Noise and Vibration Technical Report

Notre Dame Boulevard Bridge Project
City of Chico, California

Prepared by ICF
for Gonzales Development Company

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Chapter 1. Project Description

Gonzales Development Company proposes constructing a new two-lane bridge across Little Chico Creek and completing the planned Notre Dame Boulevard roadway link from Emerson Way, south of Little Chico Creek, to the terminus of Notre Dame Boulevard north of the creek in the city of Chico. The project road segment is approximately 500 feet in length and would include width for bicycle and pedestrian facilities. The purpose of this report is to evaluate potential noise and vibration impacts from the construction and operation of the project according to City of Chico (City) standards, in accordance with CEQA. Where significant impacts are identified, mitigation measures are identified and evaluated to reduce impacts to less-than-significant levels.

Chapter 2. Fundamentals of Noise and Vibration

2.1. 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 hearing organ, such as a human ear. *Noise* is defined as loud, unexpected, or annoying sound.

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

2.2. 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 (kHz), or thousands of Hz. The audible frequency range for humans is generally between 20 Hz and 20,000 Hz.

2.3. 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 (μPa). One μPa 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 μPa. Because of this huge range of values, sound is rarely expressed in terms of μPa. Instead, a logarithmic scale is used to describe sound pressure level (SPL) in terms of decibels (dB). The threshold of hearing for young people is about 0 dB, which corresponds to 20 μPa.

2.4. 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 three-dB increase. In other words, when two identical sources are each producing sound of the same loudness, the resulting sound level at a given distance would be three dB higher than one source under the same conditions. For example, if one automobile produces an SPL of 70 dB when it passes an observer, two cars passing simultaneously would not produce 140 dB—rather, they would combine to produce 73 dB. Under the decibel scale, three sources of equal loudness together produce a sound level 5 dB louder than one source.

2.5. 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 that range better than sounds of the same amplitude in higher or lower frequencies. To approximate the response of the human ear, sound levels of individual frequency bands are weighted, depending upon the human sensitivity to those frequencies. Then, an A-weighted sound level (expressed in units of dBA) can be computed based upon 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 regarding the relative loudness or annoyance of a sound, their judgments correlate well with the A-scale sound levels of those sounds. Other weighting networks have been devised to address high noise levels or other special problems (e.g., B, C, and D scales), but these scales are rarely used in conjunction with highway traffic noise. Noise levels for traffic noise reports are typically reported in terms of dBA. Table 1. describes typical A-weighted noise levels for various noise sources.

Table 1. 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 lawnmower at 3 feet		
	— 90 —	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	— 80 —	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawnmower at 100 feet	— 70 —	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	— 60 —	
		Large business office
Quiet urban daytime	— 50 —	Dishwasher (next room)
Quiet urban nighttime	— 40 —	Theater; large conference room (background)
Quiet suburban nighttime		
	— 30 —	Library
Quiet rural nighttime		Bedroom at night; concert
	— 20 —	
		Broadcast/recording studio
	— 10 —	
Lowest threshold of human hearing	— 0 —	Lowest threshold of human hearing

Source: Caltrans 2013a.

2.6. Human Response to Changes in Noise Levels

As discussed above, doubling sound energy results in a three-dB increase in sound. 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 is able to discern one dB change in sound levels when exposed to steady single-frequency (pure-tone) signals in the midfrequency (1,000 Hz –8,000 Hz) range. In typical noisy environments, changes in noise of one to two dB are generally not perceptible. However, it is widely accepted that people are able to begin to detect sound level increases of three dB in typical noisy environments. Further, a five-dB increase is generally perceived as a distinctly noticeable increase, and a 10-dB increase is generally perceived as a doubling of loudness. Therefore, a doubling of sound energy (e.g., doubling the volume of traffic on a highway), which would result in a three-dB increase in sound, would generally be perceived as barely detectable.

2.7. Noise Descriptors

Noise in our daily environment fluctuates over time. Various noise descriptors have been developed to describe time-varying noise levels. The noise descriptors most commonly used in traffic noise analysis are listed below.

- **Equivalent Sound Level** (Leq): Leq represents an average of the sound energy occurring over a specified period. In effect, Leq is the steady-state sound level containing the same acoustical energy as the time-varying sound that actually occurs during the same period. The one-hour A-weighted equivalent sound level (Leq(h)) is the energy average of A-weighted sound levels occurring during a one-hour period, and it is the basis for noise abatement criteria (NAC) used by Caltrans and FHWA.

- **Percentile-Exceeded Sound Level** (Lxx): Lxx represents the sound level exceeded for a given percentage of a specified period (e.g., L10 is the sound level exceeded 10 percent of the time, and L90 is the sound level exceeded 90 percent of the time).

- **Maximum Sound Level** (Lmax): Lmax is the highest instantaneous sound level measured during a specified period.

- **Day-Night Level** (Ldn): Ldn is the energy average of A-weighted sound levels occurring over a 24-hour period, with a 10 dB penalty applied to A-weighted sound levels occurring during nighttime hours between 10 p.m. and 7 a.m.

- **Community Noise Equivalent Level** (CNEL): Similar to Ldn, CNEL is the energy average of the A-weighted sound levels occurring over a 24-hour period, with a 10 dB penalty applied to A-weighted sound levels occurring during the nighttime hours between 10:00 p.m. and 7:00 a.m. and a five-dB penalty applied to the A-weighted sound levels occurring during evening hours between 7 p.m. and 10 p.m.

2.8. Sound Propagation

When sound propagates over a distance, it changes in level and frequency content. The manner in which noise reduces with distance depends upon the factors listed below.

2.8.1. 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 six dB for each doubling of distance from a point source. Highways consist of several localized noise sources on a defined path and, hence, can be treated as a *line source*, which approximates the effect of several point sources. Noise from a line source propagates outward in a cylindrical pattern, often referred to as *cylindrical spreading*. Sound levels attenuate at a rate of three dB for each doubling of distance from a line source.

2.8.2. Ground Absorption

The propagation path of noise from a highway to a receptor is usually very close to the ground. Noise attenuation from ground absorption and reflective-wave canceling adds to the attenuation associated with geometric spreading. Traditionally, the excess 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 receptor, such as a parking lot or body of water), no excess ground attenuation is assumed. For acoustically absorptive or soft sites (i.e., soft dirt, grass, or scattered bushes and trees), an excess ground-attenuation value of 1.5 dB per doubling of distance is normally assumed. When added to the cylindrical spreading, the excess ground attenuation results in an overall drop-off rate of 4.5 dB per doubling of distance.

2.8.3. Atmospheric Effects

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

2.8.4. Shielding by Natural or Human-Made Features

A large object or barrier in the path between a noise source and a receptor can substantially attenuate noise levels at the receptor. The amount of attenuation provided by shielding depends upon the size of the object and the frequency content of the noise source. Natural terrain features (e.g., hills and dense woods) and human-made features (e.g., buildings and walls) can substantially reduce noise levels. Walls are often constructed between a source and a receptor for the specific purpose of noise reduction. A barrier that breaks the line of sight between a source and a receptor will typically result in at least five dB of noise reduction. Taller barriers provide increased noise reduction. Vegetation between the highway and receptor is rarely effective in reducing noise because it does not create a solid barrier.

