-Sensitive Receivers to Construction-Generated Noise

To minimize noise levels generated by construction activities, the New Zoo shall require its construction contractors to comply with the following measures during construction to reduce construction noise by at least 8 dBA:

- All construction equipment and material staging areas shall be set back as far as possible from nearby off-site noise-sensitive receivers, including but not limited to the residences along Lotz Parkway and Overture Way.
- All construction equipment shall be properly maintained and equipped with noise-reduction intake and exhaust mufflers and engine shrouds, in accordance with manufacturer specifications. Equipment engine shrouds shall be closed during equipment operation.
- Construction equipment with back-up alarms shall be equipped with either audible self-adjusting backup alarms or alarms that sound only when an object is detected. Self-adjusting backup alarms shall automatically adjust to 5 dBA louder than the surrounding background levels. All non-self-adjusting backup alarms shall be set to the lowest setting required to be audible above the surrounding noise levels.
- The construction contractor shall use noise-reducing operation measures, techniques, and equipment that reduce construction noise by at least 8 dBA. This requirement shall be enforced through its inclusion on all construction bid specifications for construction contractors hired to work on the Project site. The bid specifications shall require that construction contractors provide an equipment inventory list for all equipment within the fleet with engines greater than 50 horsepower. The list will identify (at a minimum), make, model, and horsepower of equipment; operating noise levels at 50 feet; available noise control devices that are installed on each piece of equipment; and associated noise reduction from the installed technology. Control devices shall include, but shall not be limited to, high-efficiency mufflers; acoustic dampening; protected internal noise absorption layers; enclosures; and electric motors. In addition, the contractor shall specify how proposed alternative construction procedures would be employed to reduce noise at sensitive receivers compared to other more traditional methods. Examples include, but are not limited to, welding instead of riveting, mixing concrete off-site instead of on-site, and using a thermal lance instead of drive motors and bits. In all cases, the

requirement is that the best commercially available noise-reducing technology and noise-reducing alternative construction method shall be used, provided that there are no safety concerns, engineering limits, or environmental constraints preventing it from being used. If a unique circumstance does exist that prevents a quieter alternative construction method from being used, the contractor shall provide evidence to support its proposal. The noise reduction elements of construction shall be approved by the City.

- Combine noisy operations (e.g., riveting, cutting, hammering) to occur in the same period (e.g., day or construction phase), such that the overall duration of these activities is reduced to the extent practical. When the noisiest operations are performed together within the same period, the overall duration that excessive noise would occur is reduced, minimizing the disturbing effects of exposure to prolonged increased noise levels.
- The contractor shall designate a disturbance coordinator and post that person's telephone number conspicuously around the publicly accessible portions of the construction site and provide it to nearby residences. A minimum of one sign shall be posted for every 1,000 feet of public frontage, or a minimum of six postings. The disturbance coordinator shall receive all public complaints and be responsible for determining the cause of the complaint and implementing any possible measures to alleviate the problem.
- When construction activities would occur within 400 feet of existing residential land uses (i.e., the distance at which noise levels of 66 dBA L_{eq} are achieved), the following measures shall be implemented:
  - Use noise-reducing enclosures and techniques around stationary noise-generating equipment (e.g., concrete mixers, generators, compressors).
  - Install temporary noise curtains as close as possible to the boundary of the construction site within the direct line of sight path of the nearby sensitive receptor(s). The noise curtains will consist of durable, flexible composite material featuring a noise barrier layer bounded to sound-absorptive material on one side.
  - Retain a qualified noise specialist to develop a noise monitoring plan, and conduct noise monitoring to ensure that noise reduction measures are achieving the necessary reductions such that levels at the receiving land uses do not exceed 5 dBA over existing levels.

Significance after Mitigation

Impacts would be **less than significant**.

