APPENDIX C

Noise and Vibration Assessment

Prepared by

Illingworth & Rodkin

July 2019

CHESTNUT SOLAR PROJECT NOISE AND VIBRATION ASSESSMENT

Kings County, California

July 31, 2019

Prepared for:

Bert Verrips
11942 Red Hill Avenue
Santa Ana, CA 92705

Prepared by:

Michael S. Thill

ILLINGWORTH & RODKIN, INC.
Acoustics • Air Quality

429 E. Cotati Avenue
Cotati, CA 94931
(707) 794-0400

I&R Project: 19-048

INTRODUCTION

This report assesses the potential significance of noise and vibration impacts resulting from the Chestnut Solar Project proposed in Kings County, California. The Project will occupy an approximately 1,040-acre site generally located to the northwest of State Route 41, south of Laurel Avenue, and west of 22nd Avenue.

The project is planned to generate a total of 150 megawatts (MW) of electrical output from solar photovoltaic (PV) modules, and is planned to be constructed over an approximate 12-month period from mid-2020 through mid-2021. The solar modules will be mounted on a series of horizontal single-axis trackers which will be oriented north-south and rotate the solar arrays in an east-west direction. The solar modules output direct current (DC) power and the electricity travels to an inverter via underground cables to be converted to alternating current (AC) power.

The Setting Section of this report presents the fundamentals of environmental noise and vibration, provides a discussion of policies and standards applicable to the project, and presents the results of the ambient noise monitoring survey made at residential receptors in the project vicinity. The Impacts and Mitigation Measures section of the report summarizes the significance criteria used in the assessment of impacts, future noise and vibration levels expected from the construction and operation of the project, and the significance determinations of project-related noise and vibration impacts.

SETTING

Fundamentals of Environmental Noise

Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. The objectionable nature of sound could be caused by its *pitch* or its *loudness*. *Pitch* is the height or depth of a tone or sound, depending on the relative rapidity (frequency) of the vibrations by which it is produced. Higher pitched signals sound louder to humans than sounds with a lower pitch. *Loudness* is intensity of sound waves combined with the reception characteristics of the ear. Intensity may be compared with the height of an ocean wave in that it is a measure of the amplitude of the sound wave.

In addition to the concepts of pitch and loudness, there are several noise measurement scales which are used to describe noise in a particular location. A *decibel (dB)* is a unit of measurement which indicates the relative amplitude of a sound. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 decibels represents a ten-fold increase in acoustic energy, while 20 decibels is 100 times more intense, 30 decibels is 1,000 times more intense, etc. There is a relationship between the subjective noisiness or loudness of a sound and its intensity. Each 10 decibel increase in sound level is perceived as approximately a doubling of loudness over a fairly wide range of intensities. Technical terms are defined in Table 1.

There are several methods of characterizing sound. The most common in California is the *A-weighted sound level (dBA).* This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Representative outdoor and indoor noise levels in units of dBA are shown in Table 2. Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This *energy-equivalent sound/noise descriptor* is called L_{eq}. The most common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration.

The scientific instrument used to measure noise is the sound level meter. Sound level meters can accurately measure environmental noise levels to within about plus or minus 1 dBA. Various computer models are used to predict environmental noise levels from sources, such as roadways and airports. The accuracy of the predicted models depends upon the distance the receptor is from the noise source. Close to the noise source, the models are accurate to within about plus or minus 1 to 2 dBA.

Since the sensitivity to noise increases during the evening and at night -- because excessive noise interferes with the ability to sleep -- 24-hour descriptors have been developed that incorporate artificial noise penalties added to quiet-time noise events. The *Community Noise Equivalent Level* (*CNEL*) is a measure of the cumulative noise exposure in a community, with a 5 dB penalty added to evening (7:00 p.m. - 10:00 p.m.) and a 10 dB addition to nocturnal (10:00 p.m. - 7:00 a.m.) noise levels. The *Day/Night Average Sound Level* (L_{dn} or *DNL*) is essentially the same as CNEL, with the exception that the evening time period is dropped and all occurrences during this three-hour period are grouped into the daytime period.

Effects of Noise

Sleep and Speech Interference

The thresholds for speech interference indoors are about 45 dBA if the noise is steady and above 55 dBA if the noise is fluctuating. Outdoors the thresholds are about 15 dBA higher. Steady noises of sufficient intensity (above 35 dBA) and fluctuating noise levels above about 45 dBA have been shown to affect sleep. Interior residential standards for multi-family dwellings are set by the State of California at 45 dBA L_{dn}. Typically, the highest steady traffic noise level during the daytime is about equal to the L_{dn} and nighttime levels are 10 dBA lower. The standard is designed for sleep and speech protection and most jurisdictions apply the same criterion for all residential uses. Typical structural attenuation is 12-17 dBA with open windows. With closed windows in good condition, the noise attenuation factor is around 20 dBA for an older structure and 25 dBA for a newer dwelling. Sleep and speech interference is therefore possible when exterior noise levels are about 57-62 dBA L_{dn} with open windows and 65-70 dBA L_{dn} if the windows are closed. Levels of 55-60 dBA are common along collector streets and secondary arterials, while 65-70 dBA is a typical value for a primary/major arterial. Levels of 75-80 dBA are normal noise levels at the first row of development outside a freeway right-of-way. In order to achieve an acceptable interior noise environment, bedrooms facing secondary roadways need to be able to have their windows closed; those facing major roadways and freeways typically need special glass windows.

Annoyance

Attitude surveys are used for measuring the annoyance felt in a community for noises intruding into homes or affecting outdoor activity areas. In these surveys, it was determined that the causes for annoyance include interference with speech, radio and television, house vibrations, and interference with sleep and rest. The L_{dn} as a measure of noise has been found to provide a valid correlation of noise level and the percentage of people annoyed. People have been asked to judge the annoyance caused by aircraft noise and ground transportation noise. There continues to be disagreement about the relative annoyance of these different sources. When measuring the percentage of the population highly annoyed, the threshold for ground vehicle noise is about 50 dBA L_{dn}. At a L_{dn} of about 60 dBA, approximately 12 percent of the population is highly annoyed. When the L_{dn} increases to 70 dBA, the percentage of the population highly annoyed increases to about 25-30 percent of the population. There is, therefore, an increase of about 2 percent per dBA between a L_{dn} of 60-70 dBA. Between a L_{dn} of 70-80 dBA, each decibel increase increases the percentage of the population highly annoyed by about 3 percent. People appear to respond more adversely to aircraft noise. When the L_{dn} is 60 dBA, approximately 30-35 percent of the population is believed to be highly annoyed. Each decibel increase to 70 dBA adds about 3 percentage points to the number of people highly annoyed. Above 70 dBA, each decibel increase results in about a 4 percent increase in the percentage of the population highly annoyed.