2.9. Vibration

In contrast to airborne sound, groundborne vibration is not a phenomenon that most people experience every day. Vibration is an oscillatory motion through a solid medium in which the motion's amplitude can be described in terms of displacement, velocity, or acceleration. The background vibration velocity level in residential areas is usually much lower than the threshold of human perception. Most perceptible indoor vibration is caused by sources within buildings, such as mechanical equipment while in operation, people moving, or doors slamming. Typical outdoor sources of perceptible groundborne vibration are construction equipment, steel-wheeled trains, and traffic on rough roads. Dynamic construction equipment, such as pile drivers, can create vibrations that radiate along the surface and downward into the earth. These surface waves can be felt as groundborne vibration. Vibration can result in effects that range from annoyance to structural damage. Variations in geology and distance result in different vibration levels with different frequencies and displacements.

Groundborne vibration can be expressed in terms of root-mean-square (RMS) vibration velocity to evaluate human response to vibration levels. RMS is defined as the average of the squared amplitude of the vibration signal. The vibration amplitude is expressed in terms of vibration decibels (VdB), which use a reference level of 1 micro-inch per second. Vibration can also measured by peak particle velocity (PPV), defined as the maximum instantaneous peak of the vibration signal in inches per second.

Chapter 3. Regulatory Setting

This section summarizes key state and local regulations, laws, and policies relevant to noise in the project area, in accordance with the requirements of CEQA.

3.1. State Regulations and Policies

3.1.1. California Noise Control Act

The California Noise Control Act was enacted in 1973. In preparing its general plan noise element, a city or county must identify local noise sources and analyze and quantify to the extent practicable current and projected noise levels from various sources, including highways and freeways; passenger and freight railroad operations; ground rapid transit systems; commercial, general, and military aviation and airport operations; and other stationary ground noise sources.

The *State of California General Plan Guidelines* (Governor's Office of Planning and Research 2017) provides noise compatibility guidelines for land use planning according to the existing community noise level; however, these guidelines offer no information regarding construction noise. The state has also published its Model Community Noise Ordinance (California Office of Noise Control 1977), which provides guidance to cities and counties on how to develop a community noise ordinance.

3.1.2. California Building Code

Title 24 of the California Code of Regulations contains standards for noise levels in interior residential building spaces. The standards state the following:

> Interior noise levels attributable to exterior sources shall not exceed 45 dB in any habitable room. The noise metric shall be either the day-night average sound level (Ldn) or the community noise equivalent level (CNEL).

3.1.3. California Airport Noise Regulations

Airport noise standards are described in the California Code of Regulations (Title 21, Sections 5000-5090). The code states the following:

> The level of noise acceptable to a reasonable person residing in the vicinity of an airport is established as a CNEL value of 65 dBA for purposes of these regulations. Noise-sensitive land uses (i.e., residential dwellings, schools, hospitals and convalescent homes, and places of worship) that are located within the 65 dBA CNEL noise contour would be considered incompatible, unless mitigation has been incorporated. This criterion level has been chosen for reasonable persons residing in urban residential areas where houses are of typical California

construction and may have windows partially open. It has been selected with reference to speech, sleep, and community reaction.

3.1.4. California Department of Transportation Vibration Standards

The California Department of Transportation (Caltrans) has developed guidelines to assess damage and annoyance potential from the transient and continuous vibration that is usually associated with construction activity. Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

Caltrans provides guidelines regarding vibration associated with construction and operation of transportation infrastructure. Table 2 provides the Caltrans vibration guidelines for potential damage to different types of structures.

Groundborne vibration and noise can also disturb people. Numerous studies have been conducted to characterize the human response to vibration. In general, people are more sensitive to vibration during nighttime hours when sleeping than during daytime waking hours. Table 3 provides the Caltrans guidelines regarding vibration annoyance potential (expressed here as peak particle velocity [PPV]).

Table 2. Caltrans Vibration Guidelines for Potential Damage to Structures

Structure Type and Condition	Maximum Peak Particle Velocity (PPV, in/sec)	
	Transient Sources	Continuous/Frequent Intermittent Sources
Extremely fragile historic buildings	0.12	0.08
Fragile buildings	0.2	0.1
Historic and some old buildings	0.5	0.25
Older residential structures	0.5	0.3
New residential structures	1.0	0.5
Modern industrial/commercial buildings	2.0	0.5

Source: California Department of Transportation, 2020.

Note: Transient sources create a single, isolated vibration event (e.g., blasting or the use of drop balls). Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

PPV = peak particle velocity.

Table 3. Caltrans Guidelines for Vibration Annoyance Potential

Human Response	Maximum PPV (in/sec) Transient Sources	Maximum PPV (in/sec) Continuous/Frequent Intermittent Sources
Barely perceptible	0.04	0.01
Distinctly perceptible	0.25	0.04
Strongly perceptible	0.9	0.10
Severe	2.0	0.4

Source: California Department of Transportation, 2020.

Note: Transient sources create a single, isolated vibration event (e.g., blasting or drop balls). Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

PPV = peak particle velocity.

3.2. Local Regulations and Policies

3.2.1. City of Chico General Plan

The Noise Element of the City of Chico *General Plan 2030* (2016) specifies guidelines for noise compatibility of land uses in the city. The following policies address noise levels within the city:

> Policy N-1.1 (New Development and Transportation Noise) – New development of noise-sensitive land uses will not be permitted in areas exposed to existing or planned transportation noise sources that exceed the levels specified in Table N-1, unless the project design includes measures to reduce exterior and interior noise levels to those specified in Table N-1 (Table 4 of this report).
> Policy N-1.2 (New Development and Non-Transportation Noise) – New development of noise-sensitive land uses will not be permitted in areas exposed to existing non-transportation noise sources that exceed the levels specified in Table N-2, unless the project design includes measures to reduce exterior noise levels to the unadjusted levels specified in Table N-2 (Table 5 of this report).

Table 4. Maximum Allowable Noise Levels from Transportation Sources

Land Use	Outdoor Activity Areas1 Ldn/CNEL, dB	Interior Spaces Ldn/CNEL, dB	Interior Spaces Leq, dB2
Residential	65 3	45	--
Transient Lodging	--	45	--
Hospitals, Nursing Homes	65 3	45	--
Theaters, Auditoriums, Music Halls	--	--	35
Churches, Meeting Halls	65 3	--	40
Office Buildings	--	--	45

Land Use	Outdoor Activity Areas1 Ldn/CNEL, dB	Interior Spaces	
		Ldn/CNEL, dB	Leq, dB2
Schools, Libraries, Museums	65 3	--	45
Playgrounds, Neighborhood Parks	70	--	--

Notes:

1. Noise standards are to be applied at outdoor activity areas with the greatest exposure to the noise source. When it is not practical to mitigate exterior noise levels at the patios or balconies of multi-family dwellings, a common area or onsite park may be designated as the outdoor activity area. For noise-sensitive land uses that do not include outdoor activity areas, only the interior noise standard shall apply.

