BEFORE THE STATE OF WASHINGTON
ENERGY FACILITY SITE EVALUATION COUNCIL

IN RE APPLICATION NO. 99-1

SUMAS ENERGY 2 GENERATION FACILITY

EXHIBIT ____ (SP-T)

APPLICANT'S PREFILED DIRECT TESTIMONY

SANYA PETROVIC

Q. Please introduce yourself to the Council.

A. My name is Sanya Petrovic.

My business address is Jacques Whitford Environmental Limited, Unit 1, 3771 North Fraser Way, Burnaby, British Columbia, Canada V5J 5G5

Q. What is the subject of your testimony?

A. My testimony will address two topics: First, my background and experience. Second, potential health impacts of the air emissions from the modified SE2 proposal contained in the Second Revised Application.

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Background

Q. What is your title and occupation?

A. I am the Group Manager for Risk Assessment at Jacques Whitford Environment Limited in Burnaby, BC. Jacques Whitford is an international environmental, geotechnical engineering and risk assessment consulting firm with offices throughout Canada and in the United States. I am responsible for assessment of health impacts of chemicals in environmental media and senior technical review of contaminated site risk assessments.

Q. Please describe your education and experience.

A. I have over ten years of experience as a toxicologist and risk assessor, with particular expertise in the assessment of health risks associated with air pollution. My professional experience includes toxicological assessment of human health impacts associated with numerous substances in a variety of environmental media, including air, soil, water and food. My clients have included government agencies, industrial clients and a non-profit organization.

I have a Master of Science degree from the Institute of Medical Science at the University of Toronto, Canada and a Bachelor of Science degree from the University of Waterloo, Canada. My M.Sc. thesis involved the assessment of cardiorespiratory effects of concentrated ambient $PM_{2.5}$ (particulate matter smaller than 2.5 micrometers in aerodynamic diameter) with and without added ozone in controlled human exposure studies with healthy and asthmatic adults.

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My experience and education are further described in my curriculum vitae, which is provided as Exhibit ____ (SP-1).

Q. Has anyone assisted the preparation of this testimony?

A. Ross Wilson has assisted in the preparation of this testimony. Ross Wilson, M.Sc., is a DABT (Diplomat of the American Board of Toxicology) and has over 12 years of work experience as a toxicologist. His previous work experience has included the assessment of health impacts associated with emissions of substances from a variety of different facilities in British Columbia, Alberta, and elsewhere in Canada. His experience and education are further described in his curriculum vitae, which is provided as Exhibit ____ (SP-2).

Q. Are you familiar with the air emissions from the SE2 project as proposed in the Second Revised Application?

A. I am familiar with the expected air emissions and the modeling of those emissions discussed in the Second Revised Application. I have reviewed the materials presented in PSD Application Section 6.1 that outline the modeled emissions from SE2 as well as sections 2.11 and 3.2 of the Application. Additionally, I have conferred with Eric Hansen of MFG, Inc. regarding the modeled air emissions.

From my review of the information, I understand that the maximum emissions proposed in the Second Revised Application are much lower than the maximum emissions associated with the original project proposal because the

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present proposal does not include oil firing and SE2 has agreed to lower limits on NOx and ammonia emissions. I also understand that increasing the height of the exhaust stacks has further reduced the impact of the project's emission of ambient air quality.

Health Impacts

Q. Based on your education, training, experience and review of the SE2 air quality data, will the SE2 project as proposed in the Second Revised Application adversely affect public health?

A. No.

Q. Would you please explain how you reached that conclusion?

A. An evaluation of potential human health risks is often required to assist regulators, the public and other stakeholders in the decision-making process for proposed developments. Risk assessment can be a useful tool for evaluating potential health impacts of relatively large-scale projects such as new airports, new highways, transportation systems, pulp and paper facilities and other projects that release substances into the air. The same principles that have been used in evaluating other large-scale developments in British Columbia and elsewhere in Canada can be used to estimate potential human health effects from the SE2 facility.

