3.11 NOISE

This section includes a description of ambient noise conditions, a summary of applicable regulations related to noise and vibration, and an analysis of the potential impacts of the proposed project.

3.11.1 ENVIRONMENTAL SETTING

NOISE FUNDAMENTALS

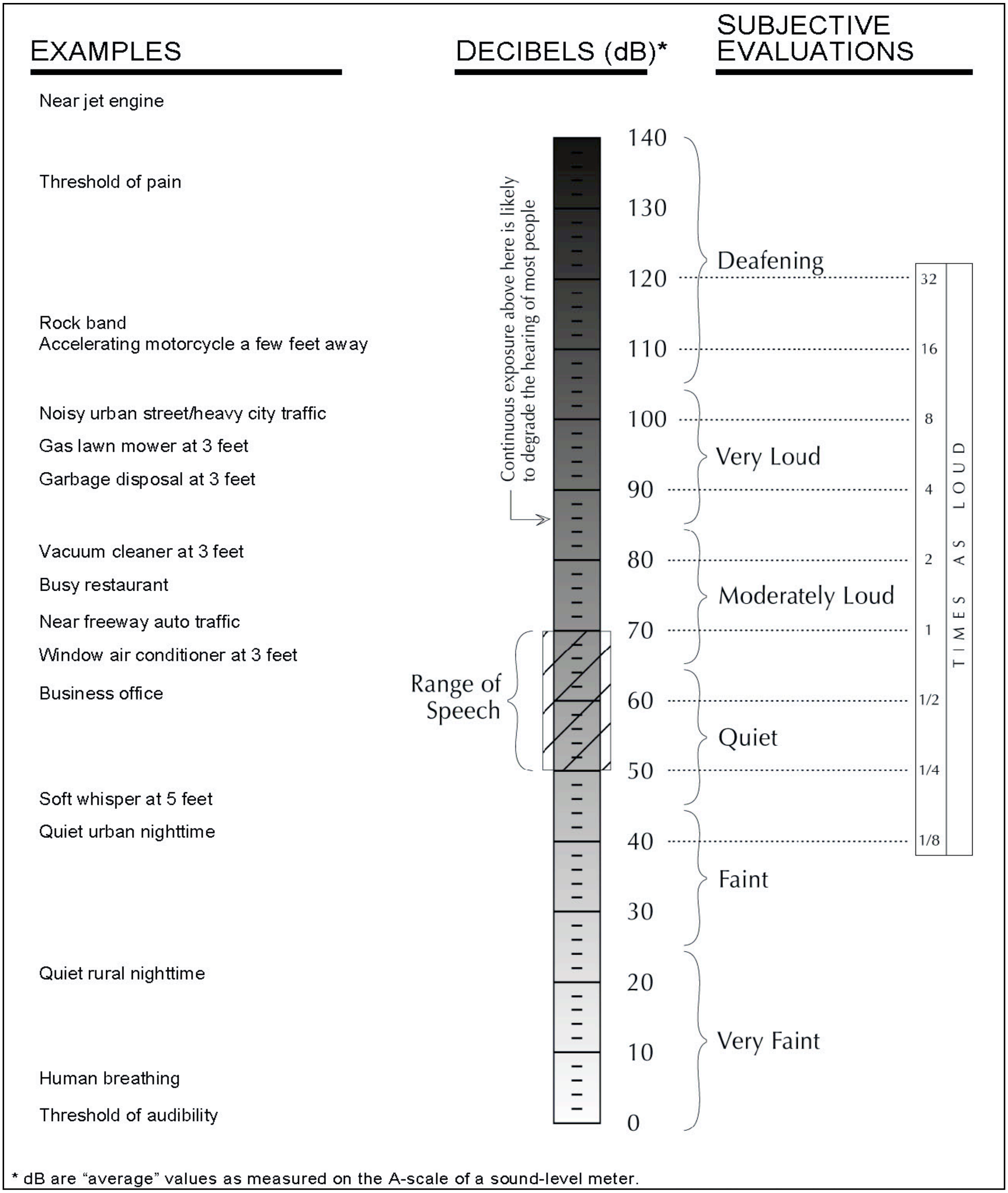
Acoustics is the scientific study that evaluates perception, propagation, absorption, and reflection of sound waves. Sound is a mechanical form of radiant energy, transmitted by a pressure wave through a solid, liquid, or gaseous medium. Sound that is loud, disagreeable, unexpected, or unwanted generally is defined as noise; consequently, the perception of sound is subjective and can vary substantially from person to person. Figure 3.11-1 shows common environmental noise sources and noise levels.

A sound wave is initiated in a medium by a vibrating object (e.g., vocal cords, the string of a guitar, the diaphragm of a radio speaker). The wave is made up of minute variations in pressure, oscillating above and below the ambient atmospheric pressure. The number of pressure variations occurring per second is referred to as the frequency of the sound wave and is expressed in hertz (Hz), which is equivalent to one complete cycle per second.

Directly measuring sound pressure fluctuations would require the use of a very large and cumbersome range of numbers. To avoid this and have a more usable numbering system, the decibel (dB) scale was introduced. A sound level expressed in dBs is the logarithmic ratio of two like pressure quantities, with one pressure quantity being a reference sound pressure. For sound pressure in air, the standard reference quantity generally is considered to be 20 micropascals, which directly corresponds to the threshold of human hearing. Using the dB scale is a convenient way to handle the million-fold range of sound pressures to which the human ear is sensitive. A dB is logarithmic; thus, it does not follow normal algebraic methods and cannot be directly added. For example, a 65 dB source of sound, such as a truck, joined by another 65 dB source results in a sound amplitude of 68 dB, not 130 dB (i.e., doubling the source strength increases the sound pressure by 3 dB). A sound level increase of 10 dB corresponds to 10 times the acoustical energy and an increase of 20 dB equates to a 100-fold increase in acoustical energy.

The loudness of sound preserved by the human ear depends primarily on the overall sound pressure level and frequency content of the sound source. The human ear is not equally sensitive to loudness at all frequencies in the audible spectrum. To better relate overall sound levels and loudness to human perception, frequency-dependent weighting networks were developed. A strong correlation exists between the way humans perceive sound and A-weighted sound levels (dBA). For this reason, the dBA can be used to predict community response to environmental and transportation noise. Sound levels expressed as dB in this section are A-weighted sound levels, unless noted otherwise.

Noise can be generated by a number of mobile sources (transportation, such as automobiles, trucks, and airplanes) and stationary sources (nontransportation, such as construction sites, machinery, and commercial and industrial operations). As acoustic energy spreads through the atmosphere from the source to the receptor, noise levels attenuate (reduce), depending on ground absorption characteristics, atmospheric conditions, and the presence of physical barriers (e.g., walls, building façades, berms). Noise generated by mobile sources generally attenuates at



Sources: Egan 1988; HUD 2009

Figure 3.11-1. Typical Noise Levels

a rate of 3 dB (typical for hard surfaces, such as asphalt) to 4.5 dB (typical for soft surfaces, such as grasslands) per doubling of distance, depending on the intervening ground type. Stationary noise sources spread with more spherical dispersion patterns that attenuate at a rate of 6 to 7.5 dB per doubling of distance.

Atmospheric conditions such as wind speed, turbulence, temperature gradients, and humidity also may alter the propagation of noise and affect levels at a receptor; however, these variables are difficult to predict and generally are not accounted in future noise predictions. Furthermore, the presence of a large object (e.g., barrier) between the source and the receptor can provide substantial attenuation of noise levels at the receptor. The amount of noise level reduction or “shielding” provided by a barrier depends primarily on the size of the barrier, the location of the barrier in relation to the source and receptors, and the frequency spectra of the noise. Natural barriers, such as berms, hills, or dense woods, and human-made features, such as buildings and walls, may be used as noise barriers.

EFFECTS OF NOISE ON HUMANS

Excessive and chronic exposure to elevated noise levels can result in auditory and nonauditory effects in humans. Auditory effects of noise on people are those relating to temporary or permanent hearing loss induced by noise. Nonauditory effects of exposure to elevated noise levels are those relating to behavioral and physiological effects. The nonauditory behavioral effects of noise on humans are associated primarily with the subjective effects of annoyance, nuisance, and dissatisfaction, which lead to interference with such activities as communications, sleep, and learning. The nonauditory physiological health effects of noise on humans have been the subject of considerable research efforts, attempting to discover correlations between exposure to elevated noise levels and health problems, such as hypertension and cardiovascular disease. The mass of research infers that noise-related health issues are predominantly the result of behavioral stressors (physiological) and not a direct noise-induced response. The degree to which noise contributes to nonauditory health effects remains a subject of considerable research, with no definitive conclusions.

The degree to which noise results in annoyance and interference with activities is highly subjective and may be influenced by nonacoustic factors. The number and effect of these nonacoustic environmental and physical factors vary, depending on the individual characteristics of the noise environment, including sensitivity, level of activity, location, time of day, and length of exposure. One key aspect to the prediction of human response to new noise environments is the individual level of adaptation to an existing noise environment. The greater the noise level change caused by a new noise source relative to an individual’s customary environment, the less tolerant of the new noise source the individual will be.

With regard to human perception of increases in sound levels expressed in dB, a 1 dB change generally is not perceivable, excluding controlled conditions and pure tones. Outside controlled laboratory conditions, the average human ear barely perceives a change of 3 dB. A 5 dB change generally fosters a noticeable change in human response, and an increase of 10 dB is subjectively heard as a doubling of loudness. Table 3.11-1 was developed on the basis of test subjects’ reactions to changes in the levels of steady-state pure tones or broadband noise, and to changes in levels of a given noise source.

Table 3.11-1. Subjective Reactions to Changes in Noise Levels of Similar Sources

Change in Level (dBA)	Subjective Reaction	Factor Change in Acoustical Energy
1	Imperceptible (except for tones)	1.3
3	Just barely perceptible	2.0
6	Clearly noticeable	4.0
10	About twice (or half) as loud	10.0

Note: dBA = A-weighted decibels
Source: Egan 1988

Noise Descriptors

The selection of a proper noise descriptor for a specific source depends on the spatial and temporal distribution, duration, and fluctuation of the noise. The noise descriptors most often used when dealing with traffic, community, and environmental noise are defined as follows:

- ***L_{max}* (maximum noise level):** The maximum instantaneous noise level during a specific period. The L_{max} may also be referred to as the “peak (noise) level.”

- ***L_{min}* (minimum noise level):** The minimum instantaneous noise level during a specific period.

- ***L_n* (statistical descriptor):** The noise level exceeding N percent of a specific period.

- ***L_{eq}* (equivalent noise level):** The energy mean (average) noise level. The instantaneous noise levels during a specific period in dBA are converted to relative energy values. From the sum of the relative energy values, an average energy value is calculated, which then is converted back to dBA to determine the L_{eq}. In noise environments determined by major noise events, such as aircraft overflights, the L_{eq} value is influenced heavily by the magnitude and number of single events that produce the high noise levels.

- ***L_{dn}* (day-night noise level):** The 24-hour L_{eq} with a 10-dBA “penalty” for noise events that occur during noise-sensitive hours (between 10 p.m. and 7 a.m.). In other words, 10 dBA is “added” to noise events that occur in the nighttime hours, and this generates a higher reported noise level when determining compliance with noise standards. The L_{dn} attempts to account the fact that noise during this specific period is a potential source of disturbance with respect to normal sleeping hours.

- ***CNEL (community noise equivalent level):*** A noise level similar to the L_{dn} described above, but with an additional 5-dBA “penalty” added to noise events that occur during noise-sensitive hours (between 7 and 10 p.m.), which typically are reserved for relaxation, conversation, reading, and television. If the same 24-hour noise data are used, the reported CNEL typically is approximately 0.5 to 1.5 dBA higher than the L_{dn}.

Community noise is commonly described in terms of the ambient noise level, the all-encompassing noise level associated with a given noise environment. A common statistical tool to measure the ambient noise level is the average (equivalent) sound level, L_{eq}, which corresponds to a steady-state sound level that contains the same total energy as a time-varying signal over a given period (usually 1 hour). The L_{eq} is the foundation of the composite noise descriptors, such as L_{dn} and CNEL (as defined above), and shows a positive correlation with community response to noise.

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 human activity (e.g., explosions; traffic; and operation of machinery, trains, or construction equipment). Vibration sources may be continuous (e.g., operating factory machinery) or transient (e.g., explosions).

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

The effects of groundborne vibration include movement of building floors, rattling of windows, shaking of items that sit on shelves or hang on walls, and rumbling sounds. In extreme cases, vibration can damage buildings, although this is not a factor for most projects. Human annoyance from groundborne vibration often occurs when vibration exceeds the threshold of perception by only a small margin. A vibration level that causes annoyance can be well below the damage threshold for normal buildings. Table 3.11-2 shows the general thresholds for human and structural responses to vibration levels.

Table 3.11-2. General Human and Structural Responses to Vibration Levels

Response	Peak Vibration Threshold (in/sec PPV)
Structural damage to commercial structures	6
Structural damage to residential structures	2
Architectural damage to structures (cracking)	1
General threshold of human annoyance	0.1
Approximate threshold of human perception	0.01

Notes:
in/sec = inches per second; PPV = peak particle velocity
Source: Caltrans 2013

Although PPV is appropriate for evaluating the potential for building damage, it is not always suitable for evaluating human response to vibration. The response of the human body to vibration relates well to average vibration amplitude. Therefore, vibration impacts on humans are evaluated in terms of RMS vibration velocity, and like airborne sound impacts on humans, vibration velocity can be expressed in decibel notation, as vibration decibels (VdB).[1]

The background vibration-velocity level typical of residential areas is approximately 50 VdB. Groundborne 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.

[1] Vibration levels described in VdB are referenced to 1 microinch per second.

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

Construction-generated vibration can be transient, random, or continuous. Transient construction vibration is generated by blasting, impact pile driving, and wrecking balls. Random vibration can result from jackhammers, pavement breakers, and heavy construction equipment. Continuous vibration results from vibratory pile drivers, large pumps, horizontal directional drilling, and compressors. Table 3.11-3 summarizes the general human response to different levels of groundborne vibration.

Table 3.11-3. Human Response to Different Levels of Groundborne Vibration

Vibration-Velocity Level	Noise Level		Human Reaction
	Low Freq*	Mid Freq**	
65 VdB	25 dBA	40 dBA	Approximate threshold of perception for many humans. Low-frequency sound: Usually inaudible. Mid-frequency sound: Excessive for quiet sleeping areas.
75 VdB	35 dBA	50 dBA	Approximate dividing line between barely perceptible and distinctly perceptible. Many people find transit vibration at this level annoying. Low-frequency noise: Tolerable for sleeping areas. Mid-frequency noise: Excessive in most quiet occupied areas.
85 VdB	45 dBA	60 dBA	Vibration tolerable only if an infrequent number of events occur per day. Low-frequency noise: Excessive for sleeping areas. Mid-frequency noise: Excessive even for infrequent events for some activities.

Notes:
dBA = A-weighted decibels; Freq = frequency; Hz = hertz; VdB = velocity decibels referenced to 1 microinch per second and based on the root-mean square vibration velocity.
* Approximate noise level when vibration spectrum peak is near 30 Hz.
** Approximate noise level when vibration spectrum peak is near 60 Hz.
Source: FTA 2018

Existing Noise Environment in the Project Area

The noise environment in the vicinity of the nearby residences is defined primarily by natural sounds, such as wind rustling foliage, insects, and birds. In areas adjacent to local roads, occasional lumber trucks and other vehicles produce localized noise. Five residences are in the project vicinity. The nearest town is Scotia, located to the north on U.S. Highway 101 (U.S. 101).

Existing Sensitive Land Uses

Land uses that are sensitive to noise and vibration are those uses where exposure would result in adverse effects (i.e., annoyance and/or structural damage) and uses where quiet is an essential element of their intended purpose. Residences are of primary concern because of the potential for increased, prolonged exposure of individuals to both interior and exterior noise and vibration. Other noise-sensitive land uses are hospitals, convalescent facilities, parks, hotels, churches, libraries, and other uses where low interior noise levels are essential. Noise-sensitive land uses near the project area include five rural residential buildings and units.

Existing Noise Sources

The project area is in a remote, rural location, where predominant noise sources consist of natural sounds, such as birds, leaves rustling, agricultural equipment, and aircraft overflights and passing traffic.

Existing-Noise Survey

To objectively characterize the noise environment, one long-term (10-day) unattended noise level measurement and one short-term (5-minute) noise measurement were conducted in an accessible location near residence R-5, shown as LT-1 and ST-1, respectively, in Figure 3.11-2.[2] The sites were selected to represent the noise environment at the adjacent residence. Noise levels at the long-term location were monitored from July 24 to August 3, 2018. Noise levels at ST-1 were monitored from 1:55 to 2:00 p.m. on July 24, 2018.

The long-term data were monitored in 10-minute intervals that were later combined to provide hourly levels. The measured levels included the L_{eq}, L_{max}, L_{min}, L_1, L_2, L_{10}, L_{25}, L_{50}, and L_{90} for each 10-minute interval. Based on review of the wave files recorded during these periods, elevated maximum levels occurring daily, primarily between 4 a.m. and 6 p.m., are attributable to truck passbys occurring along the adjacent roadway. Because of the high maximum noise levels generated by the trucks as they passed the measurement location, hourly average noise levels during these periods were also affected. Therefore, the L_{50} levels were used to represent ambient noise levels. Elevated noise levels occurring during some nighttime hours are attributable to insect sounds, which are typical in summer months in forested areas.

As shown in Table 3.11-4, daytime L_{50} noise levels at LT-1 were similar to nighttime levels. This was anticipated because the noise environment at LT-1 consisted primarily of natural sounds, such as wind rustling foliage, insects, and birds. Occasional truck passbys resulted in elevated L_{eq} levels during some daytime hours. The CNEL values calculated for LT-1, which included natural sounds and truck passbys, ranged from 50 to 60 dBA CNEL. With local traffic removed, the CNEL at LT-1 ranged from 44 to 53 dBA CNEL (see Table 3.11-5). The local traffic-generated noise at LT-1 ranged from 42 to 59 dBA CNEL.

In addition to the long-term measurements, an attended short-term measurement (ST-1) was made near LT-1. At this location, the 5-minute L_{eq} level, which consisted of natural noises, was 37 dBA.

Table 3.11-4. Existing Ambient Noise Levels

Location	Time Period	10-Minute L_{50}		L_{50} Standard Dev. (dBA)	Hourly L_{eq}		L_{50} Standard Dev. (dBA)	CNEL (dBA) L_{min}
		Average (dBA)	Range (dBA)		Average (dBA)	Range (dBA)		
LT-1	Daytime	39	26–52	5.6	44	30–68	6.4	50–60
	Nighttime	40	23–56	5.3	43	26–56	5.0	

Notes:
CNEL = community noise equivalent level; dBA = A-weighted decibels; L_{eq} = equivalent noise level; L_{max} = maximum noise level; L_{50} = noise level exceeded 50% of a specific period of time
[1] Measurement locations are shown in Figure 3.11-2.
Source: Illingworth & Rodkin 2018a

[2] Noise levels were measured with Larson-Davis 820 and 831 precision Type 1 sound level meters, fitted with a half-inch pre-polarized condenser microphone and a windscreen. The meters were calibrated before and after the surveys with a 94 dB, 1,000 Hz Larson Davis acoustic calibrator.

Table 3.11-5. Summary of Existing Ambient Noise Levels without Traffic

Date	CNEL, dBA	CNEL, Ambient/Natural Noise, dBA	CNEL, Local Traffic, dBA
Wednesday, July 25, 2018	52	52	42
Thursday, July 26, 2018	56	53	53
Friday, July 27, 2018	60	51	59
Saturday, July 28, 2018	56	53	53
Sunday, July 29, 2018	52	48	51
Monday, July 30, 2018	52	47	50
Tuesday, July 31, 2018	50	46	48
Wednesday, August 1, 2018	56	44	55
Thursday, August 2, 2018	53	51	48

Notes:
CNEL = community noise equivalent level; dBA = A-weighted decibels
Source: Illingworth & Rodkin 2018a

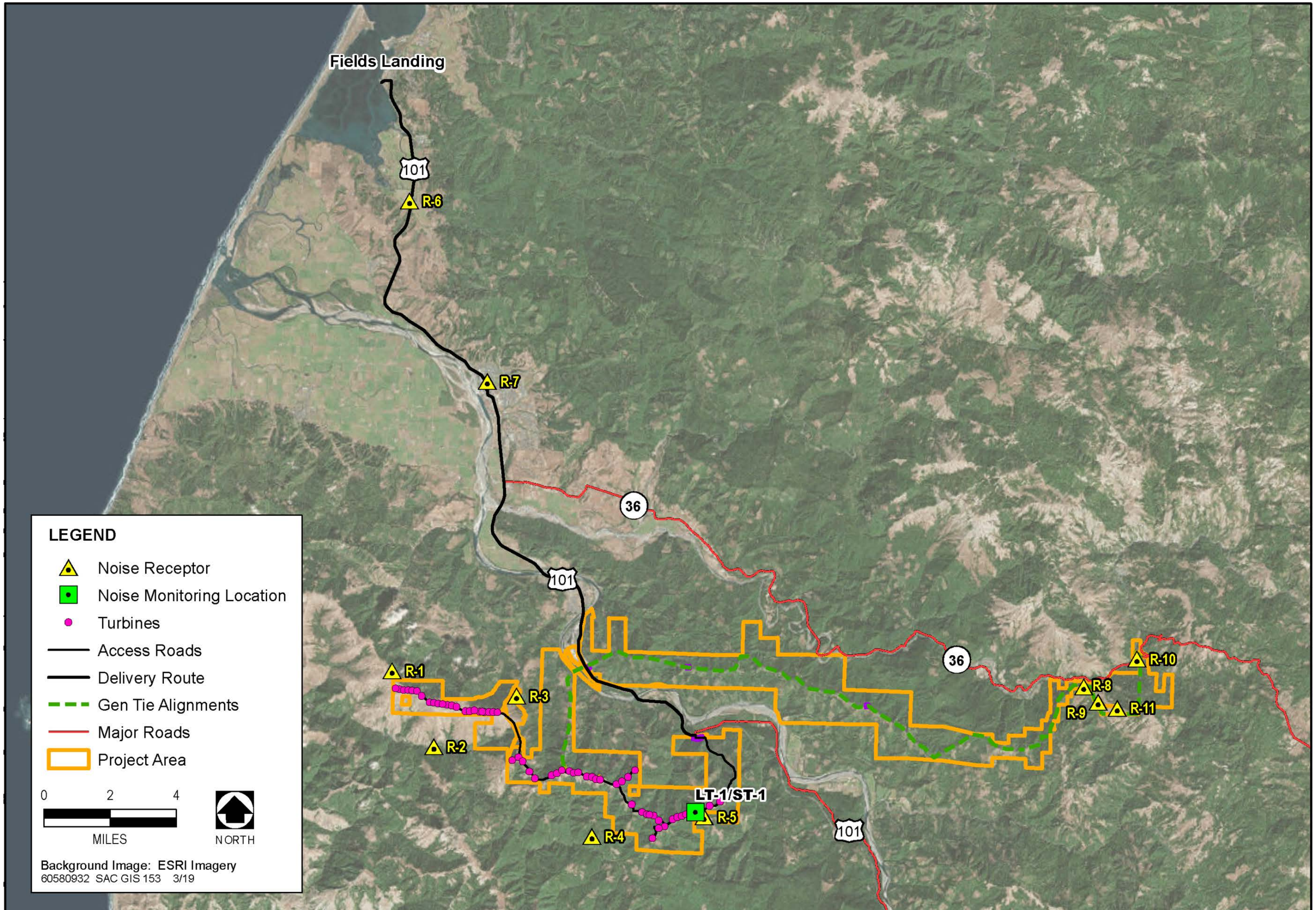
Existing Traffic Noise Levels

Existing traffic noise levels for the roadways around the project site were estimated using the Federal Highway Administration's (FHWA's) traffic noise prediction model (FHWA-RD-77-108) and traffic data obtained from California Department of Transportation (Caltrans) average daily traffic counts. Table 3.11-6 shows the predicted CNEL noise levels at 100 feet from the centerline and distances from roadway centerline to the 55-, 60-, 65-, and 70-dBA CNEL contours for existing average daily traffic (ADT). Additional input data included day/night percentages of autos, medium and heavy trucks, vehicle speeds, and ground attenuation factors. Actual noise levels varied from day to day, depending on local traffic volumes, shielding from existing structures, variations in attenuation rates attributable to changes in surface parameters, and meteorological conditions.

