

August 18, 2022

Mr. Peter Carli
ReNew Developers, LLC
14 Chestnut Hill Road
Colchester, CT 06415

SUBJECT: Environmental Sound Evaluation
234 Riverside Ave. Fuel Cell Power Plant
Bristol, CT

Dear Mr. Carli,

Cavanaugh Tocci Associates has evaluated environmental sound impacts associated with the proposed 4 MW fuel cell power plant at 234 Riverside Avenue in Bristol, Connecticut. The objectives of this evaluation were:

- To quantify and characterize existing background sound in the community surrounding the project,
- To define acoustic design goals,
- To estimate the acoustic impact of the proposed project in the surrounding community.

Results of the evaluation are summarized herein. Appendix A of this report is a glossary of relevant acoustic terminology.

Existing Background Sound

Sound is a feature of all environments. Sound is only objectionable when it is inconsistent with its environment; by being either too loud or by being distinctive in character (i.e. tonally or temporally varying). The goal of acoustical design is to render facility noise consistent with the level and character of other sounds in the environment. To this end, the following environmental noise analysis evaluates sound produced by the proposed Project in light of existing environmental sound levels.

An environmental sound survey was conducted to quantify and characterize the existing acoustic environment in the vicinity of the project site. To document typical background sound levels in the project area, the sound monitoring program consisted of continuous sound monitoring for a weeklong period (starting at 12:00 noon July 13, 2022). Figure 1 is an aerial photograph of the Project area that indicates the sound monitoring location (SM-1). This location was selected to provide data that is representative of typical sound levels at the nearest properties.

Sound levels were monitored using a Rion NL-52 sound level meter outfitted with ½ inch electret microphones and windscreen. The instrument was calibrated before the measurement period using a Larson Davis CAL-200 acoustical calibrator. These instruments and their use conform to ANSI S1.4 for Type 1 precision sound measurement instrumentation and have current calibration certificates traceable to National Institute of Standards and Technology (NIST). During the measurements, the microphone was mounted on a telephone pole approximately 5 feet above the ground.

For this study, the sound monitor was programmed to record the following hourly A-weighted and one-third octave band environmental noise descriptors:

- Maximum and minimum sound levels (L_{max} , L_{min})
- Percentile sound levels (L_{99} , L_{90} , L_{50} , L_{10} , L_{01})
- Equivalent sound level (L_{eq})

Figure 2 presents selected results of the environmental sound survey. The data indicates that hourly background sound levels at the nearest properties typically range between 45 dBA and 55 dBA with the lowest levels occurring during the early morning hours when local traffic is at a minimum.

Environmental Sound Regulations

There are two regulations that are pertinent with respect to sound produced by the proposed Project. These are the Connecticut Regulations for the Control of Noise, which are enforced by the Connecticut Department of Energy and Environmental Protection, and City of Bristol Noise Ordinance. The following briefly discusses the applicable aspects of these regulations.

State of Connecticut Noise Regulation

The State of Connecticut Noise Regulation (Section 22a-69-1 to 7.4) defines sound level limits for environmental sound produced by the Project. These limits are based on both emitter and receptor land use classifications, and are listed below in Table 1:

Table 1: Connecticut Regulations for the Control of Noise Sound Level Limits (dBA)

Emitter Class	Receptor Class			
	C	B	A/Day	A/Night
C	70	66	61	51
B	62	62	55	45
A	62	55	55	45

Definitions

In the above table, day is defined as the time interval 7:00 a.m. to 10:00 p.m. Night is defined as the time interval 10:00 p.m. to 7:00 a.m. Noise Zone Classifications are based on the actual use of the land. Where multiple land uses exist on the same property, the least restrictive limits apply.

- A Class A noise zone is land generally designated for residential use or areas where serenity and tranquility are essential to the intended use.
- A Class B noise zone includes land uses generally of a commercial or agriculture nature. In addition, vacant, undeveloped land, and parks are classified as Class B noise zones.
- A Class C noise zone includes uses generally of an industrial nature. The proposed fuel cell facility is considered a Class C noise emitter.

Exceptions and Other Limit Provisions

Section 22a-69-3.3 Prominent Discrete Tones

To offset the undesirable nature of tonal sound in the environment, the regulation penalizes sources of prominent, audible discrete tones. If a facility produces such sounds, the applicable limits in Table 1 are reduced by 5 dBA. In its definitions (Section 22a-69-1.2), the regulation defines a method for identifying prominent discrete tones based on measuring one third octave band sound levels.