The initial step in the evaluation of potential health impacts is comparison of estimated air concentrations to ambient air quality standards or objectives of

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the jurisdiction that is affected. The standards/objectives for air quality are established by regulatory agencies at levels designed for protection of human health and the environment, based on an extensive evaluation of available scientific literature.

In order to assess the risks associated with the revised SE2 project emissions, I reviewed the information supplied in Section 6.1 of the Application that summed the maximum predicted emissions of SO_2, NO_2, CO and $PM_{2.5}$ from SE2 to the current maximum background concentrations and compared the total to Canadian and U.S. health-based standards/objectives (page 6.1-59). This comparison is very conservative because it adds the worst case project emissions to the worst case background and assumes that these events may occur at the same time. Even using this highly conservative scenario, the ambient air concentrations caused by the SE2 project are substantially less than both Canadian and US health-based standards/objectives.

The second step of a health risk assessment involves review of the most current scientific literature on parameters of concern to identify whether there are more recent data that indicate potential health effects at lower levels of exposure. The scientific database on each parameter of interest is evaluated using a weight of evidence approach. Evidence from epidemiological studies, animal toxicological studies and controlled human exposure studies is evaluated. These evaluations include consideration of data gaps and uncertainties in the research, evidence (or lack of evidence) of causal, rather than merely statistical,

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associations, and levels of background ambient air quality. The potential health risks due to incremental increases in emissions relative to background conditions are evaluated in light of this evidence. Increases in emissions of parameters of concern for the SE2 project, particulate matter and ozone, will be a small fraction of current background concentrations and below levels that are considered acceptable for protection of human health.

The conclusion of my assessment based on the data presented is that the emissions from the SE2 facility will not adversely affect public health. The two most important data which lead to the conclusion that no adverse health impacts would be expected are: (1) SE2 emissions are unlikely to cause exceedances of the Canada-wide Standards for $PM_{2.5}$ and ozone or the BC objective for PM_{10}; and (2) increases in particulate matter and ozone from the SE2 facility will be a small fraction of current background concentrations. These facts have lead me to conclude that the health impacts from SE2 facility emissions will be neither measurable nor will they pose unacceptable health risks for persons living in the Lower Fraser Valley.

Q. Can you elaborate on your conclusion regarding potential heath impacts from particulate matter emissions?

A. Yes. The Canadian air quality objectives/standards considered the most relevant for evaluation of potential health impacts in the Lower Fraser Valley

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are the British Columbia Air Quality Objectives and the Canada-wide Standards. The province of British Columbia Air Quality Objective for PM_{10} was established at 50 $\mu g/m^3$ in 1995 following review of scientific literature. The GVRD refers to this PM_{10} objective as acceptable. The "maximum acceptable" objective is defined in the "Lower Fraser Valley Ambient Air Quality Report, 1999" from the Greater Vancouver Regional District (GVRD) and the Fraser Valley Regional District (FVRD) (FVRD, 1999) as a level that "is intended to provide adequate protection against effects on soil, water, vegetation, material, animals, visibility and personal comfort and well being" (page 12). Although the Great Vancouver Regional District has also provided lower "desirable" objective levels and higher "tolerable" objective levels for some pollutants, it has not established objectives for "desirable" or "tolerable" levels of PM_{10}.

Subsequent to the derivation of the BC Air Quality Objective, Canada-wide Standards were endorsed in 2000 for particulate matter smaller than 2.5 microns in aerodynamic diameter ($PM_{2.5}$). The Canada-wide Standard for $PM_{2.5}$ is 30 $\mu g/m^3$ over a 24-hour duration (achievement based on the 98^{th} percentile ambient measurement annually, averaged over 3 consecutive years). This standard was established following review of all relevant scientific literature available for that parameter. These objectives/standards are summarized below.