Fundamentals of Groundborne Vibration

Ground vibration consists of rapidly fluctuating motions or waves with an average motion of zero. Several different methods are typically used to quantify vibration amplitude. One method is the Peak Particle Velocity (PPV). The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. In this report, a PPV descriptor with units of mm/sec or in/sec is used to evaluate construction generated vibration for building damage and human complaints. Table 3 displays the reactions of people and the effects on buildings that continuous or frequent intermittent vibration levels produce. The guidelines in Table 3 represent syntheses of vibration criteria for human response and potential damage to buildings resulting from construction vibration.

Construction activities can cause vibration that varies in intensity depending on several factors. The use of pile driving and vibratory compaction equipment typically generates the highest construction related groundborne vibration levels. Because of the impulsive nature of such activities, the use of the PPV descriptor has been routinely used to measure and assess groundborne vibration and almost exclusively to assess the potential of vibration to cause damage and the degree of annoyance for humans.

The two primary concerns with construction-induced vibration, the potential to damage a structure and the potential to interfere with the enjoyment of life, are evaluated against different vibration limits. Human perception to vibration varies with the individual and is a function of physical setting and the type of vibration. Persons exposed to elevated ambient vibration levels, such as people in an urban environment, may tolerate a higher vibration level.

Structural damage can be classified as cosmetic only, such as paint flaking or minimal extension of cracks in building surfaces; minor, including limited surface cracking; or major, that may threaten the structural integrity of the building. Safe vibration limits that can be applied to assess the potential for damaging a structure vary by researcher. The damage criteria presented in Table 3 include several categories for ancient, fragile, and historic structures, the types of structures most at risk to damage. Most buildings are included within the categories ranging from "Historic and some old buildings" to "Modern industrial/commercial buildings." Construction-induced vibration that can be detrimental to the building is very rare and has only been observed in instances where the structure is at a high state of disrepair and the construction activity occurs immediately adjacent to the structure.

The annoyance levels shown in Table 3 should be interpreted with care since vibration may be found to be annoying at lower levels than those shown, depending on the level of activity or the sensitivity of the individual. To sensitive individuals, vibrations approaching the threshold of perception can be annoying. Low-level vibrations frequently cause irritating secondary vibration, such as a slight rattling of windows, doors, or stacked dishes. The rattling sound can give rise to exaggerated vibration complaints, even though there is very little risk of actual structural damage.

TABLE 1 Definition of Acoustical Terms Used in this Report

Term	Definition
Decibel, dB	A unit describing, the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20 micro Pascals.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micro Pascals (or 20 micro Newtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e. g., 20 micro Pascals). Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hz and 20,000 Hz. Infrasonic sound are below 20 Hz and Ultrasonic sounds are above 20,000 Hz.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
Equivalent Noise Level, L_{eq}	The average A-weighted noise level during the measurement period.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
L_{01}, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Day/Night Noise Level, L_{dn} or DNL	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 p.m. and 7:00 a.m.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 p.m.to 10:00 p.m. and after addition of 10 decibels to sound levels measured in the night between 10:00 p.m. and 7:00 a.m.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

Source: Handbook of Acoustical Measurements and Noise Control, Harris, 1998.

TABLE 2 Typical Noise Levels in the Environment

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

Source: Technical Noise Supplement (TeNS), California Department of Transportation, September 2013.

TABLE 3 Reaction of People and Damage to Buildings from Continuous or Frequent Intermittent Vibration Levels

Velocity Level, PPV (in/sec)	Human Reaction	Effect on Buildings
0.01	Barely perceptible	No effect
0.04	Distinctly perceptible	Vibration unlikely to cause damage of any type to any structure
0.08	Distinctly perceptible to strongly perceptible	Recommended upper level of the vibration to which ruins and ancient monuments should be subjected
0.1	Strongly perceptible	Threshold at which there is a risk of damage to fragile buildings with no risk of damage to most buildings
0.25	Strongly perceptible to severe	Threshold at which there is a risk of damage to historic and some old buildings.
0.3	Strongly perceptible to severe	Threshold at which there is a risk of damage to older residential structures
0.5	Severe - Vibrations considered unpleasant	Threshold at which there is a risk of damage to new residential and modern commercial/industrial structures

Source: Transportation and Construction Vibration Guidance Manual, California Department of Transportation, September 2013.

Regulatory Criteria

The State of California and Kings County establish regulatory criteria that are applicable in this assessment. The California Environmental Quality Act (CEQA) Guidelines are used to assess the potential significance of impacts pursuant to local General Plan policies, Municipal Code standards, or the applicable standards of other agencies. A summary of the applicable regulatory criteria is provided below.

State CEQA Guidelines. CEQA contains guidelines to evaluate the significance of effects of environmental noise attributable to a proposed project. Under CEQA, noise impacts would be considered significant if the project would result in:

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

(b) Generation of excessive groundborne vibration or groundborne noise levels;

(c) For a project located within the vicinity of a private airstrip or an airport land use plan or where such a plan has not been adopted within two miles of a public airport or public use airport, if the project would expose people residing or working in the project area to excessive noise levels.

CEQA does not define what noise level increase would be considered substantial. Typically, project-generated noise level increases of 1.5 dBA L_{dn}/CNEL or greater, where the pre-project noise level is 65 L_{dn}/CNEL or greater, would be considered significant. Project-generated noise level increases of 3 dBA L_{dn}/CNEL or greater would be considered significant where exterior noise levels would exceed the normally acceptable noise level standard (60 dBA L_{dn}/CNEL for residential land uses). Where noise levels would remain at or below the normally acceptable noise level standard with the project, noise level increases of 5 dBA L_{dn}/CNEL or greater would be considered significant. These commonly accepted criteria are also adopted as part of the Kings County Noise Standards for New Uses Affected by Transportation Noise Sources (Kings County 2035 General Plan Noise Element, Table N-7).

Kings County 2035 General Plan. The Noise Element establishes goals, objectives, and policies to guide planning decisions and prevent the exposure of County residents and noise sensitive land uses from excessive noise levels.

Applicable goals and policies presented in the General Plan are as follows:

N GOAL B1 — Protect the economic base of Kings County by preventing the encroachment of noise-sensitive land uses into areas affected by existing noise-producing uses. More specifically, to recognize that noise is an inherent byproduct of many land uses, including agriculture, and to prevent new noise-sensitive land uses from being developed in areas affected by existing noise-producing uses.

N OBJECTIVE B1.1 — Reduce the potential for exposure of County residents and noise-sensitive land uses to excessive noise generated from Non-Transportation Noise Sources.

N Policy B1.1.1: — Appropriate noise mitigation measures shall be included in a proposed project design when the proposed new use(s) will be affected by or include non-transportation noise sources and exceed the County's "Non-Transportation Noise Standards" (Table N-8). Mitigation measures shall reduce projected noise levels to a state of compliance with this standard within sensitive areas. These standards are applied at the sensitive areas of the receiving use.

