NOISE LEVELS FROM HEAVILY TRAVELLED ROADS FOR USE WITH ENVIRONMENTAL NOISE REGULATIONS IN BRITISH COLUMBIA AND ALBERTA

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1 Introduction

Noise Impact Assessments (NIAs) for oil and gas facilities in British Columbia (BC) are typically conducted in accordance with the BC Oil & Gas Commission's (BC OGC) Noise Control Best Practices Guideline [1]. NIAs for industrial facilities in Alberta are typically conducted in accordance with Alberta Utilities Commission (AUC) Rule 012 [2] or Alberta Energy Regulator (AER) Directive 038 [3]. The BC OGC Guideline, AUC Rule 012, and AER Directive 038 are very similar with respect to assessment methodology and compliance limits. All three documents require that noise be assessed cumulatively and, in particular, require that the contribution of heavily travelled roads be included when testing noise compliance for industrial facilities. The three documents have slightly different definitions of a heavily travelled road; Directive 038 has the most specific definition, requiring at least 10 vehicles per hour during the nighttime period. All three documents endorse the same desktop technique for estimating A-weighted Ambient Sound Levels (ASLs) at various distances from heavily travelled roads. This paper compares ASL values estimated using the regulatory desktop technique and noise levels calculated using a widely-accepted computer model of road traffic noise. Noise levels are compared for various receptor distances and various traffic levels.

2 Method

2.1 Computer Noise Model

A computer noise model was developed to predict traffic noise levels using commercially available software. There are a number of different traffic noise standards available; the Traffic Noise Model (TNM) developed by the Federal Highway Administration (FHWA) was selected for use in this study.

The Type 7810 Predictor® software (version 9.11), developed by Softnoise GMBH and distributed by Brüel & Kjær, implements TNM 2.5 and was used to develop predictive noise models for this study. The TNM standard characterizes road source emissions based on traffic volume, vehicle speed, road width, pavement type, and vehicle category distribution (i.e., car, heavy truck). The TNM standard accounts for noise attenuation related to ground cover

The computer model for this study predicted daytime and nighttime noise levels at distinct receptor distances and for a variety of hourly traffic volumes. As these predicted noise levels are from traffic only, the noise contribution from non-road sources must be added to be comparable to regulatory ASLs.

2.2 Ambient Sound Levels

The ASL represents background noise levels in the absence of energy resource and power generating facilities. The BC OGC Guideline, AUC Rule 012, and AER Directive 038 all use the same method for determining the relevant ASL for a given receptor. Based on research conducted by the Environment Council of Alberta, the average rural ASL in Alberta is approximately 35 dBA during the nighttime period. Daytime ASLs are 10 dB higher than nighttime ASLs and therefore the daytime rural ASL is 45 dBA. The guidelines indicate that these default ASL values are appropriate for low population areas and far from transportation infrastructure, but provide a specific method for adjusting ASL values for population density or transportation infrastructure. Table 1 presents ASLs for a number of different dwelling densities and distances to a road.

Table 1: Ambient Sound Levels for varying distances to heavily travelled roads and dwelling densities.

Distance (m)	Dwelling density per quarter section of land[1]					
	<9 dwellings		9-160 dwellings		>160 dwellings	
	Day	Night	Day	Night	Day	Night
<30	55	45	58	48	61	51
30-500	50	40	53	43	56	46
>500	45	35	48	38	51	41

[1] Quarter section of land is equivalent to an area with radius 451 m and the affected dwelling at the centre.

The ASLs prescribed for a receptor greater than 500 m from a road, which corresponds to the ASL for an area unaffected by road noise, were logarithmically added to the modelled traffic noise levels discussed in Section 2.1 to capture non-road related noise.

3 Results

Predicted nighttime noise levels for three different dwelling densities and various traffic volumes are shown in Figure 1, alongside the relevant regulatory ASL. A vehicle speed of 80 km/hr and a vehicle category distribution of 80% cars and 20% heavy trucks was used for this modelling.

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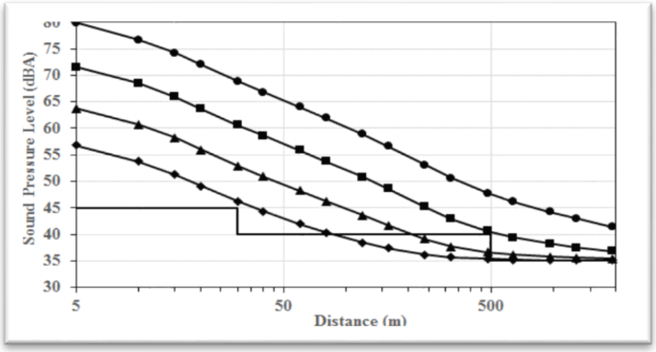
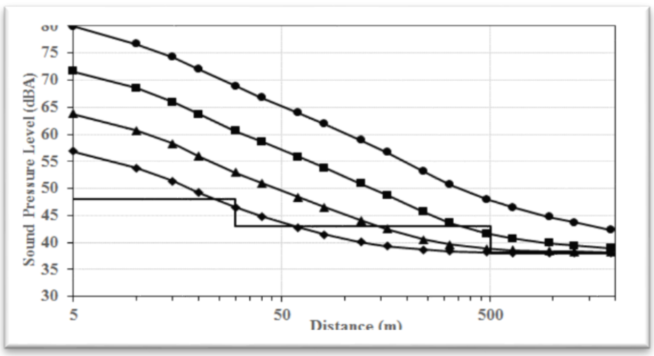
a)