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

3. Where it is not possible to reduce noise in outdoor activity areas to 65 dB Ldn/CNEL or less using all feasible noise reduction measures, an exterior noise level of up to 70 dB Ldn/CNEL may be allowed provided that interior noise levels are in compliance with this table.

Table 5. Maximum Allowable Noise Levels from Transportation Sources

Noise Level Descriptor (dBA)	Exterior Noise Level (dBA)	
	Daytime (7 a.m. to 10 p.m.)	Nighttime (10 p.m. to 7 a.m.)
Average-Hourly Noise Level (Leq)	55	50
Intermittent Noise Level (L2 or Lmax)	75	65

Notes:

1. Noise levels are for planning purposes and may vary from the standards of the City's Noise Ordinance, which are for enforcement purposes.

2. Noise levels shall be lowered by five dB for simple tone noises, noises consisting primarily of speech or music, or for recurring impulsive noises. Noise level standards do not apply to mixed-use residential units established in conjunction with industrial or commercial uses provided interior noise levels remain below 45 dB Ldn/CNEL.

3. In areas where the existing ambient noise level exceeds the established daytime or nighttime standard, the existing level shall become the respective noise standard and an increase of 3 dBA or more shall be significant. Noise levels shall be reduced 5 dBA if the existing ambient hourly Leq is at least 10 dBA lower than the standards.

4. Noise standards are to be applied at outdoor activity areas with the greatest exposure to the noise source. When it is not practical to mitigate exterior noise levels at patio or balconies of multi-family dwellings, a common area or onsite park may be designated as the outdoor activity area.

3.2.2. Chico City Code

City of Chico Municipal Code Chapter 9.38 regulates noise levels within the city. In accordance with the City's Municipal Code, noise levels associated with residential land uses, measured at any point outside the property line, are limited to a maximum of 70 dBA between the hours of 7 a.m. and 9 p.m. and 60 dBA between the hours of 9 p.m. and 7 a.m.

For construction-related activities that occur between the hours of 10 a.m. and 6 p.m. on Sundays and holidays, and 7 a.m. and 9 p.m. on other days, the following limitations apply:

1) No individual device or piece of equipment shall produce a noise level exceeding 83 dBA at a distance of 25 feet from the source. If the device or equipment is housed within a structure on the

property, the measurement shall be made outside the structure at a distance as close as possible to 25 feet from the equipment.

2) The noise level at any point outside the property plane of the project shall not exceed 86 dBA.

Chapter 4. Existing Noise Environment

4.1. Existing Land Uses and Modeling Receptor Locations

A field investigation was conducted to identify land uses that could be subject to traffic and construction noise impacts from the proposed project. Land uses in the project area were categorized by land use type and the extent of frequent human use. Although all developed land uses are evaluated in this analysis, the focus of this impact analysis is on locations of frequent human use that would benefit from a lowered noise level, such as locations with defined outdoor activity areas. For this project, the potentially affected noise-sensitive uses with defined outdoor activity areas consist of single- and multi-family residences, parks, and Marsh Junior High School.

Short-term measurement locations were selected to represent frequent outdoor use areas along the project alignment. Additionally, long-term measurements were conducted to capture the day-night traffic noise level pattern in the study area. Short-term and long-term measurement locations were also used as receivers in the noise prediction model. Additional prediction sites were added to the model to fully characterize the noise environment at outdoor use areas along Notre Dame Boulevard.

4.2. Sound Level Measurements

A field noise study was conducted using recommended procedures in the Caltrans Technical Noise Supplement (2013). Although use of this guidance is not required for a locally funded project, the guidance includes best practices for data collection in the field. The following is a summary of the procedures that were used to collect short-term and long-term sound level data.

4.2.1. Short-Term Measurements

Short-term monitoring was conducted at three locations along the project alignment on Tuesday, March 1, 2022 using a Larson Davis Model 831 Type 1 (precision grade) digital integrating sound level meter. Short-term measurements were attended by field staff to count traffic and record observations concurrent with each measurement. The L_{eq} values collected during each measurement period were recorded with sound-level meters. Dominant noise sources observed and other relevant measurement conditions were identified and logged manually. Calibration of the sound level meter was checked before and after each measurement using a Larson-Davis Model CAL 200 calibrator. According to observations recorded during short-term measurements shown in Table 6, construction equipment was audible at all sites, in addition to noise from local traffic. The short-term measurement locations are shown in Figure 1.

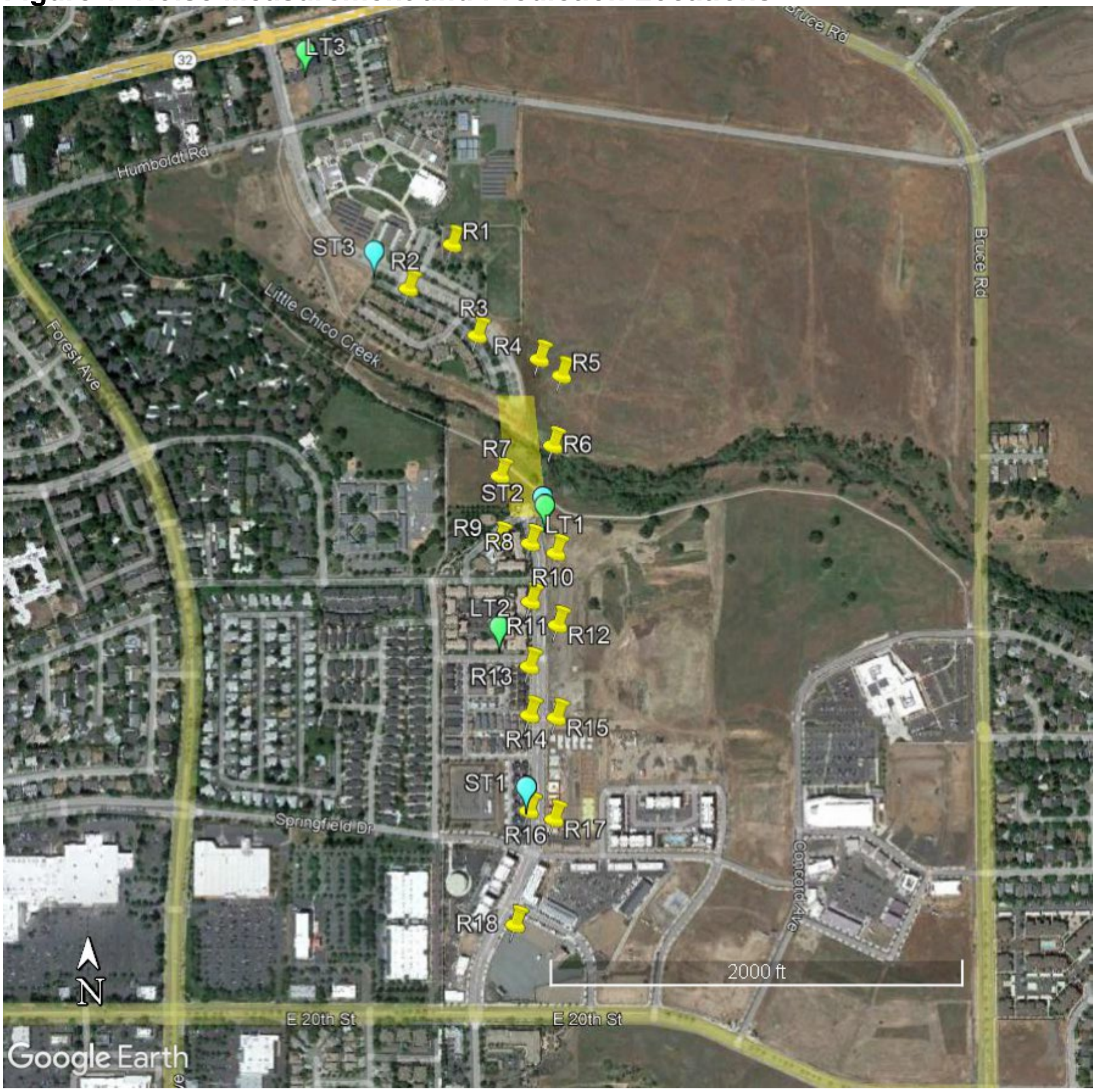
Table 6. Summary of Short-Term Noise Level Measurements