N Policy B1.1.3: — Noise associated with construction activities shall be considered temporary, but will still be required to adhere to applicable County Noise Element standards.

Kings County General Plan Noise Element Table N-7

Table N-7 Noise Standards for New Uses Affected by Transportation Noise Sources

New Land Use	Sensitive[1] Outdoor Area - CNEL	Sensitive Interior[2] Area - CNEL	Notes
Residential	60	45	5
Residences in Ag. Zones	65	45	6
Transient Lodging	65	45	3,5
Hospitals & Nursing Homes	60	45	3, 4, 5
Theaters & Auditoriums	---	35	3
Churches, Meeting Halls	60	40	3
Schools, Libraries, etc.	60	40	3
Office Buildings	65	45	3
Commercial Buildings	65	50	3
Playgrounds, Parks, etc.	70	---	
Industry	65	50	3

Notes:

1. Sensitive areas are defined acoustic terminology section.
2. Interior noise level standards are applied within noise-sensitive areas of the various land uses, with windows and doors in the closed positions.
3. Where there are no sensitive exterior spaces proposed for these uses, only the interior noise level standard shall apply.
4. Hospitals are often noise-generating uses. The exterior noise level standards for hospitals are applicable only at clearly identified areas designated for outdoor relaxation by either hospital staff or patients.
5. If this use is affected by railroad or aircraft noise, a maximum (Lmax) noise level standard of 70 dB shall be applied to all sleeping rooms with windows closed to reduce the potential for sleep disturbance during nighttime noise events.
6. Due to the noise-generating nature of agricultural activities, it is understood that residences constructed on agriculturally-designated land uses may be exposed to elevated noise levels. As a result, a 65 dB CNEL exterior noise level standard is applied to noise-sensitive outdoor areas of these uses.

Kings County General Plan Noise Element Table N-8

Table N-8 Non-Transportation Noise Standards
Average (Leq) / Maximum (Lmax)[1]

Receiving Land Use	Outdoor Area[2] Daytime	Outdoor Area[2] Nighttime	Interior[3] Day & Night	Notes
All Residential	55 / 75	50 / 70	35 / 55	
Transient Lodging	55 / 75	---	35 / 55	4
Hospitals & Nursing Homes	55 / 75	---	35 / 55	5, 6
Theaters & Auditoriums	---	---	30 / 50	6
Churches, Meeting Halls, Schools, Libraries, etc.	55 / 75	---	35 / 60	6
Office Buildings	60 / 75	---	45 / 65	6
Commercial Buildings	55 / 75	---	45 / 65	6
Playgrounds, Parks, etc.	65 / 75	---	---	6
Industry	60 / 80	---	50 / 70	6

<u>Notes:</u>

1. The Table N-8 standards shall be reduced by 5 dB for sounds consisting primarily of speech or music, and for recurring impulsive sounds. If the existing ambient noise level exceeds the standards of Table N-8, then the noise level standards shall be increased at 5 dB increments to encompass the ambient.
2. Sensitive areas are defined acoustic terminology section.
3. Interior noise level standards are applied within noise-sensitive areas of the various land uses, with windows and doors in the closed positions.
4. Outdoor activity areas of transient lodging facilities are not commonly used during nighttime hours.
5. Hospitals are often noise-generating uses. The exterior noise level standards for hospitals are applicable only at clearly identified areas designated for outdoor relaxation by either hospital staff or patients.
6. The outdoor activity areas of these uses (if any), are not typically utilized during nighttime hours.

N GOAL C1 — Provide sufficient noise exposure information so that existing and potential noise impacts may be effectively addressed in the land use planning and project review processes, and allow flexibility in the development of infill properties which may be located in elevated noise environments.

N OBJECTIVE C1.1 — Ensure the sufficient provision of project and site noise information is available along with alternative mitigation approaches to better inform County staff and land use decision makers.

N Policy C1.1.1: All noise analyses prepared to determine compliance with the noise level standards contained within this *Noise Element* shall be prepared in accordance with the County's "Requirements for Acoustical Analyses Prepared in Kings County" (Table N-9).

Kings County General Plan Noise Element Table N-9

Table N-9 Requirements for Acoustical Analyses Prepared in Kings County	
An acoustical analysis prepared pursuant to the *Noise Element* shall:	
A.	Be the responsibility of the applicant.
B.	Be prepared by qualified persons experienced in the fields of environmental noise assessment and architectural acoustics.
C.	Include representative noise level measurements with sufficient sampling periods and locations to adequately describe local conditions.
D.	Estimate projected future (20 year) noise levels in terms of the Standards of Tables N-7 and N-8, and compare those levels to the adopted policies of the *Noise Element*.
E.	Recommend appropriate mitigation to achieve compliance with the adopted policies and standards of the *Noise Element*.
F.	Estimate interior and exterior noise exposure after the prescribed mitigation measures have been implemented.

N Policy C1.1.2: Where noise mitigation measures are required to satisfy the noise level standards of this *Noise Element*, emphasis shall be placed on the use of setbacks and site design, prior to consideration of the use of noise barriers.

Kings County Code of Ordinances. Article 10 of the Code of Ordinances sets forth requirements and procedures for noise abatement in the County. Section 15-211 (Certain Noise Prohibited) provides as follows:

> "No person shall make, suffer, or permit upon any premises owned, occupied or controlled by such person any noises or sounds which are physically annoying to the senses of persons of ordinary sensitivity, or which are so harsh or so prolonged or unnatural or unusual in their use, time or place, as to cause physical discomfort to neighbors or to interfere with the comfortable use and enjoyment of life or property, or which constitutes a public or private nuisance, within any unincorporated territory of the County of Kings.

The Code of Ordinances provides no further detail on acceptable noise levels or limits on hours for operational or construction noise sources. As such, the General Plan Noise Element requirements and standards (reproduced above) are controlling with respect to quantitative noise thresholds.

The Kings County Subdivision Ordinance (Chapter 21 of the Kings County Code of Ordinances) provides that one of its objectives is to ensure that land developments will not adversely affect the values or enjoyment of nearby properties. Under Section 21-10 of the Ordinance, the Health Department is responsible for analyzing project elements affecting the environment such as noise.

Existing Noise Environment

Figure 1 shows the project vicinity. The existing noise environment in the project area is typical of rural agricultural environments. The primary noise sources in the project vicinity include: 1) traffic on State highways and County roads (SR-41, Nevada Avenue, and Avenal Cutoff Road); 2) agricultural equipment and crop dusters; and 3) occasional overflights by military aircraft from Naval Air Station Lemoore.