b)



c)

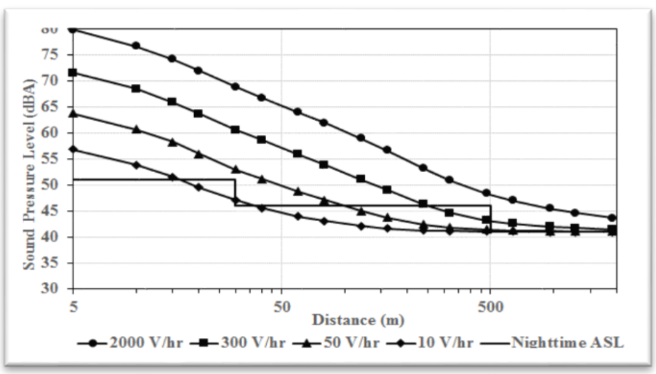


Figure 1: Predicted nighttime noise levels for various traffic volumes and the following dwelling densities per quarter section: a) <9 dwellings; b) 9-160 dwellings; and c) >160 dwellings.

ASLs are predicted to be within 5 dBA of noise levels from a road with 10 vehicles per hour (except very close to the road), consistent with Directive 038's definition of a heavily travelled road at night. The predicted sound pressure levels are higher than the prescribed ASLs for high traffic volumes and short distances to the road. As the dwelling density increases, the differences between the predicted noise levels and the ASLs become smaller.

Figure 1 is based on a vehicle speed of 80 km/hr; changing the vehicle speed has a substantial effect on noise levels near to the road. Increasing the speed to 110 km/hr increases the predicted noise level by an average of 3.7 dBA at receptors closer than 20 m to the road. Decreasing the speed to 50 km/hr decreases the noise level by an average of 3.5 dBA at receptors closer than 20 m to the road.

Traffic noise was predicted for daytime and nighttime periods for three road classes with high traffic volumes: expressway, major arterial, and minor arterial. These road types were quantified based on the parameters presented in Table 2. Table 2 also presents the predicted noise levels for a dwelling density of less than nine dwellings per quarter section.

Table 2: Modelled noise levels for different types of high-traffic roads assuming <9 dwellings per quarter section.

Parameter	Expressway		Major Arterial		Minor Arterial	
	Day	Night	Day	Night	Day	Night
Vehicle/hr	7200	1680	1800	420	840	196
Speed (km/hr)	80	80	60	60	50	50
% Heavy Truck	25	45	20	20	20	20
Distance (m)	Predicted Noise Levels (dBA)					
10	84	79	74	68	70	64
30	78	74	69	62	64	58
100	70	66	60	53	56	49
250	58	54	**51**	**44**	**49**	**41**
500	**54**	50	**49**	**41**	**47**	**39**
1000	51	46	**47**	**39**	**46**	**37**

Bold indicates prediction within 5 dBA of the regulatory ASL

4 Discussion

Noise modelling indicates that regulatory ASLs underestimate noise levels at receptors near roads with high traffic counts. Figure 1 indicates that nighttime ASLs are representative of roads with 10 vehicles per hour and with a vehicle speed of 80 km/hr; roads with higher traffic volumes and higher vehicle speeds result in higher noise levels that are underestimated by regulatory ASL values. Table 2 indicates that predicted noise levels for typical types of heavily travelled roads are greater than the regulatory ASL for almost all distances. At distances less than 250 m, predicted noise levels are greater than regulatory ASLs by more than 5 dBA.

5 Conclusion

Predicted noise levels for varying traffic volumes were compared with ASL values prescribed in BC and Alberta noise regulations. ASLs were found to be representative of a road with a low traffic count (10 cars per hour during the nighttime) travelling 80 km/hr. The ASLs are not representative of noise levels from roads with higher traffic counts or higher vehicle speeds; both of these factors should be taken into account when establishing existing conditions as part of regulatory NIAs.

References

[1] BC OGC. Noise Control Best Practices Guideline. 2009.

[2] AUC. Rule 012: Noise Control. 2013.

[3] AER. Directive 038: Noise Control. 2007.