Site	Location	Primary Source(s)	Date/Time	Duration of Measurement (minutes)	Measured L_{eq} (dBA)
ST-1	Apartment building on Notre Dame Boulevard, near Springfield Drive	Local traffic, construction equipment	March 1, 2022, 12:32 PM	20	53.8
ST-2	Across from Apartment building on Notre Dame Boulevard, near Emerson Way	Local traffic, construction equipment	March 1, 2022, 12:04 PM	20	44.5
ST-3	Across from Marsh Junior High School	Local traffic, construction equipment	March 1, 2022, 12:32 PM	20	59.6

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

Temperature, wind speed, and humidity were recorded manually during the short-term monitoring sessions using a Kestrel 3000 portable weather station. During the short-term measurements, weather was partly cloudy, with a wind speed of 1 to 2 miles per hour (mph). Temperatures ranged from 68 degrees Fahrenheit (°F) to 77°F.

Figure 1. Noise Measurement and Prediction Locations

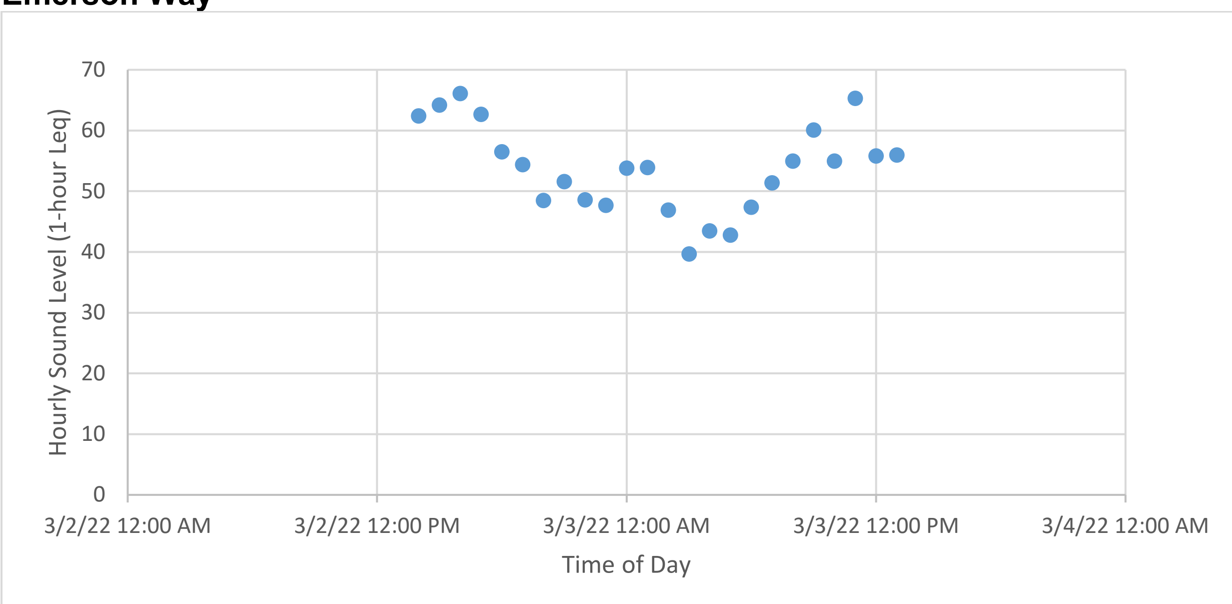


4.2.2. Long-Term Measurements

Long-term monitoring was conducted at three locations using SoftdB Piccolo Type 2 sound-level meters. The locations of measurements are shown in Figure 1. The purpose of the measurements was to characterize the traffic noise pattern throughout a typical day/night cycle. Long-term sound level data was collected continuously at each site for at least 24 hours, beginning Tuesday, March 1 and ending Thursday, March 3, 2022.

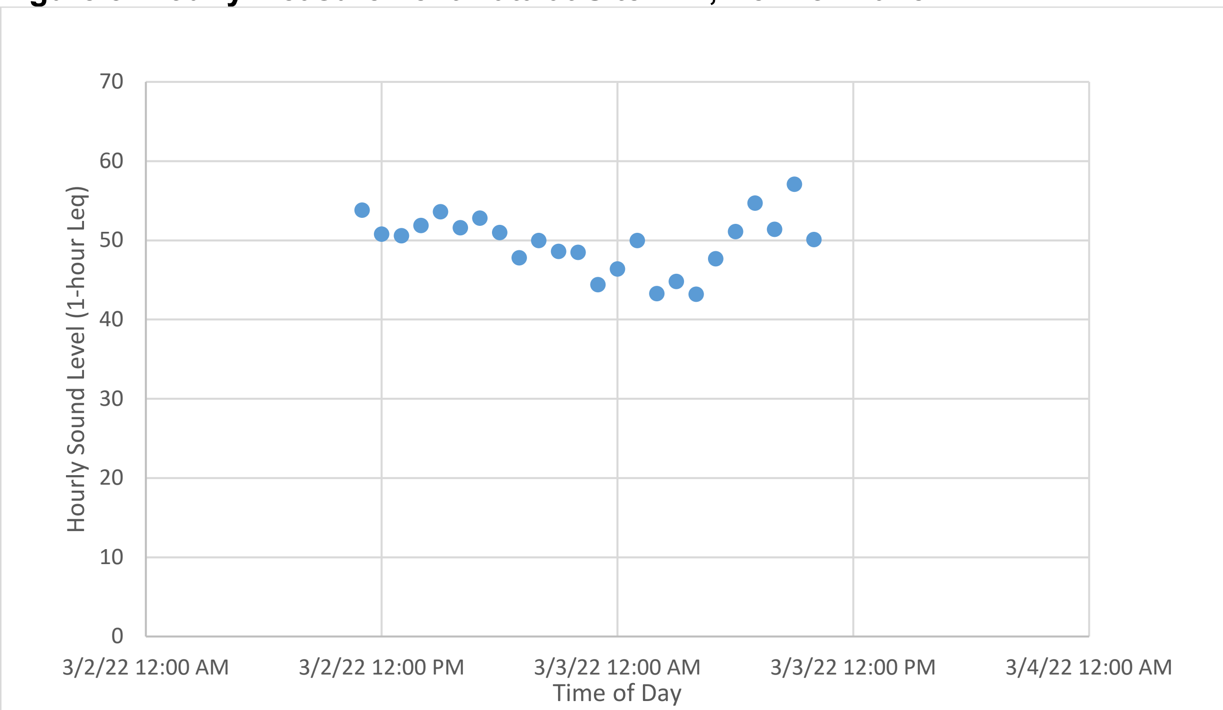
Long-term noise monitoring location LT1 was located across Notre Dame Boulevard from the Parkside Terrace apartment complex at Notre Dame Boulevard and Emerson Way. The sound level meter was mounted on a light pole at a height of about 10 feet above the ground, and about 35 feet away from the near lane of Notre Dame Boulevard. Ambient noise sources at the site included local traffic and noise from nearby construction sites. The loudest-hour noise level measured was 66.1 dBA L_{eq}(h) during the 4:00 p.m. hour. The day-night noise level for this collection of data was calculated to be 60.3 dBA L_{dn}. A chart of hourly noise levels is shown in Figure 2.