City of Bristol, CT Noise Ordinance

Chapter 15 Article II of the Code of the City of Bristol is a noise ordinance. The definitions and limits found in this regulation are nearly identical to the state regulations.

Facility Acoustic Requirements

Our interpretation of the above referenced regulations follows:

- The Fuel Cell facility is classified as Class C emitter and will produce sound continuously during daytime and nighttime hours. As such, where the regulations provide more stringent limits for nighttime operation, these will apply.
- Sound produced by the fuel cell facility is not expected to contain prominent discrete tones as defined by the regulation.
- The Project is surrounded on the north, east, and west sides by commercial land uses. To the south is a park. All of these properties are classified as Class B receptors with a limit of 66 dBA (day or night).

- The nearest residential uses are approximately 450 feet north and south of the Project. At these residential property boundaries, the most stringent limit of 51 dBA applies.

Facility Sound Analysis

Facility related sound impacts that are associated with equipment at the proposed Project have been calculated using CadnaA environmental sound modeling software (Version 2022 DataKustic GmbH). The CadnaA sound modeling software uses algorithms and procedures described in International Standard ISO 9613-2:1996 "Acoustics- Attenuation of sound during propagation outdoors – Part 2: General method of calculation". This standard and its associated methodology are the most universally accepted approach for environmental sound modeling of industrial and transit sound sources. The methodology described in this standard provides estimates of A-weighted and octave band sound levels for meteorological conditions that are favorable for the propagation of sound (downwind with a wind speed of 1-5 meters/sec). This methodology is also valid for sound propagation under well-developed moderate ground-based temperature profile inversions, which commonly occur on clear calm nights.

The analysis is based on source sound emission data derived from measurements performed near similar fuel cell equipment located in Cambridge, Massachusetts, and Colchester Connecticut. Figures 3 presents the results of the acoustic modeling. As indicated in Figure 3, facility sound impacts are expected to be 55 dBA or lower at all receptor property boundaries. In addition, estimated sound levels at existing residences are 42 dBA or lower.

Conclusion

Based on our review of the modeling results, it is our opinion that sound produced by the proposed project will comply with the most stringent requirements of the state noise regulations. Furthermore, it is our opinion that sound produced by the proposed project will not produce a noticeable impact on the acoustic environment at existing nearby residences and will not have an unreasonable adverse effect at all surrounding properties.

Sincerely,
CAVANAUGH TOCCI



Douglas H. Bell
22183/234 Riverside Ave Britol CT Fuel Cell Power Plant - Sound Evaluation.docx

FIGURES



Aerial Photograph of Project Area Indicating Sound Monitoring Location

Figure 1

Sound Levels Measured at Project Site (SM-1)