Impact 3.11-2: Create Substantial Temporary (Construction) Vibration Levels

The use of heavy-duty construction equipment can generate levels of vibration that could result in disturbance to nearby sensitive residential land uses or structural damage. Based on modeling conducted, vibration levels for a vibratory roller at the structure nearest to the Project site, approximately 50 feet from where the use of construction equipment could occur, would be 87 VdB and 0.098 PPV in/sec. Construction vibration would occur during daytime hours, when people are less likely to be disturbed. Therefore, the potential for disturbance to nearby receivers is low. In addition, the Caltrans criterion of 0.2 PPV in/sec would not be exceeded at the nearest structure. This impact would be **less than significant**.

Construction activities generate varying degrees of temporary ground vibration, depending on the specific construction equipment used and activities involved. Ground vibration generated by construction equipment spreads through the ground and diminishes in magnitude with increases in distance. The effects of ground vibration may be imperceptible at the lowest levels, result in low rumbling sounds and detectable vibrations at moderate levels, and, at high levels, cause annoyance, sleep disturbance, or damage to nearby structures.

Pile driving and blasting are the types of construction activities that typically generate the highest vibration levels and, therefore, are of greatest concern when evaluating construction-related vibration impacts. However, pile driving and blasting would not occur during Project construction. Table 3.11-11 presents vibration levels for typical pieces of equipment that would be used during Project construction.

Table 3.11-11 Vibration Reference Levels for Construction Equipment

Equipment	PPV at 25 ft, in/sec	Approximate VdB at 25 ft
Vibratory roller	0.210	94
Large bulldozer	0.089	87
Loaded truck	0.076	86
Small bulldozer	0.003	58

Notes: ft = feet; in/sec = inches per second; PPV = peak particle velocity; VdB = vibration decibels.

Source: FTA 2018: 184.

Based on reference vibration levels for typical construction equipment (Table 3.11-11), the piece of equipment that could generate the greatest level of ground vibration would be a vibratory roller during paving, which generates ground vibration levels of 0.210 in/sec PPV and 94 VdB at 25 feet (FTA 2018: 184). Adjusting the reference vibration levels for a vibratory roller to the structures nearest to the Project site, single-family residences located 50 feet from the Project site boundary, construction vibration levels would be as high as 87 VdB and 0.098 PPV in/sec. Considering FTA's criterion of 80 VdB for places where people sleep, vibration levels could exceed the recommended levels and cause annoyance or sleep disturbance. However, as required by the City of Elk Grove Construction Specifications Manual and Section 6.32.100 of the EGMC, construction activities would occur Monday through Friday during daytime hours. Construction would not occur during times of day when people are more sensitive to disturbance. Although vibration may be perceptible at nearby receivers because it would occur during the daytime hours when existing ambient noise levels are higher, higher ambient noise levels can mask vibration noise, thereby reducing the potential to result in intolerable levels (Caltrans 2020). Regarding the potential for structural damage, based on the modeling conducted, vibration levels at the nearest existing residential structure would be 0.098 PPV in/sec and below the Caltrans threshold for structural building damage of 0.2 PPV in/sec (for nonengineered timber and masonry buildings). Therefore, there would be a low potential for structural damage. This impact would be **less than significant**.

Mitigation Measures

No mitigation is required.

Impact 3.11-3: Create Long-Term (Operational) Traffic-Generated Noise

Project-generated weekday and weekend traffic would not expose residential land uses to transportation noise standards included in General Plan Policy N-2-2. Therefore, this impact would be **less than significant**.

Project-generated vehicle trips generated by employees and visitors would result in an increase in average daily traffic volumes and associated increases in traffic noise levels along local roadway segments used to travel to and from the Project site. To analyze the impact of Project-generated transportation noise sources, traffic noise levels under existing, existing plus Phase 1 buildout, cumulative, and cumulative plus full buildout conditions were modeled for the most affected local roadway segments. Traffic noise from full future buildout of the New Zoo is also analyzed in Chapter 4, "Cumulative Impacts." For further detail about the parameters used to model traffic noise levels, refer to Appendix H.

Table 3.11-12 summarizes the weekday and weekend modeled traffic noise levels at adjacent land uses for each roadway segment under existing and existing plus Phase 1 buildout conditions. Additionally, Table 3.11-12 shows the incremental increase in noise levels under Phase 1 buildout relative to existing conditions.

