REPORT

Site Specific Human Health and Ecological Risk Assessment - Technical Study Report

DURHAM YORK
RESIDUAL WASTE EA STUDY

REPORT NO. 1009497

EXECUTIVE SUMMARY

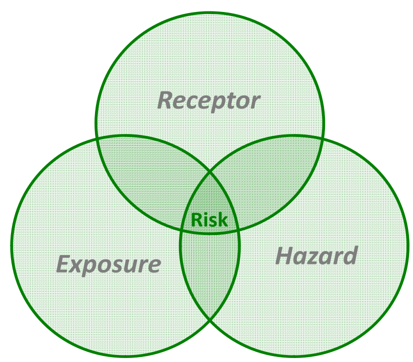
Durham and York Regions (the Regions) have partnered to undertake a joint Residual Waste Planning Environmental Assessment (EA) Study. Both municipalities are in need of a solution to manage the residual solid waste that remains after diversion. The Regions are working together to address the social, economic, and environmental concerns through an EA Study process to examine potential long-term residual waste management alternatives.

Risk Assessment Framework

People are concerned with potential health and ecological effects that could arise from contact with chemicals released to the environment from a Thermal Treatment Facility. Through many years of study and research, government agencies and scientists around the world have developed a process which allows us to understand the movement of chemicals in the environment and whether they may have an effect on people and the ecosystem. This process is called Human Health and Ecological Risk Assessment (HHERA).

All chemicals have the potential to cause effects in people and the ecosystem, but it is the level (or concentration) and the manner (the route) by which people and the ecosystem come into contact with a particular chemical that determines if it may cause harm to health. In order for there to be a potential health risk:

- people or wildlife (Receptor) must be present;
- receptors must come into contact with chemicals emitted from a Facility (Exposure); and,
- chemicals must be emitted at a high enough level and must be able to cause some adverse health effect (Hazard).



If any one of these three components is missing then there would not be a risk to either human or ecological health.

The risk assessment framework used in this Technical Study Report follows the standard paradigm: problem formulation, exposure assessment, hazard assessment, and risk characterization (Figure 1).

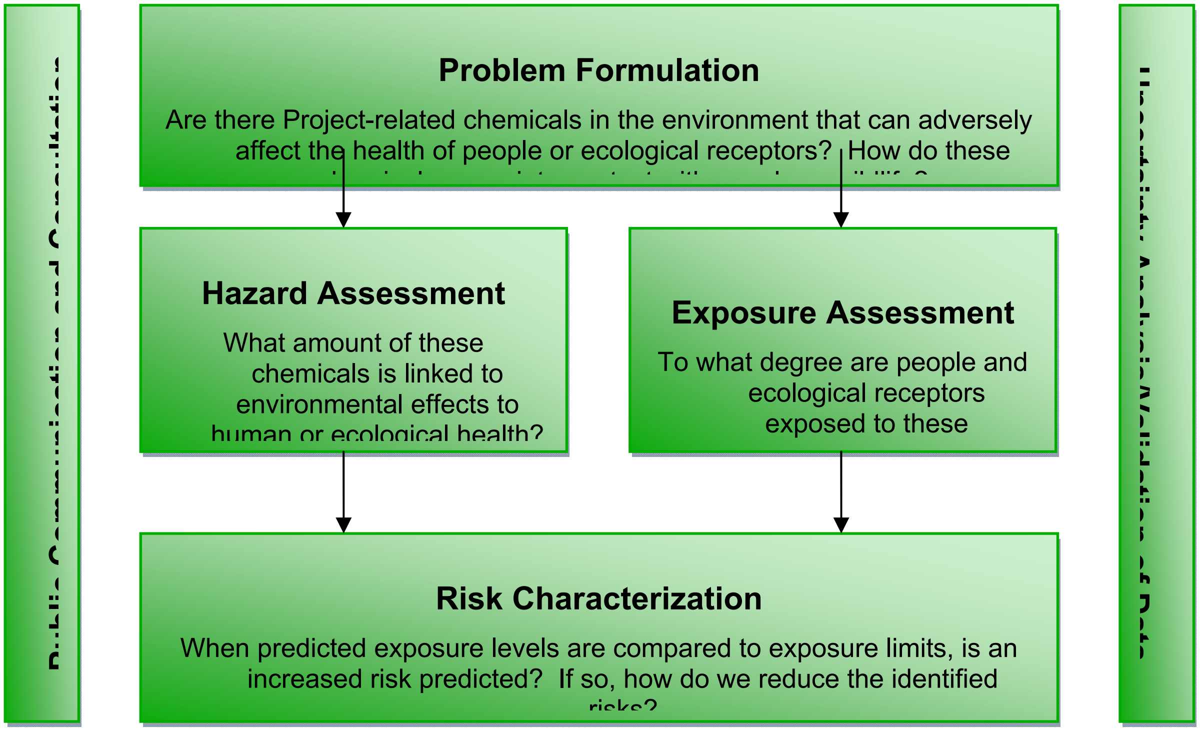


Figure - 1 Risk Assessment Framework

The Facility Risk Assessment

The risk assessment, undertaken as part of the subject EA study, examined the potential for emissions from the Proposed Thermal Treatment Facility (the Facility) to pose an unacceptable risk to human and ecological receptors in the short-term and long-term (i.e., after 30 years of operating the Facility). For the purposes of this assessment, potential risks from the Facility have been estimated for both the initial operating design capacity of 140,000 tonnes/year and the maximum design capacity of 400,000 tonnes/year.

The Study Area and Receptor Locations

The "Site" is the area where the Facility would be built. Currently, it is undeveloped land which is owned by the Region of Durham and located south of Highway 401 within the Municipality of Clarington. The highest level of emissions from the Facility would be deposited in the area identified as the Local Risk Assessment Study Area (LRASA). The LRASA extends approximately 10 km in all directions around the Site.

In order to assess the potential risk to humans and the environment, receptor locations (both human and ecological) within the LRASA were selected. There are a variety of land uses within the LRASA, including light industrial, agricultural, rural, urban residential and natural areas. The final list of receptor locations incorporated land use, air modeling results and input from various sources such as open houses, EA studies, official plans and online and government sources.

The primary route of human exposure to Facility-related air emissions would be through inhalation (breathing). These exposures were evaluated in the human health risk assessment at 309 locations within the LRASA.

Additional potential routes of exposure were considered for chemicals which deposit in the environment and move into other environmental media (e.g. soil, water, and food). This process is called a multi-pathway risk assessment which evaluates the potential for humans and wildlife to be exposed to chemicals from soil, water and food. One hundred and thirty-two of the 309 receptor locations were selected for use in the multi-pathway human health risk assessment. In the ecological risk assessment, 22 of the 309 receptor locations were selected for use in the multi-pathway ecological risk assessment.

Assessment Scenarios

There were 10 main project scenarios that were assessed in this HHERA. All operational cases were evaluated at the initial operating design capacity of 140,000 tonnes/year and the maximum design capacity of 400,000 tonnes/year.

Project Scenarios	Case	Description
Existing conditions	Baseline Case	Evaluation of the Baseline Case involved the quantitative (i.e. measureable) assessment of existing conditions in the assessment area. Health risks were assessed using measured concentrations of chemicals of potential concern (COPC) in air and in other environmental media (e.g. soil, water, food). No Facility-related emissions or exposures were monitored in this assessment case as this completed prior to construction and operation of the Facility.
	Baseline Traffic Case	Evaluation of the Baseline Traffic Case involved the quantification of existing offsite vehicle traffic emissions prior to the start-up of the Facility.
Construction	Construction Case	Evaluation of the Construction Case involved the qualitative (i.e. based only on qualities not numerical data) assessment of the potential health risks associated with air emissions during construction and commissioning of the Facility.
Operational Cases	Project Alone Case	Evaluation of the Project Alone Case during operation of the Facility involved the quantitative (i.e. measureable) assessment of COPC emissions from the Facility. This scenario was evaluated at 140,000 tonnes/year and 400,000 tonnes/year.

Project Scenarios	Case	Description
	Project Case (Baseline + Project)	Evaluation of the Project Case during operation of the Facility involved the quantitative (i.e., measureable) assessment of COPC emissions from the Facility in combination with existing/baseline conditions. This scenario was evaluated at 140,000 tonnes/year and 400,000 tonnes/year.
	Process Upset Case	Evaluation of the Process Upset Case involved the quantitative (i.e. measureable) assessment of COPC emissions from the Facility operating at upset conditions (i.e., Facility startup, shutdown, loss of air pollution control systems). This scenario was evaluated at 140,000 tonnes/year and 400,000 tonnes/year.
	Process Upset Project Case (Baseline+ Upset Conditions)	Evaluation of the Process Upset Case involved the quantitative (i.e. measureable) assessment of COPC emissions from the Facility operating at upset conditions (i.e., Facility startup, shutdown, loss of air pollution control systems). These upset conditions were evaluated in combination with existing/baseline conditions. This scenario was evaluated at 140,000 tonnes/year and 400,000 tonnes/year.
	Traffic Case	Evaluation of the Traffic Case involved the assessment of emissions from offsite and onsite traffic associated with the Facility and baseline traffic conditions in combination with onsite stationary source emissions for the Facility. This scenario was evaluated at 140,000 tonnes/year and 400,000 tonnes/year.
	Future and Existing Conditions Case	Evaluation of the Future and Existing Conditions Case involved the qualitative (i.e. based only on qualities not numerical data) evaluation of the Facility emissions in combination with future or existing sources of air emissions. This scenario was evaluated at 140,000 tonnes/year and 400,000 tonnes/year.
Decommissioning	Decommissioning (Closure Period) Case	Evaluation of the Decommissioning Case involved the qualitative (i.e. based only on qualities not numerical data) assessment of air emissions related to the removal of infrastructure and rehabilitation of the Site.

Potential Chemical Releases from the Project to Air

Eighty-seven chemicals that would be emitted from the Facility were evaluated for their potential to pose a risk to human from inhalation (breathing). Of these, 57 were carried forward to the multi-pathway risk assessment because they can persist (remain in soil) and bioaccumulate (transfer from soils to plants and animals). Following their release to air, these chemicals are deposited into the environment and their concentrations can be predicted in:

- soil;
- surface water;
- garden and farm produce and fruit;
- agricultural products (i.e., beef, chicken, pork, dairy and eggs);
- wild game;
- fish; and,
- breast milk.

Exposure Assessment

The exposure assessment predicted the degree to which people and the ecosystem would come into contact with chemicals emitted from the Facility. This human health risk assessment examined the exposure of people based on their age and physiology (e.g. body weight, breathing rate and ingestion rates), how they use the land and the behaviour of the individual chemicals in the environment.

The following types of receptors were considered in the human health risk assessment.

- local residents;
- local farmer;
- daycare/school staff and pupils;
- recreation user – sport; and,
- recreation user – camping.

Two additional exposure scenarios were evaluated in the human health risk assessment, these are:

- additional exposure from swimming; and
- additional exposure from hunting and fishing.

The following types of receptors were considered in the ecological risk assessment:

- mammalian receptors (e.g., White-tailed Deer);
- avian receptors (e.g., American Robin);
- terrestrial plants (e.g., plant communities);
- soil invertebrates ; (e.g., earthworm);

- aquatic life (e.g., fish); and
- benthic invertebrates (e.g., crayfish).

Hazard Assessment

The hazard assessment identifies the level (concentration) at which chemicals have the potential to pose health effects. Safe levels are established by international regulatory agencies and are commonly referred to as toxicity reference values (TRVs). These agencies consider two types of chemicals:

- non-carcinogenic chemicals that have the potential to cause non-cancer effects in people and wildlife; and
- carcinogenic chemicals that have the potential to cause cancer in people.

For non-carcinogenic chemicals, if the exposure amount is less than the safe amount, then the chemical is not considered to pose a health risk.

For carcinogenic chemicals, toxicity reference values are based on the chance (probability) that exposure would cause an increased risk of cancer. Risk assessments are conducted using conservative assumptions which overestimate exposure and risk. Government agencies provide conservative benchmarks against which results are compared. Health Canada uses a benchmark that considers exposure to a carcinogen that would result in 1 additional cancer case in 100,000 people to be negligible. In comparison, the Ontario Ministry of the Environment (MOE) uses an even more conservative benchmark of 1 additional cancer case in 1,000,000 people. Both of these benchmarks are based on the idea that this rate of cancer from exposure to environmental chemical concentrations would not tip the balance of the current Canadian cancer incidence rate of approximately 0.4 (or 40%). In other words, if the Facility's air emissions were to increase the Canadian cancer incidence rate from 0.4 to 0.400001, then the MOE would consider the Facility to pose an unacceptable risk to the population.