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Summary of the Most Relevant Health-Based Air Quality Standards and Objectives for Particulate Matter

Constituent	Air Quality Standard/Objective	Source of Air Quality Standard/Objective
PM_{10}	50 $\mu g/m^3$ (24 hour average)	BC Objective, BC Environment, 1995
$PM_{2.5}$	30 $\mu g/m^3$ (24 hour average; achievement based on the 98th percentile ambient measurement annually, averaged over 3 consecutive years)	Canada-wide Standard, Canadian Council of Ministers of the Environment, 2000

The modeled ambient air quality impact of particulate matter emissions from the SE2 project is very low compared to Canadian ambient air standards and objectives. The maximum annual average concentration contributions from the SE2 facility to ambient air in the lower Fraser Valley were modeled by MFG to be less than 0.5 $\mu g/m^3$ PM_{10}. The maximum impacts over a 24-hour duration were estimated to be less than 1 $\mu g/m^3$ PM_{10} in Abbotsford, Chilliwack and Hope, and less than 3.7 $\mu g/m^3$ PM_{10} at the maximum point of impingement (MPI) on Sumas Mountain. MFG modeling conservatively assumed that 100% of PM_{10} was $PM_{2.5}$. A summary of the predicted incremental increases from SE2 based on the most recent modeling is provided in the table below.

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Summary of Estimated Incremental Increase in Mean Air Concentrations from SE2 for Particulate Matter Based on Most Recent Modeling

Constituent	Estimated Increase in Air Concentration from SE2 Expressed as Maximum 24 Hour Average	Estimated Increase in Air Concentration from SE2 Expressed as Annual Average
$PM_{10}/PM_{2.5}$	Abbotsford: 0.54 $\mu g/m^3$ Sumas Mountain: 3.67 $\mu g/m^3$ Chilliwack: 0.41 $\mu g/m^3$ Hope: 0.17 $\mu g/m^3$	Abbotsford: 0.02 $\mu g/m^3$ Sumas Mountain: 0.38 $\mu g/m^3$ Chilliwack: 0.04 $\mu g/m^3$ Hope: 0.02 $\mu g/m^3$

Maximum background ambient 24-hour concentrations of PM_{10} in the Lower Fraser Valley occasionally exceed the BC objectives for ambient air. The "Lower Fraser Valley Ambient Air Quality Report, 1999" from the Greater Vancouver Regional District (GVRD) and the Fraser Valley Regional District (FVRD) (FVRD, 1999) indicates that "higher levels of inhalable particulate were infrequent and were generally associated with short term local influences" (page 25). The Joint Technical Report (JTR, 2000) from BC Ministry of Environment, Lands and Parks, Environment Canada and the Greater Vancouver Regional District entitled "Sumas Energy 2 Generation Facility Air Quality Issue Summary," (dated September 11, 2000) reported that such exceedances occurred 1.5% of the time (page 20). From a health analysis perspective, it is important to note that not only are such exceedances of the PM_{10} objective very infrequent, but for most of the year, the levels of PM_{10} are

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much lower than the objectives. Similarly, for $PM_{2.5}$, on most days of the year, the levels are less than 10 $\mu g/m^3$. Maximum daily levels of $PM_{2.5}$ are occasionally higher than this, but below Canada-wide Standards. Section 6.1 of the Application cites a maximum $PM_{2.5}$ 24 hour average concentration of 18 $\mu g/m^3$ based on Canada-wide Standards (page 6.1-59).

Furthermore, the probability is extremely low that maximum emissions from SE2 will occur at the same time that maximum background levels are elevated. In a letter to the BC Ministry of the Environment, Lands and Parks (dated April 18, 2000), MFG used historical meteorological data to model predicted maximum concentrations of PM_{10}, and compare the results to simultaneous Abbotsford PM_{10} values on Sumas Mountain (the maximum point of impingement). The results indicated that the maximum emissions coincided with days where PM_{10} background concentrations varied from 15 to 27 $\mu g/m^3$ (page 32). This modeling was conducted with and without oil firing, and it is recognized that there will be no oil firing at the facility under the current application. The additive levels of 24-hour maximum emissions from SE2 and background 24-hour ambient conditions were therefore less than the BC PM_{10} objectives for acceptable air quality, and unlikely to cause adverse health impacts.

