APPENDIX 3-XI

HEALTH CANADA'S SUM 15 ASSESSMENT OF $PM_{2.5}$ HEALTH RISKS

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1 INTRODUCTION

Predicted acute and chronic inhalation Risk Quotients (RQs) for particulate matter smaller than 2.5 micron (μm) in diameter ($PM_{2.5}$) were less than 1.0 for all people residing in and/or participating in recreation or traditional activities in the area under all assessment cases (i.e., Existing and Approved Case [EAC], Project Case and Planned Development Case [PDC]) evaluated within the Human Health Risk Assessment (HHRA). Acute health risks for $PM_{2.5}$ air concentrating were based on the Canada-Wide Standard (CWS) of 30 $\mu g/m^3$ (98^{th} percentile) (CCME 2000), while chronic health risks were based on the California Air Resource Board's (CARB) standard of 12 $\mu g/m^3$ (annual average) (CARB 2002). In addition to comparing the predicted $PM_{2.5}$ air concentrations to these recognized standards, Alberta Health and Wellness (AHW) routinely requests an evaluation of the PM-attributable health impacts based on Health Canada's SUM15 method (Health Canada 1999).

Other governmental organizations (U.S. EPA 2005; WHO 2005) and academic researchers (e.g., Samet 2000; Cohen 2004) have investigated and determined the excess risk of mortality and morbidity effects from exposure to daily or short-term changes in ambient PM concentrations. For example, the World Health Organization (WHO) estimates that health risks increase 0.5% for every 10 $\mu g/m^3$ increase in daily $PM_{2.5}$ concentrations above 25 $\mu g/m^3$ (WHO 2005). Health Canada's SUM15 method is different from more recent methods and calculates excess health risk when $PM_{2.5}$ air concentrations exceed a daily threshold of 15 $\mu g/m^3$ (Health Canada 1999).

2 SUM15 METHOD

The assessment of health risks based on the SUM15 method as requested by AHW is provided for the receptor locations at which maximum $PM_{2.5}$ concentrations were predicted to exceed 15 µg/m^3. These include:

- Conklin;
- Janvier/Chard (IR 194);
- Winefred Lake (IR 194B);
- Hunter/Trapper A;
- Hunter/Trapper B;
- Operator's Residence (MEG House);
- Christina Lake Lodge; and
- Fence-line Maximum Point of Impingement (MPOI).

The type of information that is required to calculate the health risks include:

- cumulative air concentrations of $PM_{2.5}$: the one-year sum (i.e., 365 days) of 24-hour $PM_{2.5}$ concentrations that exceed the Health Canada reference level of 15 µg/m^3 (i.e., sum of [24-hour $PM_{2.5}$ air concentration -15 µg/m^3]);
- relative risk estimates for mortality, Respiratory Hospital Admissions (RHA) and Cardiovascular Hospital Admissions (CHA); and
- baseline mortality, RHA and CHA incidence rates.

Table 1 outlines the cumulative $PM_{2.5}$ air concentrations that were determined for the different receptor locations for 2002.

Table 1 Cumulative Daily $PM_{2.5}$ Air Concentrations Exceeding Health Canada's Reference Level of 15 µg/m^3 in 2002

Location	EAC	Project Case	PDC
Conklin	2.9	3.5	10.8
Janvier/Chard (IR 194)	11.1	11.5	21.5
Winefred Lake (IR 194B)	–	–	3.8
Hunter/Trapper A	–	–	2.9
Hunter/Trapper B	–	–	4.7
Operator's Residence (MEG House)	–	–	3.2
Christina Lake Lodge	–	–	0.8
Fence-line MPOI	1.2	4.5	9.0

– = No exceedance of Health Canada's reference level of 15 µg/m^3.

Health Canada's baseline incidence rates for mortality, CHA and RHA are presented in Table 2.

Table 2 Baseline Incidence Rates and Relative National Risk Estimates

Health Endpoint	Incidence Rate per 1,000,000 Population per Day	Relative Risk per 1 µg/m³ Change in $PM_{2.5}$	
		Point Estimate	95% Confidence Interval
Mortality	18.4	1.0014	1.001 to 1.0018
Respiratory Hospital Admissions (RHA)	16	1.00074	1.00049 to 1.00099
Cardiovascular Hospital Admissions (CHA)	14.4	1.0007	1.00036 to 1.001

Source: Health Canada 1999.