<u>Results of the Human Health Risk Assessment</u>

Human Health Inhalation Assessment

140,000 Tonnes/Year

The results indicate that no acute (1-hr or 24-hr) or chronic (annual average) exposures at the maximum ground level concentration exceed the regulatory benchmark for any of the 10 evaluated cases at 140,000 tonnes/year. Additionally, no carcinogenic COPC exceed the conservative Ontario MOE regulatory cancer benchmark of 1 in 1,000,000 for all evaluated cases.

In addition to the evaluation of individual COPC, an assessment of chemical mixtures was conducted. Chemical mixtures represent groups of chemicals that act similarly on the human body (for example, a mixture of chemicals may irritate the respiratory system). There are currently no regulatory benchmarks to evaluate chemical mixtures. Furthermore, the evaluation of exposure to chemical mixtures is complicated by the narrow probability of each chemical in the mixture occurring at one specific location at the same time with a receptor also present at that location and time to be exposed to them. Regardless of these limitations chemical mixtures were evaluated for information purposes only in the risk assessment.

400,000 Tonnes/Year

The results indicate that no acute (1-hr or 24-hr) or chronic (annual average) exposures at the maximum ground level concentration or individual receptor locations exceed the regulatory benchmark for any of the 10 evaluated cases at 400,000 tonnes/year.

However, there was one exception for the Process Upset Case, as the maximum 1-hr concentration of hydrogen chloride modelled at the Commercial/Industrial receptor group resulted in a CR value of 1.0. This slight exceedance of the government benchmark of 1.0 occurred when the facility was operating under upset conditions where two of the three exhaust streams being affected, for the entire one hour period, and at the time of the worst meteorological conditions. The probability of this hypothetical situation actually occurring is expected to be very low.

Additionally, no carcinogenic COPC exceed the conservative Ontario MOE regulatory cancer benchmark of 1 in 1,000,000 for all evaluated cases. An assessment of chemical mixtures was also conducted, however as stated for the 140,000 tonnes/year assessment, the exposures associated with the chemical mixtures could not be definitively stated as there are no regulatory benchmarks for this type of assessment.

<u>Human Health Multi-Pathway Assessment</u>

Human Health Baseline Case

The only exceedances of regulatory benchmarks were from existing conditions in the Baseline Case. It is very important to note that the baseline chemical concentrations in environmental media sampled in the Clarington 01 area were determined to be no different than those that would be found anywhere else in southern Ontario. Therefore, these modelled potential baseline chemical risks would also be the same for anywhere else in Ontario.

These Baseline Case modelled potential risks can be largely attributed to two sources of uncertainty in the risk assessment process, namely:

- the use of laboratory method detection limits as environmental media concentrations,

- conservative receptor characteristics used to represent toddler receptor consumption patterns of homegrown produce and agricultural products,
- conservative nature of risk assessment exposure calculations that tend to lead to an overestimation of potential risk to humans.

The "method detection limit" is the smallest amount of a chemical that the laboratory instrument is able to detect and is not representative of the actual media concentration of a chemical in a sample. Using the method detection limit as an actual media concentration was a conservative assumption because media concentrations were likely much lower than the method detection limit of the instrument or not present at all.

Secondly, the use of child-specific consumption rates to represent a toddler's consumption rate of homegrown produce and agricultural products in lieu of toddler-specific rates also lead to an overestimation of exposure and therefore exceedance of regulatory benchmarks.

Inherent in the risk assessment process is the need to err on the side of overestimation of potential risks. Therefore, one should not construe from these Baseline Case risk assessment results that people living in the Clarington area are actual at any greater undue risk than the rest of Ontarians from background exposure to chemicals in the environment.

140,000 Tonnes/Year

The results of the multi-pathway assessment indicate that exposure to Facility-related air emissions will not result in any undue carcinogenic or non-carcinogenic risk to human receptors living or visiting the LRASA while the Facility is operating at 140,000 tonnes/year. All hazard quotients and incremental lifetime cancer risks were below their respective government benchmarks for all chemicals and exposure scenarios.

400,000 Tonnes/Year

The results of the 400,000 tpy maximum design capacity determined that for the majority of chemicals and scenarios there would be no undue risk to people working and living in the area from exposure to the EFW facility emissions.

The lone exception was an infant farmer modelled to be exposed to breast milk of a mother living in close proximity to the EFW facility under the Process Upset Case for dioxin and furan exposure. The farmer infant dioxin and furan HQ of 0.22 was slightly in excess of the government benchmark of 0.2. Again the Process Upset Case assumes that the Facility is operating at full capacity with two of the three exhaust streams being affected for 20% of the year. This is based on the conservative US EPA default scenario for process upsets when there is a lack of empirical data. In addition, the sole source of food for an infant is breast milk, thus an acceptable benchmark for comparison of potential risk could have been selected as 1.0.

Overall, the results of the human health risk assessment indicate that, with the exception of a potential Process Upset scenario farm infant to dioxin and furan in breast milk, it is not expected the Facility will lead to any adverse health risks to local residents, farmers or other receptors in LRASA while operating at 400,000 tonnes/year. Regardless, in the event that a 400,000 tpy expansion of the facility is eventually contemplated, special consideration should be given at that time to ensure that Process Upset Conditions do not result in an undue risk to people living and working in the area surrounding the facility.

Results of the Ecological Risk Assessment

Ecological Baseline Case

There were a limited number of chemicals in some environmental media that were predicted to pose a potential risk to various ecological receptors in the Baseline Case. However, as stated above it is very important to note that the baseline chemical concentrations in environmental media sampled in the Clarington 01 area were determined to be no different than those that would be found anywhere else in southern Ontario. Therefore, these modelled potential baseline chemical risks to some ecological receptors would also be the same for anywhere else in Ontario.

Most of the these baseline modelled chemical risks were due to the use of method detection limits, rather than actual media concentrations that produced conservative estimates of COPC concentrations in environmental media samples. However, in some cases baseline risk was estimated from exposure of VECs to actual measured concentrations. It was determined that these risks were due to the use of conservative toxicity benchmarks, highlighting the conservatism in the ERA. Potential baseline risk was estimated for avian species at risk (SAR) through the use of surrogate species for two of the metals. The nitrogen dioxide background value concentration was found to exceed the World Health Organization phytotoxicity benchmark for the annual averaging period. However, visual inspection of the plant communities during extensive field surveys revealed healthy vegetation with no evidence of nitrogen dioxide related stress.

Similar to human health risk assessment, inherent in the ecological risk assessment process is the need to err on the side of overestimation of potential risks. Therefore, one should not construe from these Baseline Case risk assessment results that the ecosystem in the Clarington area is actual at any greater undue risk than species found throughout Ontario.

140,000 Tonnes/Year

The results of the 140,000 tpy ecological risk assessment for inhalation of VEC to Facility-related air emissions is not expected to result in unacceptable health effects to ecological receptors living in the LRASA. Sulfur dioxide, nitrogen dioxide, and hydrogen fluoride concentrations in the environment related to the Project are not expected to affect plant communities within the LRASA. As with the human health multi-pathway risk assessment, no unacceptable risks were calculated from Project related activities (e.g., Project Alone case, Upset Case) for ecological receptors.

Overall, it is not expected that chemical emissions from the Project will lead to any adverse health risks to ecological receptors or any species at risk in the LRASA.

400,000 Tonnes/Year

Sulfur dioxide, nitrogen dioxide, and hydrogen fluoride concentrations in the environment related to the Project are not expected to affect plant communities within the LRASA under the 400,000 tpy scenario. No unacceptable risk were calculated from Project related activities (e.g., Project Alone case, Upset Case) in the 400,000 tpy for ecological receptors and the only risks in the evaluated cases were a result of existing conditions evaluated in the Baseline Case.

Potential unacceptable risk was estimated for freshwater receptors exposed to benzo(g,h,i)perylene (HQ=1.1), marginally in excess of the Provincial benchmark, as a result of Process Upsets when two of the three exhaust streams are being affected. However, a low level of confidence in the Provincial benchmark used for this COPC in this assessment indicates that a realization of this estimated risk is unlikely.

Overall, the results of the ecological risk assessment indicate that it is not expected the Facility operating at 400,000 tpy will lead to any adverse health risks to ecological receptors or any species at risk in the LRASA and a combination of the chemical and non-chemical stressors (noise, habitat alteration), is not expected to have an unacceptable effect on ecological receptors within LRASA.

Overall Summary and Conclusions of the Human Health and Ecological Risk Assessment

Overall, the results of the human health risk assessment indicate that chemical emissions from the EFW Facility would not lead to any adverse health risks to local residents, farmers or other receptors in LRASA under either the initial operating design capacity of 140,000 tpy or the maximum design capacity of 400,000 tpy.

However, a limited number of chemicals under the Process Upset Case of the 400,000 tpy maximum design capacity resulted in slightly elevated potential risks above the government benchmarks for human health. These include:

- maximum exposure to the 1 hour hydrogen chloride concentration at the commercial/industrial receptor location resulting in a CR of 1.0 (benchmark CR=1.0);
- exposure of farmer infant to breast milk of a mother living in close proximity to the EFW facility under the Process Upset Case resulted in an infant dioxin and furan HQ of 0.22, slightly in excess of the government benchmark of 0.2.

Overall, the results of the ecological risk assessment indicate that chemical emissions from the EFW Facility would not lead to any adverse ecological risks to receptors or species at risk in LRASA under either the initial operating design capacity of 140,000 tpy or the maximum design capacity of 400,000 tpy. In addition, a combination of the chemical and non-chemical stressors (noise, habitat alteration), is not expected to have an unacceptable effect on ecological receptors within LRASA.

However, a potential unacceptable risk was estimated for freshwater receptors exposed to benzo(g,h,i)perylene (HQ=1.1), marginally in excess of the Provincial benchmark (HQ=1.0), as a result of Process Upsets.

These slight exceedances of benchmark risk levels were seen when the EFW Facility at 400,000 tpy was operating under upset conditions, where two of the three exhaust streams are being affected for the entire one hour period, and at the time of the worst meteorological conditions. The probability of this hypothetical situation actually occurring is expected to be very low.

Regardless, in the event that a 400,000 tpy expansion of the facility is eventually contemplated, special consideration should be given at that time to ensure that Process Upset Conditions do not result in an undue risk to people living and working in the area surrounding the facility or to ecological receptors.

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GLOSSARY AND ABBREVIATIONS

Glossary

Additive Interaction	Chemicals that have similar targets and modes of action but do not interact. The hazard for exposure to the mixture is simply the sum of hazards for the individual chemicals
Alternative Methods	Alternative methods of carrying out the proposed undertaking are different ways of doing the same activity. Alternative methods could include consideration of one or more of the following: alternative technologies; alternative methods of applying specific technologies; alternative sites for a proposed undertaking; alternative design methods; and, alternative methods of operating any facilities associated with a proposed undertaking.
Alternatives	Both alternative methods and alternatives to a proposed undertaking.
Alternatives To	Alternatives to the proposed undertaking are functionally different ways of approaching and dealing with a problem or opportunity.
Antagonistic Interaction	There is a negative interaction among the chemicals so that the response is less than would be expected if the chemicals interacted independently
Bioaccumulation	The accumulation of a substance in various tissues of a living organism. Bioaccumulation takes place within an organism when the rate of intake of a substance is greater than the rate of excretion or metabolic transformation of that substance
Bioavailability	The degree to which a substance becomes available to the target tissue after administration or exposure
Biomagnification	The increasing concentration of a substance in the tissues of organisms at successively higher levels of a food chain.
Criteria Air Contaminants	Pollutants known to be hazardous to human health, including nitrogen dioxide, Sulfur dioxide, particulate matter less than 2.5 $\mu g/m^3$ in diameter and carbon monoxide.
Durham	The Regional Municipality of Durham or its geographic area, as the context requires.
Durham/York Residual Waste Study	The Durham/York Residual Waste Study is a joint initiative between the Region of Durham and York Region to work together to find a way to manage solid waste remaining after at-source diversion.

Ecological Risk Assessment	A scientific method used to examine the nature and magnitude of risks from the exposure of plants and animals to contaminants in the environment.
Thermal Treatment Facility	The recovery of energy in the form of heat and/or power from the Thermal Treatment of waste. Generally applied to incineration, pyrolysis, gasification but can also include the combustion of landfill gas and gas produced from anaerobic digestion of organic materials.
Environment*	The environment is broadly defined under the *Environmental Assessment Act* as follows: (a) Air, land or water; (b) Plant and animal life, including human life; (c) The social, economic and cultural conditions that influence the life of humans or a community; (d) Any building, structure, machine or other device or thing made by humans; (e) Any solid, liquid, gas, odour, heat, sound, vibration or radiation resulting directly or indirectly from human activities; or, (f) Any part or combination of the foregoing and the interrelationships between any two or more of them.
Environmental Assessment	Environmental assessment is a study, which assesses the potential environmental effects (positive or negative) of a proposal. Key components of an environmental assessment include consultation with government agencies and the public; consideration and evaluation of alternatives; and, the management of potential environmental effects. Conducting an environmental assessment promotes good environmental planning before decisions are made about proceeding with a proposal.
Environmental Assessment Act	The *Environmental Assessment Act* (and amendments and regulations thereto) is a provincial statute that sets out a planning and decision-making process to evaluate the potential environmental effects of a proposed undertaking. Proponents wishing to proceed with an undertaking must document their planning and decision-making process and submit the results from their environmental assessment to the Minister for approval.
Impact Management Measures	Measures which can lessen potential negative environmental effects or enhance positive environmental effects. These measures could include mitigation, compensation, or community enhancement.
Impact Studies	Studies that predict negative consequences (if any) of a proposed undertaking. Air, visual, natural environmental, traffic, hydrogeological, Noise, Health Risk, Land Use and Hydrological Impact Studies are required under the Environmental Protection Act.