In addition to minimal health effects expected based on a maximum 24-hour average duration, health effects are also not expected to be associated with daily emissions on an annual basis. There are no Canadian Objectives or

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Standards for particulate matter on an annual basis. However, it is noted that addition of the average and maximal SE2 emissions to background annual average concentrations in the Lower Fraser Valley also result in ambient air levels that are below 24-hour average standards/objectives on an annual basis. This is because the mean PM_{10} annual average concentrations are less than 20 $\mu g/m^3$ and $PM_{2.5}$ concentrations are less than 10 $\mu g/m^3$ ("Lower Fraser Valley Ambient Air Quality Report, 1999" from the Greater Vancouver Regional District (GVRD) and the Fraser Valley Regional District (FVRD) (FVRD, 1999, page 25 and 27, respectively). The incremental daily increases in PM_{10} and $PM_{2.5}$ on an annual basis are conservatively estimated to be less than 0.5 $\mu g/m^3$, even at the maximum point of impingement on Sumas Mountain. Therefore, based on the results of the modeling, the potential impacts are considered to be minimal, and unlikely to result in adverse health effects.

The important component to note here is not only that SE2 emissions combined with existing background will not cause exceedances of the Canadian standards and objectives, but how <u>low</u> the increases caused by SE2 are – less than 0.5 $\mu g/m^3$ annually and average maximum 24-hour concentrations of less than 1 $\mu g/m^3$ in Abbotsford, Chilliwack and Hope, and less than 3.7 $\mu g/m^3$ on Sumas Mountain. These are very small increases relative to existing conditions and there is no scientific evidence that incremental increases of those levels have a measurable impact on human health.

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Q. Can you also elaborate regarding potential health impacts from ozone caused by the revised project emissions?

A. Yes. As I said, the Canadian air quality objectives/standards considered the most relevant for evaluation of potential health impacts in the Lower Fraser Valley are the Canada-wide Standards and the British Columbia air quality objectives. The Canada-wide Standard for ozone is 65 ppb over an 8-hour duration (achievement based on the 4th highest measurement annually, averaged over 3 consecutive years). The standard is similar to the Canadian federal objective of 82 ppb averaged over a 1-hour period, as indicated by the Canada-wide Standards Development Committee for Particulate Matter and Ozone in the "Workshop Discussion Paper: Options for Canada-wide Standards for PM and Ozone", dated September 25, 1998 (page 28). It was noted that "either 8-hour or 1-hour would be an acceptable averaging time for health protection. It should be noted that the U.S., the European Community, the U.K. and the World Health Organization have all gone to an 8-hour averaging time for their new ozone standards" (page 24).

The "Lower Fraser Valley Ambient Air Quality Report, 1999" from the Greater Vancouver Regional District (GVRD) and the Fraser Valley Regional District (FVRD) (FVRD, 1999) reference Federal Objectives for comparison of ambient ozone data measured at monitoring stations. The desirable objective for a 1-hour duration is 51 ppb and the acceptable objective for a 1-hour duration is 82 ppb. For a 24-hour duration, the desirable and acceptable objectives are 15 and 25 ppb, respectively (page 22). The FVRD (1999) defines

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the maximum desirable objective as " the long-term goal for air quality and provides a basis for an antidegradation policy for the country and for the continuing development of control technology" (page12). The FVRD (1999) states that the maximum acceptable objective "is intended to provide adequate protection against effects on soil, water, vegetation, material, animals, visibility and personal comfort and well-being" (page 12). These standards and objectives for ozone are set forth in the table below.