Figure 2. Hourly Measurement Data at Site LT1, Notre Dame Boulevard and Emerson Way



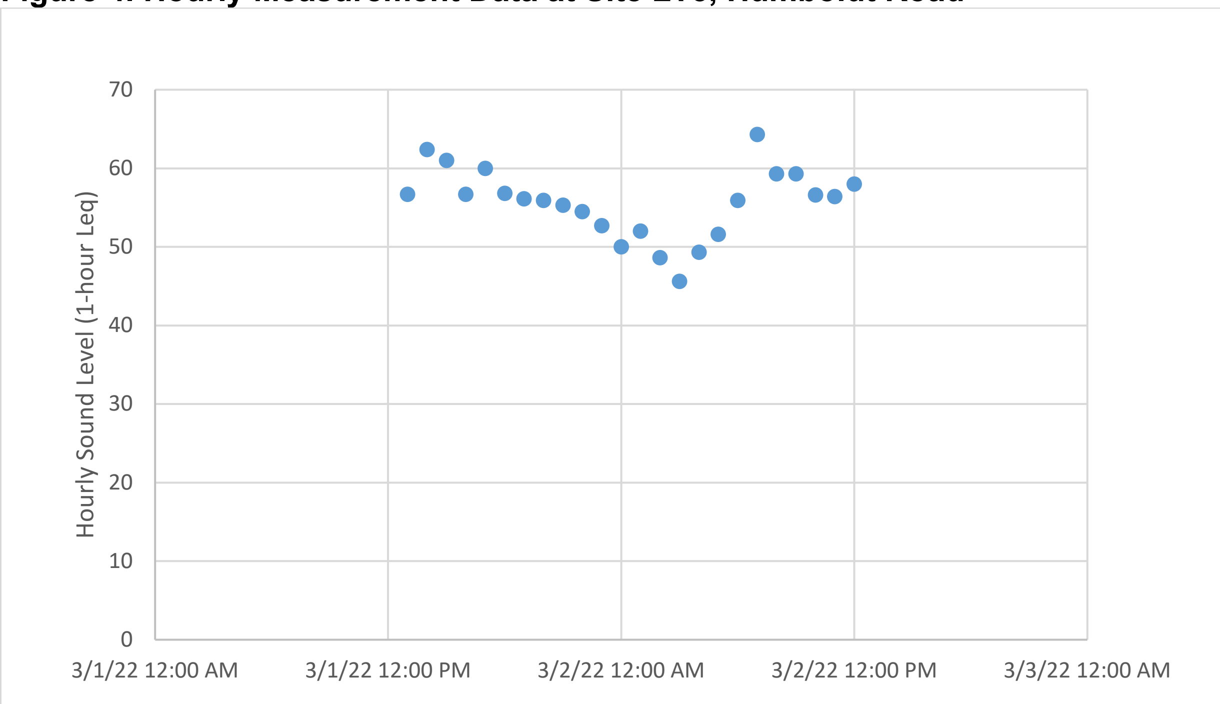
Long-term noise monitoring location LT2 was located in a residential neighborhood along Kenrick Lane. The sound level meter was mounted on a tree at a height of about 8 feet above the ground, and about 150 feet away from the near lane of Notre Dame Boulevard. Ambient noise sources at the site included local traffic, people talking nearby and noise from nearby construction sites. The loudest-hour noise level measured was 57.1 dBA L_{eq}(h) during the 9:00 a.m. hour. The day-night noise level for this collection of data was calculated to be 55.3 dBA L_{dn}. A chart of hourly noise levels is shown in Figure 3.

Figure 3. Hourly Measurement Data at Site LT2, Kenrick Lane



Long-term noise monitoring location LT3 was located in a residential neighborhood in the northeast quadrant of the intersection of Notre Dame Boulevard and Humboldt Road. The sound level meter was mounted on a tree at a height of about 10 feet above the ground, and about 100 feet away from the near lane of Notre Dame Boulevard. Ambient noise sources at the site consisted primarily of local traffic and construction equipment. The loudest-hour noise level measured was 64.3 dBA L_{eq}(h) during the 7:00 a.m. hour. The day-night noise level for this collection of data was calculated to be 60.5 dBA L_{dn}. A chart of hourly noise levels is shown in Figure 4.

Figure 4. Hourly Measurement Data at Site LT3, Humboldt Road



4.2.3. Comparison of Measurement Data to Modeled Existing Traffic Noise Levels

TNM 2.5 was used to compare measured traffic noise levels to modeled noise levels at field measurement locations using average daily traffic data provided by the project engineer.

A comparison between measured and modeled noise levels at each measurement location are shown in Table 7. Noise levels were in reasonably close agreement (within 3.3 dB) between measured and modeled values for all long-term measurement locations. Therefore, no additional adjustments to the modeling calculations were used.

Table 7. Comparison of Measured with Modeled Noise Levels

Measurement Location	Measured Existing Noise Level, dBA Ldn	Modeled Existing Traffic Noise Level, dBA Ldn	Modeled Minus Measured (dBA)
LT1	60.3	62.0	+ 1.7
LT2	55.3	55.5	+ 0.2
LT3	60.5	57.2	- 3.3

Note: Ldn = day-night noise levels. dBA = A-weighted decibels.

Chapter 5. Environmental Consequences

5.1. Prediction of Traffic Noise Levels

Traffic noise levels were predicted using FHWA Traffic Noise Model (TNM), version 2.5. TNM is a computer model based upon two FHWA reports: FHWA-PD-96-009 and FHWA-PD-96-010 (FHWA 1998a; FHWA 1998b). Geometric inputs to the traffic noise model include the locations of roadways, shielding features (e.g., topography and buildings), noise barriers, and receptors, as well as ground type. Three-dimensional representations of these inputs were developed using computer-aided design (CAD) drawings and topographic contours for both existing and with-project conditions provided by the project engineer. MicroStation V8i software was the primary tool used to digitize model objects for input into TNM version 2.5.