The Chestnut Solar Project site is located approximately 9.0 miles south of the airfield at Naval Air Station Lemoore (NASL), and is included in the study area for the NAS Lemoore Joint Land Use Study. The project site is located within the NASL flight pattern, and the eastern half of the site falls between the 60 dBA and 70 dBA CNEL noise contours as mapped in the NAS Lemoore Joint Land Use Study (JLUSPC 2011, p. 2-11.).

There are no noise-sensitive residential receivers within 1.0 mile of the project site. The nearest residences consist of a series of 7 ranch dwellings located in two ranch complexes along the south side of SR-41, at distances ranging from 1.0 to 1.5 miles south of the project site. The next nearest residences comprise a series of dispersed agricultural residences located along 22nd Avenue at distances ranging from 1.6 to 3.0 miles east and northeast of the project site. The next nearest residences consist of the 20 single-family dwellings at the Shannon Ranch complex located at the southwest corner of Avenal Cutoff Road and Lincoln/Gale Avenue approximately 2.8 miles northwest of the project. The Stone Land Company Ranch, located on the south side of Nevada Avenue, approximately 4.6 miles southwest of the Chestnut Solar Project site, includes two dwellings and other ranch buildings.

In order to document noise conditions at the receptors in the Shannon Ranch complex, a long-term noise measurement was conducted alongside Avenal Cutoff Road at the ranch between Monday, December 14, 2015 and Tuesday, December 15, 2015. The sound level meter was placed approximately 80 feet from the center of Avenal Cutoff Road to represent the noise exposure at residences in the immediate vicinity of the roadway. The noise measurements documented the existing daily trend in noise levels due to traffic. The day-night average noise level at this site was 75 dBA L_{dn}. Typical daytime hourly average noise levels were approximately 66 to 72 dBA L_{eq}. Data collected from the long-term noise measurement at Shannon Ranch are graphically displayed on Figure 2.

In order to document conditions at the receptors in the Stone Land Company Ranch complex, a long-term noise measurement was conducted alongside Nevada Avenue at the ranch between

Monday, December 14, 2015 and Tuesday, December 15, 2015. The sound level meter was placed approximately 27 feet from the center of Nevada Avenue to represent the noise exposure at residences in the immediate vicinity of the roadway. The noise measurements documented the existing daily trend in noise levels due to traffic. The day-night average noise level at this site was 67 dBA L_{dn}. Typical daytime hourly average noise levels were approximately 57 to 69 dBA L_{eq}. Data collected from the long-term noise measurement at Stone Land Company Ranch are graphically displayed on Figure 3.

NOISE IMPACTS AND MITIGATION MEASURES

This section describes the significance criteria used to evaluate project impacts under CEQA, provides a discussion of each project impact, and presents mitigation measures, where necessary, to provide a compatible project in relation to sensitive land uses in the project vicinity.

Significance Criteria

The following criteria were used to evaluate the significance of environmental noise resulting from the project:

a) **Temporary or Permanent Noise Increases in Excess of Established Standards.** A significant impact would be identified if project construction or operations would result in a substantial temporary or permanent increase in ambient noise levels at sensitive receivers in excess of the local noise standards contained in the General Plan or Municipal Code.

b) **Generation of Excessive Groundborne Vibration.** A significant impact would be identified if the construction of the project would generate excessive vibration levels.

c) **Exposure of Residents or Workers to Excessive Noise Levels in the Vicinity of a Private Airstrip or an Airport Land Use Plan.** A significant impact would be identified if the project would expose people residing or working in the project area to excessive aircraft noise levels.

Impact Discussion

a) Would the project 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?

Less-than-Significant Impact. Noise would be generated during the construction, operations, and decommissioning phases of the Chestnut Solar Project. The potential for temporary and permanent noise sources from the project to exceed applicable noise standards is discussed below for each phase of the project.

Construction Phase

During the construction phase, the two main sources of noise would be from on-site grading and construction, and from off-site traffic generation, each of which is discussed in turn below.

On-Site Construction Noise

The construction noise levels would depend on the noise generated by various pieces of construction equipment, the timing and duration of noise-generating activities, and the distance between construction noise sources and noise sensitive receptors. In accordance with the 2035 Kings County General Plan Noise Element policies, a significant noise impact would occur if construction noise levels exceed 55 dBA L_{eq}, and if they exceed the ambient noise environment by 5 dBA L_{eq} or more.

Construction noise levels would be highest during site grading, excavation, and installation of solar equipment. Hourly average noise levels generated by construction equipment associated with the project are calculated to range from 85 dBA L_{eq} to 87 dBA L_{eq} at a distance of 50 feet, assuming that all equipment proposed for each construction phase are operating simultaneously. Construction generated noise levels drop off at a rate of about 6 dBA per doubling of distance between the source and receptor. The nearest noise-sensitive residential land uses are located over 1.0 mile to the east and southeast. At this distance, the maximum construction noise levels reaching the nearest residences would range from 45 dBA L_{eq} to 47 dBA L_{eq}, taking into consideration the attenuation of sound with distance from the noise source. These construction-related noise levels would be well below the applicable County noise standards and would be lower than ambient daytime noise levels at the nearest receptors. Therefore, project construction activities would not exceed applicable noise standards and the impact would be *less than significant*.

Construction Traffic

The analysis of construction traffic noise used a baseline of existing Average Daily Traffic (ADT) volumes on the affected roadway segments, and added worker and truck volumes generated during project construction. It was calculated that the highest noise level increase on the affected roadways due to project construction traffic would be less than 0.3 dBA L_{dn}/CNEL above existing traffic noise conditions without the project at the most affected roadways – Nevada Avenue and Avenal Cutoff Road.

Under 2035 Kings County General Plan Noise Policy B1.2.1, the project would result in a significant noise impact if: a) the noise level increase is 5 dBA L_{dn}/CNEL or greater, where the pre-project noise level is less than or equal to 60 dBA L_{dn}/CNEL; or b) the noise level increase is 3 dBA L_{dn}/CNEL or greater, where the pre-project noise level between 60 and 65 dBA L_{dn}/CNEL; or c) the noise level increase is 1.5 dBA L_{dn}/CNEL or greater, where the pre-project noise level between 65 dBA L_{dn}/CNEL or greater (Kings County 2010f).

