Acoustic and Vibration Technical Memo

Longboat Solar, LLC Project

July 2015

Prepared for

San Bernardino County Planning Department
385 N Arrowhead Ave
San Bernardino, CA 92415

Executive Summary

An acoustic and vibration study was completed for the Longboat Solar Project to identify potential impacts to nearby sensitive land uses. Project construction and operational noise and vibration were calculated and compared to applicable laws, guidelines, and/or regulations.

Construction and operational noise and vibration would not result in significant impacts to nearby sensitive land uses.

Operational noise and vibration and construction noise and vibration impacts would be less than significant. Operational noise is not predicted to result in an increase in received sound levels at nearby noise sensitive receptors. Vibration would not result from operating the Project. Construction noise from the Project is not predicted to result in a significant impact at nearby noise sensitive receptors although temporary increases over ambient noise levels are predicted to range from no increase to at worst a 19 dBA increase. The highest increases in sound levels from construction noise would only last a few days and would be restricted to daytime hours (7:00 a.m. to 7:00 p.m.). Vibration from Project construction would attenuate quickly with distance from the source and is not predicted to result in perceptible levels at nearby sensitive structures. Therefore, construction and operation of the project would not cause a significant noise or vibration impact to nearby noise sensitive receptors or vibration sensitive structures.

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Acronyms and Abbreviations

µPa	Micropascals
AEP	Association of Environmental Professionals
APN	Assessor's Parcel Number
Caltrans	California Department of Transportation
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
dB	Decibel
dBA	A-weighted decibel
EDF	EDF Renewables, Inc.
EPA	United States Environmental Protection Agency
FTA	Federal Transit Authority
Hz	Hertz
IS	Initial Study
Kv	Kilovolt
L_{dn}	Day-Night Sound Level
L_{eq}	Time averaged equivalent sound pressure level
$L_{eq(Day)}$	Time averaged daytime (7:00 a.m. to 10:00 p.m.) L_{eq}
$L_{eq(Night)}$	Time averaged nighttime (10:00 p.m. to 7:00 a.m.) L_{eq}
L_{max}	Maximum sound level
Lw	Sound power level
MSL	Mean sea level
MW	Megawatt
NSR	Noise sensitive receptor
OSHA	Occupational Health and Safety Administration
PPV	Peak particle velocity
PV	Photovoltaic
RMS	Root mean square
SCADA	Supervisory Control and Data Acquisition
SCE	Southern California Edison
SR-58	State Route 58

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1 Introduction

The Longboat Solar, LLC Project (Project) is a proposed solar energy facility that would generate up to 20 megawatts (MW) of alternating current electricity using single axis tracker solar photovoltaic (PV) technology within an approximately 233.47-acre portion of 324.94 acres of previously disturbed agricultural lands. The Project is located on unincorporated lands located to the immediate northwest of the City of Barstow, and north of the community of Lenwood, in San Bernardino County, California. State Route 58 (SR-58) bounds the site to the east and north.

The Project would connect to the electrical grid by way of a line tap on an existing Southern California Edison (SCE) 33 kilovolt (kV) transmission line located adjacent to the site along Community Boulevard, at which point the power generated from the Project changes ownership from the Project developer to SCE. SCE will undertake distribution line upgrades, repairs and modifications along the 33kV lines to SCE's Barstow Substation located in the City of Barstow approximately 4.5 miles east of the Project site. SCE upgrade work will consist of up to eleven pole replacements, re-conducting of up to 2,900 feet of electrical line, and several minor substation upgrades at existing substation facilities.

Construction of the project is expected to begin in the fourth quarter of 2015 and last up to 10 months. Construction would be comparable to other renewable energy projects and is anticipated to be divided into the following sequence: (1) roads, grading, and fencing (2) electrical infrastructure, (3) PV assembly and installation, (4) substation interconnection, (5) electrical system upgrades, (6) PV commissioning, and (7) project finalization. As detailed in the analysis below, various elements of the Project would be constructed concurrently on the property.

The proposed Project would generate electricity during daylight hours when electricity demand is at its peak. When fully developed, the Project would produce enough electricity to supply the energy needs of over 4,300 California residences.

1.1 Project Location and Setting

The Project is located in unincorporated San Bernardino County, approximately 1.6 miles north of the community of Lenwood and immediately northwest of the City of Barstow (Figure 1-1). The Project site is associated with County Assessor's Parcel Numbers (APNs) 0497-071-40, 0497-121-28, 0497-101-05, and 0497-101-14 (Table 1-1 and Figure 1-2). The Project site is located within the U.S. Geological Survey (USGS) 7.5-minute Barstow quadrangle (Township 10 North, Range 2 West, Section 33 and Township 9 North, Range 2 West, Sections 4 and 5). The site is mostly flat with the elevation only increasing slightly from 2,167 feet above mean sea level (MSL) in the eastern portion of the site to 2,185 feet above MSL in the western portion. The Project site is bounded to the north and east by SR-58, Community Boulevard bounds much of the northern boundary and the south is bounded by undeveloped land adjacent to the Mojave River.

Table 1-1. Project Site APNs

Assessor's Parcel Number	Gross Acreage	Owner	Address (Barstow, CA 92311)
0497-071-40	40.34	Hill's Ranch, Inc.	25749 Community Blvd.
0497-101-05	77.51	Hill's Ranch, Inc.	25749 Community Blvd.
0497-101-14	99.77	Soppeland Revocable Trust	25409 Community Blvd.
0497-121-28	107.32	Hill's Ranch, Inc.	25749 Community Blvd.
0497-101-09*	9.85 (3.83 acres leased to Project)	Max Eddy	25499 Community Blvd.

* Temporary construction laydown and lease area proposed on up to 3.83 acres. No permanent use is proposed.