Traffic noise was evaluated under existing year (2021), near-term opening year (2026), and future year (2041) conditions. Both with-project and no-project alternatives were analyzed for each model case. Traffic volume data for Notre Dame Boulevard and cross-streets was provided by Headway Transportation LLC (2022).

The loudest hour is characterized by the highest hourly volume of traffic traveling at the roadway's design speed (i.e., in a free-flowing state). Average daily traffic for each of the existing year, near-term, and future year conditions were used to model traffic noise emissions on the Notre Dame Boulevard.

5.2. Prediction of Construction Noise Levels

The assessment of potential construction noise levels was based on methodology developed by the FTA (2018) and construction noise criteria from applicable local guidance (such as local general plan documents or noise ordinances). Noise levels produced by commonly used construction equipment are shown in Table 8. Individual types of heavy construction equipment are expected to generate maximum noise levels ranging from 80 to 101 dBA at a reference distance of 50 feet. At a distance of 100 feet, individual type of construction equipment are expected to produce maximum noise levels from 74 to 95 dBA. The construction noise level at a given receiver location depends on the type of construction activity and the distance and shielding between the activity and noise-sensitive receivers.

Table 8. Commonly Used Construction Equipment Noise Emission Levels

Equipment	Typical Noise Level (dBA) 50 Feet from Source	Typical Noise Level (dBA) 100 Feet from Source
Impact Pile Driver	101	95
Vibratory Pile Driver	96	90
Auger Drill Rig (for drilled piles)	85	79
Crane	83	77
Heavy Truck	84	78
Excavator	85	79
Bulldozer	85	79
Pump	81	75
Generator	81	75
Air compressor	80	74
Cement Mixer	80	74
Grader	85	79
Compactor	82	76
Scraper	89	83
Backhoe	85	79
Loader	84	78

Source: Federal Transit Administration 2018.
dBA = A-weighted decibel.

Construction equipment used would vary by construction phase of the proposed project and would involve the use of impact pile drivers, vibratory pile drivers, excavators, bulldozers, heavy trucks, pumps, generators, graders, compactors, and other heavy equipment. The source levels used to calculate noise exposure are based on the Lmax of equipment emission levels developed by FTA. Usage factors for construction noise are used in the analysis to develop reasonable worst-case noise exposure values. The noise level value accounts for the energy-average of noise over a specified interval (usually one hour), and usage factors represent the amount of time a type of equipment is used during a typical interval.

Potential noise levels resulting from construction of the proposed project were evaluated by combining the noise levels of the three loudest pieces of equipment that would likely operate at the same time (for example, an excavator, bulldozer, and truck being operated simultaneously during the site preparation phase) and applying the appropriate usage factor (percent of time equipment is in operation) to each piece of equipment. Sound levels from construction activities are calculated as a function of distance from the source(s), based on point-source attenuation over hard (i.e., acoustically reflective) ground, noting that 6 dB of reduction per doubling of distance can be assumed over hard ground.

5.3. Prediction of Construction Vibration Levels

With regard to potential vibration impacts during construction, such effects were evaluated using the construction vibration modeling methods recommended by the U.S. Department of Transportation, along with construction equipment data provided by the project sponsor. Reasonable worst-case construction vibration levels are provided and compared to the *Caltrans Vibration Guidelines for Damage and Annoyance* (refer to Tables 3 and 4).

Table 9 summarizes typical vibration levels generated by construction equipment at a reference distance of 25 feet and other distances up to 100 feet. The construction vibration analysis assumes that piles would be installed using impact-hammer and vibratory-hammer methods.

Table 9. Vibration Source Levels for Construction Equipment

Equipment	PPV at 25 Feet	PPV at 50 Feet	PPV at 75 Feet	PPV at 100 Feet
Impact Pile Driver	1.518	0.054	0.2920	0.190
Vibratory Pile Driver	0.734	0.260	0.141	0.092
Auger drill	0.089	0.032	0.017	0.011
Hoe ram	0.089	0.032	0.017	0.011
Large bulldozer	0.089	0.032	0.017	0.011
Loaded trucks	0.076	0.027	0.015	0.010

Source: Federal Transit Administration 2018.
PPV = peak particle velocity.

5.4. Thresholds of Significance

In accordance with City of Chico CEQA Guidelines, the proposed project or its related activities would be considered to have a significant effect if it would result in any of the conditions indicated in the environmental checklist, which asks the following questions related to noise and vibration:

1) Exposure of persons to or generation of noise levels in excess of standards established in the 2030 Chico General Plan, noise ordinance, or applicable standards of other agencies?
2) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?
3) Exposure of sensitive receptors (residential, parks, hospitals, schools) to exterior noise levels (CNEL) of 65 dBA or higher?
4) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?
5) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?
6) For a project located within the airport land use plan, would the project expose people residing or working in the Study Area to excessive noise levels?

7) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the Study Area to excessive noise levels?

5.5. Selection of Future Year Baseline Conditions

The CEQA Guidelines provide that existing conditions at the time a Notice of Preparation is released or when environmental review begins “normally” constitute the baseline for environmental analysis. (Guidelines Section 15125). In 2010, the California Supreme Court issued an opinion holding that while lead agencies have some flexibility in determining what constitutes the baseline, relying on “hypothetical allowable conditions” when those conditions are not a realistic description of the conditions without the project would be an illusory basis for a finding of no significant impact from the project and, therefore, a violation of CEQA (Communities for a Better Environment v. South Coast Air Quality Management District (2010) 48 Cal.4th 310).

On August 5, 2013, the California Supreme Court handed down its second baseline decision when it decided Neighbors for Smart Rail v. Exposition Metro Line Construction Authority (57 Cal.4th 439). This latest decision has clarified that, under certain circumstances, a baseline may reflect future, rather than existing, conditions. The rule specifies that factual circumstances can justify an agency departing from that norm in the following circumstances, when such reasons are supported by substantial evidence:

- When necessary to prevent misinforming or misleading the public and decision makers; and
- When their use in place of existing conditions is justified by unusual aspects of the project or surrounding conditions.

With respect to the proposed project, utilizing existing conditions to evaluate operational noise impacts would misrepresent and mislead the public and decision makers with respect to potential noise impacts because the project will be constructed and operational by 2026, after the time environmental review was initiated. Existing conditions do not represent the traffic volumes and traffic-related noise levels anticipated at the time the proposed project is first operational. These facts represent substantial evidence in support of utilizing a future baseline, rather than existing conditions, to evaluate operational noise impacts. Accordingly, the CEQA baseline for the purposes of this analysis is defined as near-term (2026) conditions. The near-term 2026 baseline represents the near-term, which reflects noise and impacts when the project is first operational. The year 2041 data represents the future with-project year, which reflects full impacts of the project, accounting for future traffic volumes from other planned development identified in the 2030 Chico General Plan. Utilizing near-term opening year and future year conditions for the determination of impacts will inform the public and decision makers with respect to operational noise impacts, consistent with current CEQA case law.

5.6. Impact Discussion

Impact NV-1. Exposure of persons to or generation of noise levels in excess of standards established in the 2030 Chico General Plan, noise ordinance, or applicable standards of other agencies?