Since the project entrance would be on Nevada Avenue, this County road will receive the highest volume of construction-related traffic, and also the greatest increase in traffic noise. The nearest sensitive receptors on Nevada Avenue consist of two dwellings at the Stone Land Company Ranch, located 4.6 miles west of the project entrance. Based on , noise measurements taken by Illingworth & Rodkin alongside Nevada Avenue at the Stone Land Company Ranch (described in 'Noise Setting' above), it is calculated that pre-project noise levels at the location of the dwelling facades (150 feet from roadway centerline) are 59 dBA L_{dn}. While most construction traffic is expected to utilize SR-41 to gain access to the project entrance, for purposes of presenting a worst-case analysis, it is assumed that all construction traffic would arrive from the west and would pass by the Stone Land Company Ranch. During the peak construction period, daily traffic volumes along Nevada Avenue would temporarily double compared to pre-project conditions. This would result in a 3 dBA increase in noise levels at the two residences. (A 3 dBA noise level increase would not normally be a perceptible noise increase. Traffic volumes would need to increase by at least three times to result in a readily perceivable (5 dBA) increase in noise.) During peak construction, noise levels at the two residences would increase to 62 dBA L_{dn} under this worst-case scenario. This noise level increase would be below the 5 dBA increase that would indicate a significant increase where ambient levels are 60 dBA L_{dn} or lower, under the County's standards. All other roadways subject to project construction traffic would be subject to traffic volume increases of 7 percent or less. The increase in noise levels associated with these relatively low increases in traffic volumes would not be perceptible at the potentially affected residential receptors and would not exceed applicable noise standards. Therefore, the noise impact associated with construction traffic generated by the Chestnut Solar Project would be *less than significant*.

Operational Phase

During the operational phase of the Chestnut Solar Project, the two main sources of noise would be from on-site activities, and from off-site traffic generation, each of which is discussed in turn below.

<u>On-Site Noise Sources</u>

Noise sources at the project site would include inverters and transformers necessary to convert the generated power to collection voltage. The 150 MW Chestnut Solar Project would include a total of 60 inverter/transformer pads (i.e., 1 per 2.5 MW of output). The predicted noise level attributable to one inverter/transformer is 52 dBA at a distance of 50 feet from the equipment. The operation of the 60 inverters/transformers at the project would result in an estimated worst-case noise level of 72 dBA, measured at a distance of 50 feet.

The project would include one substation, located in the northeast corner of the site, for the purpose of stepping up voltage levels to 230-kV for transmission on the Gen-Tie Line to the Gates Substation in Fresno County. (The impacts associated with the Gen-Tie Line were addressed in the Aquamarine Solar Project and Gen-Tie Line IS/MND, which is anticipated to be adopted by the Kings County Planning Commission on September 9, 2019.) Sources of audible noise within a substation include equipment such as transformers, reactors, voltage regulators, circuit breakers and other intermittent noise generators. Among these sources, transformers, reactors, and circuit breakers have the greatest potential for producing noise. The broadband sound from fans, pumps and coolers has the same character as ambient sound and tends to blend with the ambient noise. Reactors are similar to transformers in terms of audible noise and would generate noise levels of about 40 dBA L_{eq} at 200 feet (SLO County 2011, p. AP. 4-114). The highest noise levels would be produced by circuit breakers, which would occur infrequently when breakers are thrown to protect the system during an electrical fault due to line overloads. The resultant noise would be impulsive in character, being loud and short in duration. The maximum impulse noise level from the breakers would be approximately 105 dBA L_{max} at 50 feet (Ibid.).

The project would also include a battery storage facility located on 1.5 acres just east of the on-site substation. Based on preliminary plans, the facility would include approximately 44 storage battery units, each enclosed within 40-foot long cargo containers). Each battery storage unit would be self-contained and would include racks, switchboards, integrated HVAC units, inverters, and transformers. Alternatively, the storage configuration could consist of containers for the batteries, with the inverters and transformers located on separate pads outside the containers. Under this configuration, there would be 44 inverters and 22 transformers, in addition to the 44 battery enclosures. In order to calculate worst-case noise conditions, the alternative configuration was evaluated since it would include more unenclosed noise sources than the self-contained configuration. The primary noise source would be the HVAC units on each container, which would typically produce noise levels of 68 dBA at a distance of 50 feet during full operation. A typical step transformer has a sound rating of 60 dBA at 5 feet, and a typical power inverter has a noise rating of 77 dBA at 6 feet. Illingworth & Rodkin calculated that the combined noise level from full operation of all of the planned energy storage elements under the worst-case alternative configuration would be 88 dBA L_{max}/L_{eq} at 50 feet. The nearest residential receptors to the battery storage facility would be located 2.5 miles to the southeast.

2035 Kings County General Plan, Noise Policy B1.1.1 requires that appropriate noise mitigation measures be included in a proposed project design when the proposed new use will include non-transportation noise sources that would exceed the County's "Non-Transportation Noise Standards" (Noise Element Table N-8). The daytime noise limits enforced at residential properties are 75 dBA L_{max} and 55 dBA L_{eq} (Kings County 2010f). The inverters/transformers at the project would operate only during daytime hours when the solar facility is generating power. There would be no noise generated by the project at night, when County noise limits are 5 dBA more restrictive (i.e., 70 dBA L_{max} and 50 dBA L_{eq}).

Noise from "point" sources decreases at a rate of 6 dBA with each doubling of the distance between the noise source and receptor. Based on the worst-case noise level estimate of 72 dBA L_{max}/L_{eq} at a distance of 50 feet from the project noise sources (i.e., inverters/transformers), predicted noise levels at the nearest residential land uses located over 1.0 mile from the project site are calculated to be less than 32 dBA L_{max}/L_{eq}. These noise levels would be inaudible above ambient noise levels. Battery storage facility noise levels would be 40 dBA L_{max}/L_{eq} at the nearest receptor approximately 2.5 miles to the southeast. The infrequent occurrence of impulsive noise from circuit breakers at the on-site substation would decrease to 57 dBA L_{max} at the nearest residences located at least 2.5 miles from the substation. The estimated noise levels from project operations would be below the County's 75 dBA L_{max} and 55 dBA L_{eq} noise limits for residential uses. Therefore, the operational noise from the Chestnut Solar Project would not exceed applicable noise standards at the nearest sensitive receptors, and the impact would be *less than significant*.

<u>Operational Traffic Noise</u>

Traffic generated during project operations would be very light, given the small number of workers that would travel to the site on an intermittent basis. It was calculated that the highest traffic noise increase attributable to project operational traffic on the affected roadways would be less than 0.1 dBA L_{dn}/CNEL above existing traffic noise conditions without the project at the most affected roadways – Nevada Avenue and Avenal Cutoff Road. The noise levels would be well below the applicable impact thresholds, discussed above, and would not be noticeable to the potentially affected sensitive receptors. Therefore, the operational traffic generated by the Chestnut Solar Project would not result in a substantial permanent increase in ambient noise levels in the project vicinity, and the impact would be *less than significant*.

Decommissioning Phase

Noise levels generated during deconstruction activities would be similar to those generated during construction except that some of the noisiest construction equipment, such as pile drivers and vibratory rollers, would not be used during decommissioning. As is the case with construction noise, the on-site noise generated during decommissioning would be well below County noise standards at the nearest sensitive receptors. Traffic volumes generated during decommissioning would be similar to those associated with construction, and the resulting noise levels would be well below applicable County standards as well. Therefore, the decommissioning activity and traffic associated with the project would not result in a substantial temporary increase in ambient noise levels in the project vicinity, and the impact would be *less than significant*.