Individual Environmental Assessment	An Individual Environmental Assessment requires the following steps to fully address the requirements of the EAA: Preparation of the Proposed EA Terms of Reference; Submission of the EA Terms of Reference to the Minister of the Environment for Approval; Completion of the EA Study in accordance with approved EA Terms of Reference, and; Submission of the EA Study to the Minister of the Environment for Approval.
LC_{50}	Median lethal concentration of a toxic substance or radiation. It is the concentration that results in mortality for half the members of a tested population.
LD_{50}	Median lethal dose of a toxic substance or radiation. It is the dose that results in mortality for half the members of a tested population.
LOAEL	Lowest-Observed-Adverse-Effect-Level. A term that describes the benchmark on a threshold dose-response curve at which adverse effects are first seen.
Maximum Point of Impingement	Maximum Point of Impingement. The nearest point where air contamination emitted by a source will impinge on a building or population beyond the property line. Defined in the MOE's ESDM Procedure as "any point on the ground or on a receptor, such as nearby buildings, located outside of a company's property boundaries at which the highest concentration of a contaminant caused by the aggregate emission of that contaminant from a Facility is expected to occur."
Ministry of the Environment (MOE) Ontario	The MOE monitors pollution and restoration trends in Ontario and uses that information to develop environmental laws, regulations, standards, policies, programs, and guidelines. The MOE works to provide cleaner air, land, and water for Ontarians.
Mitigation	Measures taken to reduce adverse impacts on the environment.
Municipal Solid Waste (MSW)	Common garbage or trash generated by industries, businesses, institutions, and homes.
Non-Interacting	Chemicals have no effect in combination with each other. The toxicity of the mixture is the same as the toxicity of the most toxic component of the mixture.
Non-Threshold Mechanism	A chemical has a non-threshold mechanism if a NOAEL cannot be identified, a lowest observed adverse effect level (LOAEL), being the minimum dose, at which (usually minor) adverse effects are observed, may be used to derive a TRV instead. The application of extra uncertainty factor to a LOAEL is warranted when deriving a TRV, since the "safe" dose level below that LOAEL may not have been identified.

NOAEL	No-Observed-Adverse-Effect-Level. A term that describes the benchmark on a threshold dose-response curve at which the highest dose does not result in adverse effects.
Ontario	The Province of Ontario, or its geographic area, as the context requires.
Ontario Ministry of the Environment Guideline A-7	Combustion and Air Pollution Requirements for New Municipal Waste Incinerators: Emission Limits from a Generic Thermal Treatment Facility
Persistence	Persistence refers to the length of time a substance resides in environmental media and is usually defined in terms of half-life.
Project	Encompasses the design, construction (including construction financing) and operation of the Thermal Treatment Facility, and includes the EA Study, the supply of municipal waste, and the sale of energy.
Proponent*	A person, agency, group or organization that carries out or proposes to carry out an undertaking or is the owner or person having charge, management or control of an undertaking.
Reference Dose/Reference Concentration (RfD/RfC)	The RfD/RfC is an estimate of lifetime daily exposure to a non-carcinogen for the general human population that appears to be without appreciable risk of deleterious effects. Reference doses are typically expressed as mg chemical/kg body weight-day, while reference concentrations are typically expressed as µg chemical/m^3 air.
Regions	Durham and York collectively.
Slope Factor	The SF is a plausible upper bound estimate of the probability of a response per unit intake of a chemical over a lifetime expressed as (mg chemical/kg body weight-day)$^{-1}$ as is used to express carcinogenic effects.
Synergistic Interaction	There is a positive interaction among the chemicals such that the response is greater than would be expected if the chemicals acted independently.
Terms of Reference	A document prepared by the proponent and submitted to the Ministry of the Environment for approval. The terms of reference sets out the framework for the planning and decision-making process to be followed by the proponent during the preparation of an environmental assessment. In other words, it is the proponent's work plan for what is going to be studied. If approved, the environmental assessment must be prepared according to the terms of reference.
Thermal Treatment	Use of elevated temperatures to treat wastes (e.g., combustion or gasification).
Tolerable	A term used by Health Canada to describe concentrations in air that a person

Concentrations	may be continuously exposed to over a lifetime without adverse effects.
Threshold Mechanism	A chemical as a threshold mechanism in a specified dose level can be identified, at which no adverse effects are observed. This dose, known as a No Observed Adverse Effects Level (NOAEL), adjusted by uncertainty factors, serves as the basis for many TRVs.
Uncertainty Factor	A factor that is applied to NOAELs or LOAELs to yield an RfC or RfD. For example, the UF can be used to account for intra-species and inter-species extrapolation.
Unit Risk	Unit risks estimate the upper bound probability of an individual developing cancer following exposure to a particular level (usually as 1 µg/L in water or 1 µg/m^3) of a potential carcinogen. For example, if the unit risk is 1.2 x 10^{-6} µg/L then it is expected that 1.2 excess tumours are expected to occur per 1,000,000 people exposed to 1 µg of that chemical in 1L of drinking water.
US EPA Mobile 6.2 Emission Factors	A trip-based model for emission factors projected based on a typical trip of 7.5 miles and on average speeds for a typical trip.
Waste-to-Energy (WTE) Facility OR Municipal-Waste Combustor	Facility where recovered municipal solid waste is converted into a usable form of energy, usually via combustion.
York	The Regional Municipality of York or its geographic area, as context requires.

List of Abbreviations

2,3,7,8 – TCDD	2,3,7,8 – tetrachlorodibenzo-*p*-dioxin
µg/kg bw/d	Micrograms per kilogram of body weight per day
µg/m^3	Microgram per cubic meter
AAQC	Ambient Air Quality Criteria (Ontario Ministry of the Environment)
ADD	Average Daily Dose
AERMOD	Ontario Ministry of the Environment Approved Air Dispersion Model (Version 04300)

AF	Absorption Factor
ATSDR	Agency for Toxic Substances and Disease Registry
AQBAT	Air Quality Benefits Assessment Tool
BAF_{Fish}	Bioaccumulation factor in fish
B[a]P TEQ	Benzo[a]pyrene Toxic Equivalent Concentration
BCF	Bioconcentration Factor
BW	Body Weight
BWt	Mean body weight for test species
BWr	Mean body weight for receptor species
CAC	Criteria Air Contaminants.
CCME	Canadian Council of Ministers of the Environment
CDI	Chronic Daily Intake
CSM	Conceptual Site Model
CWF	Canadian Wildlife Federation
CWS	Canadian Wildlife Service
CWS	Canada Wide Standards
CEAA	Canadian Environmental Assessment Act
CEPA	Canadian Environmental Protection Act, 1999

CofA	Certificate of Approval
CLO	Critical Load
CLOCA	Central Lake Ontario Conservation Authority
COPC	Chemical(s) of Potential Concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CR	Concentration Ratio
CSF	Cancer Slope Factor
DFO	Department of Fisheries and Oceans
EA	Environmental Assessment
ECSM	Ecological Conceptual Site Model
EHQ	Ecological Hazard Quotient
EPA	Environmental Protection Agency
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
f_{site}	Fraction of the total ingestion rate from the site
GLC	Ground Level Concentration
ha	Hectares
HC	Health Canada

HF	Hydrogen Fluoride
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
IARC	International Agency for Research on Cancer. An organization of the WHO
ICAP	Illness Costs of Air Pollution
IF	Intake Factor
ILCR	Incremental Lifetime Cancer Risk
IR	Ingestion Rate
IRIS	Integrated Risk Information System
JWMG	Joint Waste Management Group
LCR	Lifetime Cancer Risk
LRASA	Local Risk Assessment Study Area
LADD	Lifetime Average Daily Dose
LOAEL	Lowest-Observed-Adverse-Effects-Level
MATC	Maximum Allowable Toxicant Concentration
MDL	Method Detection Limit
MET	Meteorology
MOE	Ontario Ministry of the Environment

MNR	Ontario Ministry of Natural Resources
MSW	Municipal Solid Waste
MTD	Maximum Tolerated Doses
NAAQO	National Ambient Air Quality Objectives
NAPS	National Air Pollution Surveillance
ND	Non-Detect Values
NHIC	Natural Heritage Information Centre
NO	Nitrogen Oxide
NOAEL	No-Observed-Adverse-Effect-Level
NWF	National Wildlife Federation
O. Reg.	Ontario Regulation
OTR_{98}	Ontario "Background" Soil Concentrations
PCB	Polychlorinated biphenyls
PCDD	Polychlorinated dioxins
PCDF	Polychlorinated furans
PEF	Potency Equivalent Factor
PM	Particulate Matter less than 44 microns in diameter
$PM_{2.5}$	Particulate Matter less than 2.5 microns in diameter

PM_{10}	Particulate Matter less than 10 microns in diameter
POI	Point of Impingement
PQRA	Preliminary Quantitative Risk Assessment
PSQG	Provincial Sediment Quality Guidelines
PWQO	Provincial Water Quality Objectives
RFP	Request for Proposals
SAR	Species at risk
SARA	Species At Risk Act
Site	Site
SSL	Soil Screening Level
TC	Tolerable Concentration
TCDD	Tetrachlorodibenzo-p-Dioxin
TDI	Tolerable Daily Intake
TEF	Toxic Equivalency Factor
ToR	Terms of Reference
TpY	Tonnes per Year
TR	Target Risk
TRV	Toxicity Reference Value

UCLM	Upper Confidence Limit of the Mean
UF	Uncertainty Factor
UP	Uptake Factor
US EPA	United States Environmental Protection Agency
VEC	Valued Ecosystem Component
VOC	Volatile Organic Compound
WHO	World Health Organization

UNITS OF MEASUREMENT

Area

ha	hectare 1 km^2 = 100 hectares
km^2	square kilometre
m^2	square metre
m^3	cubic metre
scf	standard cubic feet 35.3 m^3

Length

m	meters
km	kilometre

Mass/Weight

Re. Orders of Magnitude: x 10^2 = x 100, x10^3 = x 1000, etc.

g	gram
mg	milligrams 1 x 10^{-3} grams

μg	microgram	1 x 10^{-6} grams
ng	nanogram	1 x 10^{-9} grams
kg	kilogram	1 x 10^{3} g
pg	picogram	1 x 10^{-12} grams
t	metric tonne	1 x 10^{3} kg
kt	kilotonne	1 x 10^{6} kg
lb	pound	1 lb = 453.592 grams

Power

W	watt	
kW	kilowatt	1 x 10^{3} W
MW	megawatt	1 x 10^{6} W

Volume

L	litre
mL	millilitre 1 L = 1 x 10^{3} mL
m^3	cubic metre 1 m3 = 1 x 10^{3} L
Rm^3 and DSm^3	dry cubic metre of flue gas corrected to standard conditions (25°C, 101.3 kPa, 11% O_2) as defined by MOE APC on Incinerators Policy 01-03-02

Time

s	second
min	minute
hr	hour
wk	week
y	year

ELEMENTS

Cd	Cadmium

Hg	Mercury
Pb	Lead
As	Arsenic
Be	Beryllium
Cr	Chromium
Cu	Copper
Ni	Nickel
Si	Silver
Tl	Thallium
Sn	Tin
V	Vanadium
Zn	Zinc

COMPOUNDS

CO	Carbon Monoxide
CO_2	Carbon Dioxide
HCl	Hydrogen Chloride
TPM	Total Particulate Matter
$PM_{2.5}$	Particulate Matter Diameter <=2.5 dìm
NO_x	Nitrogen Oxides
NO_2	Nitrogen Dioxide
PCDD	Polychlorinated Dibenzodioxins
PCDF	Polychlorinated Dibenzofurans
SO_2	Sulfur Dioxide
VOCs	Volatile organic compounds
PCP	Pentachlorophenol
PCB	Polychlorinated biphenyl
PCDD/F	Polychlorinated dibenzo-dioxin/furan
PAH	Polycyclic aromatic hydrocarbons

PUF	Polyurethane foam

MISCELLANEOUS

°C	Temperature in degrees Celsius
N/A	Not Available
%	Percent
ppm (part per million)	mg/kg, ug/g, ng/mg, pg/ug, mg/L, ug/mL, ng/uL
ppb (part per billion)	ug/kg, ng/g, pg/mg, ug/L, ng/mL, pg/uL
ppt (part per trillion)	ng/kg, pg/g, fg/mg, ng/L, pg/mL, fg/uL
min	minimum
max	maximum

REPORT

1.0 INTRODUCTION

Durham and York Regions (the Regions) have partnered to undertake a joint Residual Waste Planning Study. Both regions are in need of a solution to manage the residual solid waste that remains after diversion. The Regions are working together to address the social, economic, and environmental concerns through an Environmental Assessment (EA) Study process to examine potential long-term residual waste management alternatives.