Table 3.11-12 Summary of Modeled Traffic Noise Levels – Phase 1

Roadway Segment	L_{dn} at Nearest Residential Land Use (Exterior, dBA)[1, 2]		Incremental Increase (dBA)
	Existing Conditions	Existing Plus Phase 1 Buildout	Existing Plus Phase 1 Buildout
Weekday Noise Levels			
Lotz Parkway, north of Classical Way	55.6	63.0	7.4
Kammerer Road, west of Lotz Parkway	68.5	70.8	2.3
Kammerer Road, Lotz Parkway to Lent Ranch Parkway	68.6	71.2	2.6
Kammerer Road, Lent Ranch Parkway to Promenade Parkway	68.6	71.6	3
Kammerer Road, Promenade Parkway to SR 99 southbound ramps	72.7	74.4	1.7
Weekend Noise Levels			
Lotz Parkway, north of Classical Way	55.5	63.0	7.5
Kammerer Road, west of Lotz Parkway	68.3	70.6	2.3
Kammerer Road, Lotz Parkway to Lent Ranch Parkway	68.5	71.6	3.1
Kammerer Road, Lent Ranch Parkway to Promenade Parkway	68.4	71.9	3.5
Kammerer Road, Promenade Parkway to SR 99 southbound ramps	72.6	74.5	1.9

Notes: dB = decibel; L_{dn} = day-night level.

1 Noise levels do not account for attenuation provided by existing structures that would block the line of sight between the modeled roadway segment and adjacent land uses. Refer to Appendix H for all traffic noise modeling input data and output results.

2 Modeled traffic noise levels for Kammerer Road are shown at the distance to the roadway centerline and are presented for disclosure purposes only. There are no existing sensitive receivers along Kammerer Road near the Project site. Parcels around Kammerer Road, however, are zoned for residential or mixed-use development, which allows for the future development of residences along this roadway segment.

Source: Noise levels modeled by Ascent Environmental in 2023.

The City has a noise standard of 60 dBA L_{dn} that applies to the outdoor activity areas of residential land uses, as shown in Table 3.11-3. As shown in Table 3.11-12, residences along Lotz Parkway would experience noise levels of 63 dBA L_{dn} during the weekdays and weekends, which exceeds the City's exterior noise standards of 60 dBA L_{dn} for residential land uses, during operation of Phase 1 of the New Zoo. However, an 8-foot-tall concrete masonry wall along Lotz Parkway blocks the line of sight between the residences and the roadway. A barrier that breaks the line of sight between a source and a receiver will typically reduce noise by at least 5 dBA (Caltrans 2013b: 2-41; FTA 2018: 42). Therefore, exterior noise levels along Lotz Parkway for existing plus Phase 1 of the New Zoo conditions would be reduced to 58 dBA L_{dn}, which is below the City's 60 dBA L_{dn} threshold. Additionally, given that typical residential construction provides an exterior-to-interior attenuation of at least 24 dB (EPA 1978: 11), interior noise levels would be 39 dBA L_{dn}, which is below the City's interior noise standard of 45 dBA L_{dn}. Although, Project generated traffic noise would exceed existing noise levels along Lotz Parkway by 7.4 dBA residences along Lotz Parkway would experience traffic noise levels at 58 dBA L_{dn} due to noise attenuation from the concrete masonry wall along Lotz Parkway. Traffic noise of 58 dBA L_{dn} would exceed existing noise levels by approximately 4 dBA. Therefore, the Project would be consistent with General Plan Policy N-2-2, designed to protect public health, that permits a 5 dBA increase in traffic noise when existing noise levels are less than 60 L_{dn}. Therefore, Project-generated traffic noise levels along Lotz Parkway would remain below the City's exterior and interior noise thresholds for sensitive land uses and would be consistent with City General Plan policies.