In summary, the noise generated during the construction, operations, and decommissioning phases of the Chestnut Solar Project would not exceed applicable noise standards, and the impact would be *less than significant*.

b) Would the project result in generation of excessive groundborne vibration or groundborne noise levels?

<u>Less-than-Significant Impact</u>. The construction of the Chestnut Solar Project may generate perceptible vibration in the immediate vicinity of the project site when heavy equipment or impact tools are used. Groundborne vibration levels would be highest during site preparation activities and when the solar arrays are installed, given that the cylindrical steel posts (or H-beams) will be driven into the ground using truck-mounted vibratory drivers.

Vibration is measured as peak particle velocity (PPV) in inches per second. The equipment to be used at the project site that would result in the greatest vibration includes sonic pile drivers, vibratory rollers, and bulldozers. The vibration levels typically produced by a sonic pile driver can reach 0.170 in/sec PPV at a distance of 25 feet. Vibratory rollers and large bulldozers typically generate vibration levels ranging from of 0.089 to 0.210 in/sec PPV at a distance of 25 feet. Vibration levels would vary depending on soil conditions, construction methods, and equipment used.

The California Department of Transportation recommends a vibration limit of 0.5 in/sec PPV for buildings that are structurally sound and designed to modern engineering standards, 0.3 in/sec PPV for buildings that are found to be structurally sound but where structural damage is a major concern, and a conservative limit of 0.08 in/sec PPV for ancient buildings or buildings that are documented to be structurally weakened. No ancient buildings or buildings that are documented to be structurally weakened are present near the project site. Therefore, the applicable impact threshold for groundborne vibration would be levels exceeding 0.3 in/sec PPV at the nearest receptors.

Within the project vicinity, the nearest structures to the construction activity would be: 1) ranch dwellings located on the east side of SR-41, at least 1.0 miles southeast of the nearest project boundary; 2) agricultural residences to the northeast, located at least 1.6 miles from the nearest project boundary; 3) ranch dwellings at Shannon Ranch, located at least 2.8 miles northwest of the nearest project boundary; and 4) the solar arrays at the Westside Solar Project Phase 1 and the Kent South solar generating facility at the junction of Avenal Cutoff Road and 25th Avenue, which would be at least 3.4 miles from the nearest on-site construction activity. The potential for greatest vibration would be during heavy equipment movement and vibratory pile driving of the support posts for the solar arrays, which would generate vibration levels of 0.210 and 0.170 in/sec PPV, respectively, at 25 feet from the source. At a distance of 1.0 miles, these vibration levels would decrease to 0.001 in/sec PPV, respectively, at the nearest receiver. These vibration levels would be well below the 0.3 in/sec PPV impact threshold for sound structures, and would also be well below the 0.08 in/sec PPV limit applicable to structurally weakened structures. The majority of construction activity at the project site would occur well beyond these distances from the nearest structures. Therefore, groundborne vibration from project construction would have *no impact* on existing structures in the project vicinity.

People can also be adversely affected by excessive vibration levels. The level at which humans begin to perceive vibration is 0.015 inches per second. Vibrations at 0.2 inches per second are considered bothersome to most people, while continuous exposure to long-term PPV is considered unacceptable at 0.12 inches per second (Illingworth & Rodkin 2019). As noted above, the nearest residential receptors are 1.0 miles southeast, and the nearest solar facilities, which may occasionally involve the presence of workers, are 3.4 miles from the nearest construction activity on the project site. At these distances, the greatest vibration from the nearest project construction activity would decrease to 0.001 in/sec PPV, which would not be perceptible to those workers. Therefore, project construction activities would not generate excessive vibration levels.

In summary, the heaviest construction equipment that would be used for construction of the Chestnut Solar Project would produce vibration levels that would be far below the vibration levels necessary to cause damage to the nearest off-site buildings, or to be perceptible to the nearest off-site persons. Therefore, the project would not generate excessive groundborne vibration levels. As such, the potential groundborne vibration and noise impacts due to construction activities associated with the Chestnut Solar Project would be *less than significant.*

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

Less-than-Significant Impact. The Chestnut Solar Project is not located near a public airport or public use airport, and is not located within an airport land use plan area. The nearest public or public use airports include the Hanford and Coalinga municipal airports, and the Harris Ranch airfield, all of which are located 16 miles or more from the project site.

The project site is located 9.0 miles south of the airfield at Naval Air Station Lemoore (NASL) and is included in the study area for the NAS Lemoore Joint Land Use Study (JLUS). The project site is located within the NASL flight pattern and is mapped as land subject to noise levels lower than 70 dBA CNEL as mapped in the NAS Lemoore Joint Land Use Study. The eastern half of the project site is exposed to noise levels just over 60 to 70 dBA CNEL, while the western half of the site is exposed to noise levels of less than 60 dBA CNEL (JLUSPC 2011, p. 2-11). The Kings County General Plan noise standard for the noise-sensitive outdoor areas of commercial or industrial developments is 65 dBA CNEL if the noise is from transportation sources such as aircraft overflights (Kings County General Plan Noise Element Table N-7). However, the proposed solar facilities are not considered noise-sensitive land uses and will have no permanent employees stationed on-site that would utilize outdoor use areas. Although Kings County has not established a noise limit for outdoor use areas that are not noise sensitive, noise levels exceeding 76 dBA CNEL are considered hazardous to health as determined by the US Environmental Protection Agency (US EPA 1974). Aircraft overflights would expose construction workers, who would be on the site temporarily, and the operational workers, who would visit the site periodically, to noise levels no greater than 70 dBA CNEL, and well below the 76 dBA CNEL threshold. Therefore, the project would not expose workers on the project site to excessive noise levels from NAS Lemoore flight operations. As such, the impact of the Chestnut Solar Project's exposure to noise from airport operations would be *less than significant*.