Figure 1-1: Regional Location

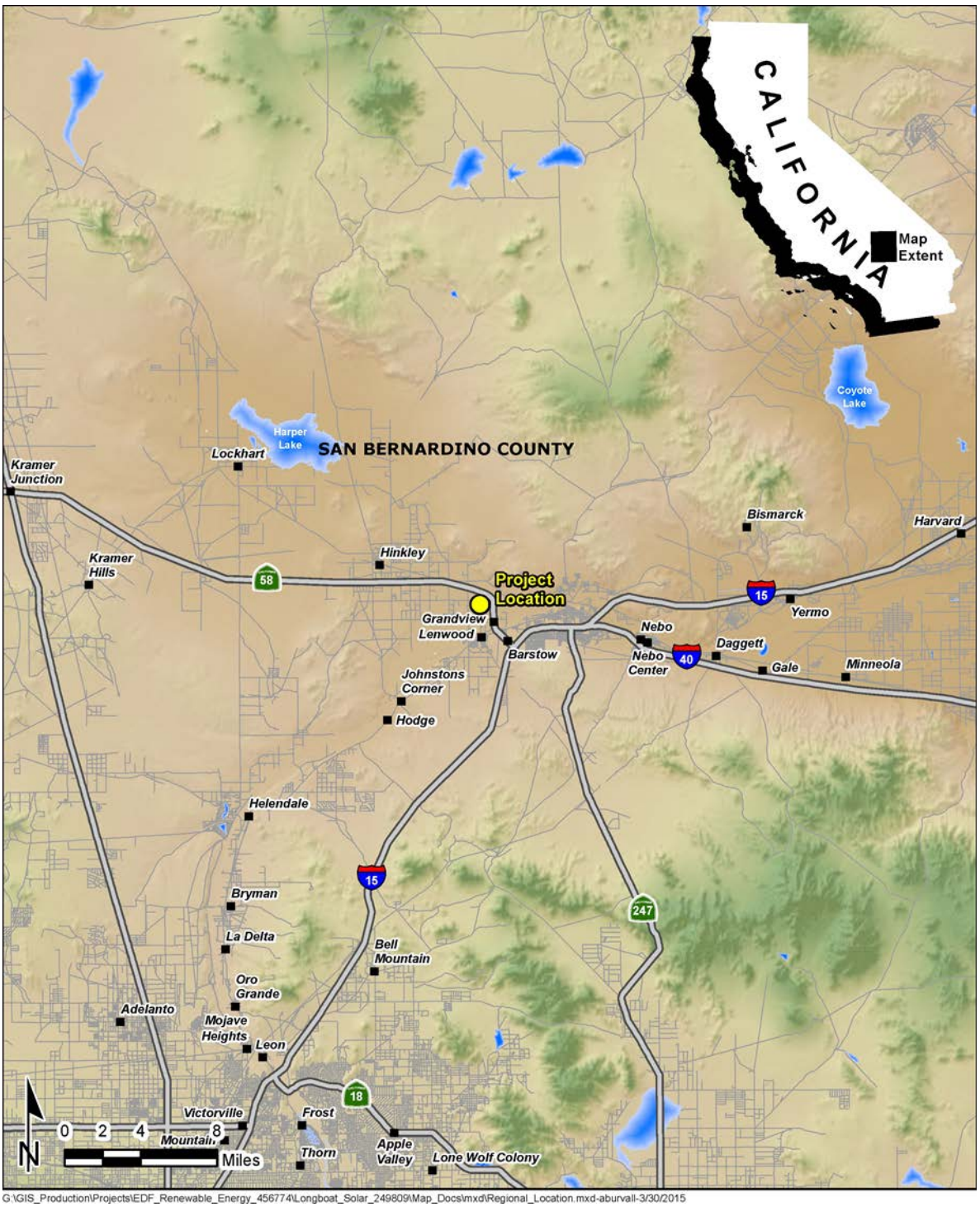

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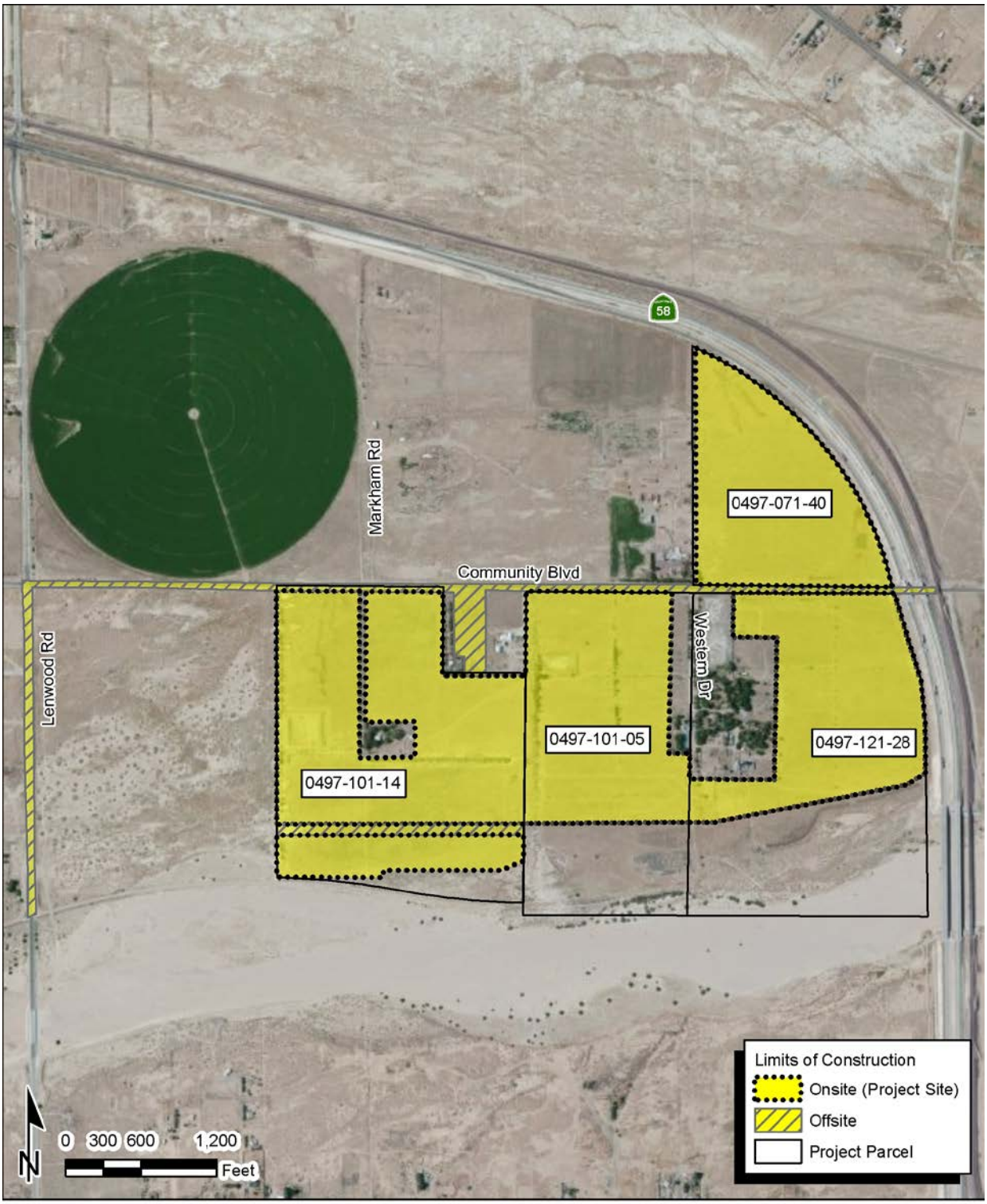
Figure 1-2: Site Location Map



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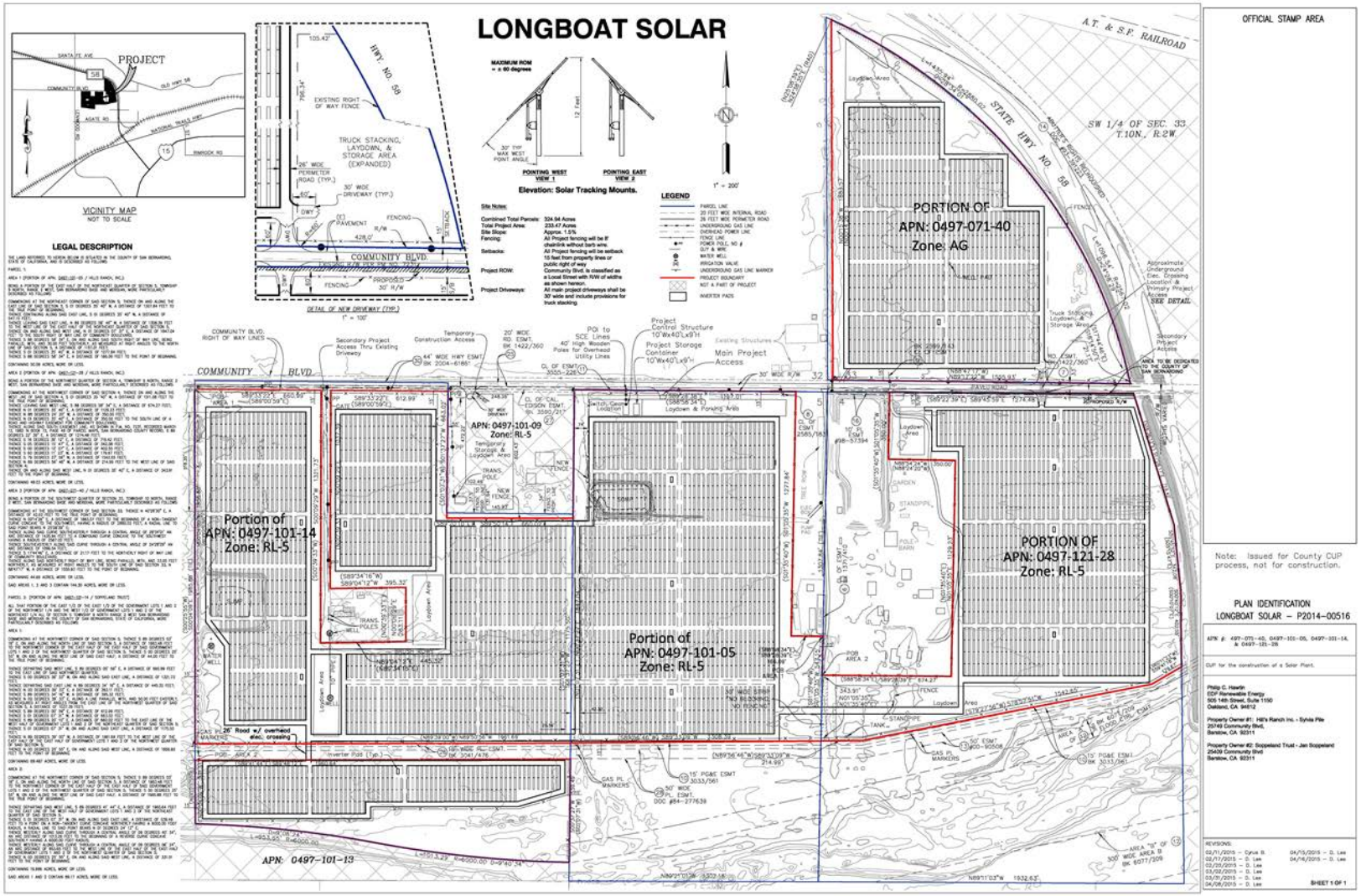
Vegetation on the site is generally disturbed and consists of fallow agriculture fields with disturbed saltbush scrub, partially stabilized dunes, tamarisk/ornamental windrows, and abandoned agriculture. Three agricultural residences are located adjacent to the Project site, south of Community Boulevard, however two of the three are the residences of the landowners who have leased their land for construction and operation of the Project while the third belongs to a landowner who has leased a portion of the same parcel for use as a laydown yard and parking area during construction. Adjacent land uses include scattered rural properties and undeveloped land, light industrial use including a Green Valley Foods Product Inc. cheese factory to the north, and active agriculture to the northwest.

1.2 Project Components

The Project would have a generating capacity of 20 megawatts (MW). Conventional photovoltaic (PV) solar modules will be used to convert the sun's radiance directly into electrical energy without the use of heat transfer fluid or cooling water. In addition to the PV modules, the Project will include inverters, control and storage containers, a Supervisory Control and Data Acquisition (SCADA) system housed within a prefabricated modular container, two or more onsite meteorological stations, interconnection lines (on- and off-site), access roads, use of an existing water well pump, lighting, fencing, and signage. A detailed description of each of the Project's components is provided in the Initial Study (IS) for the Project. Figure 1-3 provides a site plan for the Project.

Figure 1-3: Site Plan



2 Acoustic and Vibration Terminology

2.1 Acoustic Terminology

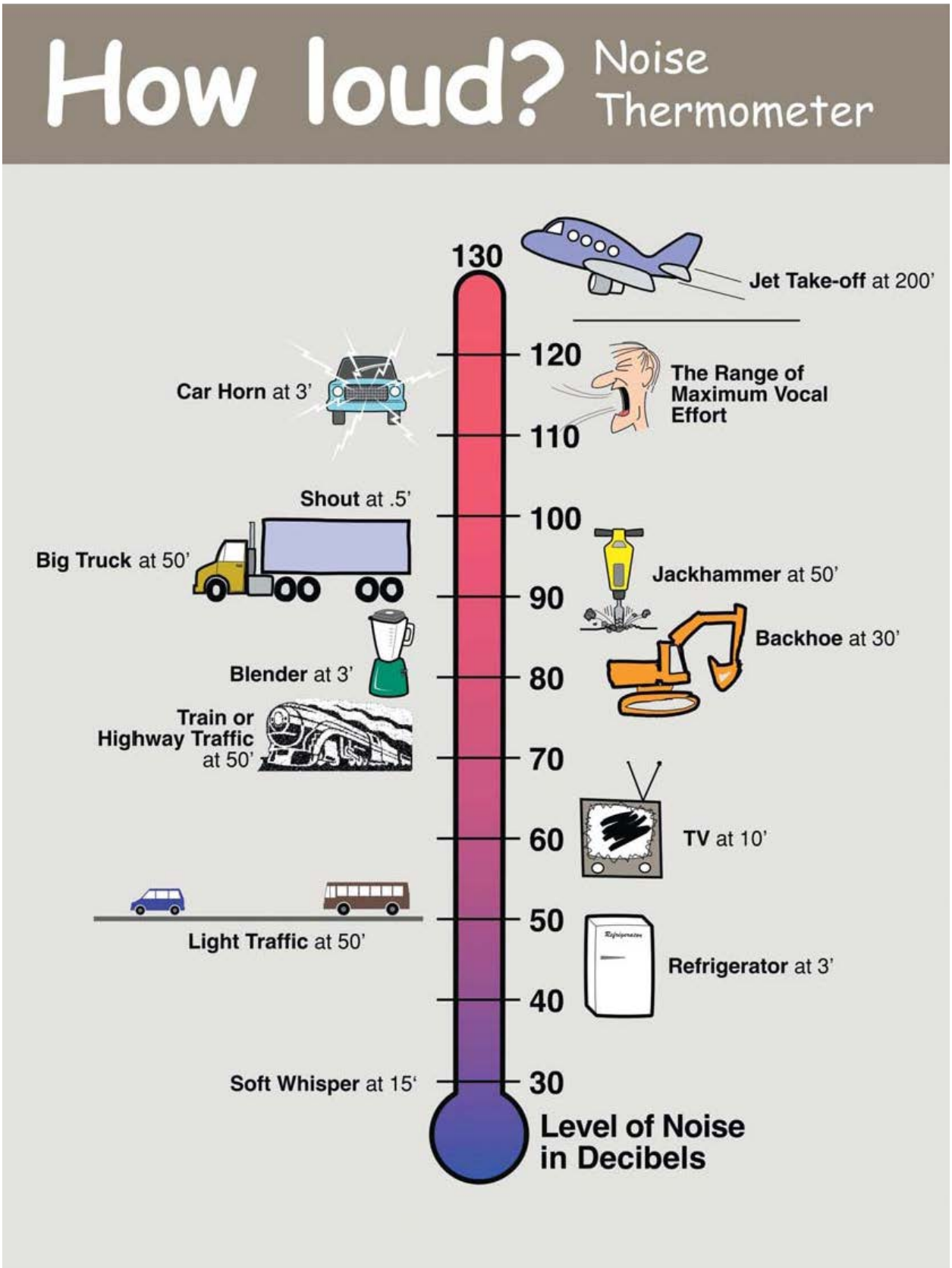
Sound levels are presented on a logarithmic scale to account for the large pressure response range of the human ear, and are expressed in units of decibels (dB). A decibel is defined as the ratio between a measured value and a reference value usually corresponding to the lower threshold of human hearing defined as 20 micropascals (µPa). Typically, a noise analysis examines 11 octave (or 33 1/3 octave) bands ranging from 16 Hz (low) to 16,000 Hz (high), which encompasses the human audible frequency range. Since the human ear does not perceive every frequency with equal loudness, spectrally varying sounds are often adjusted with a weighting filter. The A-weighted filter is applied to compensate for the frequency response of the human auditory system, known as dBA.