Table 3.11-6. Summary of Modeled Existing Vehicular Traffic Noise Levels

Roadway	From	To	Distance (feet) from Roadway Centerline to CNEL				CNEL (dBA) 100 Feet from Centerline
			70 dBA CNEL	65 dBA CNEL	60 dBA CNEL	55 dBA CNEL	
U.S. 101	State Route 254	South Fork Road	67	144	310	667	67
	South Fork Road	South Scotia Road	68	147	317	684	68
	South Scotia Road	State Route 36	101	218	469	1,011	70
	State Route 36	Singley Road	111	239	516	1,111	71
	Singley Road	Loleta Drive	119	257	553	1,192	71
	Loleta Drive	Eureka city limits	120	258	555	1,196	71

Notes:
CNEL = Community Noise Equivalent Level; dBA = A-weighted decibels; U.S. 101 = U.S. Highway 101
Calculated noise levels do not consider any shielding or reflection of noise by existing structures, vegetation, or terrain features, or noise contributed by other sources. See modeling results in Appendix U for further details.
Source: Caltrans 2016; modeling performed by AECOM in 2018



Sources: U.S. Natural Resources Conservation Service, Stantec

Figure 3.11-2. Ambient Noise Measurements

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3.11.2 Regulatory Setting

Federal Plans, Policies, Regulations, and Laws

No federal plans, policies, regulations, or laws related to noise are applicable to the project.

Guidelines have been established to address the potential for groundborne vibration to cause structural damage to buildings. For fragile structures, a maximum limit of 0.25 in/sec PPV is recommended (FTA 2018).

State Plans, Policies, Regulations, and Laws

The *State of California General Plan Guidelines*, published by the Governor's Office of Planning and Research (OPR 2017), provides guidance for the acceptability of projects within specific CNEL/L_{dn} contours. Generally, residential uses are considered acceptable in areas where exterior noise levels do not exceed 60 dBA CNEL/L_{dn}. Hospitals are normally acceptable in areas up to 70 dBA CNEL/L_{dn} and normally unacceptable in areas exceeding 70 dBA CNEL/L_{dn}. The guidelines also present adjustment factors that may be used to arrive at noise-acceptability standards reflecting the particular community's noise-control goals, noise sensitivity, and assessment of the relative importance of noise issues.

With respect to vibration, Caltrans recommends a more conservative threshold of 0.5 in/sec PPV for newer residential buildings, 0.3 in/sec for older residential buildings, and 0.25 in/sec PPV for old or historically significant structures, to protect fragile, historic, and residential structures (Caltrans 2013). These standards are consistent with the federal guidance presented in the discussion of federal plans, policies, regulations, and laws above.

Local Plans, Policies, Regulations, and Ordinances

Humboldt County General Plan

The Noise Element of the *Humboldt County General Plan* (General Plan) establishes noise standards for mobile and stationary noise sources and exterior and interior locations, as well as land use compatibility for adjoining land uses. The following standards would be applicable to the project:

- **Standard N-S1: Land Use/Noise Compatibility Matrix.** The Land Use/Noise Compatibility Standards [Table 13-C of the Noise Element and Table 3.11-7 of this document] shall be used as a guide to ensure compatibility of land uses. Development may occur in areas identified as "normally unacceptable" if mitigation measures can reduce indoor noise levels to "Maximum Interior Noise Levels" and outdoor noise levels to the maximum "Normally Acceptable" value for the given Land Use Category.

- **Standard N-S2: Noise Impact Combining Zones.** The 20-year projected noise contours in the Map Book Appendix and the most current Airport Land Use Compatibility Plans shall be used to identify noise impact combining zone areas to indicate where special sound insulation measures may apply.

Table 3.11-7. Land Use/Noise Compatibility Standards

Clearly Acceptable	Normally Acceptable	Normally Unacceptable	Clearly Unacceptable

Land Use Category	Maximum Interior Noise Levels *	Land Use Interpretation for CNEL (or L_{dn}) 50–60	60–70	71–80	81–90	91
Residential Single Family, Duplex, Mobile Homes	45					
Residential Multiple Family, Dormitories, etc.	45					
Transient Lodging	45					
School Classrooms, Libraries, Churches	45					
Hospitals, Nursing Homes	45					
Auditoriums, Concert Halls, Music Shells	35					
Sports Arenas, Outdoor Spectator Sports						
Playgrounds, Neighborhood Parks						
Golf Courses, Riding Stables, Water Rec., Cemeteries						
Office Buildings, Personal, Business & Professional	50					
Commercial: Retail, Movie Theaters, Restaurants	50					
Commercial: Wholesale, Some Retail, Ind., Mfg., Util.						
Manufacturing, Communications (Noise Sensitive)						
Livestock Farming, Animal Breeding						
Agriculture (except Livestock), Mining, Fishing						
Public Right-of-Way						
Extensive Natural Recreation Areas						

Notes:

CNEL = Community Noise Equivalent Level; L_{dn} = day-night noise level

Clearly Acceptable—The noise exposure is such that the activities associated with the land use may be carried out with essentially no interference. (Residential areas: both indoor and outdoor noise environments are pleasant.)

Normally Acceptable—The noise exposure is great enough to be of some concern, but common construction will make the indoor environment acceptable, even for sleeping quarters. (Residential areas: the outdoor environment will be reasonably pleasant for recreation and play at the quiet end and will be tolerable at the noisy end.)

Normally Unacceptable—The noise exposure is significantly more severe so that unusual and costly building constructions are necessary to ensure adequate performance of activities. (Residential areas: barriers must be erected between the site and prominent noise sources to make the outdoor environmental tolerable.)

Clearly Unacceptable—The noise exposure at the site is so severe that construction costs to make the indoor environmental acceptable for performance of activities would be prohibitive. (Residential areas: the outdoor environment would be intolerable for normal residential use.)

* Due to exterior sources.

Source: Humboldt County 2017: Table 13-C, adapted by AECOM in 2019

- **Standard N-S3: Environmental Review Process.** For noise-sensitive locations where noise contours do not exist, the environmental review process required by the California Environmental Quality Act shall be utilized to generate the required analysis and determine the appropriate mitigation per Plan and state standards. Future noise levels shall be predicted for a period of at least 10 years from the time of building permit application.

- **Standard N-S4: Noise Study Requirements.** When a discretionary project has the potential to generate noise levels in excess of Plan standards, a noise study together with acceptable plans to assure compliance with the standards shall be required. The noise study shall measure or model as appropriate, Community Noise Equivalent Level (CNEL) and Maximum Noise Level (L_{max}) levels at property lines and, if feasible, receptor locations. Noise studies shall be prepared by qualified individuals using calibrated equipment under currently accepted professional standards and include an analysis of the characteristics of the project in relation to noise levels, all feasible mitigations, and projected noise impacts. *The Noise Guidebook* published by the U.S. Department of Housing and Urban Development, or its equivalent, shall be used to guide analysis and mitigation recommendations.

- **Standard N-S5: Noise Standards for Habitable Rooms.** Noise reduction shall be required as necessary in new development to achieve a maximum of 45 CNEL (Community Noise Equivalent Level) interior noise levels in all habitable rooms per California building standards.

- **Standard N-S7: Short-term Noise Performance Standards (L_{max}).** The following noise standards [as shown in Table 3.11-8 below], unless otherwise specifically indicated, shall apply to all property within their assigned noise zones and such standards shall constitute the maximum permissible noise level within the respective zones.

The General Plan considers residential land uses “clearly acceptable” in noise environments of 55 dBA CNEL or less, “normally acceptable” in noise environments between 55 to 60 dBA CNEL, and “normally unacceptable” in noise environments between 60 to 75 dBA CNEL. See Table 13-C of the General Plan’s Noise Element.

Humboldt County Code of Ordinances

Humboldt County (County) does not have an adopted noise ordinance.

Supplemental Criteria for Low Frequency and Infrasonic Noise

Neither the State of California nor the County specifically addresses low-frequency noise and infrasonic noise from wind energy or other projects. This EIR nonetheless analyzes low-frequency noise and infrasonic noise from the proposed wind energy project. Other criteria can be considered to determine whether the project would exhibit high potential to generate infrasonic noise. In general, low-frequency noise has been associated with older generation, downwind wind turbine generators (WTGs). For these WTGs, the wake of the tower interacts with the passing blades to generate pulses at the rate the blades pass the tower. Low-frequency noise is typically eliminated with upwind WTGs.