Summary of the Most Relevant Health-Based Air Quality Standards and Objectives for Ozone

Constituent	**Air Quality Standard/Objective**	**Source of Air Quality Standard/Objective**
Ozone	51 ppb (100 ug/m^3) (1 hour average, desirable) 82 ppb (160 ug/m^3) (1 hour average, acceptable)	Canadian Council of Ministers of the Environment, 1999; GVRD Objective
Ozone	65 ppb (130 μg/m^3) (8 hour average; achievement based on the 4^{th} highest measurement annually, averaged over 3 consecutive years)	Canada-wide Standard, Canadian Council of Ministers of the Environment, 2000

The modeled ambient ozone impact of SE2 emissions is very low compared to these ambient air standards/objectives. Based on SE2 emissions prior to the Second Revised Application, an unpublished manuscript from Environment Canada (2000) entitled: "A numerical simulation of impacts on ambient

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ground-level ozone concentrations from the proposed Sumas Energy 2, Inc. power generation facility" (dated January 31, 2000) indicated that the potential increases in ozone attributable to SE2 ranged from less than 2 ppb within 5 km of the facility and to less than 0.5 ppb beyond 5 km. Environment Canada further indicated that Abbotsford is located 6 km north of the proposed SE2 facility, and concluded that Abbotsford would rarely have greater than a 0.2 ppb increase in ozone from the proposed SE2 facility (page 7). With decreased NO_x emissions, increases in ground level ozone concentrations under the Second Revised Application would be much lower than the levels used for Environment Canada's modeling. Therefore, the predicted concentrations of ozone are considered to be very conservative estimates.

Background ambient ozone in the Lower Fraser Valley is periodically elevated such that daily 1-hour maximum concentrations of ozone occasionally exceed BC Environment's air quality objectives. However, the FVRD (1999) report on air quality indicates that "on average, the 1-hour Desirable Objective was met over 99.7% of the time" (page 23). The Joint Technical Report (JTR, 2000) reported that ambient ozone exceeds the most conservative air quality objective of 51 ppb (1 hour average) in approximately 1% of background ozone measurements per year (page 15). Background ozone concentrations do not exceed the recently endorsed Canada-wide Standard for ozone which is a risk-based value.

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As stated in the Joint Technical Report (JTR, 2000) , "[s]ince there are no present ozone CWS exceedences in Abbotsford and the predicted ozone increase due to S2GF is small and limited in time and space, it is unlikely that the S2GF emissions will result in exceedences of the new ozone CWS in either Abbotsford or Chilliwack." (page 16). Environment Canada (2000) indicated that "increases in ozone episode intensity, as a result of the Sumas 2 Energy project will be small and localized" (page 6).

Once again, the actual incremental ozone increases attributable to SE2 are the most significant factor. While it is possible that people sensitive to ozone may experience adverse health effects during an ozone episode, the incremental increase in ozone intensity due to SE2 is so small that it is not considered to contribute to a measurable negative health impact. As indicated by the Environment Canada (2000) modeling, the incremental increase from SE2 of ozone at a level of generally less than 0.5 ppb in Abbotsford is immeasurable. Current science also confirms that the overall increases of less than 2 ppb within 5 kilometres of the facility and less than 0.5 ppb beyond 5 kilometres do not have a measurable impact on human health.

Q. You refer to Canada-wide Standards and B.C. objectives as the most relevant ambient air quality standards for evaluation of potential health impacts in the Lower Fraser Valley. What about the Canadian Reference Levels?

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A. The Canada-wide Standards and BC Objectives are established for protection of the health of the general public and the environment. The province of BC has an Air Quality Objective for PM_{10} that is intended to provide guidance for environmental protection. For the evaluation of $PM_{2.5}$ and ozone, Canada looks to the Canada-wide Standards as a reasonable approach for assessing potential human health impacts. As is the case with any environmental standard, the Canada-wide Standards are subject to repeated review to ensure that the recommended values remain current and include the most recent scientific knowledge. The Canada-wide Standards were endorsed by the Canadian Council of Ministers of the Environment (CCME) and represent an important balance between the desire to protect human health and the feasibility and costs of reducing pollutant emissions. Although it is still possible that air concentrations less than the Canada-wide Standards could present theoretical risks, the Canada-wide Standards minimize human health risks to levels that Canada deems acceptable. This is the standard used for health risk assessments in Canada, including permitting assessments. CCME states that Canada-wide Standards are developed using a firm scientific foundation and a risk-based approach (page 1, "Canada-wide Standards – Overview" prepared by Canadian Council of Ministers of the Environment, dated June 2000). In addition, CCME states that the Canada-wide Standards for particulate matter and ozone "represent a balance between achieving the best health and environmental protection possible and the feasibility and costs of reducing the pollutant emissions that contribute to PM and ground-level ozone in ambient air" (page

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1, "Particulate Matter and Ozone Canada-wide Standards" prepared by Canadian Council of Ministers of the Environment, dated June 2000).

The Reference Levels provide an entirely different guide. In 1999, the CEPA/FPAC Working Group on Air Quality Objectives and Guidelines in Canada created Reference Levels for $PM_{2.5}$ and ozone in ambient air. Reference Levels are defined as "levels above which there are demonstrated effects on human health and/or the environment" (National Ambient Air Quality Objectives for Particulate Matter, Part 1: Science Assessment Document, page 1). Reference Levels are an estimate of the lowest level of $PM_{2.5}$ or ozone in ambient air that was associated with statistically significant effects in the literature reviewed.

The Reference Levels were derived from data presented in epidemiological studies (population-based studies) that identified increases in morbidity (hospital admissions) and mortality associated with increases in ambient $PM_{2.5}$ or ozone measured at centrally located monitors. There were small, but statistically significant increases in morbidity and mortality when mean ambient levels of $PM_{2.5}$ and ozone were in the range of the Reference Levels. However, there are significant data gaps and uncertainties associated with the available database for health effects used in the derivation of the Reference Levels. In the "National Ambient Air Quality Objectives for Particulate Matter. Executive Summary. Part 1: Science Assessment Document" CEPA/FPAC (1998) noted that "Overall, these findings from the epidemiological literature

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are not well supported by either the clinical or toxicological literature" (page 16). Additionally, in this document, it was concluded that: "As more scientific research is conducted, the Reference values will change, either because of better delineation of the adverse effects at lower concentrations, or because of better statistical analysis of the concentration-response relationship at low ambient concentrations." (page 19).

Additionally, the epidemiological studies regarding particulate matter have received criticism in peer reviewed literature (McClellan and Miller, 1997[1]; Phalen, 1998[2]). Furthermore, background conditions in many relatively pristine areas of Canada already exceed the Reference Levels. For instance, in the "National Ambient Air Quality Objectives for Ground-Level Ozone. Summary Science Assessment Document", CEPA/FPAC (1999) indicates that "reasonable estimates of background ozone for areas of Canada relatively unimpacted by anthropogenic pollution are: Daily 1 hr. Maximum (May-Sept) 35-48 ppb ; Monthly 1 hr. Average (May-Sept.) 25-40 ppb" (page S-7).

Let me explain this further. There are statistical associations with $PM_{2.5}$, PM_{10} and ozone and increased morbidity and mortality at levels below current air

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[1] McClellan, R.O. and Miller, F.J. 1997. An overview of EPA's proposed revision of the particulate matter standard. Chemical Industry Institute of Toxicology, Vol 17, No. 4, page 1-21.

[2] Phalen, R.F. 1998. Uncertainties relating to the health effects of particulate air pollution: The US EPA's particle standard. Toxicology Letters 96.97, page 263-267.

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quality objectives/standards; however, these are not causal associations. Significant scientific research is underway to address the uncertainties and data gaps in the knowledge base. For instance, for the assessment of particulate matter, a biological mechanism of effect has not yet been elucidated, and the models that the epidemiological studies have used may not be adequate.