An inherent property of the logarithmic decibel scale is that the sound pressure levels of two separate sources are not directly additive. For example, if a sound of 50 dBA is added to another sound of 50 dBA in the proximity, the result is a 3-decibel increase (or 53 dBA), not an arithmetic doubling to 100 dBA. With respect to how the human ear perceives changes in sound pressure level relative to changes in “loudness”, scientific research demonstrates the following general relationships between sound level and human perception for two sound levels with the same or very similar frequency characteristics:

- 1 dBA is the practical limit of accuracy for sound measurement systems and corresponds to an approximate 10 percent variation in the sound pressure level. A 1 dBA increase or decrease is a non-perceptible change in sound.
- 3 dBA increase or decrease is a doubling (or halving) of acoustic pressure level and it corresponds to the threshold of change in loudness perceptible in a laboratory environment. In practice, the average person is not able to distinguish a 3 dBA difference in environmental sound outdoors.
- 5 dBA increase or decrease is described as a perceptible change in sound level and is a discernible change in an outdoor environment.
- 10 dBA increase or decrease is a tenfold increase or decrease in acoustic pressure level but is perceived as a doubling or halving in loudness (i.e., the average person will judge a 10 dBA change in sound level to be twice or half as loud).

Estimations of common noise sources and outdoor acoustic environments, and the comparison of relative loudness are presented in Figure 2-1.

Figure 2-1: Relative Loudness



Sound levels can be measured, modeled and presented in various formats. The sound metrics that were employed in this analysis have the following definitions:

L_{eq}: Conventionally expressed in dBA, the L_{eq} is the energy-averaged, A-weighted sound level over a specified time period. It is defined as the steady, continuous sound level over a specified time, which has the same acoustic energy as the actual varying sound levels over the specified period.

L_{max}: The maximum A-weighted sound level as determined during a specified measurement period. It can also be described as the maximum instantaneous sound pressure level generated by a piece of equipment or during a construction activity.

L_{dn}: The L_{dn} is the averaged hourly A-weighted L_{eq} for a 24-hour period with a 10 dB penalty added to sound levels occurring during the evening hours (7:00 p.m. to 10:00 p.m.) to account for individuals' increased sensitivity to noise levels during nighttime hours.

CNEL: Community Noise Equivalent Level (CNEL) is another average A-weighted L_{eq} sound level measured over a 24-hour period; however, this noise scale is adjusted to account for some individuals' increased sensitivity to noise levels during the evening and nighttime hours. A CNEL noise measurement is obtained after adding 5 dB to sound levels occurring during evening hours (7:00 p.m. to 10:00 p.m.) and 10 dB to sound levels occurring during nighttime hours (10:00 p.m. to 7:00 a.m.).

2.2 Vibration Terminology

According to the Federal Transit Authority Noise and Vibration Impact Assessment (FTA 2006), construction activities can be a source of ground-borne vibration. Activities such as pile driving and operation of heavy equipment may cause ground-borne vibration while constructing the Project. Vibration is an oscillatory motion which can be described in terms of the displacement, velocity or acceleration (FTA 2006). Velocity or acceleration is typically used to describe vibration. Two descriptors are frequently used when discussing quantification of vibration, the peak particle velocity (PPV) and the root mean square (rms):

Peak particle velocity (PPV) – The maximum instantaneous positive or negative peak of the vibration signal (FTA 2006).

Root mean square (rms) – The square root of the average of the squared amplitude of the vibration signal, typically calculated over a one-second period (FTA 2006)

The Caltrans construction vibration guidance is used in this assessment. This guidance includes a human response equivalent based on the PPV instead of using rms.

3 Regulatory Setting

This section provides an overview of federal, state, and local regulations related to noise issues applicable to the Project.

3.1 Federal

3.1.1 Occupational Safety and Health Administration - Occupational Noise Exposure Standards

The Occupational Health and Safety Administration (OSHA) established standards for occupational noise exposure under 29 CFR 1910.95. This standard establishes mandates to protect employees from excessive noise exposure and requires a Hearing Conservation Program when routine exposure to high noise levels would occur. The standard identifies permissible daily noise exposures and stipulates that personal protection against the effects of noise exposure must be provided if those levels are exceeded.

3.1.2 U.S. Environmental Protection Agency –"Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety" (EPA 550/9-74-004)

Published in 1974, this document identifies safe levels of environmental noise exposure and is intended to "provide State and Local governments as well as the Federal Government and the private sector with an informational point of departure for the purpose of decision making." While the United States Environmental Protection Agency (EPA) has no regulation governing environmental noise, the agency has conducted several extensive studies to identify the effects of sound level on public health and welfare. In residential areas, the recommended EPA guideline is an outdoor L_{dn} limit of 55 dBA and an indoor L_{dn} limit of 45 dBA (Table 3-1). In non-residential areas where limited amounts of time are spent, the EPA recommends a 24-hour L_{eq} limit of 55 dBA (both indoors and outdoors). These levels are identified as desirable to protect against speech interference and sleep disturbance for residential, educational, and healthcare areas. In commercial and industrial areas, EPA recommends a 24-hour L_{eq} limit of 70 dBA (both outdoors and indoors) to protect the population against hearing damage.

This publication is considered an authoritative study on protective noise levels based on its large sampling of community reaction to noise. The EPA noise level guidelines do not provide an absolute measure of noise impact, but rather a reasonable estimate of potential activity interference, human health and welfare effects, and annoyance. Since these protective levels were derived without concern for technical or economic feasibility, and contain a margin of safety to ensure their protective value, they should not be viewed as standards, criteria, regulations, or goals. Rather, they should be viewed as levels below which there is no reason to suspect that the general population will be at risk from any of the identified effects of noise. The EPA guideline limits are summarized in Table 3-1.

Table 3-1. Summary of EPA Cause and Effect Noise Levels

Location	Level	Effect
All public accessible areas with prolonged exposure	70 dBA $L_{eq(24)}$	Safety
Outdoor at residential structure and other noise sensitive receptors where a large amount of time is spent	55 dBA L_{dn}	Protection against annoyance and activity interference

Location	Level	Effect
Outdoor areas where limited amounts of time are spent, e.g., park areas, school yards, golf courses, etc.	55 dBA $L_{eq(24)}$	
Indoor residential	45 dBA L_{dn}	
Indoor non-residential	55 dBA $L_{eq(24)}$	

EPA 1974

3.2 State

3.2.1 California Department of Health Services - Noise Guidelines

In 1987, the California Department of Health Services published guidelines for the noise element of local general plans (Office of Planning and Research, 2003). These guidelines include a noise level/land use compatibility chart that categorizes various outdoor L_{dn} ranges into up to four compatibility categories (normally acceptable, conditionally acceptable, normally unacceptable, and clearly unacceptable), depending on land use. For many land uses, the chart shows exterior L_{dn} ranges for two or more compatibility categories. The noise element guidelines chart identifies the normally acceptable range for low-density residential uses as less than 60 dBA, while the conditionally acceptable range is 60-70 dBA. The normally acceptable range for high-density residential uses is identified as L_{dn} values below 65 dBA, while the conditionally acceptable range is identified as 65-70 dBA. For educational and medical facilities, L_{dn} values below 60 dB are considered normally acceptable, while Ldn values of 60-70 dBA are considered conditionally acceptable. For office and commercial land uses, Ldn values below 67.5 dBA are considered normally acceptable, while L_{dn} values of 67.5-77.5 dBA are categorized as conditionally acceptable.

These normally and conditionally acceptable L_{dn} ranges are intended to indicate that local conditions (existing noise levels and community attitudes toward dominant noise sources) should be considered in evaluating land use compatibility at specific locations. These guidelines are used by many agencies, environmental planners, and acoustical specialists as a starting point to evaluate the potential for noise impact on and by a project. The guidelines are also employed to evaluate methods for achieving noise compatibility with respect to nearby existing uses. Table 3-2 summarizes these guidelines for the normally and conditionally acceptable L_{dn} exposures.

Table 3-2. California Department of Health Services Noise Guidelines

Land Use Category	Community Noise Exposure (L_{dn} or CNEL, dBA)	
	Normally Acceptable	Conditionally Acceptable
Residential – Low Density	50 - 60	60 - 70
Residential – High Density	50 - 65	65 - 70
Transient Lodging – Motels, Hotels	50 - 65	65 – 70
Schools, Libraries, Churches, Hospitals, Nursing Homes	50 – 60	60 - 65
Auditoriums, Concert Halls, Amphitheaters	NA	50 - 70
Sports Arenas, Outdoor Spectator Sports	NA	50 - 75
Playgrounds, Neighborhood Parks	50 – 67.5	NA
Golf Courses, Riding Stables, Water Recreation, Cemeteries	50 - 70	NA
Office Buildings, Business Commercial and Professional	50 – 67.5	67.5 – 77.5
Industrial, Manufacturing, Utilities, Agriculture	50 - 70	70 - 80

3.2.2 California Department of Housing and Community Development - Noise Insulation Performance Standards

The California Department of Housing and Community Development have adopted noise insulation performance standards for new hotels, motels, and dwellings other than detached single-family structures (24 CCR T25-28). These standards require that "interior CNEL with windows closed, attributable to exterior sources, shall not exceed an annual CNEL of 45 dB in any habitable room."

3.2.3 California Division of Occupational Health and Safety – Occupational Noise Standards

The California Division of Occupational Safety and Health (Cal/OSHA) administers industrial safety regulations in California. Cal/OSHA regulations establish a time-weighted noise exposure limit of 90 dBA averaged over 8 hours (California Code of Regulations, Title 8, Group 15, Article 105, Sections 5095-5100). Noise source controls, administrative procedures, or worker hearing protection must be provided if worker noise exposure would exceed the 90 dBA limit.

