NATIONAL GUIDELINES FOR ENVIRONMENTAL ASSESSMENT: HEALTH IMPACTS OF NOISE

DRAFT VERSION
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Noise levels must, at a minimum, be in accordance with applicable occupational and environmental legislation as well as applicable Federal and Provincial guidelines and policies to help reduce impact on human health.

NOISE ISSUES

1. GENERAL

- all hospitals, schools, day-cares and seniors' residences for which a significant effect is plausible from either project construction or operation noise (see Section 4 for effect assessment as a function of noise level for these sensitive sites) – if there are none, state this explicitly and provide a rationale;
- any sites within the study area where socially significant First Nations cultural or religious ceremonies take place;
- an estimation of the average duration that residents have lived in the baseline noise environment
- an indication of whether the community is a quiet rural one

Much of the information required above should be determined as part of the preliminary community consultation.

1.1 Option I. Monitoring selected sites for noise impact

Provide a list of selected noise sensitive receiver sites including:

- selected residences within the study area and the reasons why the sites were chosen; include selected residences from foreseeable site developments as per Figure 1, 3.2.4.1, Cumulative Effects Practitioners Guide (CEAA website http://www.ceaa-acee.gc.ca/013/0001/0004/index_e.htm)
- the number of residences (include seasonal cottages) that will be affected similarly to the selected residences;
- an indication of whether the community is a quiet rural one (as guidance, the AEUB Guide 38 indicates that the average rural ambient sound level in Alberta is about 35 dBA Leq at night)

1.2 Option II. Noise Contour Maps for assessing noise impact

Provide noise contour maps with the number of residences (including seasonal cottages) in each 5 dB interval. Include the number of foreseeable residences as well, as per Figure 1, 3.2.4.1,

Cumulative Effects Practitioners Guide (CEAA website http://www.ceaa-acee.gc.ca/013/0001/0004/index_e.htm). The Leq24 maps should normally start at an Leq24 value that clearly bounds the lowest reasonable value for the ambient level. A similar rule should be followed for the night time contour map.

If noise contour maps are calculated, selected monitoring is needed to validate predicted Leq 24 levels which may be as low as 40 dBA or Leq night time as low as 30 dBA in quiet rural areas

2. CHARACTERIZATION OF THE NOISE LEVELS

2.1 Baseline Noise Levels

Provide:

- representative baseline noise levels at the most exposed facade and a description of the measurement/prediction methods used (including an indication of commercial software used for predictions) - including:
    1. daytime (hours from 07:00 to 23:00) time-average sound level;
    2. night time (23:00 to 07:00) time-average sound level,
    3. 24 hour time-average sound level (Leq) values,
    4. 1 hour Leq from 22:00 to 23:00
- the number of hours/days used for monitoring and a rationale explaining why the noise levels can be considered representative
- an estimate of the effect of seasonal differences, differences between the weekend and weekday and, if applicable, differences due to weather conditions;
- identification of all noise sources contributing significantly to the baseline, by type (ie. traffic, aircraft, train, industrial, etc.). Each noise type shall be characterized by descriptors such as continuous, intermittent, regular impulsive, highly impulsive and high energy impulsive (examples of the different types of impulsive noise are given in CAN/CSA-ISO1996-1:05 (section 3.5) continuous tonal, intermittent tonal, etc. (ie. continuous traffic noise, intermittent aircraft noise);
- wind speed must not exceed 14 km/h and relative humidity should not exceed 90% since wind noise and precipitation would affect readings.

2.2 Construction Noise Levels

Provide:

- noise limits for construction activities and details on the enforcement procedures and penalties for non compliance
- a list of all sources that will contribute significantly to construction noise
- descriptors for each type of significant construction noise source such as continuous, intermittent, regular impulsive, highly impulsive and high energy impulsive (examples of the different types of impulsive noise are given in CAN/CSA-ISO1996-1:05 (section 3.5) continuous tonal, intermittent tonal (e.g., backup alarms),

- estimates for noise levels based on previous measurements at similar construction sites and/or predicted from source sound levels