1.1 The Environmental Assessment Process

The purpose of the undertaking (i.e., what the outcome of this EA Study is intended to do) as described in the approved EA Terms of Reference is:

"To process - physically, biologically and/or thermally - the waste that remains after the application of both Regions' at-source waste diversion programs in order to recover resources - both material and energy - and to minimize the amount of material requiring landfill disposal. In proceeding with this undertaking only those approaches that will meet or exceed all regulatory requirements will be considered."

The EA Study follows a planning approach where environmental constraints or opportunities are considered in the context of the broadly defined environment under the *Environmental Assessment Act* (EAA) (i.e., the natural environment as well as the social, economic and heritage and other "environments" relevant to the undertaking) and potential effects are understood and addressed before development occurs. In accordance with the Approved EA Terms of Reference and EAA, the EA process evaluates: alternatives considering potential effects on the environment; the availability of mitigation measures that address, in whole or in part, the potential effects; and, the comparison of the advantages and disadvantages of the remaining or "net" effects. The result of this process provides the planning rationale and support for a preferred approach and method to implement the undertaking.

It is understood and contemplated that environmental management measures recommended as part of the EA process and this Technical Study Report will in many cases be refined, updated, modified and/or superceded as a result of subsequent approval processes.

The EA Study document has been prepared and conducted in accordance with the EAA, including in accordance with the Terms of Reference approved by Ontario's Minister of the Environment on March 31, 2006. There are currently no federal environmental assessment process triggers identified and, therefore, this project does not require approval under the *Canadian Environmental Assessment Act* (CEAA).

This EA process essentially consists of three parts taking place in stages including:

- the Development and Approval of an EA Terms of Reference,
- the evaluation of "Alternatives to" the undertaking, and;
- the evaluation of "Alternative methods" of implementing the undertaking.

Refer to the Environmental Assessment for a detailed description of the EA process undertaken as part of the Durham/York Residual Waste EA.

1.2 Purpose of the Report

This draft report entitled "*Human Health and Ecological Risk Assessment (HHERA) Technical Study Report*" has been prepared to evaluate the potential human health and ecological related impacts associated with the development of the Proposed Thermal Treatment Facility (the Facility) on the Facility site, Clarington Site 01 (the Site). The Risk Assessment evaluated the potential for adverse health effects in populations exposed to air emissions from the Facility. This Report will form part of the supporting documentation and materials completed as part of the EA study.

1.3 Overview of Report Contents

Existing environmental conditions within the Local Risk Assessment Study Area are described in this HHERA Technical Study Report, followed by an analysis of the potential adverse environmental effects of the Project on the health of human and ecological receptors. The key components of the Report are as follows:

- Section 1.0: a general introduction and background information about the Project and the Human Health and Ecological Risk Assessment;
- Section 2.0: the risk assessment framework is described;
- Section 3.0: the assessment areas and operational scenarios are described;
- Section 4.0: the chemicals of potential concern (COPC) are presented;
- Section 5.0: the baseline conditions at the assessment area are described;
- Section 6.0: the fate and transport models and methodology are described;
- Section 7.0: the Human Health Risk Assessment (HHRA) is presented;
- Section 8.0: the Ecological Risk Assessment (ERA) is presented;
- Section 9.0: a summary of conclusions made in the HHERA;

- Section 10.0: Closing Remarks;
- Section 11: References used in the HHERA are listed; and,

Appendices providing supporting documentation.

2.0 STUDY METHODOLOGY

2.1 Risk Assessment Framework

The purpose of a HHERA is to evaluate the potential for adverse health outcomes from both short-term (acute) exposures and long-term (chronic) exposures resulting from contaminants released to air, land and water. A HHERA consists of two main components: a Human Health Risk Assessment (HHRA) and an Ecological Risk Assessment (ERA). The first component, the HHRA, is an assessment of potential toxicological risks of the Project on human receptors. The second component, the ERA, is an assessment of ecotoxicological risks of the Project on ecological receptors. The evaluations, documented in this Technical Study Report, were completed for two (2) design capacity scenarios for the Facility. These are: an initial design capacity of 140,000 tonnes per year (tpy) (140,000 tpy); and a potential maximum design capacity of 400,000 tpy for the Facility (400,000 tpy).

The potential human health and ecological risks of the Facility emissions were considered in this HHERA. This Study focuses on the quantification of potential risks of adverse environmental effects, from exposure to airborne contaminants emitted from the Facility at the Site. The study includes the evaluation of direct inhalation of airborne contaminants and the chemical exposure to humans and ecological receptors through various exposure pathways (i.e. ingestion and dermal).

All chemicals (from anthropogenic and natural sources) have the potential to cause environmental effects. However, the magnitude of environmental effects (i.e., risk) depend on the receptor (person or wildlife) being exposed, the route of exposure, and the hazard (inherent toxicity) of the chemical. As illustrated in the diagram to the right, if all three components are present (i.e., where the three circles intersect), the possibility of a risk exists. If one or more of these three components is missing, then there would be no risk. For example, a receptor could be exposed to a chemical, but if that chemical is essentially hazardless (low toxicity) and present at only very low levels, then no unacceptable risk would be expected. Alternatively, an extremely hazardous chemical may be present, but if there is no way for a receptor to be exposed (i.e., no

route of exposure), then that receptor is not at risk for contact with the chemical.

This HHERA was conducted according to widely accepted and utilized risk assessment methodologies published and endorsed be regulatory agencies, including the Ontario Ministry of Environment (2006), Health Canada (2004a), the Canadian Council of Ministers of the Environment (1996), Environment Canada, and the United States Environmental Protection Agency (1989; 2004; 2005)

The risk assessment framework used in the Technical Study Report follows the standard paradigm (Figure 2-1) and is described in the sections that follow:

- Problem Formulation;
- Exposure Assessment;
- Hazard Assessment;
- Risk Characterization; and,
- Uncertainty Analysis.

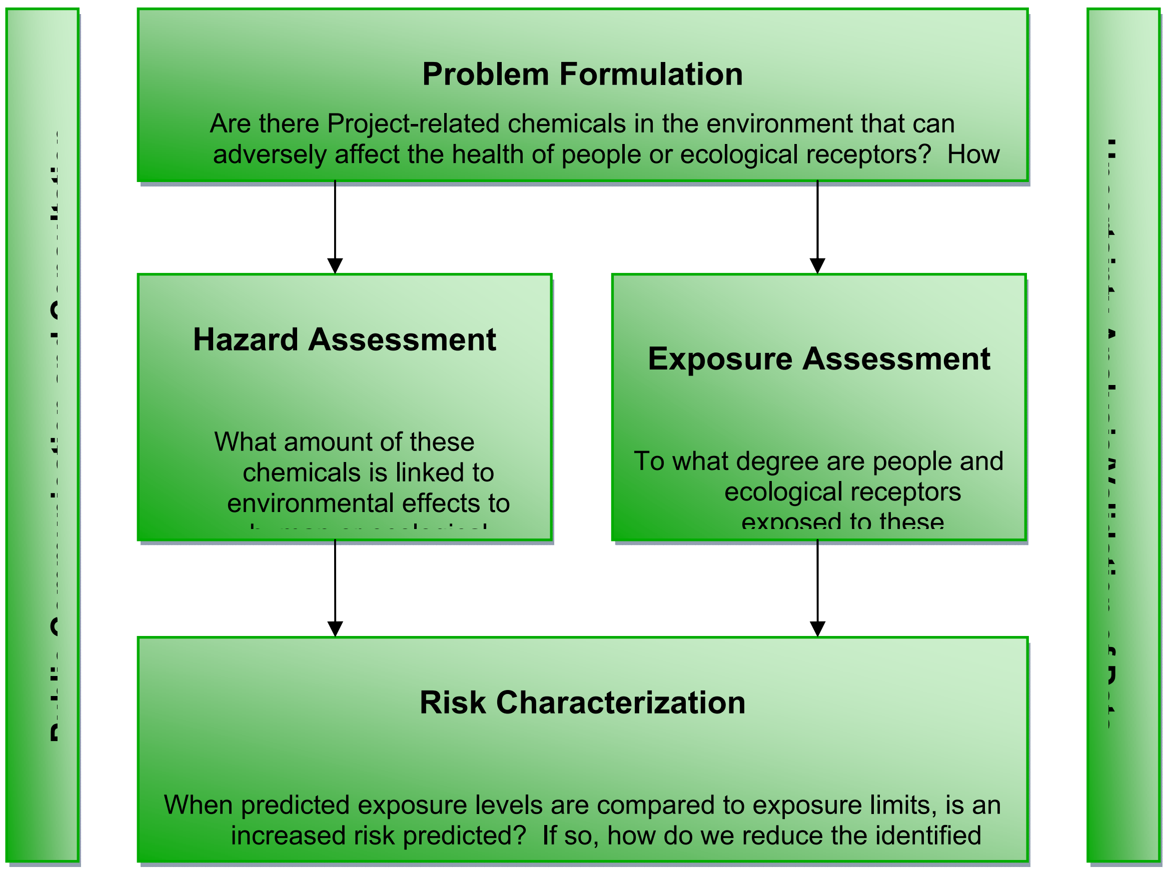

Figure 2-1 Risk Assessment Framework

2.1.1 Problem Formulation

During the problem formulation stage information is gathered and interpreted, which concentrates the study on the primary areas of concern for the Project. Problem formulation defines the nature and scope of the risk assessment, permits practical boundaries to be placed on the overall scope of work, and ensures that the HHERA is directed at the key areas and issues of concern related to the Facility emissions. The gathered data provide information regarding the physical layout and characteristics of the Assessment Area, possible exposure pathways, potential human and ecological receptors, COPC, and any other specific areas or issues of concern to be addressed.

The key tasks requiring evaluation within the problem formulation step include:

- Characterization of the Project and the Assessment Area, including habitat and land use;

- Identification of COPC associated with Project-related emissions;
- Identification of the potentially affected environmental media;
- Receptor identification and characterization; and
- Identification of exposure pathways and routes.

An important component of these tasks was the engagement of the public and stakeholder groups to inform them of the HHERA process and to ensure that the problem formulation captured their views and concerns at the outset of the HHERA. These engagement activities included targeted stakeholder meetings, open houses, and other avenues for public discussion and engagement.

2.1.2 Exposure Assessment

People and ecological receptors can come into contact with chemicals in their environment in a variety of ways, depending on their daily activities and land use patterns. The means by which receptors contact a chemical in an environmental medium is referred to as an exposure pathway. The means by which a chemical enters the body from the environmental medium is referred to as an exposure route. The exposure assessment incorporates information about Facility-related chemical emissions, activities and land use in the area, receptor characteristics, and the exposure pathways identified during the problem formulation phase of the HHERA.

Generally, receptors (human or ecological) can be exposed to chemicals in the environment by:

- Directly inhaling them;
- Coming into direct dermal contact with them; or
- Ingesting them along with food, or water.

The exposure assessment predicts the rate of exposure (i.e., the quantity and rate at which a chemical is received) of the selected receptors to the COPC via the various exposure scenarios and pathways identified in the problem formulation step. The rate of exposure to chemicals from many pathways is usually expressed as the amount of chemical taken in per body weight per unit time (e.g., microgram (μg) chemical/kilogram (kg) body weight/day).

The magnitude of the exposure of receptors to chemicals in the environment depends on the interaction of a number of variables, including the:

- Concentration of chemicals in various environmental media;

- Physical-chemical characteristics of the COPC, which affect their environmental fate and transport and determine such factors as efficiency of absorption into the body;
- Influence of site-specific environmental characteristics, such as geology, soil type, topography, hydrology, hydrogeology, local meteorology, and climatology on a chemical's behaviour within environmental media; and
- Physiological and behavioural characteristics of the receptors (e.g., respiration rate, soils/dusts intake, time spent at various activities and in different areas).

Exposure estimation in the HHERA was facilitated through the use of integrated multi-media environmental risk assessment models. The models incorporate techniques and procedures for exposure modeling developed by various regulatory agencies (e.g. MOE, Health Canada, CCME, and US EPA) and published academic and scientific literature sources.

Separate exposure assessments were conducted for each of the Project scenarios, which are further discussed in Section 3.4. If data were lacking, such that exposures could not be evaluated in a quantitative manner, then exposures to chemicals were estimated and risks discussed qualitatively.