To evaluate future (2050) traffic noise conditions Table 3.11-13 summarizes the weekday and weekend modeled traffic noise levels at adjacent land uses for each roadway segment under existing and full buildout conditions. Additionally, Table 3.11-13 shows the incremental increase in noise levels under full buildout relative to existing conditions.

Table 3.11-13 Summary of Modeled Traffic Noise Levels – Full Buildout

Roadway Segment	L_{dn} at Nearest Residential Land Use (Exterior, dBA)[1, 2]				Incremental Increase (dBA)	
	Existing Conditions	Cumulative	Cumulative Plus Full Buildout	Applicable Incremental Noise Standard (dB)	Cumulative Increase	Full Buildout Increase over Cumulative
Weekday Noise Levels						
Lotz Parkway, north of Classical Way	55.6	70.2	70.3	5	14.7	0.1
Kammerer Road, west of Lotz Parkway	68.5	75.6	75.6	1.5	7.1	0
Kammerer Road, Lotz Parkway to Lent Ranch Parkway	68.6	75.8	75.9	1.5	7.3	0.1
Kammerer Road, Lent Ranch Parkway to Promenade Parkway	68.6	76.7	76.8	1.5	8.2	0.1
Kammerer Road, Promenade Parkway to SR 99 southbound ramps	72.7	78.0	78.0	1.5	5.3	0
Weekend Noise Levels						
Lotz Parkway, north of Classical Way	55.5	70.1	70.2	5	14.7	0.1
Kammerer Road, west of Lotz Parkway	68.3	75.4	75.4	1.5	7.1	0
Kammerer Road, Lotz Parkway to Lent Ranch Parkway	68.5	75.6	75.9	1.5	7.4	0.3
Kammerer Road, Lent Ranch Parkway to Promenade Parkway	68.4	76.6	76.8	1.5	8.4	0.2
Kammerer Road, Promenade Parkway to SR 99 southbound ramps	72.6	77.8	77.9	1.5	5.3	0.1

Notes: dB = decibel; L_{dn} = day-night level.

1 Noise levels do not account for attenuation provided by existing structures that would block the line of sight between the modeled roadway segment and adjacent land uses. Refer to Appendix H for all traffic noise modeling input data and output results.

2 Modeled traffic noise levels along Kammerer Road include the distance to the roadway centerline and are presented for disclosure purposes only. Traffic noise levels along this roadway segment are not subject to any of the incremental noise increase standards established by General Plan Policy N-2-2 because, under existing conditions, there are no residential land uses along this roadway segment. Parcels along Kammerer Road near the Project site, however, are zoned for residential and mixed-use development, which allows for the future development of residential units. If multi-family residential units are developed on this parcel then, pursuant to General Plan Policies N-1 and N-2, the design of this development should comply with the exterior and interior noise standards in Table 3.11-3 (i.e., 60 dB L_{dn} at outdoor activity areas and an interior noise standard or 40 dB L_{dn}). Design measures to comply with these noise standards may include, but are not limited to, including a sound barrier along the road, setting back outdoor activity areas from the road, placing buildings between the road and outdoor activity areas to act as a noise barrier, and/or including more noise insulation to protect interior noise levels.

Source: Noise levels modeled by Ascent Environmental in 2023.

As shown in Table 3.11-13 the Project would result in an increase in transportation related noise for residents along Lotz Parkway during weekdays and weekends. However, the Project's contribution to increased noise levels would be 0.1 dBA. Therefore, the Project would be consistent with General Plan Policy N-2-2 that permits a 5 dBA increase in traffic noise when existing noise levels are greater than 60 L_{dn}. Therefore, under cumulative conditions the Project would be consistent with General Plan Policy N-2-2, designed to protect public health.

As the Project would contribute 0.1 dBA under cumulative conditions noise levels at residences along Lotz Parkway would be exposed to exterior noise levels of 58.1 dBA L_{dn} and interior noise level of 39.1 dBA L_{dn}, which is below the City's 60 dBA L_{dn} and 40 dBA L_{dn} standards for exterior and interior land uses. Therefore, Project-generated traffic noise levels along Lotz Parkway would remain below the City's exterior and interior noise thresholds for sensitive land uses and would be consistent with City General Plan policies.