234 Riverside Ave, Bristol, CT (July 13 - July 20, 2022)

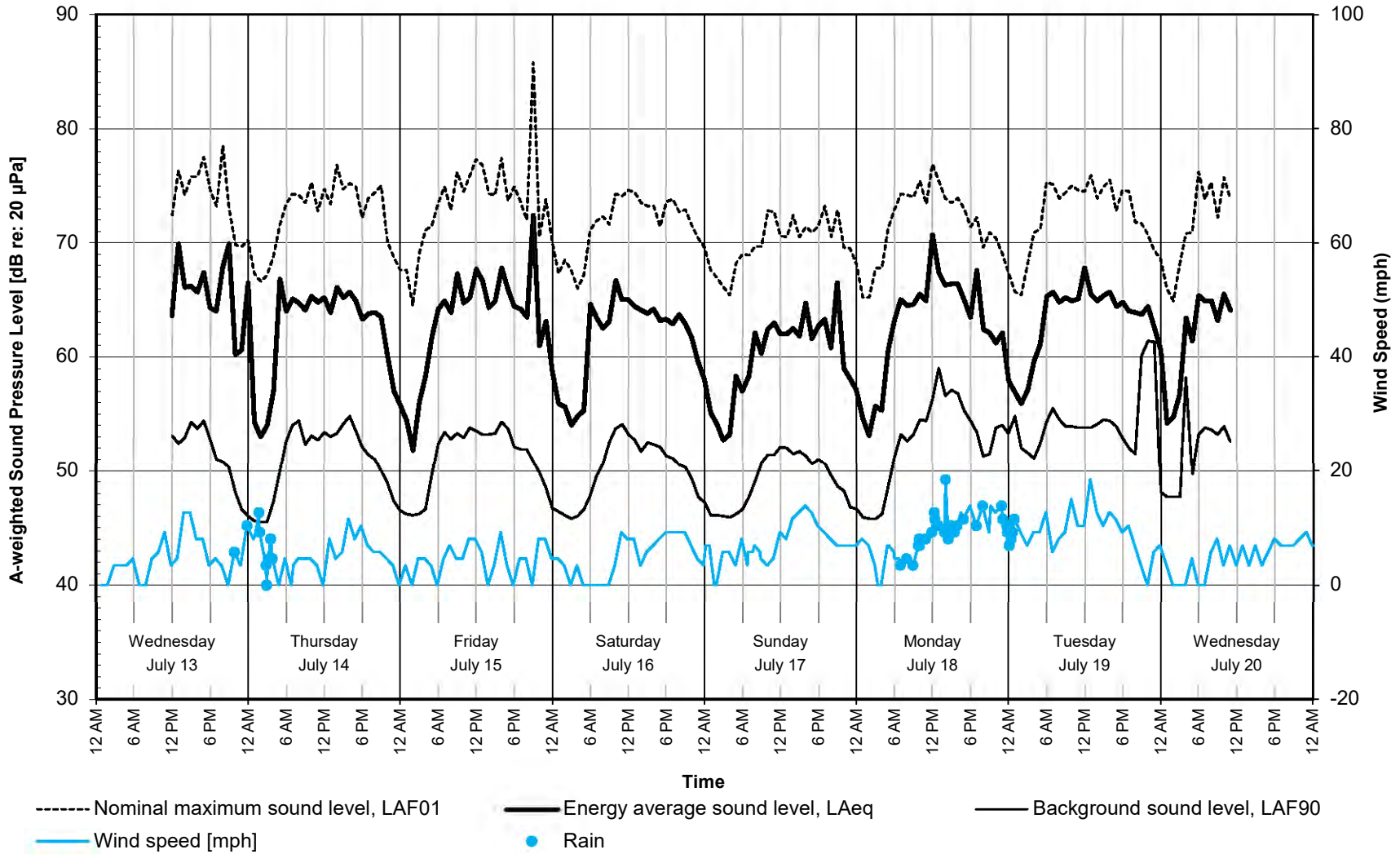
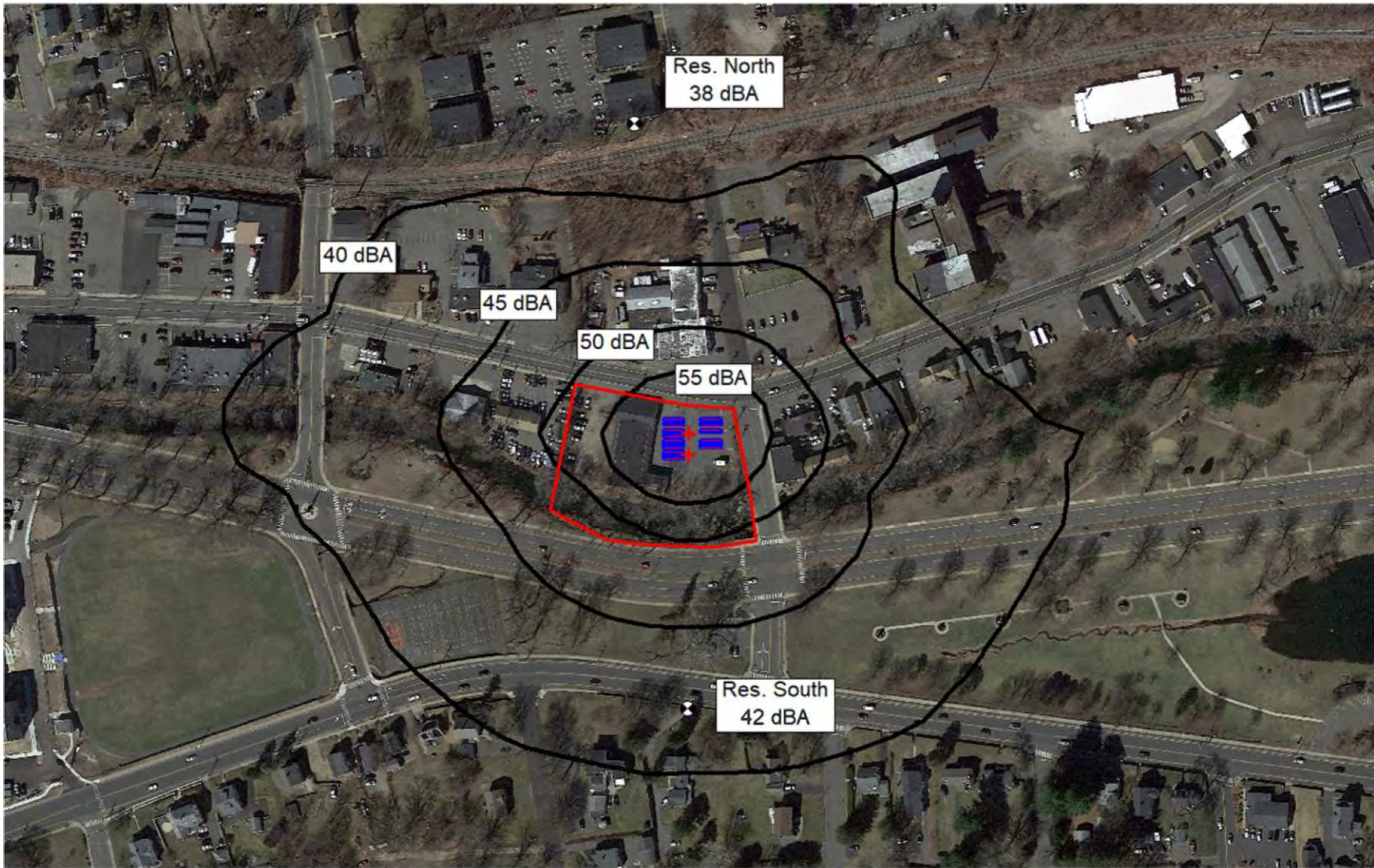


