

NATIONAL GUIDELINES FOR ENVIRONMENTAL ASSESSMENT: HEALTH IMPACTS OF NOISE

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1. INTRODUCTION

The *Canadian Environmental Assessment Act* (CEAA) requires certain projects with Federal Government involvement to undergo an environmental assessment (EA) before they are allowed to proceed. The intent is to identify, predict, evaluate and mitigate environmental and health impacts of a proposed project before it begins. Under CEAA, a project may not proceed if it causes significant adverse impacts, after mitigation is accounted for [1,2]. Impacts include health effects from project-related noise. Noise will likely continue to be an important issue in projects of major social, economic and military importance.

To cope with this issue, the efficiency and transparency of environmental noise impact assessment needs to be improved. The current situation is problematic because the number of assessments across Canada has increased considerably. Also, a wide variety of noise sources have been assessed, including: aircraft (civilian and military), rockets, rail, highway traffic, energy (wind turbines, gas pipeline compressor stations), construction and industrial. Furthermore, a wide variation has developed in the information and analyses used to assess the potential health impacts of project-related noise. An existing Federal-Provincial document, *National Guidelines for Environmental Noise Control* [3] was not designed to address these problems and elements of the document are out of date.

A new guideline document, *National Guidelines for Environmental Assessment: Health Impacts of Noise* is proposed to address the problems. This paper summarizes some options and considerations for development of the proposed guidance document.

2. HEALTH IMPACTS ASSESSMENT

The EA must consider direct and cumulative effects on human health, *i.e.*, physical, mental and social well-being [2]. The EA must also determine whether health effects are: (i) adverse, (ii) significant and (iii) likely. Significance is determined by: (i) severity, (ii) duration, (iii) frequency, and (iv) reversibility of the effects. The number of people affected may also need to be taken into account.

2.1 Characterizing the Noise Environment

To determine whether effects from project-related noise are adverse, the existing quality of the noise environment (baseline) must be compared to the quality of the noise environment after the project is in place [1]. This requires characterization of the noise environment through noise measurement and/or modeling.

The Guidelines will have to clarify requirements for measurement and/or modeling of noise levels, depending on noise source and type of noise. For example, impulsive noise, from shunting in rail yards and pile driving during construction, requires special consideration compared to more continuous noise, as from highway traffic. Ideally, the sound exposure level should be determined for each impulsive noise event and then appropriately adjusted [4].

Some guidance is also needed to ensure consistent prediction of noise levels from: (i) construction where multiple pieces of heavy machinery are in use simultaneously and (ii) noise sources at marine ports where propagation over water can be important.

The Guidelines will either need to reduce the number of noise metrics used to assess health impacts or provide guidance on conversion between metrics. Some Canadian guidelines require the A-weighted 24 hr time-average sound level, L_{eq24h} , whereas, others require a worst-case A-weighted 1 hr time-average sound level, L_{eq1h} . Annoyance assessments utilize the day-night sound level, DNL. However, civilian aircraft noise is mapped by Noise Exposure Forecast (NEF) contours in the airport vicinity [5].

Various national and international standards and commercial software/equipment are available for measuring/modeling environmental noise levels and these will need to be referenced/described in the Guidelines.

The proponent needs to determine representative baseline and project-related noise levels. The Guidelines will need to provide some guidance regarding the number of hours/days needed for monitoring and whether seasonal differences and differences between the weekend and weekday need to be taken into account. Guidance should also be provided for

determining noise levels so that all noise-sensitive sites are satisfactorily taken into account, including residences and noise-sensitive facilities such as schools or hospitals. Part of this guidance will be whether to use noise level contours or measurement/prediction at selected sites.

2.2 Standards and Guidelines

Ideally, existing Canadian guidelines and standards could be used to determine whether adverse health impacts are significant but, for noise, this is complicated by differences between various Canadian guidelines/standards. Important differences also exist between Canadian, international and U.S. standards and guidelines.

One important issue that needs to be addressed is whether, as the baseline noise level increases, health impacts become more severe for a fixed change in noise level. In some Canadian guidelines, the change in sound level is limited to a fixed value, regardless of baseline noise level. At the other extreme, some guidelines have sound level limits.

The “competition” between existing standards and guidelines also applies to noise sources such as: (i) gas compressor stations, where low frequency noise can be easily transmitted into residences, potentially causing vibration and rattling, and (ii) wind turbines.

In Canadian and U.S. guidelines, industrial, energy, highway, aircraft and rail noise sources are all treated differently. The Guidelines will need to indicate, with a rationale, which standard(s) and/or guideline(s) should be applied, depending on the noise source.

There are no guidelines for the important issue of determining the significance of noise impacts on cultural and ceremonial activities of First Nations people [2].

2.3 Dose-Response Relationships

Given the challenge of applying standards and guidelines to determine the significance of health impacts of noise, dose-response relationships need to be used to judge the severity and likelihood of effects. Various dose-response relationships for environmental noise have been established for speech interference, sleep disturbance and annoyance. Thresholds for associations with: (i) impaired reading comprehension in children and (ii) cardiovascular disease in adults have been suggested but causal relationships have not been demonstrated.

An international standard for environmental noise assessment [4] provides a dose-response relationship for the percentage highly annoyed as a function of rating level, for transportation and industrial noise sources in a typical community. The rating level arises from adjustments to the DNL to account for specific situations. The adjustments are: +10 dB in quiet rural settings, +12 dB for highly

impulsive noise such as rail yard shunting, +3 to +6 dB for aircraft noise, 0 dB for road traffic and industrial noise and -3 to -6 dB for electric trains.

“Competing” dose-response relationships for construction noise have been used in EAs based on: (i) the ISO annoyance relationship and (ii) U.S. guidelines for a qualitative complaints response to noise [6]. The challenge is that effects are temporary but may be relatively severe, particularly at night from pile driving and backup alarms.

Critical analysis of available dose response relationships will be needed to decide on their use in the Guidelines.

2.4 Mitigation

To some extent, the Guidelines will also have to address mitigation measures. CEAA emphasizes community consultation and this is known to be a non-acoustical factor that can help mitigate annoyance with noise. With regard to acoustical factors, practices in other countries include controversial issues such as compensation of exposed residents for sound proofing within residences. These practices must be evaluated in a Canadian context.

3. CONCLUSIONS

National Guidelines are needed with criteria, methodologies and rationales for determining, as required by CEAA, whether project-related noise is likely to cause significant adverse health effects. A balanced working group must develop the document because of the complexity and broad range of issues. There must be wide ranging consultations with major Federal, Provincial, Territorial, industry and community stakeholders. The guidance document should also contain a checklist so that proponents would know the basic information needed for an environmental noise assessment, suggested criteria levels to be targeted and guidance for mitigation. This format would also serve to help make the environmental assessment more easily understood by all stakeholders.

REFERENCES

- [1] Canadian Environmental Assessment Agency (2003). Reference Guide: Determining Whether A Project is Likely to Cause Significant Adverse Environmental Effects.
- [2] Health Canada (1999). Canadian Handbook on Health Impact Assessment.
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- [4] ISO (2003). ISO 1996-1:2003. Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures.
- [5] Transport Canada (1996) TP 1247E - Land Use in the Vicinity of Airports, Part IV – Aircraft Noise.
- [6] U.S. EPA (1974) Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety.