Review of
Excelaron Project Draft EIR
Noise Chapter 4.11

for
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1.0 Executive Summary

The Excelaron Project Draft EIR begins to answer some questions about potential impact of proposed operational noise on the activities of the residents of Huasna Valley. However, the Draft EIR does not adequately explain many assumptions that were made, and does not give the reader enough technical or practical information to adequately define the real impact, given contemporary knowledge, science and practice of noise impact prediction. There are many deficiencies in the EIR that need further explanation and analysis before technical conclusions may be drawn with certainty.

CEQA requires the Project Draft EIR to disclose if the total Project-related noise emissions will be harmful and to propose adequate noise mitigations. To do that, a DEIR must:

(a) evaluate the existing ambient noise conditions where affected by the Project, then

(b) calculate the additional noise emissions resulting from the Project, then

(c) analyze if the total noise in (a) & (b) exceeds applicable noise standards,

(d) analyze by using other tests if total noise levels significantly impact the community even if the total emissions do not exceed noise standards, then,

(e) propose adequate noise mitigations and project alternatives if the total noise impacts are determined to be significant using either test in (c) or (d).

The Excelaron Project Draft EIR does not adequately accomplish any of these steps.

(f) The Draft EIR declares the level of significance of noise impact is doubling, tripling or quadrupling the noise level to 45 dBA, above existing background level of 20 dBA.

(g) The Draft EIR does not limit construction noise impacts to normal daytime hours.

2.0 Introduction

The goal of this review is to evaluate the Excelaron Project Draft EIR Noise Chapter 4.11, along with Appendix F, June 2011. The noise chapter describes existing noise levels and the potential impact of future noise generated from proposed activities on nearby residential sensitive receptors in Huasna Valley, California.

In order to fully evaluate the projected noise impact of this project, it is necessary to take all noise generation, noise propagation and noise attenuation factors into consideration. The information presented in the EIR is not comprehensive enough to fully understand the soundscape or sound environment of Huasna Valley, and the full noise impact of the proposed oil exploration operation. All known acoustical factors that determine potential impact must be considered, including the likelihood of annoyance and potential health effects. The EIR considers only two factors of the many possible means of assessing noise impact.

3.0 Excelaron Noise EIR Questions

The Excelaron Draft Noise EIR conclusions and mitigation recommendations are based primarily on the standards contained in the County Noise Element, dated May 1992, and the County Noise Ordinance, amended 1992. These two standards are simple in their scope and approach to a "one-size-fits-all" standard for community noise problems which may have been appropriate at their inception, more than two decades ago. These two standards are equally applied in the most noise-intensive rail and highway corridors as well as in remote, bucolic country settings with very low background noise. In the intervening period since 1992, acoustics research, and the capabilities of noise measurement instrumentation and methods of analysis and simulation have given a much better understanding of the environmental impact of stationary and transportation noise on sensitive residential receptors in rural and urban settings.

The County Noise Element uses the LDN 24-hour metric and the Noise Ordinance uses the LEQ one hour metric as standards for compliance. Each of these measurement terms is based on the total energy equivalent of noise contained in continuously varying sound environments. The science and practice of contemporary acoustics embraces several additional metrics that more fully describe the sound environment and its impact on sensitive receptors; these additional descriptors are missing from the EIR: An illustration of the relationship of LDN to LEQ is shown in "Figure 2. LDN and LEQ for the ML1 site" on page 14. Other questions are itemized below:

In addition to these local noise standards, California courts (see "4. Berkeley Keep Jets Over the Bay Committee v. Board of Port Commissioners. 2001. 91 CA 4th 1344, available at: http://ceres.ca.gov/ceqa/cases/2001/berkeley_keep_083001.html" on page 16) have considered noise exposure to be a potentially significant impact if it is of a character and intensity capable of disturbing nighttime sleep and creating a physiological response and annoyance from increased facility operations even if it does not exceed the local noise standards. In the case of Excelaron's proposed operations, residents are exposed to loud, low frequency noise that easily penetrates and rattles windows and walls. This low frequency noise can create sleep disturbance, stress and annoyance, even if exposure to low frequency noise is not prohibited by the "A-scale weighted" local noise standards.

(h) There is no mention or use of the "C" scale in sound level measurement or evaluation of potential noise. The importance of the "C" scale is explained in "4.3 "C-Weighted Sound Level (dBC)"" on page 8.