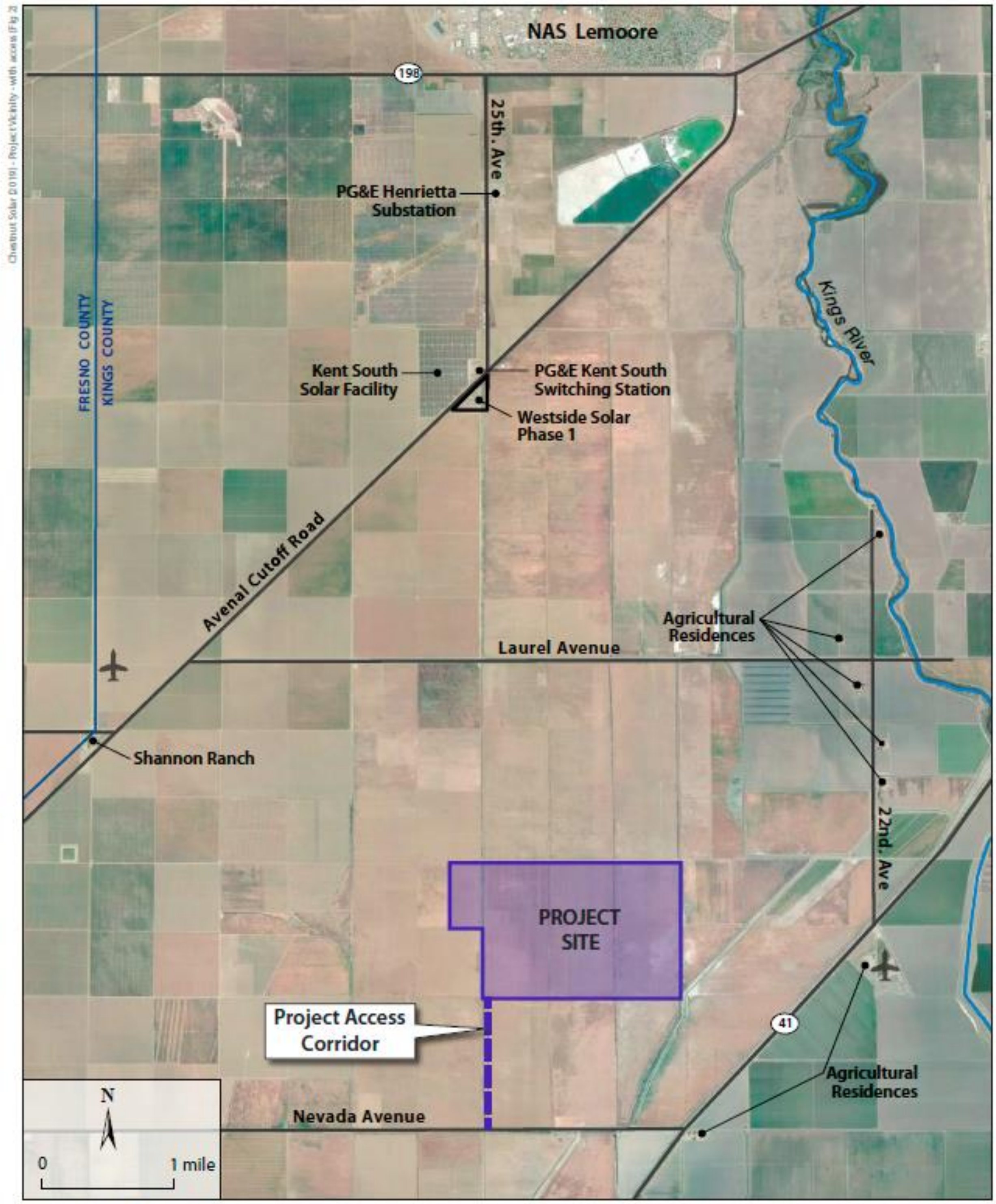
The Chestnut Solar Project site is not located within the vicinity of a private airstrip. There are 5 airstrips within a 5-mile radius of the site, the nearest of which is 1.5 miles to the east. As such, the project would not expose people working at the project site to excessive noise levels associated with the operation of a private airstrip. Therefore, the Chestnut Solar Project would be associated with *no impact* due to private airstrips in the vicinity.

In summary, the impact associated the Chestnut Solar Project's exposure to noise from airport operations associated with a private airstrip or public airport or public use airport or would be *less than significant*.

REFERENCES

Caltrans 2013	California Department of Transportation (Caltrans). 2013. *Transportation and Construction Vibration Guidance Manual*. September. http://www.dot.ca.gov/hq/env/noise/pub/TCVGM_Sep13_FINAL.pdf
CPUC 2009	California Public Utilities Commission (CPUC). 2009. *Draft Environmental Impact Report – Southern California Edison's San Joaquin Cross Valley Loop 220 KV Transmission Line Project*. CPUC A.08-05-039. June 2009. http://www.cpuc.ca.gov/Environment/info/esa/sjxvl/deir_toc.html
JLUSPC 2011	Naval Air Station Lemoore Joint Land Use Study Policy Committee, 2011. NAS Lemoore Joint Land Use Study – Final Release. August 30. https://www.kingscog.org/jlus_docs#B93D5C3D-9848-4BBF-8A50-E7769AD28E68
Kings County 2010	County of Kings. 2010. *2035 Kings County General Plan – Noise Element*. Adopted January 26, 2010. http://www.countyofkings.com/home/showdocument?id=3120
Kings County 2018	County of Kings. 2018. *Kings County Code of Ordinances, as amended through April 24*. https://www.municode.com/library/ca/kings_county/codes/code_of_ordinances
SLO County 2011	San Luis Obispo County. 2011. *California Valley Solar Ranch EIR; Appendix 4 – Transmission Upgrades to PG&E Solar-Midway 230 kV Transmission Line*. January 2011. http://www.sloplanning.org/EIRs/CaliforniaValleySolarRanch/feir/apps/Ap04_Transmission_Upgrades_Solar-Midway.pdf
US EPA 1974	U.S. Environmental Protection Agency (US EPA). 1974. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. March. Available at https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=2000L3LN.TXT