3.2.4 California Environmental Quality Act

The California Environmental Quality Act (CEQA) requires that significant environmental impacts be identified and that such impacts be eliminated or mitigated to the extent feasible. Appendix G of the CEQA guidelines (AEP 2012) sets forth a series of suggested thresholds for determining a potentially significant impact. Under the thresholds suggested in Appendix G, the Project could be considered to have significant noise and vibration impacts if it results in one or more of the following:

1. Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.

2. Exposure of persons to or generation of excessive ground-borne vibration or ground-borne noise levels.

3. A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project.

4. A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

5. For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, exposure of people residing or working in the project area to excessive noise levels.

6. For a project within the vicinity of a private airstrip, exposure of people residing or working in the project area to excessive noise levels.

The CEQA Guidelines Appendix G thresholds for items three and four do not define the term “substantial”; however, the California Energy Commission (CEC) provides guidelines for operational noise or permanent increases which indicate that an increase of 5 dBA over ambient conditions may be significant and an increase of 10 dBA is significant (CEC 2006).

The CEC and the County do not provide threshold guidelines for temporary construction-related increases, although the County’s noise regulations do exempt temporary construction noise and vibration from 7 am to 7 pm except on Sundays and federal holidays (Section 3.3.2, below, provides a summary of the San Bernardino County Development Code noise standards).

Compliance with County Code noise regulations may not dispositively determine whether a substantial temporary or periodic increase in ambient noise levels has occurred. Therefore, to determine whether a periodic increase in ambient noise levels from short-term, construction-related activities is substantial and therefore significant, this analysis applies (i) a 20 dBA over baseline sound levels standard for short-term, daily noise; and (ii) a construction-phase average sound level standard (e.g., the average sound level for a given phase of construction) of 10 dBA over baseline sound levels. As explained below, these thresholds and analytical approach were identified after conducting a review of scientific literature and regulatory agency documents.

The Federal Transit Administration (FTA) provides guidelines for assessing construction noise impacts. The FTA's Detailed Construction Noise Assessment identifies the limits provided in Table 3-3. These regulatory thresholds are based on scientific analysis of noise impacts to public health.

Table 3-3. FTA 8-hour and 30-day Construction Exterior Noise Limits (dBA)

Land Use Category	8-hour L_{eq}		L_{dn}
	Day	Night	30-day Average
Residential	80	70	75[(a)]
Commercial	85	85	80[(b)]
Industrial	90	90	85[(b)]

Source: FTA 2006
Notes: (a) In urban areas with very high ambient noise levels (L_{dn} > 65 dBA), L_{dn} from construction operation should not exceed existing ambient + 10 dBA. (b) Twenty-four-hour L_{eq}, not L_{dn}.

Baseline measurements are described in Section 4 of this document and identified exterior CNELs ranging from 50 to 65 dBA at Project area NSRs. The FTA recommends that for areas already exposed to high ambient noise levels (e.g., 65 dBA L_{dn} or greater) that ambient sound levels not be increased by more than 10 dBA averaged over a 30-day period. In this context the L_{dn} and CNEL are roughly the same. Due to the transitory nature of construction noise, and semi-mobile characteristics of some construction equipment (e.g., dozers, graders, etc.) two ambient threshold increase limits have been identified to determine significant temporary increases in ambient noise levels: a short-term (daily) 20dBA threshold and a long term (overall construction phase) 10 dBA threshold.

In addition, the EPA's 1974 publication "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety", described above in Section 3.1.2, identifies a level of 70 dBA Leq(24), which translates to 77 dBA CNEL, as the limit beyond which sustained noise can contribute to hearing loss. This threshold was used as the quasi absolute (24-hour) limit for construction noise from the Project to establish a relative threshold limit. As a consequence, the 20 dBA daily and 10 dBA construction phase ambient increase thresholds are capped at 77 dBA CNEL.

The combined temporary ambient increase thresholds for the project are therefore:

- Daily Construction Noise Relative to Baseline Limit = 20 dBA over baseline up to 77 dBA CNEL
- Average Construction Phase Noise Relative to Baseline Limit = 10 dBA over baseline up to 77 dBA CNEL
- For areas with existing CNELs of 65 dBA or greater, any construction noise exceedance over baseline of 10 dBA or greater would be significant per FTA guidelines.

These thresholds have been identified as a conservatively appropriate for assessing the significance of temporary ambient noise increases as a result of construction of this Project because:

1. The noise ceiling of 77 dBA CNEL for both daily and construction phase noise levels represents a level that, if exceeded on a sustained basis, could contribute to hearing loss and is less than the criterion employed by FTA on similar major infrastructure projects.

2. A daily relative construction noise level limit of 20 dBA over baseline would be perceived as a quadrupling of sound level at the exterior of an NSR and represents a level that would be significant on a daily basis for when construction is closest to a given receptor.

3. An average construction phase noise level increase of 10 dBA over baseline would be perceived as a doubling in noise level and, because it would last for a longer period of time, its exceedance would be considered significant.

4. The noise environment in the vicinity of the Project frequently includes periodic noise from heavy farm equipment such as tractors, which are similar to heavy machinery used in construction.

5. The temporary, 10-month construction period for the Project will occur in shorter-term phases across the entire Project site, such that sensitive receptors will be exposed to higher noise levels for only a portion of the Project's construction period.

6. San Bernardino County has identified increases in sound levels of 20 dBA or greater as being an impact from operational sound for any time period.

7. Mono (Mono 2015), Imperial (Imperial 2015), and San Diego (San Diego 2015) counties prescribe a fixed limit for daytime construction noise of 75 dBA 8-hour L_{eq}, which is 20 dBA over the San Bernardino County residential operational noise level limits.

8. Ventura County (Ventura 2010) implements a 20 dBA L_{max} over their fixed construction noise level limits.

3.3 Local

3.3.1 San Bernardino County General Plan - Noise Element

The San Bernardino County General Plan includes a "Noise Element" that identifies major noise sources and contains policies intended to protect the community from exposure to excessive noise levels. Countywide goals and policies identified in the Noise Element generally aim to prevent excessive noise exposures by incorporating mitigation measures into the design of new noise-generating and new noise-sensitive land uses and protecting areas where present noise levels are acceptable.

Noise-impacted areas are defined as areas exposed to existing or projected future exterior noise levels that exceed the standards identified in Chapter 83.01 of the Development Code (see Table 5 below). Noise sensitive land uses include residential uses, schools, hospitals, nursing homes, places if worship and libraries. New development of sensitive land uses in noise impacted areas is prohibited unless mitigation measures are incorporated into the design to reduce noise levels to acceptable levels. When new noise-generating developments are proposed for areas containing noise-sensitive land uses, noise levels shall not exceed the performance standards listed in Chapter 83.01 of the Development Code (see Tables 5 and 6 below). In both situations, an acoustical analysis is required for approval of proposed developments. The Noise Element includes acoustical analysis guidelines and impact criteria.

San Bernardino County regulates noise sources including transportation sources such as aircraft, rail lines, and motor vehicles; recreational sources such as shooting facilities, racetracks, and

outdoor concerts; and industrial sources such as rail switching yards, utilities, and manufacturing facilities. The Project would be considered an industrial source of noise.

3.3.2 San Bernardino County Development Code - Noise Ordinance

Section 83.01.080 of the San Bernardino Development Code establishes standards concerning acceptable noise levels for both noise-sensitive and noise-generating land uses. Noise standards for stationary noise sources vary by land use and time of day and are summarized in Table 3-4.

Table 3-4: Noise Standards for Stationary Noise Sources

Affected Land Uses	7:00 a.m. - 10:00 p.m. L_{eq}	10:00 p.m. – 7:00 a.m. L_{eq}
Residential	55 dBA	45 dBA
Professional Services	55 dBA	55 dBA
Other Commercial	60 dBA	60 dBA
Industrial	70 dBA	70 dBA

Areas where noise levels exceed the standard for a receiving land use may be designated as “noise impacted areas” based on the following criteria:

- The noise standard for the receiving land use is exceeded for a cumulative period of more than 30 minutes in any hour.
- The noise standard plus five dB(A) is exceeded for a cumulative period of more than 15 minutes in any hour.
- The noise standard plus ten dB(A) is exceeded for a cumulative period of more than five minutes in any hour.
- The noise standard plus 15 dB(A) is exceeded for a cumulative period of more than one minute in any hour.
- The noise standard plus 20 dB(A) is exceeded for any period of time.

If the measured ambient level exceeds any of the five criteria listed above, the allowable noise exposure is increased to reflect the ambient noise level. Some exemptions to the Noise Ordinance include emergency vehicles and temporary construction, maintenance, repair or demolition activities between 7:00 a.m. and 7:00 p.m. Monday through Saturday, excluding federal holidays.

The County also prescribes noise standards for mobile noise sources such as that from project vehicles; however, the County exempts Project related maintenance noise from mobile sources as long as they are used within daytime hours from 7:00 a.m. to 7:00 p.m. Because routine maintenance would take place during these hours, the Project is except from the County’s mobile source standard.

3.3.3 San Bernardino County Development Code – Vibration Standards

Section 83.01.090 of the San Bernardino County Development Code establishes performance standards concerning vibration. These standards prohibit ground vibrations that can be felt without the aid of instruments or produce a particle velocity greater than or equal to two-tenths inches per second should from extending beyond the lot lines from which they originate. Temporary construction, maintenance, repair and demolition activities between 7:00 a.m. and 7:00 p.m. Monday through Saturday (excluding federal holidays) are exempt from this regulation.

4 Existing Conditions

A baseline sound survey was conducted on June 11th and 12th, 2015 to document ambient sound levels at noise sensitive areas near the Project. The sound survey included two short-term (30-minute) sound level measurements at each of the measurement locations, one representing daytime conditions when roadway traffic contributions were low (between 10:00 a.m. and 3:00 p.m.) and another during nighttime conditions during times where human activity is minimal (between 12:00 a.m. and 3:00 a.m.). The existing acoustic environment consists of sounds from roadway traffic, railway traffic, periodic aircraft flying relatively high overhead, a nearby rail yard, dogs, and natural sounds such as wind and birds.