Table 3.11-8. Short-Term Noise Standards (L_{max})

Zoning Designation	Day (maximum) 6:00 a.m. to 10:00 p.m. dBA	Night (maximum) 10:00 p.m. to 6:00 a.m. dBA
MG, MC, AE, TPZ,TC, AG, FP, FR, MH	80	70
CN, MB, ML, RRA, CG, CR C-1, C-2, C-3	75	65
RM, R-3, R-4	65	60
RS, R-1, R-2, NR	65	60

Notes:
dBA = A-weighted decibels; L_{max} = maximum noise level (the maximum instantaneous noise level during a specific period)
Exceptions. The Short Term Noise levels shown in the above table shall not apply to uses such as, but not limited to:
1. Portable generator use in areas served by public electricity when electrical service is interrupted during emergencies as determined by the Planning Director.
2. Temporary events in conformance with an approved Conditional Use Permit.
3. Use of chainsaws for cutting firewood and power equipment used for landscape maintenance when accessory to permitted on-site uses.
4. Heavy equipment and power tools used during construction of permitted structures when conforming to the terms of the approved permit.
5. Emergency vehicles.
Source: Humboldt County 2017:Standard N-S7, adapted by AECOM in 2019

This EIR adopts a criterion based on the difference in overall sound levels that also has been proposed as a predictor of annoyance for other windfarm projects (Solano County 2010). This occurs when the C-weighted sound level exceeds the A-weighted level by 20 dB or more.

3.11.3 Environmental Impacts and Mitigation Measures

Thresholds of Significance

The following thresholds of significance are based on the environmental checklist in Appendix G of the State CEQA Guidelines, as amended. Implementing the project would result in a significant noise impact if it would result in:

- generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;
- generation of excessive groundborne vibration or groundborne noise levels; or
- for a project within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport, exposure of people residing or working in the project area to excessive noise levels.

Based on the guidelines listed above, the following quantitative thresholds have been applied to determine whether this impact analysis adheres to them:

- **Transportation Impacts.** A long-term transportation noise impact would be significant if noise levels would exceed the applicable County standards shown in Table 3.11-7 or result in a substantial permanent increase (i.e., 5 dB) in ambient noise levels.

- **Stationary and Area Noise Impacts.** A long-term stationary or area noise impact would be significant if project-generated noise levels would exceed the applicable County standards shown in Table 3.11-7 or result in a substantial permanent increase (i.e., 5 dB) in ambient noise levels.

- **Temporary Construction Impacts**. Noise generated during construction of permitted structures, when conforming to the terms of an approved permit, is not subject to the numeric short-term noise standards in General Plan Noise Element Policy N-S7, “Short-Term Noise Performance Standards (L_{max}),” and Exception 4 thereto (see Table 3.11-8, above).

- **Land Use Compatibility Impacts.** A land use compatibility impact would be significant if noise levels from mobile or stationary sources would exceed the applicable County standards shown in Table 3.11-7, at proposed noise-sensitive land uses.

- **Vibration Impacts.** A vibration impacts would be significant if project-related vibration levels would exceed the Caltrans-recommended standard of 0.3 in/sec PPV with respect to the prevention of structural damage for normal buildings.

- **Impacts from Differences in Overall Sound Levels.** An impact related to differences in overall sound levels would be significant if the C-weighted sound level from a WTG while operating would exceed the A-weighted level by more than 20 dB at any sensitive receptor.

The project is located more than 5 miles from the nearest public airport, public use airport, or private airstrip, which is Rohnerville Airport, located to the north in the community of Fortuna. The project would not involve any activities in an airport land use compatibility plan area. Thus, the project would not have the potential to expose people residing or working in the project area to excessive noise levels generated by airport operations. Therefore, this issue is not discussed further.

ANALYSIS METHODOLOGY

The following analysis evaluates potential construction and operational noise impacts specific to the project based on the significance criteria for noise included in the State CEQA Guidelines. The analysis is presented at a project level.

To assess potential noise impacts from mobile, stationary, and area sources, noise-sensitive receptors and their relative exposure were identified. The thresholds of significance applied in this analysis address primarily the exterior noise standards established by the County. Unless otherwise stated, an exceedance of interior noise level standards would not occur if exterior noise standards are achieved, given the sufficient exterior-to-interior noise reduction commonly provided by buildings.

The FHWA Traffic Noise Prediction Model was used to model traffic noise levels along affected roadways, based on daily volumes and the distribution thereof, from the traffic analysis prepared for full project buildout. The project’s contribution to the existing traffic source noise levels along area roadways was determined by comparing the modeled noise levels at 100 feet from the centerline of the near travel lane under no project and plus project conditions. The project’s land use compatibility with traffic source noise levels was determined by comparing modeled noise levels at proposed noise-sensitive receptors under plus project conditions.

Stationary noise sources were based on the *Humboldt Wind Energy Project Noise Technical Report* (Illingworth & Rodkin 2018a) and supplemental *Humboldt Wind Energy Project—60 Turbine Layout Noise Assessment* technical memorandum (Illingworth & Rodkin 2018b), both prepared for the project. Land use compatibility between conflicting land uses were determined based on proposed project land uses, adjacent parcels, and existing zoning. Vibration sources and levels were determined based on FTA guidance (FTA 2018).

Existing Fields Landing harbor activities include docking of ships and boats, loading and unloading, storage, repair, and maintence, which all generate noise. The harbor is located west of U.S. 101 and south of Eureka. Municipal noise sources result in an existing noisy environment. Activities generated by the project at Fields Landing are considered compatible with existing and adjacent uses. Increases in Depot Road traffic noise attributable to the proposed project are analyzed below.

IMPACTS AND MITIGATION MEASURES

IMPACT 3.11-1	Generation of a Substantial Temporary Increase in Ambient Noise Levels in the Vicinity of the Project in Excess of Standards Established in the Local General Plan or Noise Ordinance, or Applicable Standards of Other Agencies. *Construction of project components would require temporary, short-term construction activities and haul truck trips to haul wind turbine generator parts and needed construction materials and equipment to the project area. Project-related construction activities and haul truck trips could expose existing sensitive receptors to temporary noise levels that would exceed the applicable noise standards and/or result in a substantial increase in ambient noise levels. This impact would be* ***less than significant****.*

Construction activities for placement of up to 60 WTGs, a 25-mile generation transmission line (gen-tie), roads (existing and new, including temporary access roads and temporary public road improvements at two locations on U.S. 101), electrical collection and communication systems, and staging areas (as described in Chapter 2, "Project Description") would generate short-term, temporary, and intermittent noise at or near individual noise-sensitive locations in the project area. Construction activities would require 12–18 months. The sequence of construction activities would be as follows: site preparation/grading, tree clearing, access road construction, WTG foundation construction, collection system installation, substation construction, gen-tie installation, switchyard installation, WTG installation, final testing and WTG commissioning, installation of operations and maintenance facilities, and cleanup and restoration. Noise-sensitive receptors near each construction stage have been identified. Construction activities would generate truck haul trips on area roads for delivery of WTG parts, construction equipment and materials (e.g., concrete), and other project components to the generation area, as described in Section 3.12, "Transportation and Traffic."

Construction Noise

Noise levels generated during construction would fluctuate, depending on the specific location and stage of construction activities in the project area, and on the particular type, number, and duration of use of various pieces of construction equipment. Equipment required for construction activities associated with WTGs could include concrete mixer/pump trucks, excavators, dozers, cranes, graders, a boring jack, pneumatic tools, and various other trucks. In addition to these individual pieces of construction equipment, construction of foundations for WTGs would require blasting and operation of a concrete batch plant to manufacture concrete. The cement batch plant is anticipated to operate 24 hours a day for up to 6 months. Individual equipment maximum noise levels produced by these construction activities could range from 80 to 94 dBA, without implementation of feasible noise control at a distance of 50 feet from the nearest noise source (Table 3.11-9).

Noise-sensitive land uses (i.e., rural residential) are near the construction sites for temporary off-ramps, WTGs, underground cabling, the overhead transmission line, and project substation in the project vicinity (see Figure 3.11-2 for receptor locations). These sensitive receptors could be exposed to intermittent construction noise during the various stages of the 12- to 18-month construction period. Typical airborne noise associated with blasting activities would be at a frequency below the range audible to humans; thus, the potential impacts associated with blasting focus on the effects of groundborne noise and vibration, which are discussed separately in Impact 3.11-2.