- a description of the methods used to obtain the estimated construction noise level, including an indication of commercial software used; if source sound power levels are used, list their estimated values and give an indication of how they were obtained.
- scope and schedule of construction activities, including duration; of particular concern is whether there is nighttime construction and whether there will be pile-driving, especially at night
- representative baseline, construction and baseline + construction noise values at the most exposed facade of sensitive receiver locations or (optionally) as noise contour maps, including:
    1. daytime (hours from 07:00 to 23:00) time-average sound level;
    2. night time (23:00 to 07:00) time-average sound level;
    3. 24 hour time-average sound level (Leq) values;
    4. the 1 hour Leq from 22:00 to 23:00.
- (for construction noise only)correction factors to the 4 types of Leq values following the prescription in U.S. EPA 1974 so that the EPA method can be used to predict qualitative levels of complaints
- information should be presented to justify the use of these correction factors as per the EPA prescription (non-acoustical factors will need to be determined via preliminary community consultations
- mitigation measures during construction and the above relevant predicted noise levels after mitigation. In particular, consideration should be given to whether there is a need for ambient noise level sensitive backup alarms or alarms that can be adjusted by the vehicle operator;
- some description of the type of impacted residences should be provided with an estimate of attenuation from outdoor to indoor sound levels
- community consultation and noise monitoring plan

2.3 Operational Noise Levels

Provide:

- a comparison between noise levels with the project in place and legislated noise limits;
- restrictions placed on operational activities by applicable legislation;
- representative baseline, operational and baseline + operational noise values at the most exposed facade of sensitive receiver locations or optionally as noise contour maps, including:
    1. daytime (hours from 07:00 to 23:00) time-average sound level;
    2. night time (23:00 to 07:00) time-average sound level;
    3. 24 hour time-average sound level (Leq) values;
    4. The 1 hour Leq 22:00 to 23:00;
    5. Adjusted Leq24 and night time time-average sound levels following the recommendations in CAN/CSA-ISO1996-1:05, where the operational

values are determined for the time period following completion of the project.

- Description of the methods used to obtain the predicted operational noise level, including an indication of commercial software used;
- Mitigation measures during operation and the above relevant predicted noise levels after mitigation
- Follow-up community consultation and noise monitoring plan

3. ASSESSING SIGNIFICANT IMPACT - ANNOYANCE/COMPLAINTS

3.1 Construction Phase

General

- restrictions that applicable construction noise legislation might place on construction activities; provide explicit statement of commitments to meet restrictions;
- Comparison between legislated construction noise limits and construction + baseline noise levels; indicate mitigation needed to meet legislation and compliance enforcement procedures

Construction Duration Less than 1 Year - Option I

1. If the construction noise is ongoing for less than one year and the US EPA method of assessing qualitative complaint levels indicates that widespread complaints can be expected (U.S. EPA 1974, pp D-18 to D-20), mitigation should be proposed.
2. The necessary normalized sound levels values should be re-calculated for an after-mitigation condition.
3. If the normalized sound levels still indicate a likelihood of widespread complaints, this may be considered as indicative of a significant impact.

Construction Duration of Less than 1 Year - Option II

1. Determine the construction noise Leq24 and night time average sound level including appropriate adjustments for impulsive and tonal construction noise sources as per CAN/CSA-ISO1996-1:05. An adjustment to the sound levels for temporary construction duration less than 1 year should be made (AEUB 1999, EPA 1974) on an equal energy basis, i.e., the recommended adjustment is 10logT where T is the construction duration in years. This adjustment should be restricted to the range of 0 to -10 dB. The temporary construction adjustment is an extrapolation of CAN/CSA-ISO1996-1:05 and is not part of the standard. The specific adjustment suggested here is not found in either Guide 38 or the EPA document.

NOTE 1. Audible highly impulsive noise contributions to the adjusted Leq 24 and night time average sound level (Ln) as may be found during construction from pavement breaking, pneumatic hammering, pile-driving etc., should have an adjustment of +12 dB.
NOTE 2. Audible regular impulsive noise contributions, as may be found from tailgate slams, should have an adjustment of +5 dB.
NOTE 3. Prominent tones as may occur in some types of backup alarms should have an adjustment of +5 dB
NOTE 4. Backup alarms and slamming tailgates on dump trucks are the most frequently noted complaints at construction sites in the USA (Thallheimer 2000).