There are no existing residential receivers or other sensitive receivers along Kammerer Road near the Project site. Therefore, increased traffic on Kammerer Road from buildout of Phase 1 and full buildout of the New Zoo would not exceed the City's noise standards for sensitive land uses.

Project-generated traffic would not result in an exceedance of the City's exterior noise standard of 60 dBA L_{dn} or interior noise standard of 45 dBA L_{dn} for residential land uses and would be consistent with General Plan Policy N-2-2 related to transportation noise. This impact would be **less than significant.**

Mitigation Measures

No mitigation is required.

Impact 3.11-4: Create a Substantial Increase in Operational On-Site Activities

The Project would involve the long-term operation of new noise sources and new noise-generating activities on the Project site that may expose off-site noise-sensitive receivers to excessive noise levels. New operational noise sources would include animals, mechanical equipment that is part of the buildings' HVAC systems, activity at the proposed parking lots, truck delivery activity, outdoor cafes, and backup generators. Noise from zoo operations would not exceed applicable noise standards. This impact would be **less than significant**.

The New Zoo would open for operation in early 2029 (or as early as 2027 with a rolling opening). However, the Project may have a rolling opening with some areas of the site open as construction of Phase 1 continues. Pursuant to the *California Building Association v. Bay Area Air Quality Management District* an EIR is not required to evaluate the Project's impacts on its future residents (i.e., visitors). As assessment of construction noise impacts on visitors is not included herein. The analysis below conservatively assumes operational noise impacts from full buildout of the New Zoo. Operational noise from a rolling opening would be less than described for full buildout below.

Noise sources associated with the New Zoo include animals, mechanical equipment, parking lot activity (e.g., opening and closing of vehicle doors, people talking), delivery truck activity, outdoor cafés, and backup generators. Noise levels associated with these noise sources are discussed separately, below.

Animals

The New Zoo would add animals to the Project site that may be audible at nearby sensitive receivers. During a visit to the Sacramento Zoo on June 2, 2023, Ascent staff conducted noise measurements to capture noise from the active animals at the zoo. The loudest animals at the Sacramento Zoo were the birds housed in the aviary. Based on 24-hour noise measurements conducted at the Sacramento Zoo and information provided by Zoo staff none of the animals housed at the New Zoo would create substantial nighttime noise (McKim, pers. comm., 2023). Therefore, this analysis focuses on daytime animal noise.

As shown in Table 3.11-8, noise from the aviary was measured at 77.8 dBA L_{eq} at 5 feet. The existing sensitive receivers nearest to the animal exhibits are residences along Lotz Parkway, which would be 250 feet east of the gelada exhibit, as shown in Figure 2-4 in Chapter 2, "Project Description." As the gelada are no louder than the aviary, single-family residences along Lotz Parkway would experience noise levels of approximately 44 dBA L_{eq} at 250 feet from the animals at the New Zoo. Assuming a 5-dBA reduction from the existing wall along the east side of Lotz Parkway, animal noise would attenuate to 39 dBA L_{eq} at the residences along Lotz Parkway. Therefore, noise levels at nearby residences would not exceed the City's daytime noise standard of 55 dBA L_{eq} for sensitive land uses. Therefore, this impact would be **less than significant**.

Mechanical Equipment

New facilities developed as part of the Project would include mechanical building equipment as part of the HVAC systems at the New Zoo. Proposed HVAC equipment would include a high-efficiency heat pump HVAC system installed on the roof of buildings. However, the specific locations of new HVAC units on new buildings were not known when this EIR was prepared. HVAC equipment can generate noise levels as high as 70 dBA L_{eq} at 3 feet (Carrier 2022). Without any intervening barriers, HVAC unit–generated noise levels would attenuate to the City's daytime standard of 55 dBA L_{eq} at a distance of 20 feet and the City's nighttime standard of 45 dBA L_{eq} at a distance

of 5 feet. There are no sensitive receivers, including the single-family residences along Lotz Parkway, located within 20 feet from buildings that may contain HVAC units. Therefore, sensitive receivers would not be exposed to noise levels exceeding City daytime or nighttime noise standards.