Figure 2

SM-1



Estimates of Facility Sound – Property Boundaries and Nearest Residences

Figure 3



Appendix A

Sound Measurement Terminology



SOUND MEASUREMENT TERMINOLOGY

In order to quantify the amplitude, frequency, and temporal characteristics of sound, various acoustical descriptors are used. The following is an introduction to acoustic terminology that is used in this report.

Sound Level

Sound levels are typically quantified using a logarithmic decibel (dB) scale. The use of a logarithmic scale helps to compress the wide range of human sensitivity to sound amplitude into a scale that ranges from approximately 0 to 180 dB. Note however, that the use of the logarithmic scale prevents simple arithmetic operations when combining the cumulative impact of sources. For example, two sources of equal sound level operated simultaneously results in a combined sound level that is only 3 dB higher than if only one source was operated alone. An important feature of the human perception of continuous sound is that an increase or decrease in sound pressure level by 3 dB or less is barely perceptible, and an increase or decrease by 10 dB is perceived as a doubling or halving of noise level.

A-weighting

Generally, the sensitivity of human hearing is restricted to the frequency range of 20 Hz to 20,000 Hz. However, the human ear is most sensitive to sound in the 500 Hz to 5,000 Hz frequency range. Above and below this range, the ear becomes progressively less sensitive. To account for this feature of human hearing, sound level meters incorporate filtering of acoustic signals that corresponds to the varying sensitivity of the human ear to sound at different frequencies. This filtering is called A-weighting. Sound level measurements that are obtained using this filtering are referred to as A-weighted sound levels and are signified by the identifier, dBA. A-weighted sound levels are widely used for evaluating human exposure to environmental sounds. To help place A-weighted sound levels in perspective, Figure A-1 contains a scale showing typical sound levels for common interior and environmental sound sources.

Spectral Characteristics – Octave and 1/3 Octave Band Sound Levels

To characterize a sound, it is often necessary to evaluate the frequency distribution of the sound energy. As mentioned before, the frequencies of most interest where human exposure is concerned range between 20 Hz and 20,000 Hz. This frequency range is commonly divided into octave bands, where an octave band is a range of frequencies. Each octave band is referred to by its center frequency and has a bandwidth of one octave (a doubling of frequency). To cover the full range of human hearing, it is necessary to measure sound in 10 separate octave bands. Typically, the lowest frequency band measured has a center frequency of 31.5 Hz. The next frequency band has a center frequency of 63 Hz. This geometric series continues to the highest frequency band that has a center frequency of 16,000 Hz. A set of octave band sound levels to describe a particular sound is called an octave band spectrum. Covering the full range of

hearing, an octave band spectrum would have 10 values, one for each band. Under certain circumstances, more frequency resolution in acoustical data is needed to identify the presence of tonal sounds. A 1/3 octave band spectrum uses filters that divide each octave band into 3 separate frequency bands. Note that octave band and 1/3 octave band sound levels are not usually A-weighted, with their units being dB.

Environmental Noise Descriptors

Sound levels in the environment are continuously fluctuating and it is difficult to quantify these time-varying levels with single number descriptors. Statistical approaches, which use *percentile sound levels* and *equivalent sound levels*, are often used to quantify the temporal characteristics of environmental sound.