Operation

Traffic noise modeling results for existing (2021), near-term year (2026), and future year (2041) conditions without and with the project are summarized in Table 10. Near-term conditions without and with the project are included for CEQA purposes and to evaluate the effect of nose level increases due to the project, excluding the effects of future growth in traffic. Future with-project comparisons without and with the project are used to determine the increase in noise levels due to project operation. The comparison of with-project to without-project conditions indicates the direct effect of the project. Modeling results are rounded to the nearest decibel.

Table 10. Noise Model Predictions for Existing, Near-term and Future Year Conditions

Receiver I.D.	Land Use	Existing Noise Level, CNEL	Opening year noise level without project, CNEL	Opening year noise level with project, CNEL	Opening-year with-project minus without-project noise level, dB	Future year noise level without project, CNEL	Future year traffic noise level with project, CNEL	Future year with-project minus without-project noise level, dB	Future year with-project minus Opening Year noise level, dB	Impact Type
R-01	School, open space	56	56	57	+ 1	56	58	+ 2	+ 2	None
R-02	Murphy Commons Apartments	57	58	59	+ 1	58	60	+ 2	+ 2	None
R-03	Murphy Commons Apartments	57	58	59	+ 1	58	60	+ 2	+ 2	None
R-04	Meriam Park Apartments	58	59	60	+ 1	59	61	+ 2	+ 2	None
R-05	Meriam Park Apartments	56	56	57	+ 1	56	58	+ 2	+ 2	None
R-06	Little Chico Creek	58	59	60	+ 1	59	61	+ 2	+ 2	None
R-07	Little Chico Creek	58	59	60	+ 1	59	61	+ 2	+ 2	None
R-08	Parkside Terrace Apartments	62	63	64	+ 1	63	65	+ 2	+ 2	None
R-09	Parkside Terrace Apartments	56	56	57	+ 1	56	58	+ 2	+ 2	None
R-10	Meriam Park Apartments	62	63	64	+ 1	63	65	+ 2	+ 2	None
R-11	Parkside Terrace Apartments	62	63	64	+ 1	63	65	+ 2	+ 2	None
R-12	Meriam Park Apartments	60	61	62	+ 1	61	63	+ 2	+ 2	None
R-13	Meriam Park Residences	62	63	64	+ 1	63	65	+ 2	+ 2	None
R-14	Meriam Park Apartments	62	63	64	+ 1	63	65	+ 2	+ 2	None

Receiver I.D.	Land Use	Existing Noise Level, CNEL	Opening year noise level without project, CNEL	Opening year noise level with project, CNEL	Opening-year with-project minus without-project noise level, dB	Future year noise level without project, CNEL	Future year traffic noise level with project, CNEL	Future year with-project minus without-project noise level, dB	Future year with-project minus Opening Year noise level, dB	Impact Type
R-15	Meriam Park Apartments	62	63	64	+ 1	63	65	+ 2	+ 2	None
R-16	Meriam Park Apartments	62	63	64	+ 1	63	65	+ 2	+ 2	None
R-17	Meriam Park Apartments	62	63	64	+ 1	63	65	+ 2	+ 2	None
R-18	Movie theater/Retail	60	61	62	+ 1	61	63	+ 2	+ 2	None
ST1	Meriam Park Residences	62	63	64	+ 1	63	65	+ 2	+ 2	None
ST2	Meriam Park Apartments	62	63	64	+ 1	63	65	+ 2	+ 2	None
ST3	Murphy Commons Apartments	62	63	64	+ 1	63	65	+ 2	+ 2	None
LT1	Meriam Park Apartments	62	63	64	+ 1	63	65	+ 2	+ 2	None
LT2	Parkside Terrace Apartments	56	56	57	+ 1	56	58	+ 2	+ 2	None
LT3	Residences, Humboldt Road	57	56	59	+ 3	58	60	+ 2	+ 4	None

As shown in Table 10, traffic noise levels at modeled receiver locations for near-term no-project conditions are predicted to be in the range of 56 to 63 dBA CNEL, accounting for all types of land use in the study area. Under near-term with-project conditions, traffic noise levels are predicted to range from 57 to 64 dBA CNEL. In the future year (2041), traffic noise levels are predicted to have the same range of values as the near-term no-project conditions. Under design year with-project conditions, traffic noise levels are predicted to range from 58 to 65 dBA CNEL. The highest receiver noise level in each of the model cases was found to occur at the nearest façade of new apartment units that face Notre Dame Boulevard.

The modeled level of 65 dBA CNEL is equal to the City maximum allowable noise standard for residential use. As such, traffic noise levels from the project under both near-term and future year conditions would be considered compatible with residential use. Therefore, operation of the project would not expose persons to noise levels that exceed standards established in the 2030 General Plan. This impact is considered **less than significant**. No mitigation is required.

Construction

Construction of the bridge is expected to use impact-hammer driven pile methods which would be driven at the bridge abutments and pier locations in the channel. Impact hammer pile driving is estimated to take five workdays to complete. In addition, sheet piles may be installed during the excavation phase, which would require three weeks of vibratory driving. Apart from pile driving, bridge construction would require standard heavy equipment such as cranes, bulldozers, loaders, excavators, trucks, generators and air compressors. Bridge construction is estimated to take approximately 100 workdays, or five months to complete (Poulin pers comm.). Construction would generally be done during standard work hours of 7:00 a.m. to 6:00 p.m. on weekdays. If circumstances require, night or evening work may be done, although this is not anticipated (Simmons pers comm).

Construction equipment used during the bridge construction would produce maximum noise levels of up to 95 dBA at the nearest receptors located to the southwest and northeast of the new bridge abutment locations, each at a distance of about 100 feet away. During bridge construction, the two loudest pieces of equipment that may operate at one time would be a bulldozer and an excavator, with a combined noise level of 82 at 100 feet. Based on this information, individual pieces of construction noise may potentially exceed the city limit of 83 dBA at 25 feet. Noise levels during construction are also expected to exceed the city limit of 86 dBA along the property plane of apartment units with frontage along Notre Dame Boulevard on an intermittent basis. However, construction noise at the bridge would be short term, and would vary as construction equipment used to build the bridge would progress over time from one end of the bridge location to the other end. Heavy equipment noise from construction of the bridge would be a temporary effect, ceasing once work is complete.

During construction, contractors will be required to comply with City noise regulations (Chapter 9.38 of the Chico Municipal Code) that limit hours of construction and minimize construction noise levels in the surrounding community.

Noise levels during construction are expected to exceed city standards on an intermittent basis. Therefore, impacts from construction would be **significant**. Implementation of Mitigation Measure NV-1 would reduce this impact to a less-than-significant level.

Mitigation Measure NV-1. Employ Best Noise Control Practices during Construction

The project proponent shall require all construction contractors to employ best noise control practices to minimize construction noise levels at nearby residences. The noise control practices shall include, at a minimum, the following:

- Use of heavy equipment shall be limited to hours allowed by the City: 7:00 a.m. to 9:00 p.m. Monday to Saturday, and 10:00 a.m. to 6:00 p.m. on Sunday.
- Stationary equipment (e.g., generators, compressors, cement mixers, idling trucks) shall be located as far as possible from noise-sensitive land uses.
- Construction equipment powered by gasoline or diesel engines shall be required to have sound control devices that are at least as effective as those originally provided by the manufacturer; all equipment shall be operated and maintained to minimize noise generation.
- Excessive noise shall be prevented by shutting down idle vehicles or equipment.