Noise from mechanical equipment would be further reduced through Project design features including HVAC screening and attenuation from proposed structures on the Project site. This impact would be **less than significant**.

Parking Lot Activity

Buildout of the New Zoo would include two guest parking lots: the North Lot and the South Lot. These two lots would be located north and south of Classical Way (see Figure 2-3 in Chapter 2, "Project Description") and would together include approximately 1,600 parking stalls. An employee parking lot would be constructed across Lotz Parkway at the intersection of Lotz Parkway and Overture Way. A masonry wall exists along the southern edge of the employee lot, and the north, east, and west edges would be fenced with an open view fencing.

The use of parking lots generates various noise sources, including vehicular traffic–related noise, car doors closing/slamming, people talking, and car alarms and radios going off. Noise levels associated with parking lots tend to increase as hourly or daily vehicular traffic increases; thus, larger parking facilities typically generate more noise than smaller ones. Further, as with any noise source, the closer the source to the receiver, the more audible the source is, and if the noise occurs during the sensitive times of the day, when background levels are lower, noise can be more audible and potentially disruptive to nearby receivers.

According to guidance from the FTA, noise generated by activity at surface parking lots located adjacent to off-site sensitive receivers varies depending on the range of vehicle turnover, ranging from 44 to 53 dBA L_{eq} at 50 feet (FTA 2018). Conservatively assuming parking lot noise would be 53 dBA L_{eq} at 50 feet, parking lot noise at the sensitive receivers nearest to the visitor lots, single-family residences along Lotz Parkway approximately 800 feet northwest of the Project site, would be approximately 30 dBA L_{eq}. This is below the City's daytime and nighttime noise standards for sensitive receivers of 55 dBA L_{eq} and 45 dBA L_{eq}, respectively. Additionally, as shown in Table 3.11-8, existing noise levels along Lotz Parkway are approximately 61 dBA L_{eq}. Therefore, parking lot noise would not be perceptible at the sensitive receivers nearest to the visitor lots.

The proposed employee parking lot would be located approximately 50 feet south of existing single-family residences at the northeast corner of Lotz Parkway and Overture Way. Depending on vehicle turnover, parking lot noise at these residences would range from 44 to 53 dBA L_{eq} at 50 feet (FTA 2018). Parking lot noise of 53 dBA L_{eq} is below the City's exterior daytime noise standard of 55 dBA L_{eq}. Although parking lot noise would exceed the City's nighttime noise standard of 45 dBA L_{eq}, employee parking noise is not anticipated during nighttime hours (10:00 p.m. to 7:00 a.m.), because employees would not be coming and going from the lot during nighttime hours. Therefore, the impact associated with parking lot noise would be **less than significant**.

Truck Activity

Operation of the New Zoo would require delivery of food for both humans and animals, waste pickup several times a week, and other shipments to support the New Zoo. Designated service and loading areas have been designed to support the New Zoo. As shown in Figure 2-10 (see Chapter 2, "Project Description"), Gate 1 would be the entrance gate for Zoo operation deliveries. The service area adjacent to the Giraffe Lodge, Gate 10, would be designated for human food deliveries. The service road around the site would allow delivery trucks to access other designated loading areas in the New Zoo, including the hay storage area at the northeast corner of the site and the service corridor adjacent to the nutrition center and Gelada Café.

Noise originating in delivery areas is usually short term and associated with truck-related activities, such as vehicle idling, engine revving, and the release of air brakes on heavy trucks. Based on a noise measurement conducted by Ascent on April 20, 2023, at the loading and unloading dock at an Anheuser-Busch facility, noise from delivery truck activity can be as loud as 59 dBA L_{eq} at 100 feet (Ascent Environmental 2023).