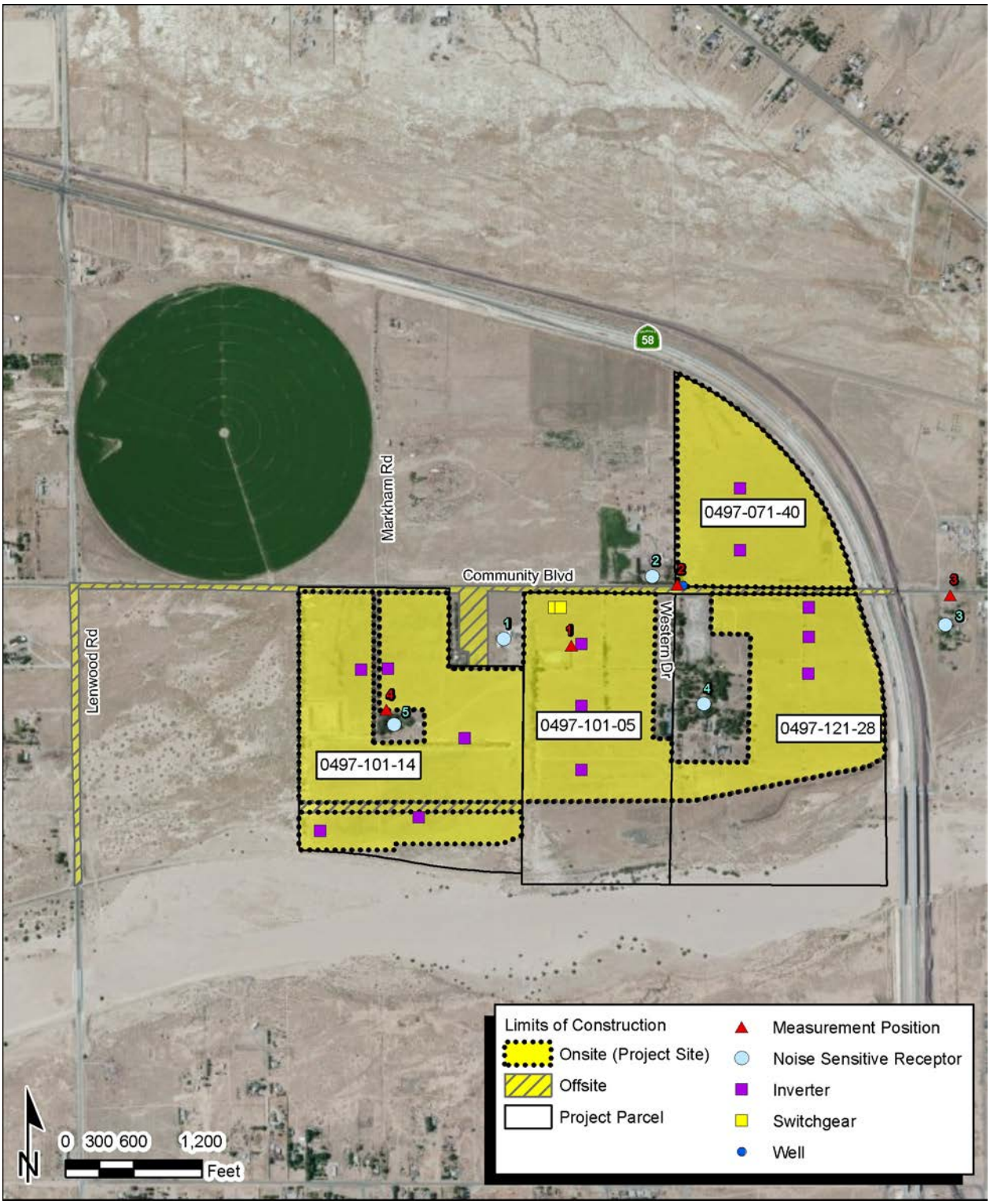
An existing well pump is located approximately 150 feet east of the multiple structures that comprise the cheese factory and associated housing near the intersection of Community Boulevard and Western Drive. The pump was not operating during the sound survey but it is expected that when operational the well pump contributes to the existing acoustic environment. EDF has indicated that the existing well pump has a pumping capacity of 920 gallons per minute. A literature review was conducted of 920 gallons per minute well pumps and the sound source level identified for this analysis is 82 dBA at 1 meter (3.3 feet)

Noise sensitive areas comprise single-family and mobile-home residential developments and are referred to in this report as noise sensitive receptors (NSRs). Four measurement locations were selected as representative of the Project area due to their proximity to existing sound sources such as the SR-58. Table 4-1 provides the results of the baseline sound survey at each of the measurement locations and Figure 4-1 is a map of the measurement locations and NSRs evaluated near the Project.

Table 4-1. Ambient Noise Measurements

Measurement Location	Monitored (Without Pump Operating)			Existing (Estimated with Pump Operating)		
	$L_{eq(Day)}$	$L_{eq(Night)}$	CNEL	$L_{eq(Day)}$	$L_{eq(Night)}$	CNEL
1	39	43	49	39	43	50
2	56	48	57	57	53	60
3	59	58	65	59	58	65
4	58	35	55	58	37	55

Figure 4-1: Measurement Locations and NSRs



5 Noise and Vibration Impact Analysis

Sound generated by the Project will consist of: (1) short duration sounds resulting from construction activities and (2) sound during normal facility operations. Vibration from the Project would only result during construction. Construction activities would take place only during daytime hours. An evaluation was performed of expected noise and vibration and compared to regulatory requirements.

Airborne noise dissipates with increasing distance from the noise source. The distances involved depend primarily on the intensity of the noise generated by the source, terrain and ground cover between source and receiver, and partly on weather conditions such as wind speed and direction, the height and strength of temperature inversions, and the height of cloud cover. Temperature inversions and cloud cover can reflect or refract sound that is radiated upwards; this effect can increase noise levels at locations that receive the reflected or refracted sound. Such reflection and refraction effects are important primarily for high intensity sounds and for the calculation of sound propagation over large distances. For noise sources such as construction activity and vehicle traffic, the region of influence is typically less than 0.5 mile from the noise source. Temperature inversions and cloud cover are not accounted for in this analysis.

The region of interest for noise and vibration issues is typically localized. Ground-borne vibrations generally attenuate rapidly with increasing distance from the vibration source. The distances involved depend primarily on the intensity of the vibrations generated by the source, and partly on soil and geologic conditions. Detectable vibrations will travel the greatest distance through solid rock and the least distance through loose, unconsolidated soils or saturated soils. For vibration sources such as construction activity and vehicle traffic, the region of influence is typically less than 1,000 feet from the vibration source.

5.1 Construction

5.1.1 Noise

Construction noise, although temporary, can be a source of concern for sensitive receptors, such as nearby residences. Construction is anticipated to take place during the fourth quarter of 2015 and last up to 10 months. The Project would be constructed during daytime hours only; specifically between the hours of 7:00 a.m. and 7:00 p.m. Construction of the Project will require the use of heavy equipment that may be periodically audible at offsite locations. Received sound levels will fluctuate, depending on the construction activity, equipment type, and distance between noise source and receiver. Additionally, sound from construction equipment will vary dependent on the construction phase and the number and class of equipment at a location at any given time. There would be five phases of construction for the Project:

1. Site preparation
2. Underground work
3. System installation
4. Testing
5. Clean-up / Restoration

The variation in power and usage imposes complexity in characterizing construction noise levels. Expected equipment types for each phase of construction are presented in Table 5-1 and were used to screen for potential construction noise impacts. Each phase identified will require different types of construction equipment. The estimated composite site noise level is based on the assumption that all equipment would operate at a given usage load factor, for a given hour (i.e., pile drivers are

assumed to be used for up to 20% of one hour, or 12-minutes), to calculate the composite average daytime hourly L_{eq}. The load factor accounts for the fraction of time that the equipment is in use over the specified time period. The composite noise level from several pieces of equipment operating during the same phase is obtained from decibel addition of the L_{eq} of each individual unit. Although it is not possible for all the construction equipment to operate at one point simultaneously, the screening level analysis represented in Table 5-1 conservatively assumes that this is the case.

Construction sound will attenuate with increased distance from the sound sources. Composite L_{eq} sound levels at 1,000 feet given in Table 5-1 were evaluated assuming spherical free-field spreading. Other factors, such as vegetation, ground effects, terrain and obstacles, such as buildings, will act to limit the impact of construction noise levels, but were not considered in the evaluation. Actual received sound levels will fluctuate, depending on the construction activity, equipment type, and separation distances between source and receiver. Some construction phases will overlap with one another at the Project site; however, multiple phases would not be conducted simultaneously in close proximity of one another. For example, when a construction phase is within 250 feet of an NSR another phase would not be within 1500 feet. Therefore, if two construction phases overlap, noise levels associated with the construction phase closest to an NSR would dominate. As a general construction practice, functional mufflers will be maintained on all equipment to maintain noise levels as low as reasonably achievable.

The predicted construction phase noise levels were used to screen for potential impact conditions at nearby NSRs. Table 5-2 provides the predicted received construction noise levels at each of the residences near the Project. Two analysis conditions were evaluated for each phase: 1) the highest work-day construction noise level, and 2) the average construction phase noise level. These two conditions were compared to the 20 dBA over baseline for daily construction noise level threshold and to the 10 dBA over baseline threshold, respectively. Additionally, it was confirmed that these predictions do not identify any exceedances of the 77 dBA CNEL EPA limit. The highest predicted sound level is for Phase 1 of construction at NSR-1 with a daytime L_{eq} of 73 dBA.

The screening level assessment did not identify any exceedances of the temporary threshold criteria employed for this project. NSR-1 is the closest to an exceedance under Phase 1 and Phase 3, with a predicted 19 dBA daily increase over ambient; however, the highest sound levels would only occur when construction is closest to the NSR and on average the received sound levels are not predicted to be above ambient conditions. Furthermore, unlike the assumptions of the screening model applied above, not all equipment would or could operate simultaneously at one location. For example, under Phase 1 the excavators, graders, tractor/loader/backhoe, and roller would operate in unison over one area of the Project site which would then be followed by another series of equipment, such as the skid steer with drill rig and cement/mortar mixer to prepare the site for the next phase. Therefore, sounds from each grouping of equipment, when at its closest to a given NSR, would dominate over other equipment working on another portion of the Project site even though all the Phase's equipment could be in operation simultaneously. The result would be slightly lower received sound levels. For example with excavators, graders, tractor/loader/backhoe, and roller operating under Phase 1 at NSR-1 (e.g., 210 feet) sound levels at worst would result in a composite L_{eq} of 68 dBA, slightly lower than the composite construction noise level for the phase.