The lack of threshold for response in the epidemiological studies may be associated with numerous uncertainties, including errors in exposure assessment, and confounding of other pollutants. However, it has been recognized by scientists and regulators that while there was a statistical association with health endpoints and increases in $PM_{2.5}$, no causal association had been identified and there was no biological mechanism of toxicity confirmed for the effects observed in the epidemiological studies. Significant scientific research has been ongoing since the promulgation of the Canada-wide Standards in an attempt to elucidate a biological mechanism of effect. Additional studies are required to identify responses to ambient $PM_{2.5}$ without covariance of other pollutants that may confound the epidemiological studies.

In summary, while Reference Levels have been conservatively established for $PM_{2.5}$ based on the best available scientific data, it is widely recognized that additional data are required to establish definitive levels that may result in adverse health effects. An incremental risk analysis conducted for $PM_{2.5}$ as part of the addendum to the Scientific Assessment Document indicated that there was a dropping off in health benefits somewhere between the Reference Level

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and the Standard $PM_{2.5}$.[3]. The Canadian regulators acknowledge that it is not possible to regulate air emissions to an extent where the entire population will be protected; however, it is believed that meeting Canada-wide Standards will minimize human health risks to an acceptable degree based on the currently available data.

For these reasons, Canadian regulators do not apply the Reference Levels to regulate air emissions. Instead, they were used to help derive the Canada-wide Standards that are applied in the regulatory process. The Canada-wide Standards are Canada's accepted guide for assessment of ambient $PM_{2.5}$ and ozone measured at centrally located monitors. Reference Levels are not therefore used for assessment of health impacts for the general population, nor are they used for comparison of acceptable ambient air quality measurements.

Q. Speaking hypothetically then, if you did consider Reference Levels in looking at health impacts, how would the emissions from the modified SE2 project affect air quality in relation to those levels?

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[3] In the Addendum to the Science Assessment Document for the National Ambient Air Quality Objectives for Particulate Matter (1999), the Working Group presented an incremental risk analysis for particulate matter that identified "an inflexion point where avoided impacts, i.e. benefits, started to drop off with improved air quality". For example, the incremental risk analysis conducted for derivation of the Canada-wide Standards, indicated that there may have been a dropping off of health benefits somewhere between the Reference Level and Canada-wide Standard for $PM_{2.5}$. Therefore, the Canadian regulators have established a Canada-wide Standard for $PM_{2.5}$ that is considered to be acceptable for the Canadian population.

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A. The Reference Level for $PM_{2.5}$ is 15 $\mu g/m^3$ (as a 24-hour average) and the Reference Levels for ozone are 20 ppb and 25 ppb (as daily 1-hour maximum concentrations) for mortality and respiratory hospitalization, respectively. Concentrations of $PM_{2.5}$ at the maximum point of impingement (*i.e.*, on Sumas Mountain) from SE2 emissions were estimated to be 3.67 $\mu g/m^3$ (maximum 24 hour average) when it was conservatively assumed that all of the PM_{10} emissions from the facility are in the $PM_{2.5}$ fraction. These values are well below the Reference Level for $PM_{2.5}$ of 15 $\mu g/m^3$. Based on the Canada–wide Standards, the maximum 24-hour average background concentration of $PM_{2.5}$ in Chilliwack (as there are no $PM_{2.5}$ monitoring data available for Abbotsford and Hope), is 18 $\mu g/m^3$ (Section 6.1 of the Application, page 6.1-59), which is above the Reference Level. Therefore, addition of levels above this value would also be above the Reference Level. However, the maximum background ambient concentrations of $PM_{2.5}$ measured in Chilliwack occurred very infrequently. On most days, the average 24-hour $PM_{2.5}$ level is less than 10 $\mu g/m^3$, which is less than the Reference Level. On a typical day, therefore, even the addition of the maximum 24-hour emissions from the proposed SE2 facility would result in ambient air concentrations that are lower than the Reference Level. Further, on average, most of the daily emissions from the facility would be less than 0.5 $\mu g/m^3$, thereby resulting in even lower additive ambient $PM_{2.5}$ levels.