Table 3.11-9. Construction Equipment Noise Emission Levels Associated with the Project

Equipment Type[1]	Typical Noise Level (dB) at 50 feet	Equipment Type	Typical Noise Level (dB) at 50 feet
Blasting	94	Generator	82
Backhoe	80	Grader	85
Clam Shovel (dropping)	93	Excavator	85
Concrete Mixer Truck	85	Crane	85
Concrete Pump Truck	82	Dozer	85
Pneumatic Tools	85	Concrete Batch Plant	85

Notes:

dB = A-weighted decibels (dBA)

[1] All equipment would be fitted with properly maintained and operational noise control device, per manufacturer specifications. Listed noise levels are the actual measured noise levels for each piece of heavy construction equipment.

Sources: Bolt Beranek and Newman 1981; FHWA 2006; FTA 2018

Construction noise attributable to the project was estimated using the FTA noise methodology for the prediction of heavy equipment noise sources and distances to the nearest construction activity sites. Table 3.11-10 shows the results for the various stages of construction activities associated with the placement of WTGs, based on the equipment requirements for construction (presented in Chapter 2, "Project Description"), assuming no intervening barriers or topography. Appendix U shows the complete listing of inputs and the methodology for predicting noise levels from construction stages at each receptor, shown in Table 3.11-10.

In addition, the project includes the temporary operation of a concrete batch plant on Monument Ridge at the proposed project substation. Concrete batch plant activities would result in noise levels of 78 dBA L_{eq} at 100 feet. Batch plant noise levels would attenuate to 43 dBA L_{eq} at 2,000 feet, not taking into account any noise reduction from intervening topography or structures. The nearest noise-sensitive receptors are R-3 and R-4, more than 2 miles from the proposed batch plant location and with intervening topography interrupting the noise path. Proposed concrete batch plant activities would not expose existing sensitive receptors to temporary noise levels that would exceed the applicable noise standards or result in a substantial increase in ambient noise levels.

Table 3.11-10. Predicted Noise Levels Attributable to Major Construction Activities at the Nearest Sensitive Receptors in the Project Vicinity

Receiver	Construction Noise Level (dBA L_{eq})[1]					
	Road Construction	WTG Foundations	Tower Erection	Underground Cable	Transmission Lines	Bridgeville Substation
R-1	41	41	39	37	–	–
R-2	38	38	37	34	–	–
R-3	31	31	30	27	–	–
R-4	28	29	27	25	–	–
R-5	55	55	53	49	–	–
R-6	68	–	–	–	–	–
R-7	63	–	–	–	–	–
R-8	–	–	–	–	70	–
R-9	–	–	–	–	66	–
R-10	–	–	–	–	60	54
R-11	–	–	–	–	54	–

Notes:
dBA = A-weighted decibels; L_{eq} = equivalent noise level; R-# = residential receptor; WTG = wind turbine generator
See Appendix U for detailed inputs and outputs for each receptor site.
[1] Distances to noise levels do not take into account intervening topography or existing structure façades.
Source: FTA 2018; FHWA 2006; data modeled by AECOM in 2018

Receptors R-1 through R-5 (shown in Table 3.11-10) would experience the longest exposure to project construction noise, which could range between 27 to 55 dBA L_{eq} during the various construction stages. As shown in Table 3.11-5, daily ambient noise levels at these rural receptors range from 44 to 53 dBA CNEL. Of these receptors, only R-5 would be exposed to construction noise levels ranging from 49 to 55 dBA L_{eq}. Modeled daily noise levels at R-5 during project construction would range from 51 to 54 dBA CNEL. Accounting for the shielding of construction noise because of the intervening topography at R-5, project construction activities would not expose receptors R-1 through R-5 to temporary noise levels that would exceed the applicable noise standards or result in a substantial temporary increase in ambient noise levels.

Temporary off-ramp construction proposed at the Hookton Road ramp and 12th Street ramp would generate hourly construction noise levels of 68 dBA (at R-6) and 63 dBA L_{eq} (at R-7), respectively. The noise environment at R-6 (400 feet from the U.S. 101 centerline) and R-7 (275 feet from the centerline) is dominated by U.S. 101 traffic, which generates traffic noise levels of 62 and 65 dBA CNEL, respectively. Modeled daily noise levels during project construction would be 67 dBA CNEL at R-6 and 64 dBA CNEL at R-7. Daily exterior noise levels at R-6 and R-7 would increase by +2 dBA over existing ambient traffic noise levels because of temporary off-ramp construction at Hookton Road and 12th Street. Based on the distance to receptor R-7 from the temporary off-ramp construction, short-term L_{max} noise levels because of project construction would exceed the County's 65 dBA L_{max} standard (shown in Table 3.11-4). Off-ramp construction activities for the proposed project would not expose existing sensitive receptors to temporary noise levels that could result in a substantial temporary increase in ambient noise levels. Although the temporary off-ramp construction would exceed the County's short-term noise standard of 65 dBA L_{max} at exterior areas at R-7, the standard is not applicable to contruction noise.

Rural residential receptors west of the existing Bridgeville Substation tie-in would be affected during construction of the transmission line. Receptors R-8 through R-10 are near the transmission line disturbance area and could be exposed to temporary construction noise levels of 60–70 dBA L_{eq} (shown in Table 3.11-10). Based on the distances to R-8 and R-9 from the transmission line construction, short-term L_{max} noise levels attributable to project construction would exceed the County's 65 dBA L_{max} standard (shown in Table 3.11-4). Construction for the entire transmission line would be conducted over 7 months and would not occur in any given location for an extended period. Construction noise would occur primarily during daytime hours, and would be temporary and short term, and would not result in annoyance at the interior locations of receptors, assuming an exterior-to-interior noise reduction of 25 dBA because of standard construction practices. Project-related transmission line construction could expose existing sensitive receptors to temporary construction noise. However, as noted previously, the County's standard is not applicable to construction noise. Therefore, this impact would be **less than significant**.

Noise from Construction Haul Trucks

Construction activities would generate truck haul trips on area roads for delivery of WTG parts, construction equipment, and materials. Associated traffic noise levels were estimated using the Federal Highway Traffic Noise Prediction Model (FTA 1978). Noise level estimates are based on the amount of truckloads, number of days of construction, and hours per day during which hauling would occur. Trucks hauling project components to the generation area would use U.S. 101 from the Fields Landing dock in Eureka to the staging area at Jordan Creek, west of U.S. 101. Roadways used by haul trucks to access the project area are shown in Figure 2-17, "Project Component Transportation Haul Route," in Chapter 2 of this EIR.

Noticeable increases of 3 dBA CNEL typically do not occur without a substantial (i.e., doubling) increase in roadway traffic volumes (Caltrans 2013). The project would generate 29,250 trips over its 12- to 18-month duration, of which 9,673 would be heavy truck trips. The majority of these trips would occur on U.S. 101 and would not cause a doubling of daily traffic volumes or a +3 dBA increase over existing traffic noise levels. However, each proposed WTG would require up to four nighttime heavy haul trips, which may require using detour routes. This analysis assumed a total of 45 nighttime trips in 1 hour for nighttime heavy haul trips—30 support vehicles and 15 heavy trucks—for FHWA model inputs. Based on the number of trips, noise levels attributable to anticipated heavy haul truck traffic could be approximately 55 dBA L_{eq} at a distance of 50 feet from the roadway centerline.

Heavy haul trucks would have the potential to travel up to 50 feet from residences along the Singley Road detour route. Noise levels from heavy haul truck traffic would comply with the County's land use compatibility exterior noise standard of 60 dBA CNEL. In addition, assuming a standard exterior-to-interior attenuation rate of 25 dBA for residential buildings, noise levels from haul trucks would not result in substantial interior noise levels (greater than 45 dBA CNEL) for residential land uses. However, predicted nighttime traffic noise levels from heavy haul trucks along the detour route could result in a noticeable increase (+3 to +5 dBA CNEL) at residential land uses along the designated route.

On-site construction noise would occur primarily during daytime hours, would be temporary and short term, and would not result in annoyance at the interior locations of receptors. Trips by heavy haul trucks along the detour route would occur primarily during nighttime hours, would be temporary and short term, and impacts would not occur at interior or exterior noise-sensitive locations. Noise levels generated by temporary off-ramp construction at Hookton Road, transmission line construction near the Bridgeville Substation, and heavy haul truck trips along detour roadways would result in a substantial increase (i.e., +5 dB) in ambient noise levels. Temporary off-ramp construction at Hookton Road and transmission line construction near the Bridgeville Substation also would exceed the County's land use compatibility exterior noise standard of 60 dBA CNEL.