The exposure assessment was conducted deterministically using exposure point concentrations representative of reasonable maximum exposure. In deterministic exposure assessment, single values are used for each parameter. This approach typically results in conservative estimates of exposure and potential risk. In probabilistic (or stochastic) exposure analysis, a range of values is used for each input parameter, where data are available, and each range is characterized by a probability distribution that reflects the variability in the data. The probability distributions (in the form of probability density functions) are assigned to the exposure parameters used in the assessment (where appropriate), and risk estimates are expressed as cumulative distribution functions. Probabilistic exposure analysis typically provides a less conservative, but more realistic estimate of exposure and risk.

Given that this HHERA is a predictive (or prospective) assessment of a Facility that has not yet been constructed, data on the chemicals that are likely to be released, and the rates and concentrations at which they will be released, have considerable inherent uncertainty (as is the case for any HHERA of a proposed industrial Facility). As such, it was considered most appropriate to use deterministic exposure analysis techniques to ensure that the HHERA was conducted in a conservative and protective manner that tends to overestimate, rather than underestimate chemical exposures and risks using of probabilistic models.

2.1.3 Hazard Assessment

The hazard assessment (also known as a toxicity assessment) step involves the selection of toxicity reference values (TRVs), also referred to as exposure limits, for COPC. Toxicity is the potential for a chemical to produce any type of damage, permanent or temporary, to the structure or functioning of any part of the receptor‘s body. The toxicity of a chemical depends on the amount of the chemical taken into a receptor (referred to as the "dose") and the duration of exposure (i.e. the length of time that a receptor is exposed to a chemical). For each COPC, there is a specific dose and duration of exposure necessary to produce a toxic environmental effect in a given receptor. This is referred to as the "dose-response relationship" of a chemical. The toxic potency of a chemical (i.e*.,* its ability to produce any type of damage to the structure or function of any part of the body), is dependent on the inherent properties of the chemical itself (i.e*.,* its ability to cause a biochemical or physiological response at the site of action), as well as the ability of the chemical to reach the site of action. This dose-response principle is central to the HHERA methodology.

2.1.4 Risk Characterization

The risk characterization step integrates the exposure and toxicity assessments to provide a conservative estimate of health risk for the receptors assessed in the various exposure scenarios. Potential risks were characterized through a comparison of the estimated or predicted exposures from all pathways (from the exposure assessment) with the identified exposure limits (from the hazard assessment) for COPC.

If the results of the risk assessment indicate the potential for adverse health risks related to Project emissions, this may lead to the requirement for the development of site-specific, Facility-specific or Assessment Area-specific risk management options and/or criteria.

Limitations and uncertainties associated with the administrative and technical boundaries of the risk assessment, in addition to conservative assumptions used in the assessment, are identified and discussed in order to provide perspective on the assessment results.

2.1.5 Uncertainty Analysis

The administrative boundaries for the risk assessment process are governed by the accepted methodologies and guidelines for the conduct of HHERA in Ontario and Canada. Although there is no specific Ontario or Canadian guidance for facilities emissions risk assessment, this HHERA has followed the standard risk assessment paradigms accepted by federal and provincial governments, including the US EPA Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (HHRAP) (2005).

Uncertainties are inherent in every aspect of the risk assessment process. Generally, these technical boundaries are addressed by incorporating conservative assumptions in the analysis. As a result, risk assessments tend to overstate the actual risk. Although many factors are considered in preparation of a risk analysis, analysis results are generally only sensitive to very few of these factors. The uncertainty analysis is included to demonstrate that assumptions used are conservative, or that the analysis result is not sensitive to the key assumptions.

A risk assessment containing a high degree of confidence is based on the following factors:

- Conditions where the nature and scope of the risk assessment, is defined with a high level of certainty based on data and physical observations; and,
- An acceptable and reasonable level of conservatism in assumptions that will ensure that risks are overstated and an appreciation of the bounds and limitations of the HHERA conclusions.

The exposure assessment performed as part of this study was based on:

- Available data to describe existing media conditions (e.g.; soil, surface water, terrestrial plant);
- Sound conservative assumptions for certain parameters, as required; and
- Well understood and generally accepted methods for risk prediction.

Throughout the entire HHERA, the use of the term conservatism is meant to convey a preference for erring on the side of overstating, as opposed to understating, risk under conditions of uncertainty. For example, analytical values or approaches were selected that would result in an overestimation of exposure or potential risk to humans and the environment, as opposed to understating the risk. A number of specific conservative assumptions are presented in both the HHRA and ERA. The uncertainty associated with HHRA and those associated with ERA, although similar in nature, are distinct and will be addressed in Sections 7.14 and 8.10, respectively. These sections describe in detail how this Technical Study meets the critical factors described above.

3.0 ASSESSMENT AREA AND SCENARIOS

3.1 Assessment Area

The Assessment Area for the HHERA was established to evaluate changes in air quality and the depositions of chemicals into the environment as a result of air emissions originating from the Facility's stack. The HHERA spatial boundaries are based on the depositions predicted in the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e). This will ensure that potential exposure pathways for chemical emissions from the Project would be adequately assessed for both human and ecological receptors.

The Project under evaluation is located in the Eastern portion of the Greater Toronto Area (GTA) in the Region of Durham (Figure 3-1). The Assessment Area includes the Site and a Local Risk Assessment Study Area (LRASA) shown in Figure 3-5 and defined below.

- *Clarington 01 or the Site* is the area of ground disturbance required for the construction of the Facility. The Site is approximately 12.1 hectares in size and is on land reserved for the development of the Clarington Energy Business Park. It is currently undeveloped land covered by shrubs and trees and is owned by the Region of Durham. The Site is south of Highway 401 in the Municipality of Clarington and is located on the West side of Osborne Road North of a CN Rail corridor. There are commercial properties north of the site. The lands east and west of the Site are undeveloped and are currently used for agricultural purposes. The Darlington Nuclear Generating Station is located approximately 2 (kilometres) km to the east. The nearest major intersection is Highway 401 and Courtice Road, which is approximately 1.7 km north of the Site.

- *Local Risk Assessment Study Area (LRASA)*: The LRASA includes land uses within a 10 km radius of the Site (Figure 3-5). This is the area where maximum air emissions from the Facility are expected and predicted with a reasonable degree of accuracy and confidence. The LRASA includes the urban centers of Oshawa, Courtice, Bowmanville and Port Darlington.

Land use in the immediate vicinity of the Site (<500m) is zoned as industrial and commercial to allow for the development of the Clarington Energy Business Park. There is light industrial activity within 1 km north of the Site. Other areas to the east and west are utilized for general agriculture and greenspace. The Courtice Water Pollution Control Plant is located south of the Site.

YORK REGION AND DURHAM REGION
RESIDUAL WASTE STUDY

Project Location

Data Provided By: Ministry of Natural Resources, 2008
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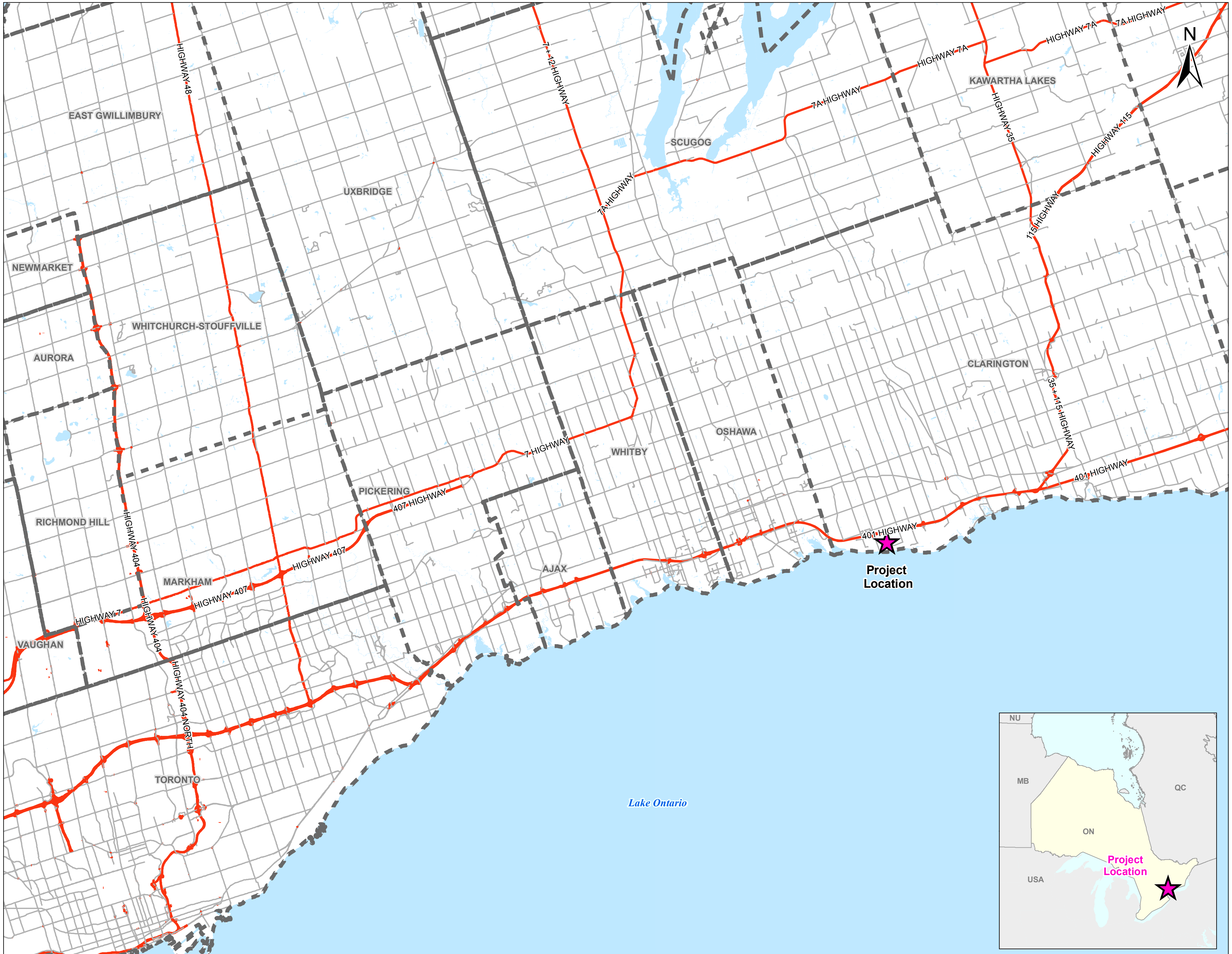
Ministry of Natural Resources © Queen's Printer for Ontario, 2004-2009



Clarington 01 Site
Road
Highway
Waterbody
Municipal Lower tier Boundaries

0 2.5 5 7.5

Kilometres - 1:250,000

1009497-049

PREPARED BY

Jacques Whitford

FIGURE NO.

3-1

Last Modified: May 5, 2009 By: S.Allen

Residential land use in the LRASA is for the most part suburban residential and rural residential. The suburban residential developments surround the three urban centers of Oshawa, Courtice and Bowmanville. Other areas are primarily rural residential. These consist of large, dispersed lots that may be used for agricultural purposes (e.g. cash crops or livestock). Within the larger urban centers there are numerous commercial developments (e.g., GM Oshawa Headquarters and local businesses) and institutional developments (e.g., schools and hospitals).

Recreational land use in the LRASA is dispersed. Recreational opportunities in the area include, but are not limited to, hiking, camping, equestrian activities, hunting and swimming. Darlington Provincial Park is located west of the Site and provides a variety of recreational activities including: hiking, swimming, canoeing, boating, wildlife viewing, and fishing.

There were 14 watersheds evaluated in this HHERA, including: Bennett Creek; Bowmanville Creek; Darlington; Drainage - Lake Ontario; Farewell/Black Creek; Harmony Creek; McLaughlin Bay; Oshawa Creek; Robinson Creek; Second Marsh; Soper Creek; Lower Tooley Creek; Upper Tooley Creek; and the Westside Marsh. The watersheds are described in greater detail in Table 3-5.

3.2 Facility Description

Covanta Energy Corporation has been chosen by the Regions and the preferred vendor of the Thermal Treatment Facility. The Facility has a maximum design capacity of 400,000 tonnes per year (tpy) within the 30-year planning period. For the purposes of this assessment, potential risks from the Facility have been estimated for both the initial operating design capacity of 140,000 tpy and a maximum design capacity of 400,000 tpy. For the initial operating design capacity of 140,000 tpy scenario, there would be two completely independent waste processing trains. Each train would consist of a feed chute, stoker, integrated furnace/boiler, acid gas scrubber, a fabric filter bag house and associated ash and residue collection systems. Steam produced in each boiler would drive a turbine-generator to produce electricity for delivery to the grid, for in-plant use and potentially to provide district heating to the neighbouring Courtice Water Pollution Control Plant and Clarington Energy Park. The expansion to the maximum design capacity of 400,000 tpy capacity would include the addition of 2 more identical waste processing trains.