Figure 1 **Project Vicinity**



Source: Google Earth, 2018

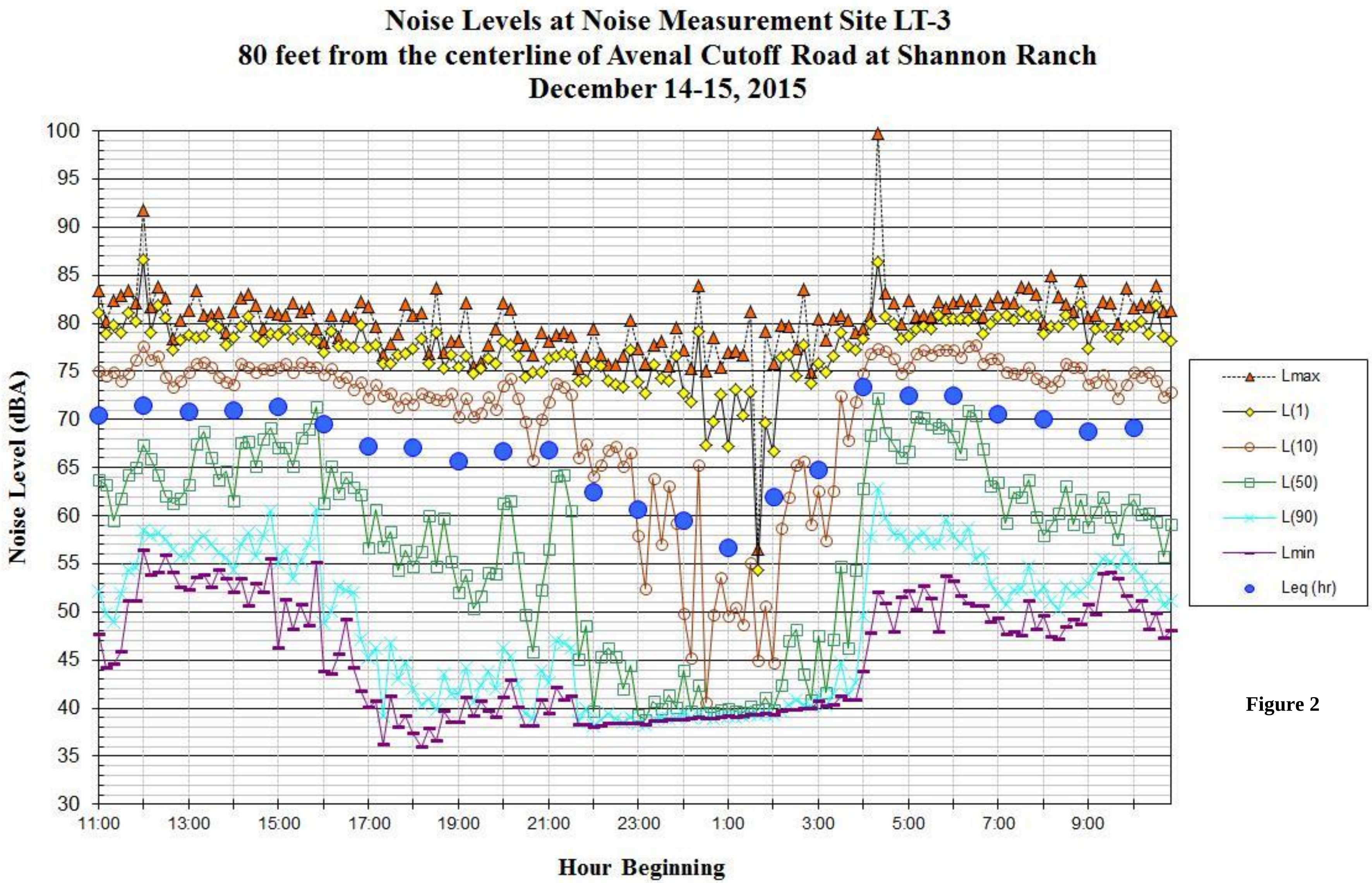

Noise Levels at Noise Measurement Site LT-3
80 feet from the centerline of Avenal Cutoff Road at Shannon Ranch
December 14-15, 2015
Noise Level (dBA)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
11:00
13:00
15:00
17:00
19:00
21:00
23:00
1:00
3:00
5:00
7:00
9:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

Figure 2

Noise Levels at Noise Measurement Site LT-2
27 feet from the centerline of Nevada Avenue across from Stone Land Offices
December 14-15, 2015

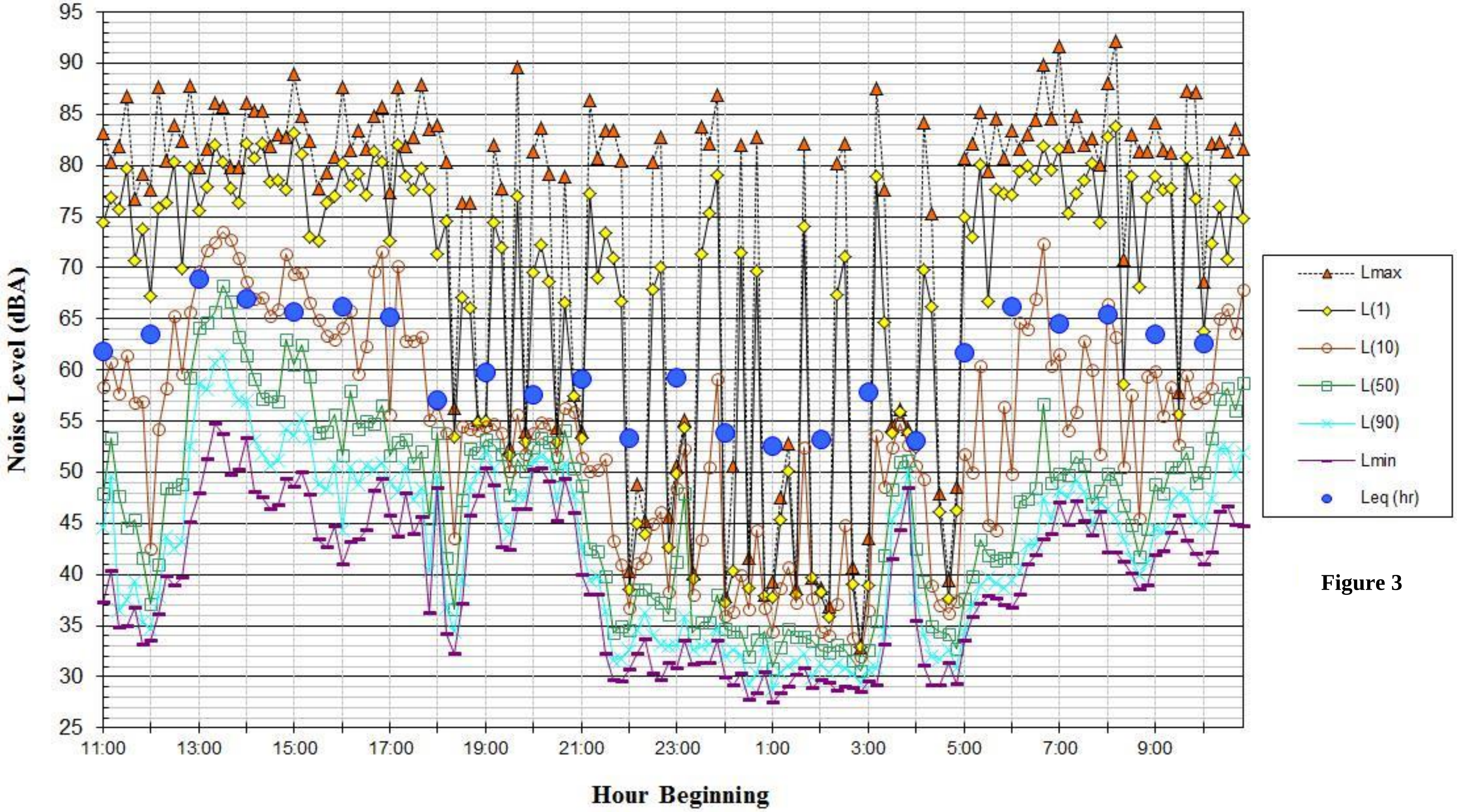


Figure 3