2. The percentage highly annoyed should be calculated using the procedure in Annex E.2 of CAN/CSA-ISO1996-1:05 for the baseline condition and the baseline + construction condition.-

NOTE 5. If the baseline noise is made up of multiple sources, ideally, the adjusted baseline Leq24 and Ln values should be determined from equations (4), (5)and (6) of CAN/CSA-ISO1996-1:05 using the appropriate adjustments for the various baseline sources as per CAN/CSA-ISO1996-1:05.

The dose-response relationship for the percentage highly annoyed HA is

$$HA = \frac{100}{1 + \exp[10.4 - 1.32*\log(10^{0.1*Leq24a} + 3.375*10^{0.1*Lna})]}$$

Leq24a – adjusted 24 hour time average sound level
Lna – adjusted night time average sound level

3. If the percentage highly annoyed increases by 6.5% or more compared to the baseline condition, OR if the value of $10\log(10^{0.1*Leq24} + 3.375*10^{0.1*Ln})$ (with only the temporary adjustment) for the baseline + construction condition exceeds 75 dBA, then the impact may be considered severe (HMMH 1995, FTA 1995, FRA 1998) and mitigation should be proposed.

4. The comparison of percentage highly annoyed should be made for the after-mitigation condition. If the change is still greater than or equal to 6.5% OR if the value of $10\log(10^{0.1*Leq24} + 3.375*10^{0.1*Ln})$ (with only the temporary adjustment), for the baseline + construction condition, exceeds 75 dBA, then this may be considered a significant impact.

Construction Duration of 1 Year or More

1. If the construction noise is ongoing for 1 year or more, then the percentage highly annoyed should be calculated using the procedures of CAN/CSA-ISO1996-1:05 for the baseline condition and the baseline + construction condition.
2. If the percentage highly annoyed increases by 6.5% or more, OR if the unadjusted value of $10\log(10^{0.1*Leq24} + 3.375*10^{0.1*Ln})$ of the baseline + construction condition exceeds 75 dBA, then the impact is considered severe (HMMH 1995, FTA 1995, FRA 1998) and mitigation should be applied.
3. The comparison of percentage highly annoyed should be made for the after-mitigation. If the value is still greater than or equal to 6.5%, OR if the unadjusted $10\log(10^{0.1*Leq24} + 3.375*10^{0.1*Ln})$ of the baseline + construction condition exceeds 75 dBA, then this may be considered a significant impact.

3.2 Operational Phase

1. The percentage highly annoyed should be calculated using the procedure of Annex E.2 of CAN/CSA-ISO1996-1:05 for the baseline condition and the baseline + operation condition.

NOTE 6. If the baseline noise is made up of multiple sources, ideally, the adjusted baseline Leq24 and Ln should be determined from equations (4), (5)and (6) using the appropriate adjustments for the various baseline sources as per CAN/CSA-ISO1996-1:05.

If the percentage highly annoyed increases by 6.5% or more OR if the value of

$10 \log(10^{0.1*Leq24}+3.375*10^{0.1*Ln})$ exceeds 75 dBA, then the impact is considered severe (HUD 1984, HMMH 1995, FTA 1995, FRA 1998). It is recommended that mitigation should be proposed in this situation.

2. The comparison of percentage highly annoyed should be made after mitigation. If the value is still greater than or equal to 6.5%, OR if the value of $10 \log(10^{0.1*Leq24}+3.375*10^{0.1*Ln})$ exceeds 75 dBA , then this should be considered a significant impact.

NOTE 7: Ideally, the comparison should be between the future situation without the proposed project and the future situation with the proposed project. As the comparison is made 10 years after completion, the no-project situation may not be equivalent to the baseline noise environment. In practice, the baseline is allowed for the comparison because it must be determined anyway and it may not be feasible to assess the no project situation.

NOTE 8: The adjusted Leq24 and Ln sound levels are equal to their unadjusted values for all industrial noise as per CAN/CSA-ISO1996-1:05. However, audible tonal components and impulsive noise components should be adjusted as per NOTES 1 –3 above and as specified in CAN/CSA-ISO1996-1:05. A +10 dB adjustment i.e., Leq24a = Leq24 +10 dB and Lna = Ln+10dB should be used if the baseline is a quiet rural setting.