(i) There is no recognition of the importance of L90 backround noise nor is there an explanation of the difference between ambient noise and background noise and its applicability to standardized mitigation of noise in this project. The importance of L90 is explained further in “4.2 “Background Sound (L90)”” on page 7

(j) There is less emphasis on “performance specification” for noise mitigation, and more emphasis on a prescriptive specification for noise barriers. A prescriptive specification runs the risk of under-performing when the results are actually measured. A performance specification assures that specified, enforceable results are obtained.

(k) Sound level measurements for the DEIR were made at only one site, and those measurements are not in agreement with previous findings reported in the DEIR. Specifically, sound level measurement at site ML-2 (p. 4.11-13) yielded higher results compared to previous measurements, without explanation. No data is shown for that single measurement. Wind speeds were greater than 5 mph on June 29-30 for most of measurement period, which may have skewed the results, but this was not mentioned in the DEIR.

(l) There is no disclosure of measurement protocol followed (i.e., ASTM E-1040), type of sound level instruments used, use of microphone windscreen, measurement of windspeed, calibration of instruments, height above ground, etc. in either the EIR chapter 4.11 or the Appendix. These omissions reflect negatively on professional diligence and may contaminate or invalidate the reported single sound level measurement.

(m) There is a confusion of the terms “ambient” and “background” in the explanation of thresholds on page 4.11-18. Neither term is objectively defined in the document as LEQ, L10, or L90, terms used in the science of acoustics and practice of acoustical engineering.

(n) There is reference to “at the residence--not the property line” for instance on p. 4-11-39. All reference points should preferably be “at the property line.”

(o) There is no mention of the impact of noise on farm animals, livestock, milk cows, poultry and grazing animals, and wildlife extant in Huasna Valley. There may be an impact that would result in disruption of wildlife or reduction of production by domestic animals.

(p) Threshold significance criteria imply that background level plus project noise of 3 or 5 or 10 dBA determines level of significance. However, “background level” is not objectively defined as LEQ, L10, or L90.

(q) Even thought the phenomenon is mentioned in the Air Quality chapter, there is no accounting of potential acoustical impact due to the prevalence of atmospheric thermal inversion layers in Huasna Valley. The impact of thermal inversion on the amplification and propagation of sound over large distances from the source is explained in “4.6 “Thermal Inversion”” on page 10.

(r) The EIR states that Excelaron operational noise will be mitigated so as to produce maximum sound levels of 45 dBA, the context implying that 45 dBA is fully compatible with the quiet rural community setting. The EIR makes no acknowledgement or disclosure of the dramatic change this will be for the noise environment of nearby families. The EIR makes no mention of how the equipment, once in operation, will raise evening and nighttime background sound levels from the existing background levels of 20 to 30 dBA to 45 dBA. The EIR makes no disclosure of the potentially considerable low frequency and impulsive and tonal content of equipment noise. The EIR fails to warn that normal modern wood frame homes have walls and roofs that cannot block low frequency noise penetration to the interior.

(s) There is no mention of the nighttime sound level recommendations set by the World Health Organization (WHO) in its report, Guidelines for Community Noise and Night Noise Guidelines." In these documents WHO recommends that sound levels during nighttime and late evening hours should be less than 30 dBA during sleeping periods to protect children's health. They noted that a child's autonomic nervous system is 10 to 15 dB more sensitive to noise than is an adult's. Even for adults, health effects are first noted in some studies when the sound levels exceed 32 dBA Lmax. These sounds are 10-20 dBA lower than the sound levels needed to cause awakening. For sounds that contain a strong low frequency component, WHO says that the limits may need to be even lower than 30 dBA to avoid health risks. Further, they recommend that the criteria use dBC frequency weighting instead of dBA for sources with low frequency content. When industrial sound levels are 45 dBA outside a home, we may find that the interior sound levels will drop to the 30 dBA level recommended for sleeping areas but low frequency noise only decreased 6-7 dBC from outside to inside. That can create sleep disturbance because the low frequency content of the noise can penetrate the home's walls and roof with little reduction.