Background concentrations of ozone both in the Lower Fraser Valley and at remote locations are sometimes higher than the Reference Levels estimated

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from epidemiological studies. The Joint Technical Report (JTR, 2000) indicated that the incremental increase in ozone levels associated with the SE2 would result in "a small increase in the intensity but no increase in duration of common ozone episodes" (page 18). The increase in ozone predicted by Environment Canada would likely be even less in the current scenario, based on the proposed reduction in NO_x emissions from the facility (as NO_x is a precursor to ozone). Therefore, the potential health impacts associated with ground level ozone resulting from SE2 would be even less than that predicted by Environment Canada. Although background concentrations in the Lower Fraser Valley and remote areas are present above the Reference Levels for ozone, the incremental addition of 0.5 to 2 ppb ozone from the SE2 is not considered to pose a significant health risk to the population.

Q. You have been speaking in terms of modeled impacts on ambient air quality. The Council has noted that the facility would emit approximately 3 tons of air pollutants per day. Did you consider the number of tons of pollutants emitted per day in your health impact assessment?

A. Not in that way. I would not evaluate potential health effects using data expressed as the tons per day emission rate. The sheer volume of emissions is not directly relevant to health impacts. In order to provide risk-based conclusions, emission rates from a facility or mobile source need to be expressed in terms of their resulting concentrations in ambient air in the breathing zone of people working or living in the area. For assessment of health effects, ambient air quality is typically reported as $\mu g/m^3$ air (e.g.,

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micrograms of chemical per cubic meter of air), ppb (parts chemical per billion parts of air) or ppm (parts chemical per million parts of air). These are the concentrations of chemicals measured or modeled in ambient air that people breathe. It is the concentrations of chemicals in the air that people breathe that may cause health impacts, not the tons emitted.

Q. The Joint Technical Report concludes that "any further worsening of air quality [in the Lower Fraser Valley] will increase risks to human health." Do you think that conclusion is valid in considering the reduced emissions and ambient air quality impacts reported in the Second Revised Application?

A. No. It certainly is not true that any calculated increase in ambient air concentrations of pollutants, no matter how small, will result in a significant increase in human health risks. While it is possible that increased air concentrations of particulate matter and ozone may present risks that can be calculated in theory, the magnitude of increase posed by the SE2 facility will be indistinguishable from that posed by existing background conditions in practice. No scientific studies have ever examined or found any measurable impact from incremental increases in particulate matter or ozone of the magnitude estimated for SE2. BC Ministry of Environment, Lands and Parks (1995) states that a 1 $\mu g/m^3$ increase in PM_{10} is "a change that everyone likely would agree is insignificant, regardless of the estimated impacts of such a small change" (p. 48, "Health Effects of Inhalable Particles: Implications for British Columbia: Overview and Conclusions", June 1995). As stated earlier, much

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smaller increases in particulate matter levels are predicted from the SE2 facility.

Q. In the Second Revised Application, SE2 has offered to offset its NOx and particulate matter emissions or to provide $1.5 million in funding for Washington State and British Columbia to invest in projects to improve air quality in the Fraser Valley airshed. How would either of these proposals affect health impacts from the SE2 project?

A. Even without this commitment, I expect no negative health impacts to result from the project. Efforts to improve air quality by offsetting emissions or funding other air quality improvements in the airshed would be positive.

Q. In light of the changes SE2 has made to reduce both the project's emissions and the impacts of those emissions, how would you assess Sumas as a location for this project, from a public health standpoint?

A. Sumas is a fine location for the revised project. The incremental increases in various parameters in ambient air are minimal and would not result in measurable health effects. The emissions from SE2 are not considered to cause a significant deterioration in the air quality of the Lower Fraser Valley. Conservative modeling indicates that ambient air quality levels are expected to remain below Canadian standards/objectives that are acceptable for protection of human health. Furthermore, SE2 has offered to provide an air improvement fund for the Lower Fraser Valley in order that air quality impacts from other

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sources may be offset, which could further minimize any impacts on ambient air quality.

END OF TESTIMONY

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