The dose-response relationship for the percentage highly annoyed HA is

$$HA = \frac{100}{1 + \exp[10.4 - 1.32*\log(10^{0.1*Leq24a}+3.375*10^{0.1*Lna})]}$$

Leq24a – adjusted 24 hour time average sound level
Lna – adjusted night time average sound level

The qualifications to the dose response relationship are described in CAN/CSA-ISO1996-1:05.

NOTE 9: Use of the words “may” and “should” are deliberate regarding consideration of a significant impact for Construction (“may”) and Operational Impacts (“should”) because construction noise is temporary and impacts are expected to be reversible, whereas operational noise is permanent and impacts can be long-term and irreversible.

3. A follow-up noise complaint survey should be done to locate noise sources and determine the degree of additional attenuation required.
4. There should be follow-up of acoustic performance within 1 year of commencement of project operation to verify if compliance to noise specifications has been satisfied.

4. ASSESSING SIGNIFICANT IMPACT - SCHOOLS, PRE-SCHOOLS/DAY-CARES, HOSPITAL AND SENIORS’ RESIDENCES

4.1 Construction Phase

4.1.1 Schools and Pre-schools - Communication

1. For schools and pre-schools, the target sound level for mitigation required to eliminate significant impacts is an indoor time-average sound level of 35 dBA (WHO 1999, Alberta Infrastructure 2001) during class time. At this level, children with normal hearing should be able to hear and understand spoken messages in classrooms (WHO 1999).
2. If this level is exceeded then mitigation should be proposed.
3. If this level is not reached after mitigation, then speech intelligibility will be negatively impacted

4.1.2 Pre-school Sleeping Areas, Hospital Wards and Rooms, Seniors' Residences - Sleep

1. For pre-school sleeping areas and hospital wards and rooms the WHO recommends an indoor Leq of 30 dBA for continuous noise. For the purposes of this guide, seniors' residences will also be included in these categories. The time periods should be 7 am - 11 pm and 11 pm - 7 am for the hospital, during nap-time hours for the preschool/ daycare and 11 pm - 7 am for the seniors' residence.
2. If the indoor noise from construction noise exceeds Leq of 30 dBA at the sites during the relevant sleep time periods, mitigation should be proposed.
3. If this is not reached after mitigation, then sleep will be negatively impacted.
4. Construction noise may also be intermittent in nature. In this case, the WHO recommends that for a good sleep, indoor sound pressure levels should not exceed approximately 45 dBA Lmax more than 10-15 times per night (for the variable sleep time periods for pre-school sleeping areas, hospital wards and rooms and seniors residences, this criteria for the night is interpreted to mean an 8 hour time period).
5. If this level is exceeded, mitigation should be proposed.
6. If the level is not reached after mitigation, then sleep may be negatively impacted.

4.2 Operational Phase

4.2.1 Schools and Pre-schools - Communication

1. For schools and pre-schools, the target sound level for mitigation required to eliminate significant impacts is an indoor time-average sound level of 35 dBA (WHO 1999, Alberta Infrastructure 2001) during class time. At this level, children with normal hearing should be able to hear and understand spoken messages in classrooms (WHO 1999).
2. If this level is exceeded then mitigation should be proposed.
3. If this level is not reached after mitigation, speech intelligibility will be negatively effected.

4.2.2 Pre-school Sleeping Areas, Hospital Wards and Rooms and Seniors' Residences - Sleep

1. For pre-school sleeping areas and hospital wards and rooms the WHO recommends an indoor Leq of 30 dBA for continuous noise. For the purposes of this guide, seniors' residences will also be included in these categories. The time periods should be both 7 am - 11 pm and 11 pm - 7 am for the hospital, during nap-time hours for the preschool/ daycare and 11 pm - 7 am for the seniors' residence. These should be the target values for the pipeline noise indoors at these facilities.
2. If these levels are exceeded, then mitigation should be proposed.
3. If these levels are not reached after mitigation, then sleep may be negatively effected

REFERENCES

Alberta Standards and Guidelines for School Facilities (Alberta Infrastructure 2001)

AEUB (1999) Guide 38: Noise Control Directive User Guide: November 1999. Alberta Energy Utilities Board.

CAN/CSA-ISO1996-1:05 (2005) (ISO 1996-1:2003). Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures.

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