ASSESSMENT OF AIRCRAFT NOISE IMPACT ON RESIDENTIAL AREA

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1. INTRODUCTION

With the flight frequencies increased recently, aircraft noise is associated with an increasing community concern. For example, Blackwell (2004) observed that noise pollution from aircrafts posed adverse impacts on workers in the airport and surrounding residents as well as their properties. The methods of assessing the noise impact in airport residential area have been proposed. For example, Janssens et al. (2006) proposed a model-based synthesis approach for vehicle and aircraft noise. Butikofer (2007) studied the concepts of aircraft noise calculations from the airport operation point of view. This paper includes a preliminary environmental assessment of the impacts (EIA) on the residential areas resulting from aircrafts activities in the Montreal international airport.

2. MATERIAL AND METHOD

2.1 Study area

The Dorval residential area, which is the closest to the Montreal Trudeau Airport, located approximately 19 kilometers from the downtown of Montreal is selected in this case study. There are numerous aircrafts of different Airlines companies, which serve at the airport, travel to various locations around the world. They are the most regular aircraft flying in and out of Montreal Trudeau Airport. Most of the flight traffics pass through the Dorval area as shown in Figure 1.

2.2 Method

According to Bram and Mills (2006), six steps are considered in an EIA regarding the aircraft noise. This study was conducted between February and May 2006. A portable Digital Sound Level Meter (Model TES-1351, GENEQ INC.) was used in this study for the field measurement. Field measurements and sociological surveys typically representing the residential areas focusing on 30 positions were undertaken to determine noise levels at different locations at the surrounding residential area of the airport. The distance from Airport to the selected sampling positions was ranging from 2 km to 11 km. The sampling and monitoring are carried out at representative locations during the morning, afternoon and evening in presence and absence of flights. The procedure was applied three times a day with 12 locations in the morning session, 9 in the afternoon, and 9 in the evening. In addition, the measurement for each position was taken two times with and without the presence of flights.

Quality control of monitoring data is conducted according to the relevant procedures and guidelines. Levels of noise emissions and impact concerns were investigated following the aforementioned six steps. Local aircraft activities are assumed fixed-wing aircraft operations and ground operations used in this study (Goff and Novak 1977):

$$EN = d + (16.7)\, n \quad (1)$$

where, EN = effective number of operations; d = number of daytime operations (0700-2200); and n = number of nighttime operations (2200-0700).

With the collected measurement data, the equivalent sound level (L_{eq}), which is the measurement of sound energy over a period of time, is calculated (Canter 1996):

$$L_{eq} = 10 \times \log\left(10^{(Lp1/10)} \times t_1 + 10^{(Lp2/10)} \times t_1\right) \quad (2)$$

where, Lp_1 and Lp_2 are noise levels; and t_1 and t_2 are time fractions of measurement associated with Lp_1 and Lp_2, respectively.

3. RESULTS AND DISCUSSION

3.1 Results

The noise levels recorded in the various locations in morning are shown in Table 1. In presence of a flight, the highest value was 86.4 dB (A) at Carson Avenue/ Elmridige Avenue while the lowest value was 54.4 dB (A) at Carson Avenue/ Boul Pine Beach. On the other hand, in absence of a flight the highest value was 68.9 dB (A) at Carson Avenue/ Elmridige Avenue and the lowest value was 52.1 dB (A) at Place Glenarry/ Boul Pine Beach. The highest Leq was 82 dB (A) at Carson Avenue/ Elmridige Avenue, while the lowest was 53.3 dB (A) at Carson Avenue/ Boul Pine Beach.

The noise levels measured during the afternoon can be shown in a table similar to Table 1. In presence of a flight, the maximum value was 97.1 dB (A) at Clement Avenue/ Dawson Avenue, while the minimum value was 52.8 dB (A) at Boul Pine Beach/ Lakeshore drive. When there was no flight the highest value was 65 dB (A) at Dawson Avenue/ Allard Avenue, and the lowest value was 51.0 at Bord Du Luc. The highest L_{eq} was 84 dB (A) at Clement Avenue/ Dawson Avenue and the lowest L_{eq} was 52 dB (A) at Boul Pine Beach/ Lakeshore drive.

The noise levels observed during the evening can be shown in a table similar to Table 1. When there was a flight the maximum value was 91.5 dB (A) at Carson/ Allard Ave, while the lowest value was 66.1 dB (A). On the contrary, in absence of a flight, the highest value was 67.1 dB (A) at Carson/ Allard Ave, while the lowest value was 52.1 dB (A) at Lepage Ave/ 5th Avenue. The maximum value of Leq was 79 dB (A) at Carson/ Allard Avenue and the minimum value of Leq was 57 dB (A) at Lepage Ave/ 5th Avenue.

Table 1. Noise levels at morning at selected sample locations

#	Location	With Flight dB (A)	No flight dB (A)	L_{eq} dB-(A)
1	Dawson Ave / Fenelon	78.0	68.9	71
2	Dorval Sec. School	70.6	57.5	63
3	Kingsley / Elmridige	86.4	59.2	74
4	Carson Ave / Pine	54.4	53.2	53.3
5	Turcot Ave / Pine	75.2	59.3	64
6	Glenarry / Pine	81.4	52.1	68
7	Carson / Meredith Ave	76.1	63.0	66
8	St. Veronica's Church	75.7	69.3	70
9	Carson / Caledonia Ave	76.7	69.4	71
10	Place Hamilton/ Pine	62.5	55.0	57

3.2 Result analysis

Canadian standard for noise level in residential area is 45 - 55 dB (A)-Leq (Madhusoodanan Pillai 2000). Figures 1 and 2 give the visualized results for the study area for the conditions with and without flights over the sky, respectively. It clearly shows the effects from the aircrafts flying activities that additional 1 to 30 dB(A) were observed at locations in a range of less 1 to 8 km away from the airport. The annual number of taking off and landing flights at the airport is approximately 200,000 including domestic flights, cross border flights and international flights. Adverse effects on residential area fairly close to the airport can be observed when there are frequent flights taking off and landing.

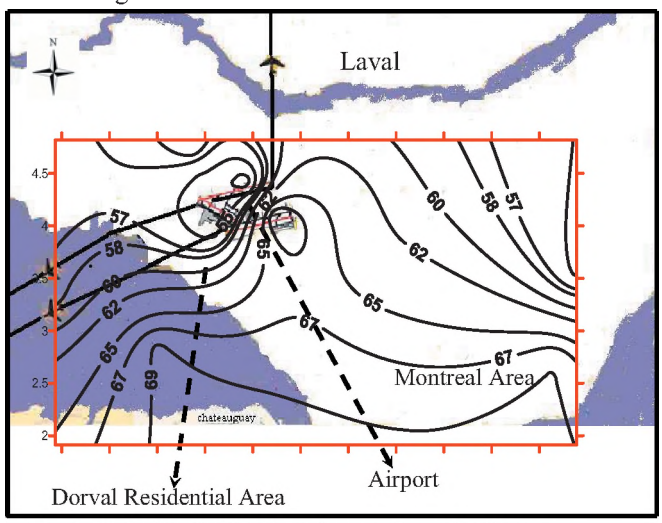

Fig. 1. Noise levels (dBA) in the morning with flights.

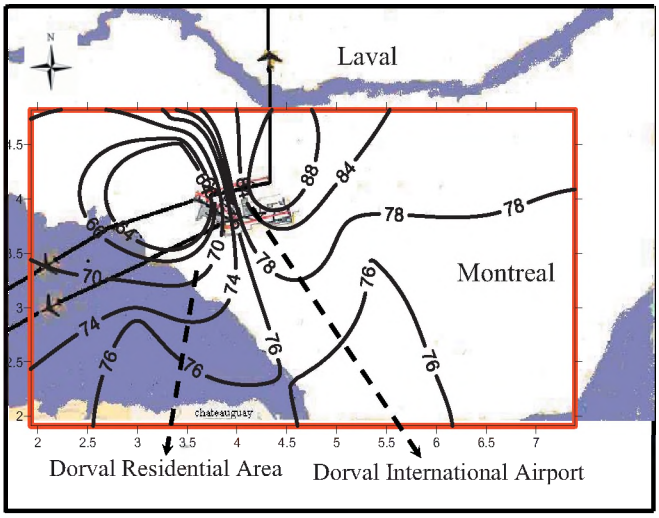

Fig. 2. Noise levels (dBA) in the morning without flights.

4. CONCLUDING REMARKS

The following conclusions are drawn from this study: (1) the background noise level in the Dorval area is relatively high compared to the national standard for residential area. With the recent expansion of Montreal airport, aircraft noise further worsens the condition; and (2) it indicates that there is marginal impact on the majority of the residential area away from the airport with the consideration of the background noise. However, the assessment shows that there are adverse effects on residential area fairly close to the airport when there are frequent flights taking off and landing.

REFERENCES

Alexandre A., Wakstein C., Bugliarello G. and Barnes J. (1975). The Impact of Noise Pollution, Franklin, Philadelphia.

Blackwell J. (2004). Noise Management and Protection of Hearing at Work, Work cover publications, New York.

Bram F. and Mills D. (2006). Introduction to Environmental Impact Assessment: a guide to principles and practice: Oxford University Press, Oxford.

Bram F. and Mills D. (2006). Introduction to Environmental Impact Assessment: a guide to principles and practice: Oxford University Press, Oxford.

Butikofer, R. (2007) Concepts of aircraft noise calculations. Acta Acustica United With Acustica, 93, 253-262.

Canter L.W. (1996). Environmental Impact Assessment, New York, McGraw-Hill.

Garcia, A. (2001). Environmental Urban Noise, WIT press.

Goff, R.J. and Novak, E.W. (1977). Environmental Noise Impact Analysis for Army Military Activities, User Manual. Construction Engineering Research Lab, Champaign Ill.

Rubhera, R. (1997). Noise Pollution Associated with the Operation of the Dar es Salaam International Airport, Transportation Research Part D 4.

Madhusoodanan Pillai, G. (2000). Standardizing noise. http://www.kerala.gov.in/keralcaljan05/p17.pdf

Note: The Second Author was a graduate student at Concordia.