The off-site noise-sensitive receivers closest to on-site delivery truck activity would be the single-family residences located on Lotz Parkway approximately 450 feet from the hay storage delivery area. Delivery truck–generated noise would be 46 dBA L_{eq} at 450 feet. Therefore, delivery truck noise would not exceed the City's exterior daytime noise

standards of 55 dBA L_{eq}. Although delivery truck noise would exceed the City's nighttime noise standard of 45 dBA L_{eq}, the Project would be consistent with Section 6.32.140 of the EGMC, which prohibits loading and unloading activity between the hours of 10:00 p.m. and 7:00 a.m. The noise impact related to delivery truck activity would be **less than significant**.

Outdoor Dining

The New Zoo would include two outdoor dining areas and a beer garden that would be operational during daytime hours. The Giraffe Lodge would be located on the southwest portion of the site, and the Gelada Café would be located in the middle of the site near Lotz Parkway (see Figure 2-3 in Chapter 2, "Project Description"). The beer garden would be located in the center of the site and would be sized to serve fewer visitors than the other two cafes. Therefore, this analysis focuses on noise from the Giraffe Lodge and Gelada Café as they would be the main sources of dining noise on the site. Noise sources from outdoor dining generally include people having conversations and eating. Based on a noise measurement conducted by Ascent on June 2, 2023, at the Sacramento Zoo outside the Kampala Café, sounds from outdoor dining are as loud as 66.4 dBA L_{eq}. No existing sensitive receivers would be located near the Giraffe Lodge. The existing sensitive receivers closest to the Gelada Café would be the single-family residences located along Lotz Parkway approximately 450 feet southeast of the Gelada Café. At a distance of 450 feet, outdoor dining noise would be as loud as approximately 46 dBA L_{eq}. Therefore, noise levels at nearby residences would not exceed the City's daytime noise standard of 55 dBA L_{eq} for sensitive land uses. Cafes at the New Zoo would not be operational during nighttime hours and would not emit nighttime noise. The noise impact related to outdoor dining would be **less than significant**.

Backup Generators

Backup generators may be used to supply necessary power to vital systems at the New Zoo. Backup generators would be battery operated to support the animal care center and server room in the entry plaza in the case of a power outage. Generator noise can range from about 50 dB to around 100 dB depending on the energy source and model for the generator with noise coming from the inverters (Electric Generators Direct 2023). Solar- and battery-powered generators are the quietest types of generators because they do not have an internal combustion engine. Conservatively assuming a noise level of 60 dBA at 32.8 feet (10 meters), generator noise levels would attenuate to the City's daytime standard of 55 dBA L_{eq} at a distance of 60 feet and the City's nighttime standard of 45 dBA L_{eq} at a distance of 175 feet (City of Inglewood 2020). No sensitive receivers would be located within 175 feet of the proposed server room. The sensitive receivers nearest to the animal care center would be single-family residences on Lotz Parkway located approximately 250 feet southeast. Therefore, noise levels from backup generators would not exceed the City's daytime or nighttime noise standards for sensitive land uses. The impact related to backup generator noise would be **less than significant**.

Mitigation Measures

No mitigation is required.

Impact 3.11-5: Create a Substantial Increase in Special Event Noise Levels

Noise from special events, such as private parties and weddings, would not exceed City noise standards at nearby sensitive receivers. However, amplification noise from the nighttime safari would expose off-site residential land uses to noise exceeding City standards. Implementation of Mitigation Measures 3.11-5 would reduce this impact to a **less-than-significant** level.

Special Events

The Project would include special events, such as private parties, weddings, and educational events. The proposed Project plans include an event lawn near the Giraffe Lodge where events may occur. Special events at the New Zoo may include amplified sound. Based on sound measurement levels collected at an outdoor event at the Sacramento Zoo that used amplified sound, it is anticipated that events on the Project site would generate sound levels of 80.3 dBA L_{eq} and 91.9 dBA L_{max} at 50 feet (see Table 3.11-8). The proposed event space would be located approximately 1,500 feet southwest of the nearest sensitive receivers: single-family residences along Lotz Parkway. At a distance of