Health Canada uses this information to calculate potential health risks related to mortality, RHA and CHA that may be attributable to $PM_{2.5}$ as follows:

Change in rate of health effect = Cumulative $PM_{2.5}$ concentration x incidence rate x (relative risk -1)

Using this equation, risks were estimated for each health endpoint. For example, the predicted change in the daily mortality rate at the Conklin location for the EAC that would be attributable to $PM_{2.5}$ was calculated as follows:

Change in mortality rate = 2.9 µg/m³ x 18.4 per 1,000,000 x (1.0014-1)
= 0.075 per 1,000,000

This calculation illustrates that the cumulative $PM_{2.5}$ concentration of 2.9 µg/m³ predicted for the EAC (2002) at the Conklin location was associated with a predicted increase in the non-accident mortality rate of 0.075 per 1,000,000 (i.e., from 18.4 to 18.5).

The remaining results for mortality, RHA and CHA attributed to changes in daily $PM_{2.5}$ are outlined in Tables 3 to 5, based on values calculated in Tables 1 and 2.

Table 3 Mortality (per 1,000,000 people) Attributed to Changes in Daily $PM_{2.5}$

Location	EAC	Project Case	PDC
Conklin	0.1	0.1	0.3
Janvier/Chard (IR 194)	0.3	0.3	0.6
Winefred Lake (IR 194B)	–	–	0.1
Hunter/Trapper A	–	–	0.1
Hunter/Trapper B	–	–	0.1
Operator's Residence (MEG House)	–	–	0.1
Christina Lake Lodge	–	–	0.0
Fence-line MPOI	0.0	0.1	0.2

– = Not evaluated.

Table 4 Respiratory Hospital Admissions (per 1,000,000 people) Attributed to Changes in Daily $PM_{2.5}$

Location	EAC	Project Case	PDC
Conklin	0.0	0.0	0.1
Janvier/Chard (IR 194)	0.1	0.1	0.3
Winefred Lake (IR 194B)	–	–	0.0
Hunter/Trapper A	–	–	0.0
Hunter/Trapper B	–	–	0.1
Operator's Residence (MEG House)	–	–	0.0
Christina Lake Lodge	–	–	0.0
Fence-line MPOI	0.0	0.1	0.1

– = Not evaluated.

Table 5 Cardiac Hospital Admissions (per 1,000,000 people) Attributed to Changes in Daily $PM_{2.5}$

Location	EAC	Project Case	PDC
Conklin	0.0	0.0	0.1
Janvier/Chard (IR 194)	0.1	0.1	0.2
Winefred Lake (IR 194B)	–	–	0.0
Hunter/Trapper A	–	–	0.0
Hunter/Trapper B	–	–	0.0
Operator's Residence (MEG House)	–	–	0.0
Christina Lake Lodge	–	–	0.0
Fence-line MPOI	0.0	0.0	0.1

– = Not evaluated.

The risk estimates are presented in terms of "health effects per 1,000,000 people". It is unlikely that a $PM_{2.5}$ attributable health effect (as it relates to the predicted air concentrations) could be detected at any of the listed locations, considering the area's small population size (i.e., when compared to a population of 1,000,000). Further, there appears to be little to no difference between the estimated $PM_{2.5}$ related changes to the EAC and Project Case mortality and morbidity rates at any of the selected locations. The Project's $PM_{2.5}$ emissions do not appear to be increasing the baseline mortality and morbidity rates to an appreciable extent.

3 CONCLUSIONS

The SUM15 assessment indicates that incremental changes in mortality and morbidity are expected to be small. In addition, RQ values calculated on an acute and chronic basis for these locations were less than 1.0, indicating that predicted 24-hour concentrations at the discrete receptor locations are below guidelines. The Project's $PM_{2.5}$ emissions are not expected to increase the mortality and morbidity rates to an appreciable extent in the region.

4 REFERENCES

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