Percentile sound levels (L_n) are the A-weighted sound levels that are exceeded for specific percentages of time within a noise measurement interval. For example if a measurement interval is one hour long, the 50th percentile sound level (L_{50}) is the A-weighted sound level that is exceeded for 30 minutes of that interval.

- L_{90} is the sound level in dBA exceeded 90 percent of the time during the measurement period. The 90th percentile sound level represents the nominally lowest level reached during the monitoring interval and is typically influenced by sound of relatively low level, but nearly constant duration, such as distant traffic or continuously operating industrial equipment. The L_{90} is often used in standards to quantify the existing background or residual sound level.
- L_{50} is the median sound level: the sound level in dBA exceeded 50 percent of the time during the measurement period.
- L_{10} is the sound level exceeded only 10 percent of the time. It is close to the maximum level observed during the measurement period. The L_{10} is sometimes called the intrusive sound level because it is caused by occasional louder noises like those from passing motor vehicles or aircraft.

By using percentile sound levels, it is possible to characterize the sound environment in terms of the steady-state background sound (L_{90}) and occasional transient sound (L_{10}).

The equivalent sound level (L_{eq}) is the energy average of the A weighted sound level for the measurement interval. Sounds of low level and long duration, as well as sounds of high level and short duration influence this sound level descriptor.

Noise levels at night generally produce greater annoyance than do the same levels which occur during the day. It is generally agreed that a given level of environmental noise during the day would appear to be 10 dBA louder at night – at least in terms of potential for causing community concern. The day night average sound level (L_{dn}) is a 24 hour average A-weighted

sound level where a 10 dB “penalty” is applied to sound occurring between the hours of 10:00 p.m. and 7:00 a.m. The 10 dB penalty accounts for the heightened sensitivity of a community to noise occurring at night.

When a steady continuous sound is measured, the L_{10} , L_{50} , L_{90} and L_{eq} are all equal. For a constant sound level, such as from a power plant operating continuously for a 24-hour period, the L_{dn} is approximately 6 dBA higher than the directly measured sound level.

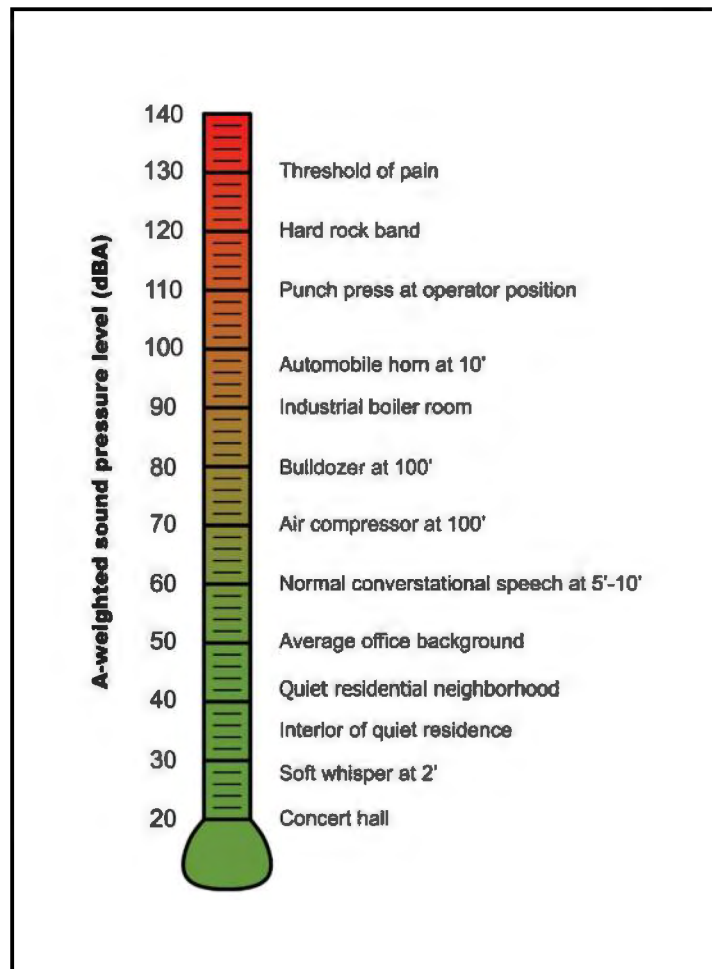


Figure A-1
Typical Sound Levels for Common Interior and Environmental Sources