Table 5-1: Project Construction Noise Levels by Phase

Phase	Equipment[1]			Composite Sound Level (L_{eq})[3]	
	Type	Quantity	L_{max} @ 50'[2]	50-feet	1,000-feet
1: Site Preparation (1 month/22 work days)	Bore/Drill Rig	1	84	87	52
	Cement/Mortar Mixer	1	79		
	Excavators	2	81		
	Graders	3	85		
	Rollers	2	80		
	Skid-Steer Loader	1	79		
	Generator Sets	5	81		
	Off-Highway Trucks (pick-ups)	3	75		
	Off-Highway Trucks (Water)	1	74		
	Tractor/Loader/Backhoe	2	79		
	Rubber-Tired Dozer	2	82		
2: Underground Work (6.5 mos./141 work days)	Dumper/Tender	2	76	83	49
	Generator Sets	5	81		
	Roller	1	80		
	Off-Highway Trucks (pick-ups)	3	75		
	Off-Highway Trucks (Water)	1	74		
	Trencher	3	80		
	Compactors	4	80		
	Tractor/Loader/Backhoe	3	79		
3: System Installation (5.5 mos./ 119 work days)	Forklifts	4	75	86	51
	Generator Sets	5	81		
	Off-Highway Trucks (pick-ups)	6	75		
	Off-Highway Trucks (Other)	3	74		
	Off-Highway Trucks (Concrete)	7	79		
	Off-Highway Trucks (Flatbed))	1	74		
	Off-Highway Trucks (Water)	1	74		
	Augers	4	84		
	Solar PV Installation Pile Drivers[4]	3	75		
	Other General Industrial Equip.	1	85		
4: Testing (1 mo./22 work days)	Generator Sets	2	81	79	45
	Off-Highway Trucks (pick-ups)	3	75		
	Off-Highway Trucks (Water)	5	74		
5: Clean-up/ Restoration (1 mo./21 work days)	Grader	1	85	82	47
	Off-Highway Trucks (pick-ups)	3	75		
	Off-Highway Trucks (Water)	1	74		

Notes:
1. Equipment mix obtained from Longboat Solar Project Air Emissions and Greenhouse Gas Analysis, GC Environmental, Inc. 2015
2. Measured Lmax @ given reference distance obtained from the FHWA Roadway Construction Noise Model, FHWA 2006.
3. Distance factor determined by the inverse square law defined as 6 dBA per doubling of distance as sound travels away from an idealized point.
4. The EPC Contractor will implement a solar PV installation pile driver with a sound power level of 75 dBA at 50 feet such as the Pauselli Self-Propelled Solar Pile Driver (Groundwork 2015) http://www.groundworkexperts.com/upload/files/Pauselli%20Solar%20Pile%20Drivers_PRINT.pdf

Table 5-2: Received Construction Noise Levels by Phase

Noise Sensitive Receptor	Distance to Construction (feet)	Baseline CNEL	Project Sound Levels (dBA)																			
			Construction																			
			Phase 1*				Phase 2				Phase 3				Phase 4				Phase 5			
			L_{eq}		Increase		L_{eq}		Increase		L_{eq}		Increase		L_{eq}		Increase		L_{eq}		Increase	
			Day	Ave.	Day	Ave.	Day	Ave.	Day	Ave.	Day	Ave.	Day	Ave.	Day	Ave.	Day	Ave.	Day	Ave.	Day	Ave.
1	210-2,840	50	69	45	19	0	67	41	17	0	69	43	19	0	63	37	13	0	65	40	15	0
2	227-3,878	60	69	50	9	0	66	46	6	0	68	48	8	0	62	42	2	0	64	45	4	0
3	739-5,943	65	56	39	0	0	52	35	0	0	54	37	0	0	48	31	0	0	51	33	0	0
4	210-3,909	55	70	51	15	0	67	48	12	0	69	50	14	0	63	44	8	0	65	46	10	0
5	164-4,083	55	73	47	18	0	70	43	15	0	71	45	16	0	66	39	11	0	68	41	13	0

Notes:
* Generator sets would be at least 500 feet from NSR-1 under Phase 1.
Day = Maximum for a given work day, representative of when construction is closest to a noise sensitive receptor.
Ave. = Average construction noise level for phase.

Because construction noise would comply with the County's noise ordinance and would not exceed the temporary increase over ambient thresholds under any phase; impacts from construction noise would be less than the applied threshold. However, given the close proximity of construction to NSRs for the duration of project construction combined with construction-related noise levels that nearly approach the applied threshold, project construction noise is considered significant and mitigation is proposed to lessen this impact.

Traffic noise associated with construction of the Project is not anticipated to be a significant source of noise. Traffic noise is not greatly influenced by lower levels of traffic, such as those associated with the Project's construction effort. For example, traffic levels would have to double in order for traffic noise on area roadways to increase by 3 dBA. The Project's traffic report anticipates that construction traffic on area roadways would increase hourly traffic volumes by much less than double; therefore, the increase in construction related traffic noise would be less than 3 dBA and is not significant.

5.1.2 Vibration

Vibration associated with construction of the Project has the potential to be an annoyance to nearby residences. Structural damage to nearby residences from construction activities is highly unlikely and not anticipated.

The California Department of Transportation (Caltrans) Construction Induced Vibration Guidance Manual identifies two impact criteria for buildings and humans. Table 5-3 describes impact criteria for buildings and Table 5-4 describes impact criteria for humans.

Table 5-3: Caltrans Vibration Damage Potential Threshold Criteria

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

Note: Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.
Source: Caltrans, June 2004

Table 5-4: Caltrans Guideline Vibration Annoyance Potential

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

Note: Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.
Source: Caltrans, June 2004

Installation of the PV solar module foundations requires pile driving and has the potential to result in temporary vibration impacts to structures and humans. The Project would utilize an impact pile driver

to install each PV tracker mount. For this analysis it is assumed that pile driving activities would not occur closer than 180 feet from the nearest sensitive land use. Other construction activities are less intensive than pile driving and would have lower PPV than pile driving. Therefore, vibration levels from pile driving are considered worst case for the solar facility construction. Caltrans vibration guidance provides the following equation to calculate PPV at sensitive receptors, such as residences:

$$\text{PPV Impact Pile Driver} = PPV_{Ref}\,(25/D)^{n}\ \text{(in/sec)}$$

Where:

PPV_{Ref} = 0.65 in/sec for a reference pile driver at 25 ft.

D = distance from pile driver to the receiver in ft.

n = 1.1 is a value related to the vibration attenuation rate through ground

Using the referenced formula and an assumed 1,212 ft-lb rated energy for the impact pile driver, the calculated PPV at the nearest residence (180 feet) would be 0.002 PPV, which according to the Caltrans guidance would not damage buildings and would be less than barely perceptible. Vibration from pile driving would be substantially less than the County's 0.2 PPV standard (which, in any event, does not apply to construction from 7 am to 7 pm, except Sundays and federal holidays. Therefore, vibration impacts associated with construction of the Project would be less than significant.

5.2 Operation

Operation of the Project would result in some acoustic emissions but would not result in vibration emissions. Operational noise from the Project would occur at the inverters, switchgear, and from the periodic use of the existing water well pump. The site would be unmanned and operated remotely. Periodic noise would result from maintenance activities at the Project such as washing the PV panels. These maintenance activities would result in negligible noise levels other than that of noise from the periodic use of the existing water well pump.

The Project would only operate during daytime hours; therefore, to be conservative in the operational predictions it was assumed that the Project would be operational approximately 16-hours per day, roughly the equivalent of the longest day of the year in the Project area. For the 16-hour scenario it is assumed that the Project would operate from 5:00 a.m. to 9:00 p.m. This operational time frame was used to calculate Project operational CNELs.

Operational noise levels were predicted using the International Standards Organization (ISO) 9613-2 standard *Acoustics -- Attenuation of sound during propagation outdoors -- Part 2: General method of calculation* (ISO 1996). The sound levels for the 1.4 MW inverters and 10 MW switchgear are both 62 dBA at 1 meter. The existing water well pump is assumed to be capable of pumping 920 gallons per minute. A literature review was conducted of 920 gallons per minute well pumps and the sound source level identified for this analysis is 82 dBA at 1 meter. These sound pressure levels at 1 meter were converted to sound power levels (L_w) that are summarized in Table 5-5. Sound power levels differ from sound pressure levels in that they are not distance dependent, and instead represent the sound level at the source that is radiated in all directions.

Table 5-5: Operational Sound Power Levels

Sound Source	1/1-Octave Bands Hertz (dBA)								Broadband (dBA)
	63	125	250	500	1000	2000	4000	8000	
1.4 MW Inverter	64.0	64.5	58.9	53.1	46.3	37.1	42.0	71.5	73.1
10 MW Switch-Gear	67.4	69.4	64.4	64.4	58.4	53.4	48.4	41.4	73.1
Well Pump (920 gpm) L_w	61.1	76.1	81.1	86.1	88.1	90.1	87.1	78.1	94.5

Using these sound source levels operational sound levels were predicted at each of the residences in the vicinity of the Project. Table 5-6 provides the results of this predictive effort. No exceedances of the County's noise standards for residential uses (see Table 3-4) and no increases over ambient conditions are predicted to occur from operating the Project. Therefore, Project operational noise impacts are less than significant.

Table 5-6: Received Operational Sound Power Levels

Noise Sensitive Area	Baseline Sound Levels (dBA)			Project Sound Levels (dBA)			
				$L_{eq(day)}$	CNEL	Increase over Baseline	
	$L_{eq(day)}$	$L_{eq(night)}$	CNEL			$L_{eq(day)}$	CNEL
1	39	43	50	31	37	0	0
2	58	54	60	51	58	0	0
3	59	58	59	24	30	0	0
4	58	41	55	38	44	0	0
5	58	36	55	22	27	0	0

As with construction, traffic associated with the Project would not result in a doubling of traffic on area roadways; therefore, increases in traffic noise would be less than 3 dBA and not significant.

6 Mitigation

Although there are no exceedances of the temporary increase over ambient threshold, as a precaution the following noise mitigation measures are recommended to minimize Project construction noise:

- The use of noise-producing signals, including horns, whistles, alarms, and bells, will be for safety warning purposes only.
- Although otherwise allowed subject to applicable County noise limits, the project's exterior construction activities will not occur before 7.a.m or after 7 p.m. and there will be no exterior construction activities on Sundays or National Holidays.
- Construction equipment will be muffled per manufacturer's specifications. Electrically powered equipment will be used instead of pneumatic or internal combustion powered equipment, where feasible.
- All stationary construction equipment will be placed in a manner so that emitted noise is directed away or blocked from sensitive receptors nearest the Project site.