(t) The DEIR implies that drill rigs will only be on site for a total of 16 weeks spread over a 3-4 year period, which is not logical or consistent with other statements in the DEIR. If we simply take the build-out scenario from the project description along with worst-case scenario for number of days and times per year for new well drills, workovers, recompletions, and redrills, then there will be drill rigs present 70-240 days per year, every year, for the life of the project. This assumes a buildout scenario for each individual pad, but Pad 2, the most exposed pad will have 8 of the 12 wells and will thus have a drill rig present for a good part of each year. The rigs are different for workovers and recompletions and don't run 24/7. If Excelaron does directional redrilling of wells, which they have told their investors they will do, then rigs will be present even more frequently. These questions need to be addressed and clarified in the assumptions for the EIR.

(u) Construction noise threshold criteria are not adequately defined and differentiated in the DEIR. During daytime hours, construction work should comply with the County construction noise threshold criteria. Normally, no evening or nighttime construction activity is permitted in areas having noise-sensitive receptors. However, in the event such activity is deemed necessary and is permitted, reduced noise threshold criteria are required.

4.0 Applicable Terms and Concepts Not Considered in EIR

The following concepts and definition of terms are found in a literature review of the contemporary science of acoustics and the practice of acoustical engineering. These terms and concepts are important factors in determining existing sound levels and should be carefully considered for scientific, evidence-based prediction of future adverse noise impacts, annoyance and potential adverse health effects. These standard definitions are either not mentioned at all in the Draft EIR or do not play a part in determining the potential impact of the proposed project. Illustrations of the relationships of these terms is found in "Figure 1. Measurement Terms" on page 13, in "Figure 2. LDN and LEQ for the ML1 site" on page 14, and in "Figure 3. Thresholds for Observed Effects" on page 15.

4.1 "Ambient Sound"

Ambient sound encompasses all sound present in a given environment, being usually a composite of sounds from many sources near and far. Ambient sound includes intermittent noise events, such as, from aircraft flying over, dogs barking, wind gusts, mobile farm or construction machinery, and the occasional vehicle traveling along a nearby road. Ambient sound will include **specific sounds** from the operations proposed by Excelaron and may be measured as L_{EQ} or L_{10} over a specific period of time. The ambient sound also includes wind noise in the landscape, farm operations noise and other nearby sounds from birds, insects, domestic and wild animals or people. The nearby and transient events are all part of the ambient sound environment but are **not to be considered part of the background (L_{90}) sound**.

4.2 "Background Sound (L_{90})"

Background sound refers to the sound level present at least 10% of the time, and exceeded 90% of the time. The background sound level is experienced for six minutes each hour. Background sounds are those heard during lulls in the ambient sound environment. That is, when transient sounds from flora, fauna, and wind and specific noises from drilling operations are not present. Background sound levels vary during different time periods of the day and night. Because Excelaron proposes operations over a 24 hour period, the background sound levels of interest are those during the quieter periods, the quietest hours, which are often during the evening, night or early morning hours, when there is a stable atmosphere and few natural sounds. Sounds from near-by birds and animals or people must be excluded from the background sound test / measurement data. Nearby electrical noise from street lights, transformers and cycling AC units, compressors and pumps etc. must also be excluded when measuring the background sound.

Background sound level (L_{90} dBA and L_{90} dBC) is the sound level that is exceeded for 90% of the time during a period of observation that is representative of the quiet time for the soundscape under evaluation and with duration of ten (10) continuous minutes. Several contiguous ten (10) minute tests may be performed in one hour to determine the statistical stability of the sound environment. Measurement periods such as at dusk when bird and insect activity is high or the early morning hours when the 'dawn chorus' is present are not acceptable measurement times. Determination of summer evening background sound levels are important because windows and doors may be open for natural ventilation, and potential for annoyance or sleep disturbance is higher. Longer term sound level averaging tests, such as 24 hours or multiple days are not appropriate since the purpose is to define the quiet time background sound level. It is defined by the LA90 and LC90 descriptors. It may be considered to be the quietest one (1) minute during a ten (10) minute test. L90A results are valid only when LA10 results are no more than 10 dB above LA90 for the same time period. LC10 less LC90 are not to exceed 15 dBC to be valid.

The background noise environment consists of a multitude of distant sources of sound. When a new nearby source is introduced the new background noise level would be increased. The addition of a new source with a noise level 10 dB below the existing background would increase the new background 0.4 dB. If the new source has the same noise level as the existing background then the new background is increased 3.0 dB. Lastly, if the new source is 3.3 dB above the existing background then the new background would have increased 5 dB. Therefore, if the existing quiet nighttime background noise level is 26 dBA, for example, then the maximum Excelaron operation noise immission contribution alone cannot exceed 29.3 dBA at a sensitive receptor dwelling to meet the requirement of LA90 + 5 dB = 31 dBA (26 dBA + 29.3 dBA = 31 dBA).