- Noise-reducing enclosures shall be used around noise-generating equipment.
- Adjacent residents shall be notified in advance of construction work.

Impact NV-2. Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?

Construction of the bridge would require the installation of piles at the bridge abutments and piers. The piles are expected to be installed using impact-hammer methods. Sheet piles driven during excavation would use vibratory driving methods. An impact drill rig would produce the highest vibration level of about 0.19 in/sec PPV at a distance of 100 feet. The residences nearest to the bridge are apartment buildings to the northeast and southwest of the bridge construction area, about 100 feet away from the abutment locations. This level of vibration would not exceed the most stringent criterion of 0.5 in/sec PPV for damage to buildings of modern construction.

In general, groundborne vibration is only noticeable inside of buildings within a highly localized area around the source of vibration. Impact pile driving at bridge abutments is not expected to exceed the Caltrans criterion of 0.25 in/sec PPV for annoyance due to distinctly perceptible vibration from transient sources. Vibratory pile driving would be done in the bridge channel, which would be further away from residences, and would produce less vibration, and as such is not expected to result in annoyance from local residents. Operation of other types of heavy construction equipment may potentially result in intermittently perceptible levels of groundborne vibration in the immediate vicinity of residences and other sensitive land uses, if staged or operated in areas near to residential buildings. Vibration-generating equipment that may be operated around the bridge site includes compactors, rollers, bulldozers, and heavy trucks. These types of equipment typically produce peak particle velocity vibration levels of less than 0.10 inches per second at a distance of 25 feet, which may intermittently be noticeable inside of buildings, but only briefly during a period of time when equipment is operated near structures, which is not anticipated to occur, but could happen occasionally. Outdoor use areas are not considered to be sensitive to vibration.

Use of heavy equipment during construction of the project would be temporary and would cease once construction is complete. The types of equipment scheduled for use in the work areas along Notre Dame Boulevard would produce a level of vibration that is not expected to result in exceedance of the Caltrans guidelines for damage and annoyance. Rubber-tired vehicles are not a significant source of groundborne vibration and operation of the project is not expected to generate noticeable levels of vibration. This impact is considered **less than significant**. No mitigation is required.

Impact NV-3. Exposure of sensitive receptors (residential, parks, hospitals, schools) to exterior noise levels (CNEL) of 65 dBA or higher?

This impact is discussed above under Impact NV-1. Operation of the project is not expected to exceed maximum allowable exterior noise levels under near-term (2026) or future year (2041) conditions. This impact is considered **less than significant**. No mitigation is required.

Impact NV-4. A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?

See the discussion above under Impact NV-1. As shown in Table 8, predicted traffic noise levels under the future-year with-project condition would result in an increase of up to 2 dB compared to future-year no-project conditions. As described in Section 2.6, a 5 dB increase in noise levels would be perceived by the human ear to be a noticeable increase. Because the future predicted increase with the project would be below this threshold, this impact is considered **less than significant**. No mitigation is required.

Impact NV-5. A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?

Project construction will temporarily increase ambient noise levels at residences near construction sites from the use of heavy equipment, which would include impact- and vibratory-hammer pile drivers, bulldozers, loaders, excavators, and heavy trucks. However, construction noise at a given location would be short term, and construction equipment used to build the bridge would progress over time from one end of the bridge location to the other end. Furthermore, project contractors would be required to comply with City noise regulations (Chapter 9.38 of the Chico Municipal Code) which limit the hours of construction to minimize construction related noise impacts. Heavy equipment noise associated with the project would cease once construction is complete.

As described in Chapter 4, existing noise levels were measured to be 55 to 60 dBA Ldn at residential uses along Notre Dame Boulevard. As described under Impact NV-1, construction noise levels would have a range of 82 to 95 dBA, depending the phase of construction. As such, noise levels would potentially increase by up to 40 dBA on a temporary basis, which would be distinctly noticeable above ambient levels. Therefore, impacts due to a temporary increase in noise levels from construction would be **significant**. Implementation of Mitigation Measure NV-1 would reduce this impact to a less-than-significant level.

Mitigation Measure NV-1. Employ Best Noise Control Practices during Construction

The full text of this measure is included above.

Impact NV-6. For a project located within the airport land use plan, would the project expose people residing or working in the Study Area to excessive noise levels?

The site is not located within the Airport Influence Area of the Chico Municipal Airport. The Chico Municipal Airport is approximately 5 miles north of the project site. The project site is not located in an airport land use plan area. Therefore, the project would not expose people to excessive airport-related noise. There would be **no impact**.

Impact NV-7. For a project within the vicinity of a private airstrip, would the project expose people residing or working in the Study Area to excessive noise levels?

The private Ranchaero airstrip is located outside the city limits approximately 4 miles west of the project site. At this distance, the proposed project would not expose people in the study area to excessive airport-related noise levels. There would be **no impact**.

Chapter 6. References

California Department of Transportation (Caltrans). 2013a. *Technical Noise Supplement to the Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects*. May. Sacramento, CA.

———. 2020. *Transportation and Construction Vibration Guidance Manual*. May. Sacramento, CA.

California Office of Noise Control. 1977. *Model Community Noise Ordinance*. April. Berkeley, CA: California Department of Health.

City of Chico. 2016. *Chico 2030 General Plan*. Chapter 13, Noise. Available: https://chico.ca.us/post/chico-2030-general-plan. Accessed March 16, 2022.

Federal Highway Administration (FHWA) (Anderson, Grant S., Cynthia S. Y. Lee, Gregg G. Fleming). 1998a. *FHWA Traffic Noise Model, Version 1.0: User's Guide*. Report No. FHWA-PD-96-009 and DOT-VNTSC-FHWA-98-1. Cambridge, MA: John A. Volpe National Transportation Systems Center, Acoustics Facility, January.

———. (Menge, Christopher W., Christopher J. Rossano, Grant S. Anderson, Christopher J. Bajdek). 1998b. *FHWA Traffic Noise Model, Version 1.0: Technical Manual.* Report No. FHWA-PD-96-010 and DOT-VNTSC-FHWA-98-2. Cambridge, MA: John A. Volpe National Transportation Systems Center, Acoustics Facility, February.

Federal Transit Administration. 2018. *Transit Noise and Vibration Impact Assessment Manual*. September. U.S. Department of Transportation. Available: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123_0.pdf. Accessed: March 16, 2022.

Governor's Office of Planning and Research. 2017. *State of California General Plan Guidelines.* Sacramento, CA.

Headway Transportation. 2022. *Traffic/Transportation Technical Study – Notre Dame Bridge Connection.* January.

Poulin, Lindsay. Gonzales Development Company, Chico, CA. March 31, 2022—email message to ICF forwarding information from Morrison Structures, Inc. with construction equipment information and work days for pile driving.

Simmons, Ross. NorthStar, Chico, CA. March 29, 2022—email message to ICF recognizing specific time windows for construction noise.