By further minimizing construction noise, these measures will ensure that construction noise from the Project remains less than significant

7 References

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Appendix A. Ambient Field Data, Photos, Field Data Sheets & SLM Calibration Certificates

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Site 1

Ambient Noise Monitoring Data Sheet

Date: 06/12/2015
Time: 12:42 AM
Monitoring Period: Night/Day
Location: Barstow, CA

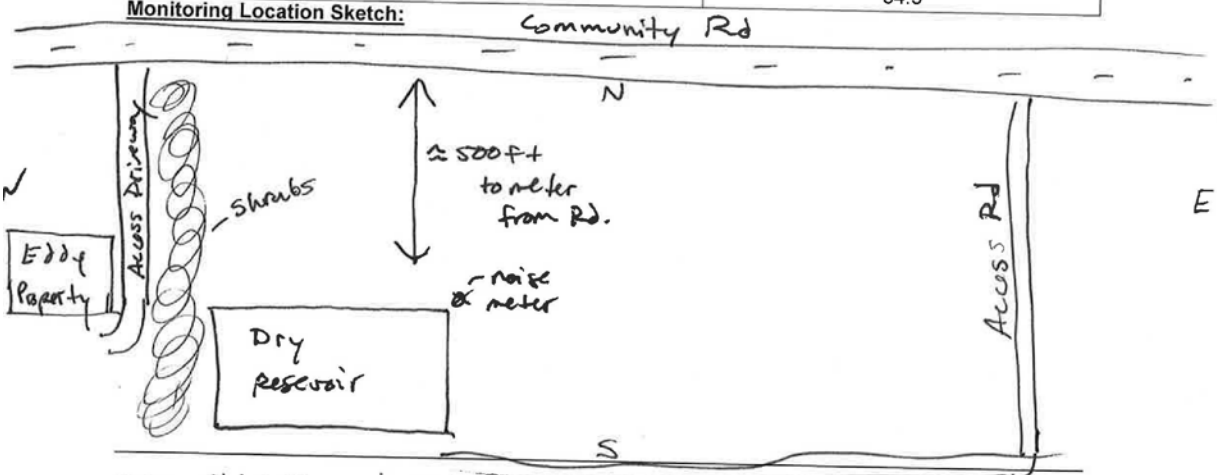
Client: EDF

Project Title: Longboat Solar

Weather Description	Temp (°F)	Wind (mph)	RH (%)
#1- Warm, slight breeze, clear	79	<1	36
#2-Hot, slight breeze, partially sunny	90	3	24

Data and Results		
Measurement	1	2
Start Time	12:42 AM	10:15 AM
Duration	30 minutes	30 minutes
Leq	43.0	38.6
Lmin	30.4	31.3
Lmax	59.5	64.4
LDN/LDL	53/53.2	38.6/38.6
L5	49.5	42.7
L10	47.6	41.2
L33	43.2	37.9
L50	41.6	36.7
L67	38.8	35.8
L90	36.4	34.3

Monitoring Location Sketch:



Notes: #1 • Dogs barked for first 10 minutes of measurement
• Traffic noise from Highway 58 was barely audible
• Train noise from far off in distance
#2 - very quiet

Site 2

Ambient Noise Monitoring Data Sheet

Date: 06/12/2015
Time: 1:23 AM
Monitoring Period: Night/Day
Location: Barstow, CA

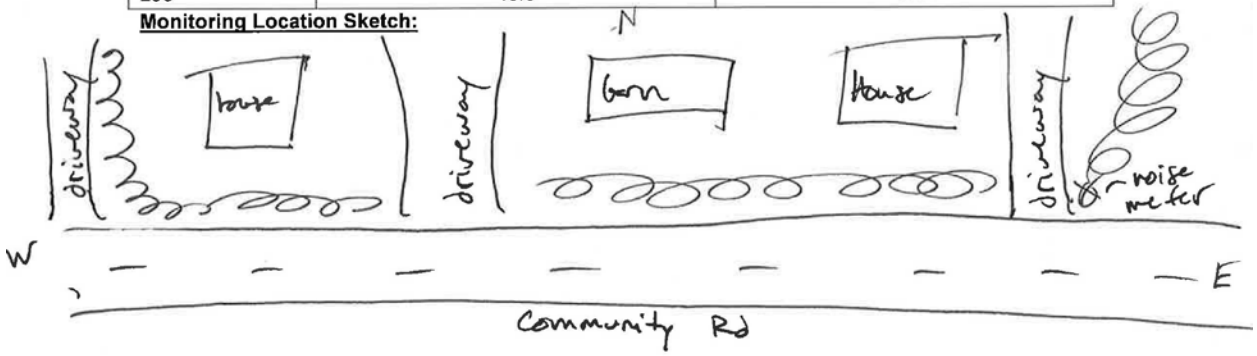
Client: EDF

Project Title: Longboat Solar

Weather Description	Temp (°F)	Wind (mph)	RH (%)
#1- Warm, no breeze, clear	77	-	37
#2-Hot, no breeze, partially cloudy	91	-	21

Data and Results		
Measurement	1	2
Start Time	1:23 AM	10:51 AM
Duration	30 minutes	30 minutes
Leq	48.4	56.3
Lmin	36.3	34.8
Lmax	72.5	79.3
LDN/LDL	58.4/48.4	56.3/56.3
L5	49.6	61.9
L10	47.9	53.2
L33	44.7	46.1
L50	43.3	44.2
L67	42.3	42.8
L90	40.6	41.2

Monitoring Location Sketch:



Notes: #1: • Light traffic visible from highway 58 / mostly heavy truck traffic • Train went by • 3 cars drove past on Community Road

#2: • Train went by • more traffic

Traffic count on US 58 & Community Rd

US 58		Community	
Cars	44	Cars	6
Heavy Trucks	30	Medium Trucks	2
medium trucks	3		

Site 3

Ambient Noise Monitoring Data Sheet

Date: 06/12/2015
Time: 2:00 AM
Monitoring Period: Night/Day
Location: Barstow, CA

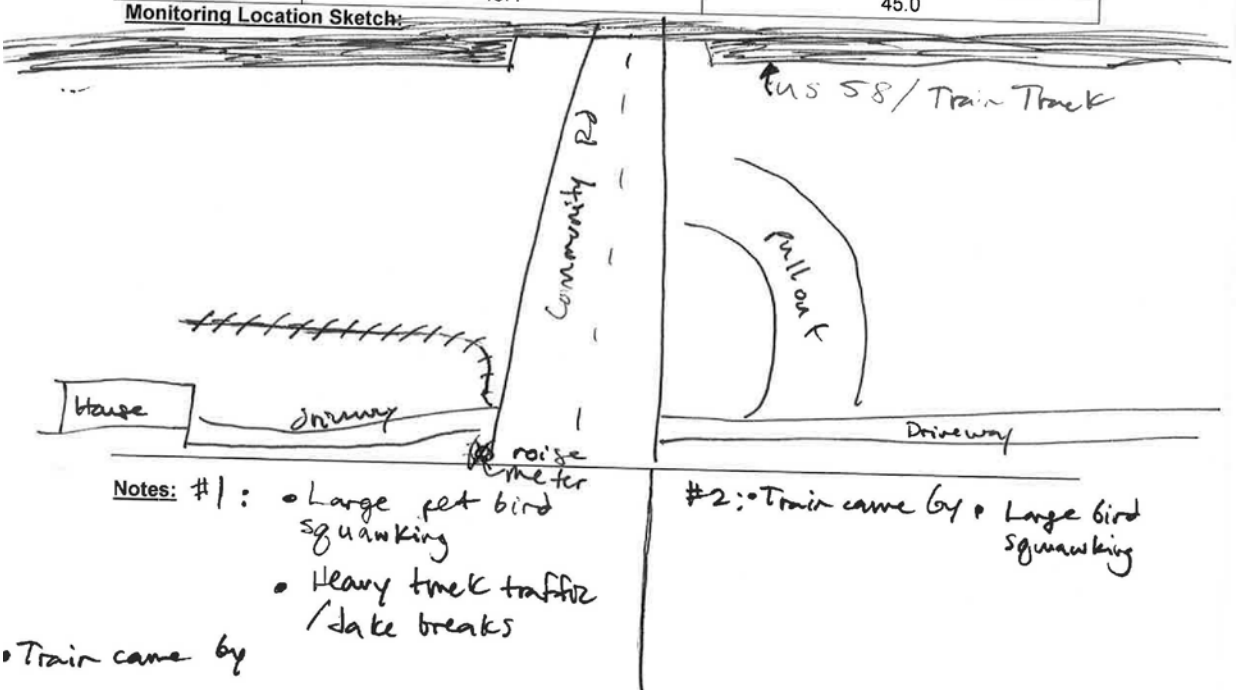
Client: EDF

Project Title: Longboat Solar

Weather Description	Temp (°F)	Wind (mph)	RH (%)
#1- Warm, no breeze, clear	75	-	39
#2-Hot, no breeze, partially cloudy	93	-	21

Data and Results		
Measurement	1	2
Start Time	2:00 AM	11:27 AM
Duration	30 minutes	30 minutes
Leq	57.8	58.9
Lmin	38.2	35.2
Lmax	78.6	83.9
LDN/LDL	67.8/57.9	58.9/58.9
L5	58.8	63.8
L10	57.1	60.7
L33	53.7	53.7
L50	52.0	50.6
L67	50.0	48.3
L90	45.4	45.0

Monitoring Location Sketch:



Notes: #1: • Large pet bird squawking
• Heavy truck traffic / take breaks
• Train came by

#2: • Train came by • Large bird squawking

Site 4

Ambient Noise Monitoring Data Sheet

Date: 06/12/2015
Time: 2:45 AM
Monitoring Period: Night/Day
Location: Barstow, CA

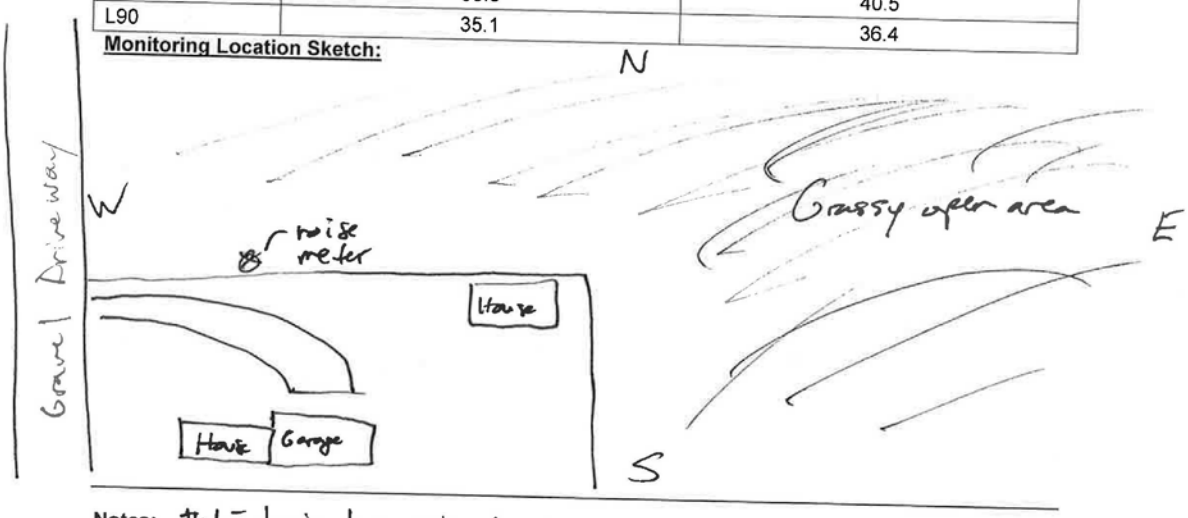
Client: EDF

Project Title: Longboat Solar

Weather Description	Temp (°F)	Wind (mph)	RH (%)
#1- Warm, no breeze, clear	75	-	41
#2-Hot, slight breeze, no clouds	93	<2	19