Further, background L90 sound levels documenting the pre-construction baseline conditions should be determined when the ten minute average wind speed is 2 m/s (4.5 mph) or less at the standard microphone location, 5 feet above grade.

4.3 “C-Weighted Sound Level (dBC)”

Similar in concept to the A-Weighted sound Level (dBA) but C weighting does not de-emphasize the frequencies below 1k Hz as A-weighting does. It is used for measurements that must include the contribution of low frequencies in a single number representing the entire frequency spectrum. Most sound level meters have a C-weighting network for measuring C-weighted sound levels (dBC) meeting the characteristics and weighting specified in ANSI S1.43-1997 Specifications for Integrating Averaging Sound Level Meters for Type 1 instruments. Normally, dBC means LeqC unless specified otherwise.

4.4 “Infra-Sound”

Infra-sound is sound with energy in the frequency range of 20 Hz and below is considered to be infrasound and is normally considered to not be audible unless in relatively high amplitude. The most significant exterior noise induced dwelling vibration occurs in the frequency range between 5 Hz and 50 Hz. Moreover, levels below the threshold of audibility can still cause measurable resonances inside dwelling interiors. Conditions that support or magnify resonance may also exist in human body cavities and organs under certain conditions, although no specific test for infrasound is provided in this document, its presence will be accounted for in the comparison of dBA and dBC sound levels for the complaint test provided later in this document.

4.5 “Low Frequency Noise (LFN)”

LFN refers to sounds with energy in the lower frequency range of 20 to 200 Hz. LFN is deemed to be excessive when the difference between a C-weighted sound level and an A-weighted sound level is greater than 20 decibels at any measurement point at the property line of a residence or other occupied structure. A large proportion of low-frequency components in noise may increase considerably the adverse effects on health. Low frequency noise can disturb rest and sleep even at low sound levels. The evidence on low frequency noise is sufficiently strong to warrant immediate concern, according to Guidelines for Community Noise, World Health Organization

Low frequency noise does not have a consistent definition, but it is commonly defined as noise that has a frequency between 20 and 200 Hz. Noise at levels below 20 Hz is referred to as infrasound. Depending on the actual conditions, many types of noise can be regarded as low frequency noise. Low frequency noise and infrasound are produced by machinery, both rotational and reciprocating, and all forms of transport and turbulence. Typical sources include pumps, compressors, diesel engines, and fans.

Combustion turbines are capable of producing high levels of low frequency noise. This noise is generated by the exhaust gas. The firing rate of many diesel engines is usually below 100 Hz, so road traffic noise can be regarded as low frequency. Similar considerations can be made for engines or compressors in industries or co-production plants. Burners can emit broadband low frequency flame roar.

Structure borne noise, originating in vibration, is also of low frequency, as is neighbor noise heard through a wall. Dwelling construction blocks higher frequencies more than lower frequencies, therefore, low frequency noise is heard when high frequency noise of the same energy content is not heard. Low frequency noise can be noise or vibration resulting from oil transport traffic or from industrial mechanical sources, totally or partly transmitted through the ground as vibration and reradiated from the floor or the walls in a dwelling.

Low frequency noise creates a large potential for residential sensitive receptor annoyance. It is most often experienced inside of homes and buildings where resonance amplifies the sound. It is a general observation that indoor noise is perceived as more “low-frequency-like” than the same noise heard out of doors. (Torben Poulsen,and Frank Rysgaard, 2002)

Also, low frequency noise can be a factor at much greater distances than audible noise sources. A case study in North Carolina near a wind turbine documented low frequency noise problems at residences located more than 1/2 mile from the turbine. (SERI, 1995)

Health Effects of Low Frequency Noise: It is well established that the annoyance due to a given noise source is perceived very differently from person to person. For many humans, their ears are not very sensitive to low levels of low frequency sound. At low frequencies, however, noise may not be perceived as sound but rather is “felt” as a vibration or pressure sensation.