1,500 feet, it is anticipated that noise from events would generate sound levels of approximately 51 dBA L_{eq} and 62 dBA L_{max}. A barrier that breaks the line of sight between a source and a receiver will typically reduce noise levels by at least 5 dBA (Caltrans 2013: 2-41; FTA 2018: 42). Assuming a 5-dBA reduction from the existing wall along the east side of Lotz Parkway and north side of Overture Way, event noise would attenuate to 46 dBA L_{eq} at the residences along Lotz Parkway. Therefore, noise levels at nearby residences would not exceed the City's daytime noise standard of 50 dBA L_{eq} for stationary noise sources that consist primarily of speech or music. Additional attenuation would be provided by new buildings constructed on the site as part of the New Zoo. Additionally, the New Zoo would adhere to AZA standards, and amplification would face away from animals at the zoo. Zoo staff would ensure that amplification would not be at a volume that would not be disruptive to nearby animals by applying monitoring, procedures, and practices to reduce noise impacts on animals. This impact would be **less than significant**.

Nighttime Safari Noise

Visitors at the New Zoo would have the opportunity to participate in a nighttime safari. The nighttime safari experience would involve visitors following a designated route around the New Zoo, as shown in Figure 2-17, in Chapter 2, "Project Description." The general hours of the New Zoo would be from 9:00 a.m. to 9:00 p.m. with guests leaving by 10:00 p.m. However, during certain seasons or for events the New Zoo may be open later and nighttime safari noise could occur after 10:00 p.m.

The nighttime safari would include amplification along the proposed route. Amplified noise during nighttime hours would consider animals asleep at the New Zoo and adhere to AZA animal care standards concerning zoo noise. However, amplified sound could be as loud as 80.3 dBA L_{eq} at 50 feet (see Table 3.11-8). The sensitive receiver nearest to the proposed nighttime safari route, single-family residences on Lotz Parkway, would be approximately 500 feet east. At a distance of 500 feet, amplified noise would be as loud as 60 dBA L_{eq}. A barrier that breaks the line of sight between a source and a receiver will typically reduce noise levels by at least 5 dBA (Caltrans 2013: 2-41; FTA 2018: 42). Assuming a 5-dBA reduction from the existing wall along the east side of Lotz Parkway and north side of Overture Way, nighttime safari noise would attenuate to 55 dBA L_{eq} at the residences along Lotz Parkway. Therefore, nighttime safari noise would exceed the City's nighttime (10:00 p.m. to 7:00 a.m.) noise standard of 40 dBA L_{eq} for sources that consist primarily of speech or music. Noise from amplified sound can be controlled by limiting the allowable volume level from equipment. Implementation of Mitigation Measure 3.11-5 would require use of amplification that does not exceed 65 dBA L_{eq} at 50 feet from the nighttime safari route. Limiting amplified noise to 65 dBA L_{eq} at 50 feet would reduce noise levels to 45 dBA L_{eq} at the nearest receivers 500 feet from the safari route. Accounting for attenuation from the existing wall along the east side of Lotz Parkway and north side of Overture Way, nighttime safari noise would attenuate to 40 dBA L_{eq} at the residences along Lotz Parkway. This impact would be **less than significant**.

Mitigation Measures

Mitigation Measure 3.11-5: Restrict Noise Levels from Amplification Devices

Exterior amplified noise from the nighttime safari shall be limited to a maximum sound level of 65 dBA L_{eq} at approximately 50 feet from the nighttime safari route boundaries by adjusting amplification equipment accordingly. The New Zoo staff/nighttime safari event coordinator shall ensure that sound equipment is calibrated annually. Sound testing of the amplification equipment shall occur annually. Two sound level measurements shall be conducted at 50 feet from the amplification equipment. The sound level meter used for the sound level measurements should meet a minimum Type 2 compliance and be fitted with the manufacturer's windscreen and calibrated before use. Noise measurement readings shall be used to ensure that 65 dBA L_{eq} at 50 feet is not exceeded.

Significance after Mitigation

Less than significant.

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