A site plan showing the layout of the basic 140,000 tpy Facility is presented in Figure 3-2; a site plan of the extended 400,000 tpy Facility is shown in Figure 3-3. Simplified process flow diagrams of the Facility's operations, for both the initial operating design capacity of 140,000 tpy and maximum design capacity of 400,000 tpy, are shown in Figure 3-4.

The following sub-sections describe the various operational components of the Facility, with particular focus on the waste processing train. Each of the proposed 4 trains would be identical to the one described below.

3.2.1 Waste Receiving, Storage and Handling

Refuse would be delivered to the Facility in standard packer vehicles or fully enclosed transfer trailers with capacities up to 92 m^3. Upon entering the Facility an automated truck scale would be used to weigh each truck in order to maintain an accurate accounting of all refuse delivered to the Facility.

After being weighed, incoming refuse trucks would proceed directly to one of the tipping buildings in either the primary structure (to service the 140,000 tonne capacity and Phase 1 expansion), or the supplementary structure (planned as part of the Phase 2 expansion). The tipping area would be totally enclosed with two motor operated entrance/exit doors. The doors would remain closed except for when vehicles are entering or exiting the tipping building. The normal flow of solid waste trucks would be through entrance and exit doors located on opposite sides of the tipping building. Multiple tipping bays would be provided at the pit to allow simultaneous discharge of waste from multiple vehicles. Barriers would be provided at each tipping bay to prevent vehicles from backing into the storage pit. The tipping floor would be sloped towards the pit to permit wash down of the area. The storage pit would be sized to allow continued firing of the system over weekends and holidays. Four days of storage would be provided and distributed above and below the tipping floor level.

After discharging their load, the trucks leaving the tipping buildings would be weighed on a second scale as they exit the property to maintain a record of all residues, recovered ferrous and non-ferrous metals and unprocessed waste removed from the Facility.

In each tipping building, mobile equipment would be used to remove any non-processible items that need to be retrieved from the pit. Two overhead traveling bridge cranes with grapples would be used to mix refuse and transfer it from the pit to the charging hoppers of the furnaces. One of the cranes would be used to keep the tipping bay cleared and combustion units properly charged. The second crane provides backup and could be used during peak delivery times to assist in refuse pit management. The cranes span the entire length and width of the refuse storage pit, furnace hopper, and charging floor.

Both buildings would be designed to draw combustion air from above the storage pit. This would maintain a negative pressure in the tipping building and help prevent the escape of dust and odour from the Facility. When the entrance/exit doors are closed during non-delivery hours, combustion air would be admitted to the tipping area from outside the buildings through manually operable louvers in the tipping building walls.

Emissions from vehicular traffic associated with transporting waste to and from the Thermal Treatment Facility were evaluated in this risk assessment.

3.2.2 Refuse Combustion

Stoker

Each of the identical waste processing trains begins with the stoker. After being charged into the feed chute hoppers, the refuse would be metered onto the surface of a Martin stoker from the bottom of the feed chutes by hydraulic feed rams. The feed rams would be designed to provide an even distribution of refuse over the entire width of the grate. The proprietary reverse-reciprocating action of the Martin stoker grate agitates the fuel bed continuously in a manner which causes the refuse to burn from the bottom of the refuse bed, resulting in thorough burnout of combustible matter.

The grate bars of the Martin stoker are machined on their sides to achieve intimate contact between adjacent bars. Combustion air would be admitted to the refuse layer through specially designed air slots that would also be machined into the stoker grate bars. This feature ensures that consistent air distribution and proper combustion conditions would be maintained across the surface of the stoker at all times. It also minimizes the dropout of siftings between the grate bars and ensures high stoker combustion efficiency and low emissions of hydrocarbons, carbon monoxide and organic compounds relative to other stoker designs.

A series of five plenum chambers along the length of each grate run would admit primary combustion air at rates precisely controlled to suit the combustion conditions of each burning zone as the refuse moves from feed end to discharge. Dampers would control the air rate to the first four zones. Underfire air flow to the fifth zone is taken from the fourth zone. The dampers would be designed to individually regulate the amount of air fed into the various zones of each grate run. The Martin stokers would include a Covanta VLN™ system, which varies the excess air and secondary (overfire) air and uses an internal recirculated gas system to reduce the NO_x generated in the furnace as well as increasing the overall boiler efficiency.

Each stoker would be furnished with a Martin residue discharger that receives the stoker residue (burned-out material) and cools it in quench bath(s).

Furnace

For each train, the boiler furnace/combustion chamber would be located above the stoker grate and would be constructed of gas-tight, continuously welded waterwalls down to the grate surface. In the combustion chamber, unburned gases would be directed into a high temperature combustion zone. This permits the maximum burnout of non-aqueous condensable matter and eliminates odours. The combustion chamber exit temperature would be sufficiently high to destroy odorous vapours. At the furnace throat, overfire air nozzles would provide additional oxygen to combust unburned gases such as carbon monoxide and hydrocarbons.

Following combustion in the furnace, the products of combustion (flue gases) would pass through the boiler convection section, a superheater and an economizer. In the boiler convection section the flue gas would pass through screen tubes at the outlet of the furnace and flow downward through a platen style superheater section and its membrane water wall enclosure, thereby lowering gas temperature. As the flue gas leaves the convection surface, it enters and flows across the boiler superheater tube surface wherein the boiler steam would be superheated. This transfer of heat continues to lower flue gas temperature. Finally the flue gas passes across the boiler economizer tube surfaces to lower its temperature to the design temperature for entry to the air pollution control system.

The furnace would be designed and operated to minimize the concentration of combustion-related pollutants such as carbon monoxide and hydrocarbons. The boiler design would incorporate state-of-the-art features including combustion air distribution and control, location and sizing of heating surfaces and appropriate cleaning methods during operations.

3.2.3 Air Pollution Control Equipment

The waste combustion gas leaving the economizer of each unit would be treated by an air pollution control system (APC) as follows:

1. Covanta's very low NOx (VLN) system in the stoker;
2. Selective Non Catalytic reduction (SNCR). The SNCR system would consist of injecting aqueous ammonia into the first pass of the boiler resulting in the conversion of NOx to nitrogen and water vapour. The combination of Covanta's very low NOx system and the SNCR system would reduce NOx emissions;
3. Mercury and dioxin/furan emissions would be controlled using a system that injects activated carbon into the flue gas after the economizer;
4. Acid gas scrubber. The scrubber removes a large percentage of the acid gases, such as sulfur dioxide and hydrogen chloride. The acid gas scrubber would either be a semi-dry design or a circulating dry design.
    a. In the semi-dry scrubber design, flue gas flows through the cylindrical vertical chamber of the scrubber where it would be intimately mixed with a mixture of lime and water droplets. The water droplets would be evaporated creating a mechanism to neutralize the acid gases and to form a dry entrained particulate.
    b. In the circulating dry scrubber design economizer flue gas is reacted with hydrated lime. Water is injected to maintain optimal humidity for the removal of acid gases. In order to maintain a fluidized bed within the scrubber vessel, ash and lime is recirculated and re-injected into the scrubber.

Acid gas removal performance would be controlled by adjusting the quantity of lime injected. Scrubber outlet temperature would be controlled by adjusting the quantity of dilution/spray water added to the scrubber.

5. A fabric filter baghouse to remove solid phase particulate matter. Fly ash particulate, carbon, scrubber reaction products and unreacted lime would be collected and removed from the flue gas by the baghouse. The filter cake which accumulates on the fabric filters also provides a substrate of unreacted lime carried over from the scrubber, allowing additional reaction with acid gases and further reduction of acid gas emissions.

After leaving the air pollution control system, the flue gas would pass through an induced draft fan and discharge to the atmosphere through the stack.

3.2.4 Residue Handling

From the quench chamber following the stoker, a hydraulically driven ram would push the residue up an inclined draining/drying chute where a low amplitude electromagnetic vibrator mounted on the chute would vibrate the residue. This vibratory motion acts to separate excess water from the residue, which drains back into the quench bath. The bottom ash containing enough moisture to prevent dusting (15 to 25 percent by weight) would then fall to a heavy duty vibrating pan conveyor with integral grizzly that services all of the boilers.

The vibratory conveyor/grizzly scalper removes large materials from the bottom ash before it is transferred by an enclosed inclined conveyor for transport to the residue storage building. Within the residue storage building a magnetic drum and a vibratory screen would be used to separate ferrous material from the bottom ash, and an eddy current separator would be used to remove the non-ferrous metal from the bottom ash. After separation, each material would be directed into dedicated storage bunkers that would store four days of each material. A front end loader would stack and recast the materials. The front end loader would also load residue trucks that would take the residue to its final location. To minimize any dust escaping to the environment during the conveying and separating process, the residue building would have a filtered ventilation system. The ventilation system would also draw air from the grizzly area up the inclined conveyor enclosure.

Fly ash would be collected separately from bottom ash. The fly ash handling system for each combustion train would collect the fly ash from the convection pass, superheater, economizer and the air pollution control system of that train. It would be collected via intermediate conveyors which would discharge into one of two redundant surge bins. Each surge bin would feed an ash conditioner that would combine and thoroughly mix the ash with Portland cement, pozzolan and water to fix any potentially harmful elements in the fly ash. The conditioned fly ash would then be discharged into the first of seven dedicated conditioned fly ash bunkers in the residue building. Each bunker would hold three days of conditioned fly ash. To maintain a consistent and manageable product, the conditioned fly ash would be turned regularly. After three days, the fly ash would be transferred to the adjacent three-day storage bunker. This process would be repeated as required for a total curing period of up to 21 days (3 days - 7 bunkers). After the fly ash has cured, it would be loaded into transportation vehicles by the front end loader. The conditioned fly ash would be kept separate from the bottom ash in the residue building by compartment walls.

Fugitive emissions from residue handling are not expected to be a significant source of Thermal Treatment Facility emissions; therefore, this exposure pathway was not evaluated in the risk assessment.

3.2.5 Energy Production

The high pressure, superheated steam generated in the boilers would be fed to a turbine-generator, where electricity would be produced. The proposed turbine-generator system consists of one unit sized to handle the steam flow of the Facility. Uncontrolled steam turbine extractions would supply the future district heating system, air heaters, the low pressure feedwater heaters and a de-aerator.

Exhaust steam from the turbine would enter an air cooled condenser which would be designed to accept the full turbine exhaust flow at the maximum continuous rating (MCR) steam flow. An independent closed cooling water loop with air-cooled heat exchangers would be provided for auxiliary cooling. The steam generating equipment would be designed to be operated independently of the turbine-generator by bypassing the turbine and routing the superheater outlet steam directly to the air-cooled condenser.

The condensate formed in the condenser would be pumped via condensate pumps through an air ejection condenser, gland steam condenser and low pressure feedwater heaters, where it would be heated prior to delivery to the deaerator. From the deaerator, heated feedwater would be pumped to the boilers' economizers. Two 50% capacity electric motor driven boiler feedwater pumps and one 100% capacity steam turbine driven boiler feedwater pump would be provided.

The electrical connection would consist of a step-up transformer, circuit breakers and other equipment and auxiliaries to convert the generator output voltage of 13.8 kV to 44 kV. The system would meet design and operational requirements for interconnection and delivery of electricity to Hydro One. A 200-300 kW emergency diesel generator will be provided for emergency back-up power.

3.2.6 Potable, Process and Waste Water

The proposed water and wastewater systems would be designed to provide suitable quality water to each process use. The Facility would be designed to be a zero wastewater discharge Facility, with the exception of the Facility's sanitary uses.

Potable water would be used for fire protection, boiler feed water, minimal wash-down water, feed hopper cooling and irrigation. For boiler feed, makeup water would be directed to a two-pass reverse osmosis (RO) unit. Boiler makeup water would be stored in a storage tank and pumped as needed to the deaerator. The process wastewater generated throughout the Facility would be collected and reused wherever possible. Floor trenches would drain to a settling basin and collected wastewater would be used for quenching residue in the ash dischargers. Boiler blowdown and RO reject water would be used as scrubber slaking and dilution water, fly ash conditioning water and supplementary water supply to the settling basin. Sanitary wastewater would be discharged to the sewer.

A chemical feed system would be provided to minimize corrosion of the condensate and feedwater systems and to minimize corrosion, scaling and deposition in the boilers. The corrosion inhibitor system would utilize either ammonia or a filming amine that would be injected into the deaerator outlet piping. The oxygen scavenger system would utilize either sodium bisulphite or equivalent that would be injected into the deaerator. The boiler water chemical treatment system would utilize either phosphate or chelant that would be injected into the boiler drum or economizer inlet pipe.

The Thermal Treatment Facility will be designed to be a closed-loop system (i.e. zero wastewater discharge); therefore, this exposure pathway was not evaluated in this risk assessment.

3.2.7 NAICS Code

The North American Industry Classification System (NAICS) code for the Facility will be 5622 – Waste Treatment and Disposal. The NAICS code for the Facility is listed in Schedule 5 of Ontario Regulation 419/05.

3.2.8 Operating Schedule

The Facility would generally be operated 24 hours a day, 7 days a week with refuse receiving hours Monday through Saturday.

The furnace/boiler combustion units would be normally operated at unit Maximum Continuous Rating (MCR); however, they would be capable of operating at a Maximum Continuous Turndown (MCTD) point, safely and for extended periods, without supplemental fuel firing.

3.2.9 Potential Facility Emissions Sources

The following potential sources of emissions to the air were identified based on the process descriptions and data supplied by the Covanta Energy Corporation for both the 140,000 and 400,000 tpy Facility design options.

The following emissions sources were identified based on the preliminary design for the core 140,000 tpy Facility:

- A conventional stack associated with air pollution control equipment on the waste processing trains which is defined by location, base elevation, stack height, stack diameter, gas exit velocity, gas exit temperature, and contaminant emission rates (the stack typically operates on a continuous basis with relatively constant emission rates);

- One 200-300 kW emergency diesel generator;
- Two 130 kW emergency diesel fire pumps;
- Diesel tanks for the emergency generator and fire pumps;
- Onsite vehicle traffic;
- Comfort heating of the administration and support buildings; and,
- A welding station in the storage and maintenance shop;

The following emission sources will be added to the plant during Phase I and II, if the Facility is expanded to 400,000 tpy capacity:

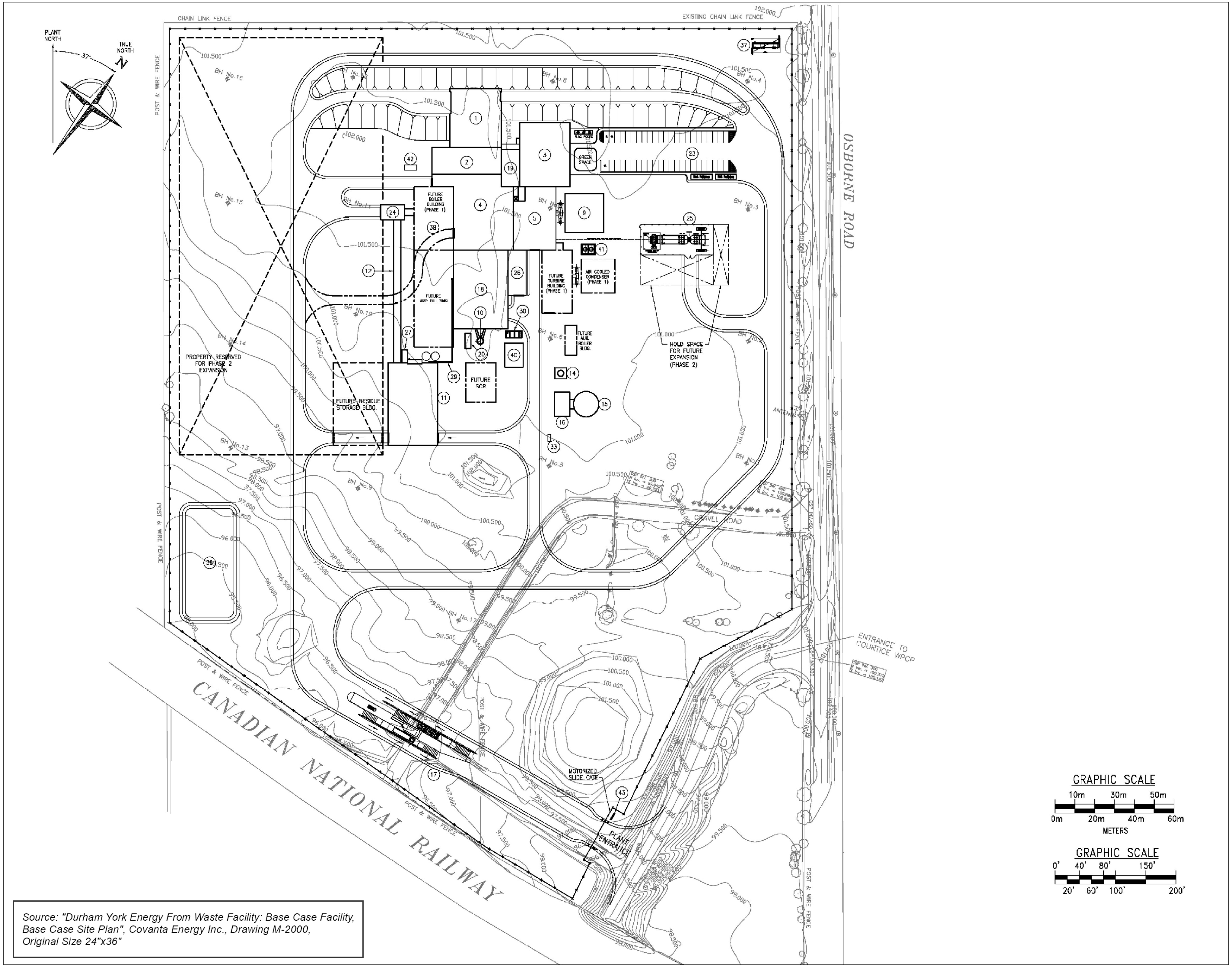
A second flue in the first stack for phase I and a second conventional stack for phase II associated with air pollution control equipment on the waste processing trains which is defined by location, base elevation, stack height, stack diameter, gas exit velocity, gas exit temperature, and contaminant emission rates; and,

A second 200-300 kW emergency diesel generator.

YORK REGION AND DURHAM REGION
RESIDUAL WASTE STUDY

Durham York Thermal Treatment Facility Proposed by Covanta Energy Corporation

Facility Site Layout



Source: "Durham York Energy From Waste Facility: Base Case Facility, Base Case Site Plan", Covanta Energy Inc., Drawing M-2000, Original Size 24"x36"

LEGEND

1. TIPPING FLOOR
2. REFUSE BUILDING
3. ADMINISTRATION BUILDING
4. BOILER BUILDING
5. TURBINE BLDG.
6. NOT USED
7. NOT USED
8. NOT USED
9. AIR COOLED CONDENSER
10. STACK
11. RESIDUE STORAGE BUILDING
12. INCLINED BELT CONVEYOR GALLERY ENCLOSURE
13. NOT USED
14. AMMONIA STORAGE TANK & CONTAINMENT
15. FIRE WATER STORAGE TANK
16. FIRE WATER PUMP HOUSE
17. TRUCK SCALE AREA
18. FDG/APC BUILDING/BAGHOUSE BLDG.
19. CONTROL/ELECTRICAL ROOMS
20. CEMS BUILDING
21. NOT USED
22. NOT USED
23. PARKING LOT
24. GRIZZLY BUILDING
25. SWITCHYARD
26. MAINTENANCE AND STORAGE BUILDING
27. RESIDUE PROCESSING ELECTRICAL BUILDING
28. NOT USED
29. FLY ASH TRANSPORT CONVEYORS
30. SETTLING BASIN
31. NOT USED
32. NOT USED
33. MAINT. TRUCK DIESEL OIL STORAGE TANK
34. NOT USED
35. NOT USED
36. RETENTION POND
37. GAS METERING STATION
38. GRAVEL ACCESS ROAD
39. NOT USED
40. ID FAN VFD BUILDING
41. CLOSED COOLING WATER HEAT EXCHANGER
42. EMERGENCY DIESEL GENERATOR ENCLOSURE
43. PLANT ENTRANCE SIGN

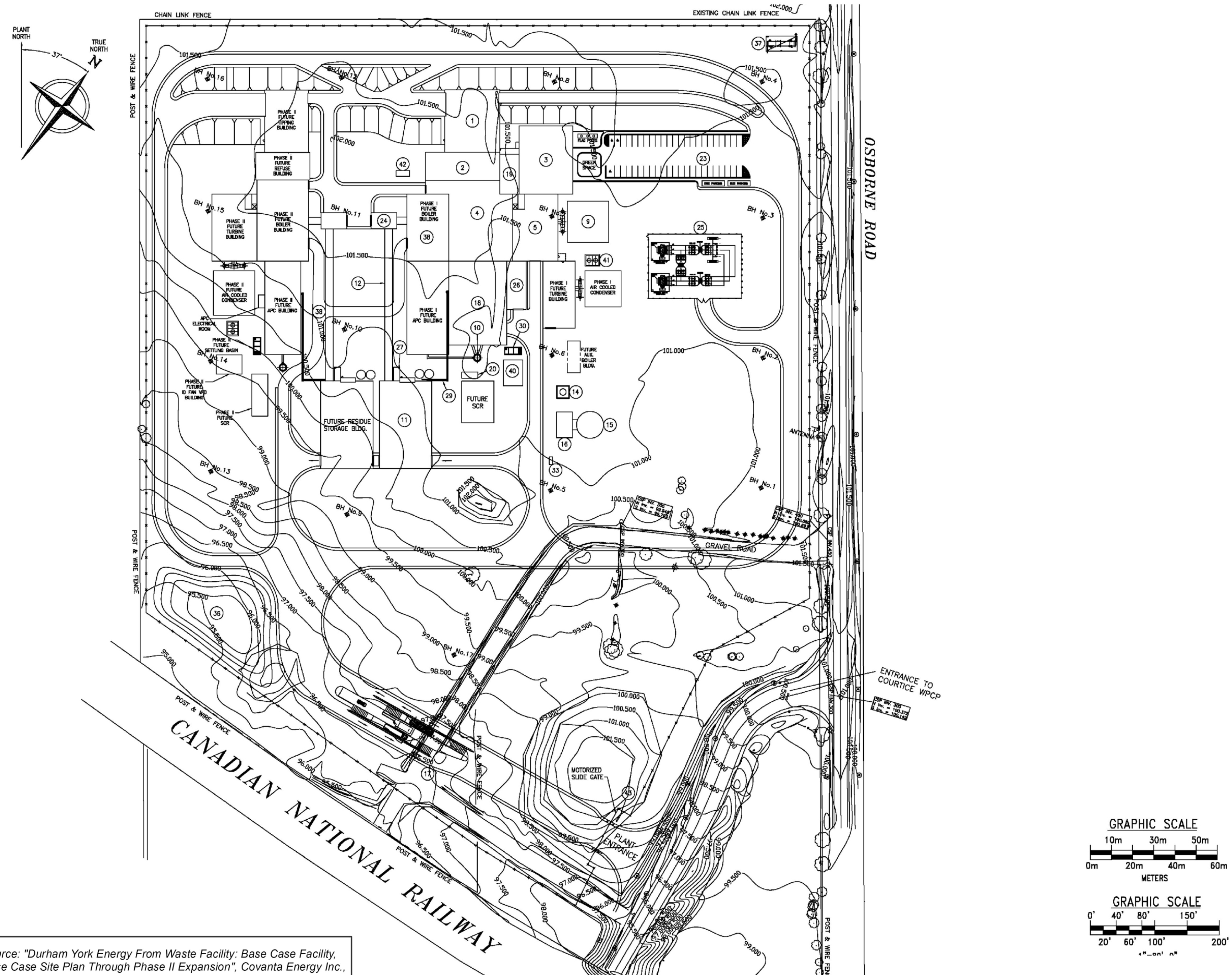
JW-1009497-NS2-4

Jacques Whitford

FIGURE NO.
3-2

YORK REGION AND DURHAM REGION RESIDUAL WASTE STUDY

Durham/York Thermal Treatment Facility Site Layout (400,000 tpy scenario)



Source: "Durham York Energy From Waste Facility: Base Case Facility, Base Case Site Plan Through Phase II Expansion", Covanta Energy Inc., Drawing M-2000_PHSII, Original Size 24"x36"

LEGEND

1. TIPPING FLOOR
2. REFUSE BUILDING
3. ADMINISTRATION BUILDING
4. BOILER BUILDING
5. TURBINE BLDG.
6. NOT USED
7. NOT USED
8. NOT USED
9. AIR COOLED CONDENSER
10. STACK
11. RESIDUE STORAGE BUILDING
12. INCLINED BELT CONVEYOR GALLERY ENCLOSURE
13. NOT USED
14. AMMONIA STORAGE TANK & CONTAINMENT
15. FIRE WATER STORAGE TANK
16. FIRE WATER PUMP HOUSE
17. TRUCK SCALE AREA
18. FGD/APC BUILDING/BAGHOUSE BLDG.
19. CONTROL/ELECTRICAL ROOMS
20. CEMS BUILDING
21. NOT USED
22. NOT USED
23. PARKING LOT
24. GRIZZLY BUILDING
25. SWITCHYARD
26. MAINTENANCE AND STORAGE BUILDING
27. RESIDUE PROCESSING ELECTRICAL BUILDING
28. NOT USED
29. FLY ASH TRANSPORT CONVEYORS
30. SETTLING BASIN
31. NOT USED
32. NOT USED
33. MAINT. TRUCK DIESEL OIL STORAGE TANK
34. NOT USED
35. NOT USED
36. RETENTION POND
37. GAS METERING STATION
38. GRAVEL ACCESS ROAD
39. NOT USED
40. ID FAN VFD BUILDING
41. CLOSED COOLING WATER HEAT EXCHANGER
42. EMERGENCY DIESEL GENERATOR ENCLOSURE
43. PLANT ENTRANCE SIGN