For those who are sensitive to low frequency sound the effects can be dramatic. Complainants often describe the noise as:

> Humming; Rumbling; Constant and unpleasant; Pressure in the ears, Affects the whole body; Sounds like a large, idling engine; Seems to be coming from far away

Vasudevan and Gordon 1977) conducted field measurements and laboratory studies of people who complained of low frequency noise in their homes, and concluded the following:

The problems arose in quiet rural or suburban environments

The noise was often close to inaudibility and heard by a minority of people

The noise was typically audible indoors and not outdoors

The noise was more audible at night than during the day

The noise had a throbbing and rumbly characteristic

The complainants had normal hearing

4.6 “Thermal Inversion”

In the California coastal climate, it is sometimes observed that stationary and transportation noise can often be substantially higher than expected at distances of 1/2 mile or farther from the sound source. It is evident that these-higher-than-normal sound levels are caused by atmospheric conditions. When an inversion layer is present, if a sound occurs at ground level, the sound wave can be reflected from the warmer upper layer -- in which the sound travels faster, i.e., the air has lower acoustic refractive index, so the sound can undergo total internal reflection -- and return back to ground level; the sound, therefore, travels much farther than normal.

The atmospheric conditions in the California coastal areas that change expected noise attenuation are du to refraction of sound in thermal and wind gradients: The effective speed of sound in air is a function of air temperature and wind speed. Similar to the way that light is bent at an air/water interface because of the different speeds of light in the two media, sound waves are refracted, or bent, when sound speed varies because of wind and thermal gradients. One scenario happens in the summer, another in the winter, each resulting in thermal inversion, typified by the “marine layer,” stable air and ground fog.

The temperature inversion conditions that form on most clear nights cause sound waves to curve downward and result in increased sound levels a good distance away from the noise source. The result is that sound levels at a distance from the noise source tend to be higher than normal between sunset and about one hour after sunrise.

Some field studies of the interaction between atmospheric conditions and sound propagation have shown that sound levels may vary by as much as 5 to 10 dB at distances greater than 1/4 mile from a noise source. The subjective effect of this increase and decrease in sound level surpasses the threshold of signifi cance (3 dB) and can be perceived as a doubling of sound level (10 dB). Atmospheric effects on noise propagation may therefore result in the audibility of sounds, with resulting annoyance for some people. According to Filonczuk, et al (1995) there is as much as a 15-percent probability of fog on any given day in basins such as Huasna Valley during the dry season, compared to a probability of around five percent on any given day during the rest of the calendar year.

4.7 "Tonal Noise"

Tonal noise is noise with a narrow sound frequency composition, i.e., the whine of an electric motor at 60 Hz or a multiple. Annoying tones can be created in numerous ways: machinery with rotating parts such as motors, gearboxes, fans and pumps often create tones. An imbalance, or repeated impacts may cause vibration that, when transmitted through surfaces into the air, can be heard as tones.

Pulsating flows of liquids or gases can also create tones, which may be caused by combustion processes or flow restrictions.

Tones can be identified subjectively by listening. However, an objective measurement of tonal content is easily accomplished. In such cases, frequency analysis, where a noise signal is electronically separated into various frequency bands (e.g., octave bands or third-octave bands) is employed. The tonal audibility or annoyance factor is then calculated by comparing the tone level to the level of the surrounding spectral components.

Tonal noise can be measured using 1/3-octave band frequency analysis: There are simple, inexpensive applications for smartphones and touchpad computers that can effectively measure 1/3 octaive band sound levels and indicate the presence of tonal noise. There is an assumption that the great majority of low frequency noise problems from industrial sources are tonal. For tonal frequencies, the allowable noise limit to avoid adverse impact is less than for non-tonal noises. If the level in a particular third-octave band is 5 dB or more above the level in the two neighboring bands, the noise is described as tonal. This is similar to a standard for tonality set by the ISO (1987).

Penalties for tonal noise: In some jurisdictions, when noise has an obvious tonal content, a penalty or correction may be used to account for the additional annoyance. (ISO, 1987) The penalty for tones varies between 0 dB (no penalty) and 6 dB. (Bruel and Kjaar, 2000) This penalty is added to the measured dB level before the measured dB level is compared to the legal allowable noise limit.

For example, if the noise from a compressor is measured as 40 dBA, but it is determined that the noise has tonal components, a penalty of 6 dBA would result in a level of 46 dBA. If the noise standard is 45 dBA, the noise from the compressor would be out of compliance.