Operation of heavy equipment, including haul trucks and power tools used during construction of permitted structures when conforming to the terms of an approved permit, would not exceed the numeric noise standards applicable in the TPZ and AG zones listed in Policy N-S7 of the General Plan's Noise Element (80 dBA daytime and 70 dBA nighttime) and in the RRA zones (75 dBA daytime and 65 dBA nighttime). Therefore, temporary construction noise impacts would be **less than significant.**

Even though impacts were determined to be less than significant, the project applicant has voluntarily agreed to implement Mitigation Measure 3.11-1 as an enforceable condition of approval.

Mitigation Measure 3.11-1: Implement Noise-Reducing Construction Practices.

The project applicant shall ensure that the following measures are implemented during construction activities, where construction occurs within 500 feet of a sensitive receptor, to avoid and minimize construction noise effects on sensitive receptors:

- All construction equipment shall be equipped with noise-reduction devices, such as mufflers, to minimize construction noise, and all internal combustion engines will be equipped with exhaust and intake silencers, in accordance with manufacturers' specifications.
- The use of bells, whistles, alarms, and horns shall be restricted to safety warning purposes only.
- Mobile and fixed construction equipment (e.g., compressors and generators), construction staging and stockpiling areas, and construction vehicle routes shall be located at the most distant point feasible from noise-sensitive receptors.
- The project applicant shall ensure that all heavy trucks are properly maintained and equipped with noise-control (e.g., muffler) devices, in accordance with manufacturers' specifications, at each work site during project construction, to minimize construction traffic noise effects on sensitive receptors.

Implementation: Project applicant.

Timing: During construction.

Enforcement: Humboldt County Planning & Building Department.

The construction activities for the Bridgeville Substation would be of a short duration and would occur in a location with no sensitive receptors in the immediate vicinity. Therefore, this impact of substation construction would be **less than significant**.

IMPACT 3.11-2	**Temporary and Short-Term Exposure of Sensitive Receptors to, or Temporary and Short-Term Generation of, Excessive Groundborne Vibration.** *Project construction activities would require the use of heavy construction equipment and blasting in the project area. Heavy construction equipment and blasting activities would not expose existing sensitive receptors to temporary vibration levels that would exceed applicable standards. This impact would be* ***less than significant****.*

Construction activities would have the potential to result in varying degrees of temporary ground vibration, depending on the specific construction equipment used and the operations involved. Vibration generated by construction equipment would spread through the ground and diminish in magnitude with increases in distance. Table 3.11-11 shows vibration levels for typical construction equipment.

Table 3.11-11. Typical Construction Equipment Vibration Levels

Equipment	PPV at 25 feet (in/sec)	Approximate Lv at 25 feet[1]
Large bulldozer	0.089	87
Trucks	0.076	86
Jackhammer	0.035	79
Small bulldozer	0.003	58

Notes: in/sec = inches per second; PPV = peak particle velocity

[1] Where Lv is the velocity level in decibels and based on the root-mean square velocity amplitude.

Source: FTA 2018

Construction activities would occur over 12–18 months. Vibration levels generated during construction would fluctuate, depending on the specific location of construction activities in the project area, and on the particular type, number, and duration of use of various pieces of construction equipment. Equipment required for construction activities associated with WTGs, the transmission line, roads (existing and new roads, including temporary access roads and temporary public road improvements at two locations on U.S. 101), electrical collection and communication systems, and staging areas could include blasting, concrete mixer/pump trucks, excavators, dozers, cranes, graders, a boring jack, pneumatic tools, and various other trucks. The most intense generation of ground vibration would be associated with large bulldozers and blasting that could generate levels of 0.089 in/sec PPV and 87 VdB at a distance of 25 feet. These levels would attenuate to 0.011 in/sec PPV and 69 VdB at a distance of 100 feet.

The nearest receptors to construction sites that would involve heavy-duty construction equipment would be 200 feet from transmission line construction and 240 feet from temporary off-ramp construction at Hookton Road. The nearest receptor to construction sites with blasting activity (WTG foundation construction areas) would be at a distance of more than 800 feet. At these distances, vibration generated by heavy-duty construction equipment would not exceed the recommended FTA (80 VdB) or Caltrans (0.3 in/sec PPV) standards at these receptors. Therefore, the temporary and short-term impact caused by vibration from project construction equipment would be **less than significant**.

Vibration associated with construction activities for the Bridgeville Substation would be of a short duration and would occur in a location with no sensitive receptors in the immediate vicinity. Therefore, this impact of substation construction would be **less than significant**.

IMPACT 3.11-3	Long-Term Increases in Project-Generated Noise. *Project operation would introduce new long-term noise sources in the project area. Noise generated by substations and overhead transmission lines would not be anticipated to expose existing sensitive receptors to a permanent increase in noise levels that would exceed the applicable noise standards or result in a substantial increase in ambient noise levels. However, noise generated by wind turbine generators could expose existing sensitive receptors to a substantial permanent increase in ambient noise levels. With respect to noise generated by substations and overhead transmission lines, and to long-term, low-frequency and infrasonic noise from operation of the wind turbine generators, this impact would be* ***less than significant****. With respect to long-term exterior noise generated by operation of the wind turbine generators, this impact would be* ***potentially significant****.*

Project Substation

Substations typically generate steady-state noise from operation of transformers, along with cooling fans and oil pumps, needed to cool the transformer during periods of high electrical demand. The main power transformer at the project substation would increase the voltage of the electricity from the 34.5 kV collection systems to 115 kV for transmission to the Bridgeville Substation.

To further substantiate noise levels that would be generated by transformers, AECOM conducted a short-term (5-minute) noise measurement at the existing Nuevo Substation (in the community of Lakeview in Riverside County), to document existing operational noise levels attributable to a similar use. During the measurement, the minimum noise level (L_{min}) measured at 18 feet from the transformer was 48.1 dBA L_{eq}. Only a chain-link fence encompasses the Nuevo Substation, similar to the proposed substation in the generation area.

The proposed substation would be on Monument Ridge. The nearest noise-sensitive receptor is more than 2 miles from the site of the proposed substation. The nearest noise-sensitive receptor to the Bridgeville Substation is R-10, at 750 feet from the proposed facility expansion site. Based on the design of the proposed Bridgeville Substation expansion, the distance between the nearest sensitive receptor and the existing and proposed transformers, and measurements of a similar substation, noise levels generated by the transformers at the proposed substation would be less than 40 dBA L_{eq}. Therefore, operation of transformers at the proposed substation would not cause a substantial permanent increase in ambient noise levels in the project area above levels existing without the project. The long-term operational impact associated with transformer operation would be **less than significant**.

The long-term operational impact associated with expansion of the Bridgeville Substation would be **less than significant.**

Overhead Transmission Lines

The proposed overhead transmission line component of the project would involve operating a 115 kV interconnect line that would generate a permanent noise. When a transmission line is in operation, an electric field is generated in the air surrounding the conductors, forming a “corona.” A corona results from the partial breakdown of the electrical insulating properties of the air surrounding the conductors. When the intensity of the electrical field at the surface of the conductor exceeds the insulating strength of the surrounding air, a corona discharge occurs at the conductor surface, representing a small dissipation of heat and energy. Some of the energy may dissipate in the form of small, local pressure changes, resulting in audible noise or in radio or television interference. Audible noise generated by corona discharge is characterized as a hissing or crackling sound, which may be accompanied by a 120 Hz hum.

Slight irregularities or water droplets on the conductor and/or insulator surface accentuate the electric field strength near the conductor surface, thereby making corona discharge and the associated audible noise more likely. Therefore, audible noise from transmission lines generally is a foul-weather (wet-conductor) phenomenon. However, during fair weather, insects and dust on the conductors also can serve as sources of corona discharge. The Electric Power Research Institute (EPRI) has conducted several studies of corona effects (CPUC 2009). Table 3.11-12 shows the typical noise levels for transmission lines with wet conductors.

Because the proposed overhead transmission line would be 115 kV, operation of the transmission line is expected to generate less than 33.5 dBA audible noise, based on studies conducted by EPRI (see Table 3.11-12). Therefore, operation of overhead transmission lines would not cause a substantial permanent increase in ambient noise levels in the project area, above levels existing without the project. The long-term operational impact associated with operation of the overhead transmission line would be **less than significant**.

The Bridgeville Substation expansion would have **no impact** associated with operation of the overhead transmission line.