Data and Results		
Measurement	1	2
Start Time	2:46 AM	12:04 PM
Duration	30 minutes	30 minutes
Leq	35.4	57.7
Lmin	34.9	32.8
Lmax	38.2	76.6
LDN/LDL	45.5/35.5	57.7/57.7
L5	35.6	64.7
L10	35.6	62.3
L33	35.6	54.3
L50	35.5	45.8
L67	35.6	40.5
L90	35.1	36.4

Monitoring Location Sketch:



Notes: #1 = train horn at start
#2: Dogs barked throughout

Figure 1: Site 1 (Site 1, Barstow, CA)
Photograph 1

Figure 2: Site 1 (Site 1, Barstow, CA)
Photograph 2

Figure 3: Site 1 (Site 1, Barstow, CA)
Photograph 3

Figure 4: Site 1 (Site 1, Barstow, CA)
Photograph 4

Figure 5: Site 2 (Site 2, Barstow, CA)
Photograph 1

Figure 6: Site 2 (Site 2, Barstow, CA)
Photograph 2

Figure 7: Site 2 (Site 2, Barstow, CA)
Photograph 3

Figure 8: Site 2 (Site 2, Barstow, CA)
Photograph 4

Figure 9: Site 3 (Site 3, Barstow, CA)
Photograph 1

Figure 10: Site 3 (Site 3, Barstow, CA)
Photograph 2

Figure 11: Site 3 (Site 3, Barstow, CA)
Photograph 3

Figure 12: Site 3 (Site 3, Barstow, CA)
Photograph 4

Figure 13: Site 4 (Site 4, Barstow, CA)
Photograph 1

Figure 14: Site 4 (Site 3, Barstow, CA)
Photograph 2

Figure 15: Site 4 (Site 3, Barstow, CA)
Photograph 3

Figure 16: Site 4 (Site 3, Barstow, CA)
Photograph 4

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.31982

Instrument:	**Acoustical Calibrator**	*Date Calibrated:* **8/13/2014** *Cal Due:* **8/13/2015**		
Model:	**CAL200**	*Status:*	**Received**	**Sent**
Manufacturer:	**Larson Davis**	*In tolerance:*	**X**	**X**
Serial number:	**7160**	*Out of tolerance:*		
Class (IEC 60942):	**1**	*See comments:*		
Barometer type:		*Contains non-accredited tests:* __Yes _X_ No		
Barometer s/n:				
Customer:	**HDR Engineering, Inc.**	*Address:*	**1001 SW. 5th Avenue Suite 1800**	
Tel/Fax:	**503-423-3845 / 503-423-3737**		**Portland, OR 97204-1134**	

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., Rev. 10/1/2010

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 7, 2013	Scantek, Inc./ NVLAP	Oct 7, 2014
DS-360-SRS	Function Generator	33584	Sep 30, 2013	ACR Env./ A2LA	Sep 30, 2015
34401A-Agilent Technologies	Digital Voltmeter	US36120731	Sep 30, 2013	ACR Env. / A2LA	Sep 30, 2014
HM30-Thommen	Meteo Station	1040170/39633	Sep 30,2013	ACR Env./ A2LA	Sep 30, 2014
8903-HP	Audio Analyzer	2514A05691	Dec 12, 2013	ACR Env. / A2LA	Dec 12, 2016
PC Program 1018 Norsonic	Calibration software	v.5.2	Validated March 2011	Scantek, Inc.	-
4134-Brüel&Kjær	Microphone	173368	Nov 8, 2013	Scantek, Inc. / NVLAP	Nov 8, 2014
1203-Norsonic	Preamplifier	14051	Oct 24, 2013	Scantek, Inc./ NVLAP	Oct 24, 2014

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	Mariana Buzduga
Signature	Lydon Dawkins	Signature	[illegible]
Date	8/13/2014	Date	8/15/2014

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Results summary: Device was tested and complies with following clauses of mentioned specifications:

CLAUSES[1] FROM STANDARDS REFERENCED IN PROCEDURES:	MET[2]	NOT MET	COMMENTS
Manufacturer specifications			
Manufacturer specifications: Sound pressure level	X		
Manufacturer specifications: Frequency	X		
Manufacturer specifications: Total harmonic distortion	X		
Current standards			
ANSI S1.40:2006 B.3 / IEC 60942: 2003 B.2 - Preliminary inspection	X		
ANSI S1.40:2006 B.4.4 / IEC 60942: 2003 B.3.4 - Sound pressure level	X		
ANSI S1.40:2006 A.5.4 / IEC 60942: 2003 A.4.4 - Sound pressure level stability	-	-	
ANSI S1.40:2006 B.4.5 / IEC 60942: 2003 B.3.5 - Frequency	X		
ANSI S1.40:2006 B.4.6 / IEC 60942: 2003 B.3.6 - Total harmonic distortion	X		

[1] The results of this calibration apply only to the instrument type with serial number identified in this report.

[2] The tests marked with (*) are not covered by the current NVLAP accreditation.

Main measured parameters [3]:

Measured[4]/Acceptable[5] Tone frequency (Hz):	Measured[4]/Acceptable[5] Total Harmonic Distortion (%):	Measured [4]/Acceptable Level[5] (dB):
999.54 ± 1.0/1000.0 ± 10.0	2.0 ± 0.6/ < 3	93.88 ± 0.12/94.0 ± 0.4
999.52 ± 1.0/1000.0 ± 10.0	0.7 ± 0.6/ < 3	113.93 ± 0.12/114.0 ± 0.4

[3] The stated level is valid at measurement conditions.

[4] The above expanded uncertainties for frequency and distortion are calculated with a coverage factor k=2; for level k=2.00

[5] Acceptable parameters values are from the current standards

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
24.4 ± 1.0	99.43 ± 0.000	49.2 ± 2.1

Tests made with following attachments to instrument:

Calibrator ½" Adaptor Type:
Other:

Adjustments: Unit was not adjusted.
Comments: The instrument was tested and met all specifications found in the referenced procedures.

Note: The instrument was tested for the parameters listed in the table above, using the test methods described in the listed standards. All tests were performed around the reference conditions. The test results were compared with the manufacturer's or with the standard's specifications, whichever are larger.
Compliance with any standard cannot be claimed based solely on the periodic tests.

Measured Data: in Acoustical Calibrator Test Report # 31982 of two pages.

Place of Calibration: Scantek, Inc.
6430 Dobbin Road, Suite C
Columbia, MD 21045 USA
Ph/Fax: 410-290-7726/ -9167
callab@scantekinc.com

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Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®

NVLAP Lab Code: 200625-0

Calibration Certificate No.31980

Instrument: **Sound Level Meter**
Model: **820**
Manufacturer: **Larson Davis**
Serial number: **1765**
Tested with: **Microphone 377B02 s/n 112593**
Preamplifier PRM828 s/n 2746
Type (class): **1**
Customer: **HDR Engineering, Inc.**
Tel/Fax: **503-423-3845 / 503-423-3737**

Date Calibrated: **8/15/2014** *Cal Due:* **8/15/2015**

Status:	**Received**	**Sent**
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes _X_ No
Calibration service: _X_ Basic _ Standard
Address: **1001 SW. 5th Avenue Suite 1800**
Portland, OR 97204-1134

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/22/2012
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 7, 2013	Scantek, Inc./ NVLAP	Oct 7, 2014
DS-360-SRS	Function Generator	33584	Sep 30, 2013	ACR Env./ A2LA	Sep 30, 2015
34401A-Agilent Technologies	Digital Voltmeter	US36120731	Sep 30, 2013	ACR Env. / A2LA	Sep 30, 2014
HM30-Thommen	Meteo Station	1040170/39633	Sep 30,2013	ACR Env./ A2LA	Sep 30, 2014
PC Program 1019 Norsonic	Calibration software	v.5.2	Validated Mar 2011	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Nov 8, 2013	Scantek, Inc./ NVLAP	Nov 8, 2014

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.2 °C	100.090 kPa	49.5 %RH

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	Mariana Buzduga
Signature	Lydon Dawkins	Signature	[illegible]
Date	8/15/2014	Date	8/15/2014

Calibration Certificates or Test Reports shall not be reproduced, except in full, without written approval of the laboratory.
This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.
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Results summary: Device complies with following clauses of mentioned specifications:

CLAUSES[1] FROM IEC/ANSI STANDARDS REFERENCED IN PROCEDURES:	RESULT[2,3]	EXPANDED UNCERTAINTY (coverage factor 2) [dB]
CALIBRATION OF SOUND LEVEL METER - ANSI S1.4 CLAUSE 3.2	Passed	0.2
LEVEL LINEARITY TEST - ANSI S1.4-1983, CLAUSE 6.9 & 6.10	Passed	0.25
WEIGHTING NETWORK TEST: A NETWORK - ANSI S1.4-1983 CLAUSE 8.2.1	Passed	0.25
WEIGHTING NETWORK TEST: C NETWORK - ANSI S1.4-1983 CLAUSE 8.2.1	Passed	0.25
F/S/I/PEAK TEST: STEADY STATE RESPONSE - ANSI S1.4 1983 CLAUSE 6.4	Passed	0.25
RMS DETECTOR TEST: CREST FACTOR TEST - ANSI S1.4-1983 CLAUSE 8.4.2	Passed	0.25
TIME AVERAGING TEST: AVERAGING FUNCTIONS - ANSI S1.43 CLAUSE 9.3.2	Passed	0.25
SUMMATION OF ACOUSTIC TESTS - ANSI S1.4 CLAUSE 5 USING ACTUATOR	Passed	0.2-0.5

[1] The results of this calibration apply only to the instrument type with serial number identified in this report.

[2] Parameters are certified at actual environmental conditions.

[3] The tests marked with (*) are not covered by the current NVLAP accreditation.

Comments: The instrument was tested and met all specifications found in the referenced procedures.

Note: The instrument was tested for the parameters listed in the table above, using the test methods described in the listed standards. All tests were performed around the reference conditions. The test results were compared with the manufacturer's or with the standard's specifications, whichever are larger.
Compliance with any standard cannot be claimed based solely on the periodic tests.

Tests made with the following attachments to the instrument:

Microphone:	PCB Piezotronics 377B02 s/n 112593 for acoustical test
Preamplifier:	Larson Davis PRM828 s/n 2746 for all tests
Other: line adaptor ADP005 (18pF) for electrical tests	
Accompanying acoustical calibrator:	Larson Davis CAL200 s/n 7160
Windscreen:	none

Measured Data: in Test Report # 31980 of 7 + 1 pages.

Place of Calibration: Scantek, Inc.
6430 Dobbin Road, Suite C
Columbia, MD 21045 USA

Ph/Fax: 410-290-7726/ -9167
callab@scantekinc.com

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