4.8 Statistical Noise Levels (L10, L50, and L90)

Statistical noise levels show how noise levels fluctuate over a given period. The L10 provides information on sound levels during the noisiest 6 minutes of any hour (or ten percent of the monitoring period). An L10 of 70 dBA means that, for 10 percent of the time, noise levels were above 70 dBA.

The L50 level provides information on sound levels in the upper half of the levels recorded—that is, the noisiest 30 minutes of any hour (or 50 percent of the monitoring period). An L50 of 65 dBA means that, for 50 percent of the time, noise levels were above 65 dBA.

The L90 metric provides information on sound levels during the quietest part of the monitoring period. An L90 of 30 dBA means that, for 90 percent of the time, noise levels were above 30 dBA, and for the remaining 6 minutes of the hour or 10 percent of the monitoring period, noise levels were below 30 dBA. The L90 measure is considered to be a conservative sound level for assessing increases arising from a proposed project because it is the near-minimum background level that only occurs, by definition, 10 percent of the time. The remaining 90 percent of the time a higher background sound level exists and project noise is less perceptible. Consequently, this background level represents the “worst-case” situation in terms of potential impact from project noise on sensitive residential receptors.

by David Lord, July 18, 2011

for 45dB.com:

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Figure 1. Measurement Terms

Graph showing instantaneous sound level measurements and the statistical descriptive terms.

LMAX is the maximum sound level reached.

L10 is the sound level exceeded only 10 percent of the time. In transportation studies, L10 sometimes taken as the traffic sound level, and is generally 3 dB higher than LEQ. During a one-hour period, L10 would be exceeded for only six minutes.

LEQ represents the total sound energy over the entire time period.

L50 is the sound level exceeded 50 percent of the time.

L90 is the sound level exceeded 90 percent of the time, also called "background sound level."

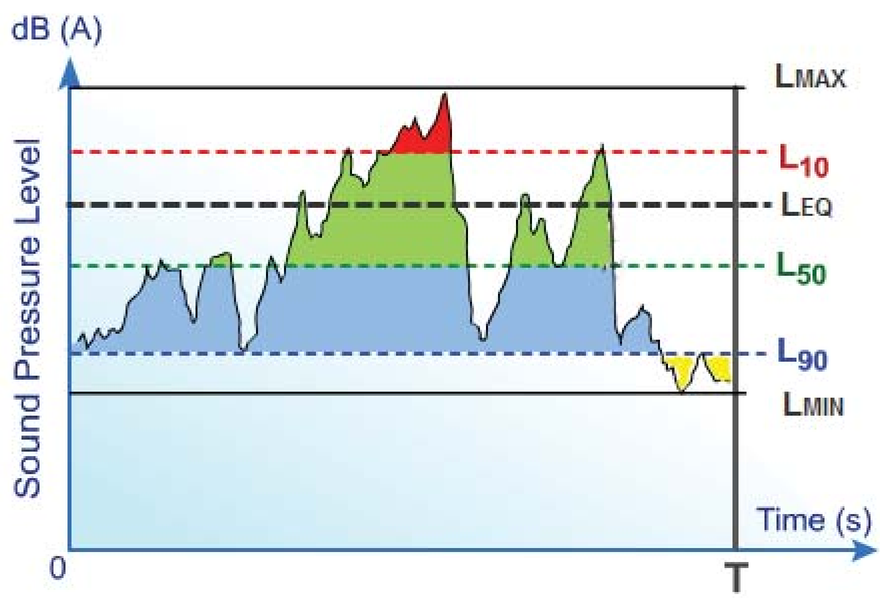

Figure 2. LDN and LEQ for the ML1 site

This figure is taken from Draft EIR Appendix F for the ML1 site. Sound Levels are expressed as LEQ 1 hour over a 24-hour period ranging from 32 dBA to 42 dBA. The LDN value for the same period is 44 dBA. Sleep disturbance and annoyance is most likely to occur during the quietest hour, generally 3am to 6am. L90 Background Sound level would be around 27 dBA during the quietest hour.