Table 3.11-12. Overhead Transmission Line Voltage and Audible Noise Levels

Line Voltage (kV)	Audible Noise Level Directly below the Conductor (dBA)
138	33.5
240	40.4
356	51.0

Notes:
dBA = A-weighted decibels; kV = kilovolts
Source: CPUC 2009

Wind Turbine Generators

Noise would be generated from operation and maintenance of the WTGs, along with occasional trips by maintenance vehicles.

Low-Frequency and Infrasonic Noise

As described above, a “typical” spectral shape was assumed, based on data of other similar WTGs. Table 3.11-13 shows the differences between the A-weighted and C-weighted L_{eq} noise levels, as calculated at each receptor location, assuming simultaneous operation of all 60 WTGs.

Table 3.11-13. Difference between A-Weighted and C-Weighted Results

Receptor	A-weighted, dBA	C-weighted, dBC	dBC – dBA, dB
R-1	36.6	40.4	3.8
R-2	26.6	33.0	6.4
R-3	30.1	35.1	5.0
R-4	47.3	48.9	1.6
R-5	23.7	31.2	7.5

Notes:

dBA = A-weighted decibels; dBC = C-weighted decibels
Source: Illingworth & Rodkin 2018a

As shown in Table 3.11-13, the difference between the A-weighted and C-weighted levels would be 2–8 dB. A difference of 20 dB or more between the A-weighted and C-weighted noise levels is the threshold of concern for low-frequency noise, relative to receptors that perceive noise in A-weighted levels. Therefore, low-frequency noise from the WTGs is expected to be below any of the typical regulations or guidelines if the A-weighted sound level limits are achieved. WTG noise levels also would be well below the threshold of 64 C-weighted dB threshold for considering reasonable complaints. Thus, the operation of WTGs at the proposed substation site would not cause a substantial permanent increase in low-frequency and infrasonic noise, above levels existing without the project. The long-term impact of low-frequency and infrasonic noise from WTG operation would be **less than significant**.

The Bridgeville Substation expansion would have **no impact** associated with WTG operation.

Exterior Noise

Operation of wind turbine generators creates aerodynamic and mechanical noise. Aerodynamic noise is generated by the moving blades passing through the air, which may produce a buzzing, whooshing, pulsing, or sizzling sound, depending on the type of WTG and operating speed. Most noise generated during operation radiates perpendicular to the rotation of the blades; however, because the WTGs rotate to face the wind, the noise may be radiated in various directions. Two or more operating WTGs may combine to create an oscillating or thumping effect. Mechanical noise may be generated by the WTG's gears, which can produce noticeable and irritating noise, depending on the degree of WTG insulation (Alberts 2006).

The effects of WTG noise on nearby receptors can be related to wind speed; high wind speeds generate noise that can mask turbine noise. Public perception of the acoustic impact of WTGs is, in part, a subjective determination. Typically, the effects of noise from WTGs on nearby receptors include annoyance, nuisance, and dissatisfaction, along with interference with speech, sleep, and learning (UMASS 2006).

The project would construct and operate up to 60 WTGs. This analysis was conducted using a WTG with a maximum sound power level of 110 dBA, which is the loudest, or worst-case, turbine that is expected to be used at the project site (Illingworth & Rodkin 2018b). Other WTG options range in sound power levels of 105–107 dBA. One-third octave band levels were unavailable for this WTG. Therefore, a "typical" spectral shape was assumed. SoundPLAN Version V8.0 was used to calculate noise levels at adjacent noise-sensitive locations, assuming a worst-case condition, with simultaneous operation of all WTGs. SoundPLAN is a three-dimensional ray-tracing program, taking into account the topography of the area and the spectral characteristics of the noise sources.

These results included the effect of atmospheric attenuation, ground reflection/absorption, and topography. Neutral environmental conditions were assessed for impact assessment purposes (i.e., no wind or temperature gradients). Table 3.11-14 shows the calculated levels at each of the nearest noise-sensitive receptors under this scenario, showing A-weighted, C-weighted, and unweighted sound pressure levels at each receptor location that could be exposed to WTG noise.

Table 3.11-14. Sound Pressure Levels from Project Wind Turbine Generators at Receptors

Receptor	A-weighted, L_{eq} dBA	C-weighted, L_{eq} dBC	Unweighted, L_{eq} dB	CNEL[1], dBA	CNEL[1], dBC
R-1	37	40	41	43	47
R-2	27	33	33	33	40
R-3	30	35	35	37	42
R-4	24	31	32	30	38
R-5	48	50	50	55	57

Notes:
CNEL = community noise equivalent level; dBA = A-weighted decibels; dBC = C-weighted decibels
[1] Assumes continuous, simultaneous operation of all wind turbine generators, 24 hours per day.
Source: Illingworth & Rodkin 2018a

As shown in Table 3.11-14, A-weighted levels would range from 24 to 48 dBA L_{eq} at nearby residences; CNEL levels, assuming a worst-case scenario with WTGs operating continuously for 24 hours per day, would range from 30 to 55 dBA. Thus, operational WTG noise levels would not exceed the County's short-term noise standards during the daytime and nighttime hours of 65 dBA L_{max} and 60 dBA L_{max}, respectively, or the County's land use compatibility interior and exterior noise thresholds of 45 and 60 dBA CNEL, respectively.

However, if all 60 WTGs were operating 24 hours a day, this could result in increases above ambient noise levels. Table 3.11-15 shows existing ambient and calculated daily (CNEL) noise levels resulting from the worst-case WTG scenario with all 60 turbines operating simultaneously, 24 hours per day.

Table 3.11-15. Increase in Community Noise Equivalent Level Resulting from Project Operations, 100 Percent Operations

Receptor	Ambient CNEL, dBA	Project-Generated CNEL,[1] dBA	Existing Plus Project Generated CNEL,[1] dBA	CNEL Increase,[1] dBA
R-1	45–53	43	47–53	0–2
R-2	45–53	33	47–53	0–1
R-3	45–53	37	47–53	0–1
R-4	45–53	30	47–53	0–1
R-5	45–53	55	55–57	4–11

Notes:
CNEL = community noise equivalent level; dBA = A-weighted decibels
[1] Assumes continuous, simultaneous operation of all wind turbine generators, 24 hours per day.
Source: Illingworth & Rodkin 2018a

As shown in Table 3.11-15, operation of all 60 WTGs 24 hours per day would result in CNEL noise level increases of 0 to +2 dBA at R-1, and of 0 to less than 1 dBA at R-2, R-3, and R-4. R-5 would be exposed to project-generated WTG noise level increases of +4 to +11 dBA above ambient noise levels, assuming operation of all 60 WTGs 24 hours per day. Ambient noise levels at all receptors are less than 60 dBA CNEL; therefore, a +5 dBA increase in ambient noise levels threshold would apply. Operational increases in WTG noise at R-1 through R-4 would range between 0 and +2 dBA. Project operation–generated WTG noise level increases would range between +5 and +11 dBA at R-5 on days where the ambient noise levels are 51 dBA CNEL or less. Therefore, the operation of WTGs would cause a substantial permanent increase in ambient noise levels at one receptor (R-5) above levels existing without the project. The long-term exterior noise impact associated with WTG operation would be **potentially significant**.

Mitigation Measure 3.11-2: Implement Noise-Reducing Wind Turbine Generator Operations.

The project applicant shall reduce the number of proposed WTGs north of receptor R-5 (shown in Figure 3.11-2) to avoid and minimize the effects of noise related to WTG operation. The following measure shall be implemented:

- Relocate, eliminate, or impose operational modifications on WTGs within 1,200 feet of receptor R-5 to reduce the permanent increase in ambient noise levels from 24-hour-per-day operation of WTGs to less than 5 dBA.

Implementation: Project applicant.

Timing: Before approval of grading or improvement plans or any ground-disturbing activities.

Enforcement: Humboldt County Planning & Building Department.

Mitigation Measure 3.11-2 would reduce operational impacts of WTG noise and would ensure that noise levels at noise-sensitive receptor R-5 would not increase more than 5 dBA over ambient noise levels during 24-hour-per-day operation of WTGs. Predicted noise levels would comply with applicable standards for local exterior noise for residential land uses (the County-established short-term noise standard of 65 dBA L_{max}). Therefore, implementing this mitigation measure would reduce the long-term impacts from project-generated noise to **less than significant**.

The Bridgeville Substation expansion would have **no impact** related to the noise produced by the WTGs.