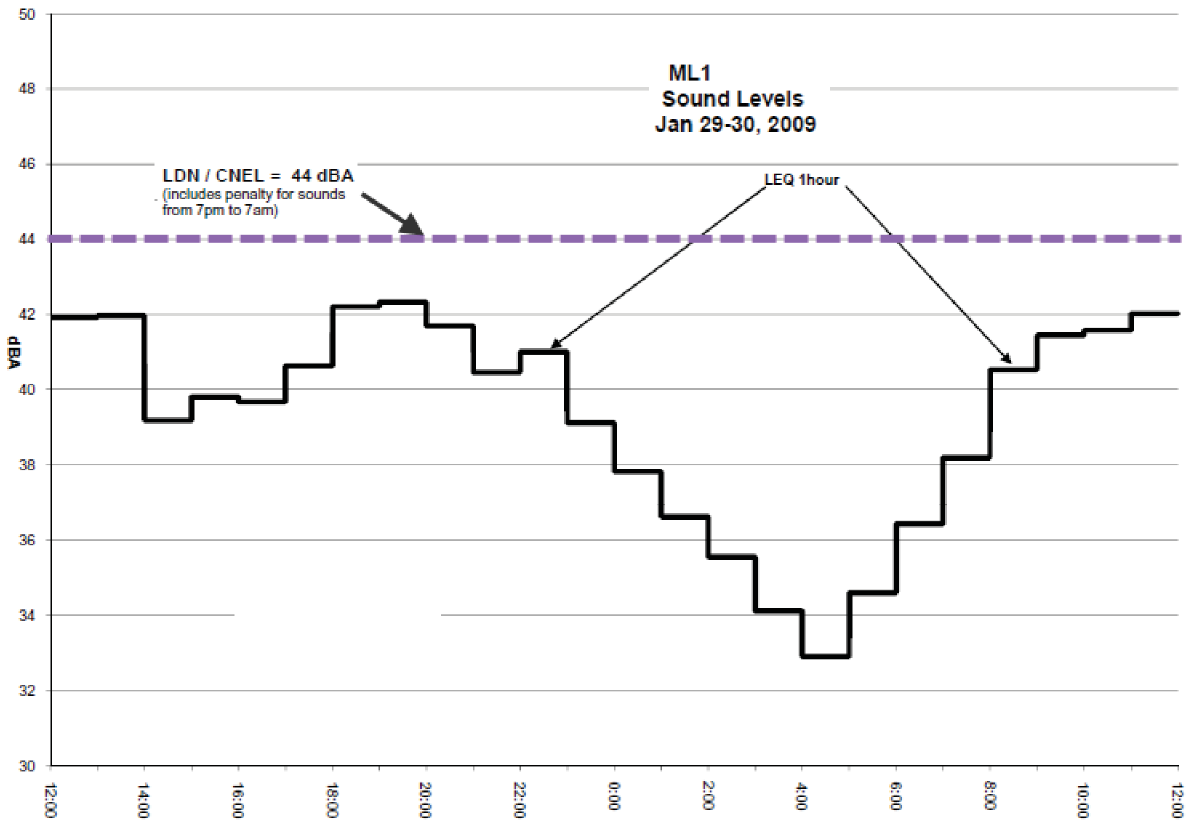

Figure 3. Thresholds for Observed Effects

Summary of effects and threshold levels for effects where sufficient evidence is available. From "12. World Health Organization (WHO). 2009. Night Noise Guidelines. Charlotte Hurtley, ed., available at: http://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf." on page 16

* although the effect has been shown to occur or a plausible biological pathway could be constructed, indicators or threshold levels could not be determined.

** *Note that "environmental insomnia" is the result of diagnosis by a medical professional while "self-reported sleep disturbance" is essentially the same, but reported in the context of a social survey. Number of questions and exact wording may differ

Effect		Indicator	Threshold, dB
Biological effects	Change in cardiovascular activity	*	*
	EEG awakening	$L_{Amax,inside}$	35
	Motility, onset of motility	$L_{Amax,inside}$	32
	Changes in duration of various stages of sleep, in sleep structure and fragmentation of sleep	$L_{Amax,inside}$	35
Sleep quality	Waking up in the night and/or too early in the morning	$L_{Amax,inside}$	42
	Prolongation of the sleep inception period, difficulty getting to sleep	*	*
	Sleep fragmentation, reduced sleeping time	*	*
	Increased average motility when sleeping	$L_{night,outside}$	42
Well-being	Self-reported sleep disturbance	$L_{night,outside}$	42
	Use of somnifacient drugs and sedatives	$L_{night,outside}$	40
Medical conditions	Environmental insomnia**	$L_{night,outside}$	42

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