JW-1009497-NS2-4_400

Jacques Whitford

FIGURE NO. 3-3

Last Modified: June 1, 2009 By: L. Kendell

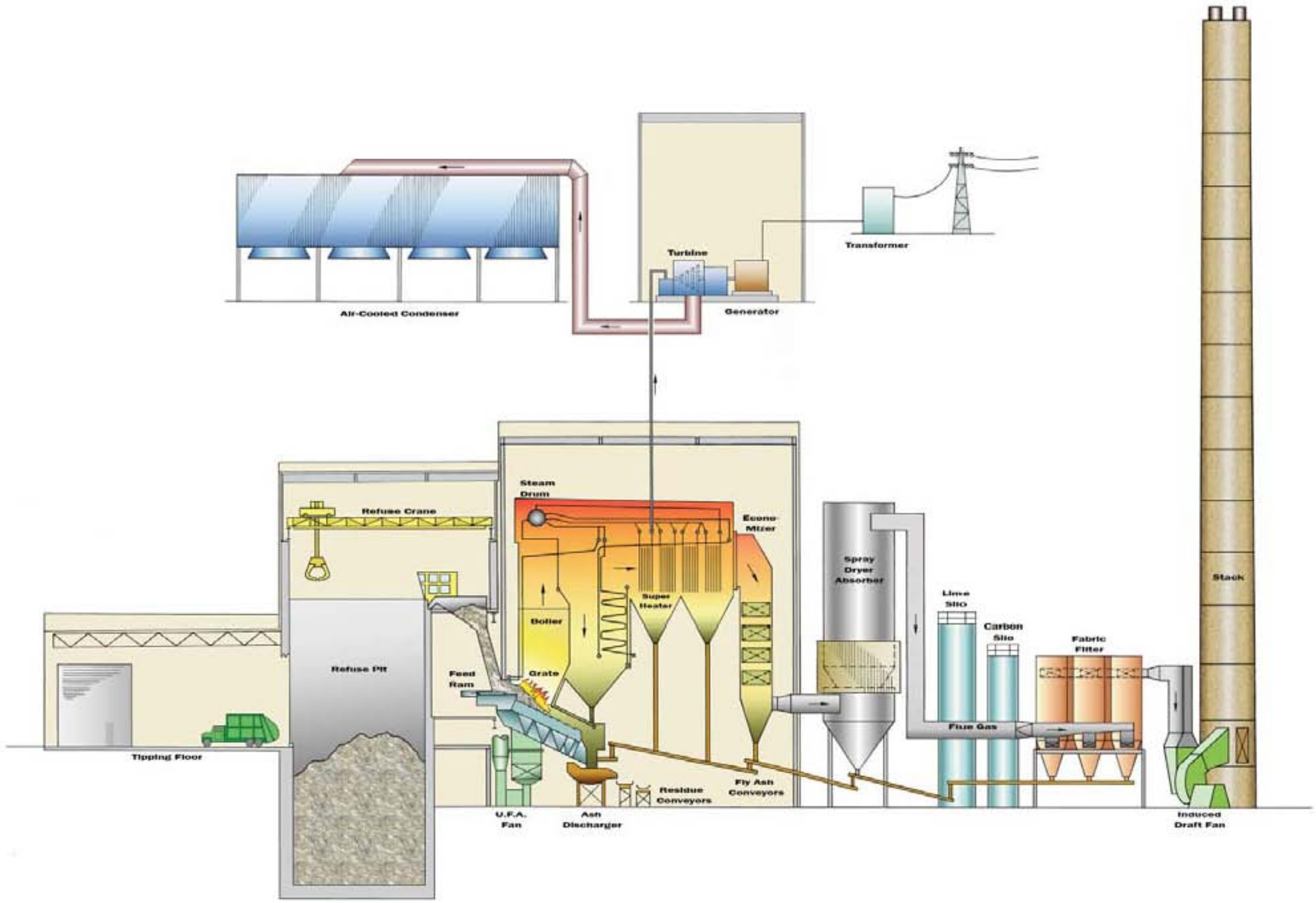


Figure 3-4 Schematic of the Thermal Treatment Process

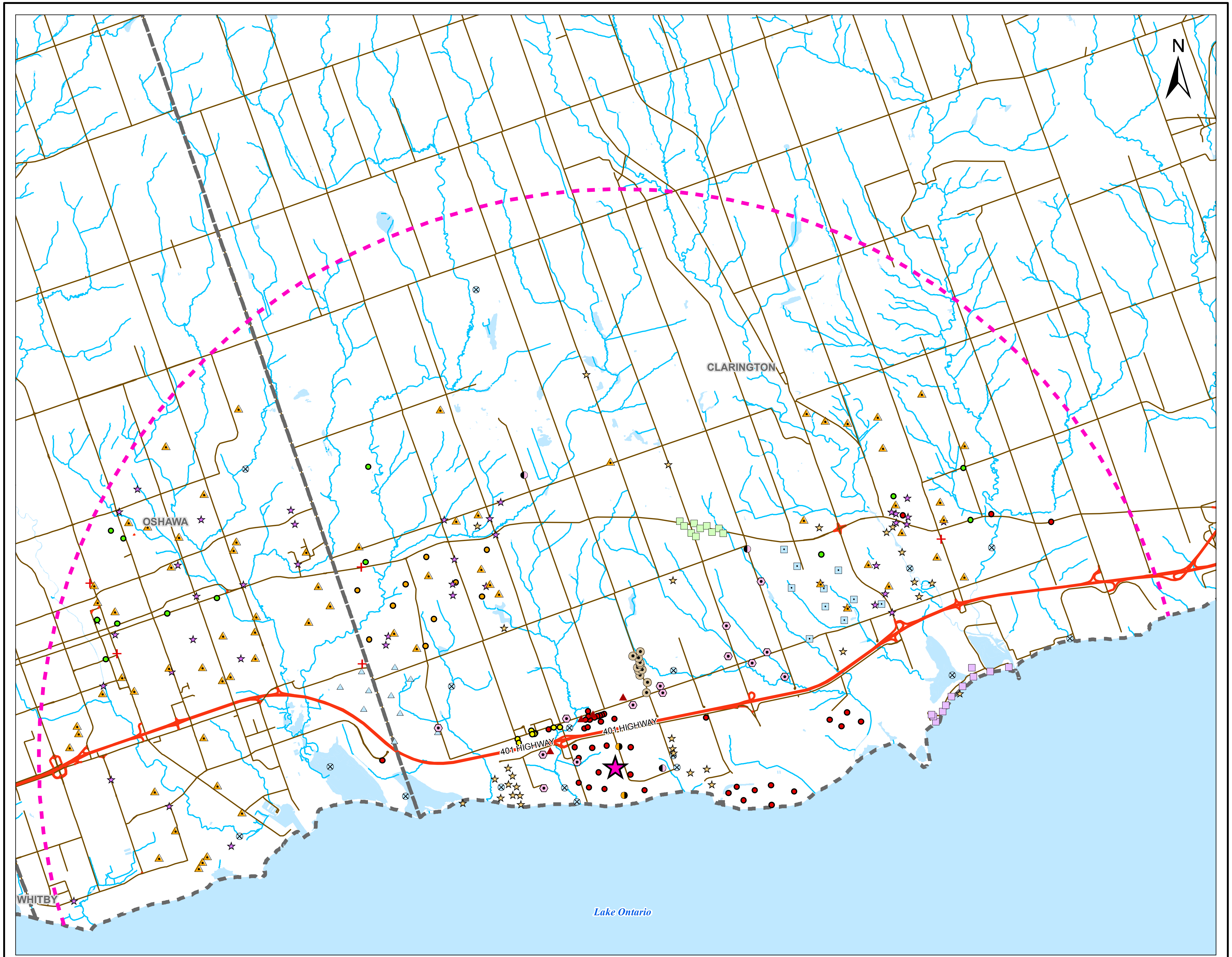
3.3 Receptor Locations

Specific locations were assessed as part of the HHERA. The selection of the receptor locations incorporated land use, air modeling results and input from various sources such as open houses, EA studies, grey literature sources and official plans.

Receptor locations were selected for several reasons including:

- Land use;
- Presence of existing residential developments;
- Presence of institutional developments (e.g. schools);
- Likelihood or known presence of ecological receptors (e.g. proximity to Site, bodies of water, wetlands);
- Locations of known recreational use (i.e. sports fields, hiking, camping);
- Habitat for local wildlife species; and,
- Air modeling results indicating where the maximum ground level concentrations for various COPC were estimated to occur.

In total, 309 receptor locations were selected for inclusion into the HHERA (Figure 3-5). The following sections address how the receptor locations were selected for the inhalation risk assessment, the multi-pathway risk assessment and the ecological risk assessment.



YORK REGION AND DURHAM REGION
RESIDUAL WASTE STUDY

Locations Considered in the Human Health and Ecological Risk Assessment

Data Provided By: Ministry of Natural Resources, 2008
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Clarington 01 Site

Human Health and Ecological Receptors

- Commercial/Industrial and Ecological Receptor Location
- Farm and Ecological Receptor Location
- Recreational Parkland and Ecological Receptor Location
- Maple Grove Subdivision
- Port Darlington Subdivision
- Bowmanville Subdivision
- Oshawa Subdivision
- Tooley Subdivision
- School
- Solina Road Subdivision
- Farm
- Hospitals
- Daycare
- Recreational Parkland
- Commercial/Industrial
- Courtice Road Subdivision
- Courtice Subdivision
- Retirement Residence
- 10km Local Risk Assessment Study Area
- Road
- Highway
- Watercourse
- Waterbody
- Municipal Lower tier Boundaries

0 0.5 1 1.5
Kilometres - 1:65,000

1009497-037

Jacques Whitford

FIGURE NO.
3-5

Last Modified: June 9, 2009 By: S.Allen

3.3.1 Human Health Inhalation Assessment Receptor Locations

In total, 309 receptor locations were selected for assessment within the HHERA. These included schools, daycares, residential development areas, commercial locations, and various terrestrial and aquatic habitat areas (Figure 3-5). The 309 receptors were subdivided into groups according to similar land use. Table 3-1 provides a breakdown of the receptor groupings used for the inhalation assessment. To ensure a conservative estimate of risk, the maximum air concentration from a location within each receptor grouping was used to calculate the level of risk for the entire grouping. Risk characterization was then performed on the resulting 15 receptor groupings (Table 3-1), which represent the originally selected 309 receptor locations. A description and location of each individual receptor included in the inhalation assessment is found in **Appendix F**.

Table 3-1 Inhalation Receptor Groupings

Group Name	Number of Individual Receptors within Group
Schools (Primary and Secondary)	68
Daycares	42
Farms	17
Commercial/Future Development	44
Park Recreational	46
Hospitals	5
Retirement Homes	13
Courtice Subdivision	10
Courtice Road Subdivision	8
Bowmanville Subdivision	10
Maple Grove Subdivision	10
Oshawa Subdivision	10
Port Darlington Subdivision	11
Solina Road Subdivision	11
Tooley Creek Area Residents	4

3.3.2 Human Health Multi-Pathway Assessment Receptor Locations

Of the 309 inhalation receptors, a subset of 133 unique receptor locations in 14 receptor groupings within the LRASA were selected to undergo a multi-pathway exposure assessment to evaluate chronic exposure to COPC through contact with different local environmental media including soil, air, local produce, agricultural products, wild game and fish. The 133 receptor locations were chosen based on their location and conformance to one of the selected receptor groupings for the multi-pathway assessment. Special attention was paid to the suitability of the location for multi-pathway assessment. For example, the inhalation Park/Recreational receptors were categorized into either Recreation User – Sport, Recreation User – Camping, Additional Exposure due to Swimming, or Additional Exposure due to Hunting and Angling receptors, or not assessed based on the description of the location. A breakdown of the receptor groupings used for the multi-pathway risk assessment is provided in Table 3-2, and a map of the multi-pathway receptor locations is provided in Figure 3-6. Note that some receptor locations were represented in multiple groupings; specifically, the daycare receptors were also represented in the Bowmanville and Courtice Subdivisions. To ensure a conservative estimate of risk, the maximum air concentration and 95th Upper Confidence Limit of the Mean (UCLM) deposition concentration from a location within each receptor grouping was used to calculate the level of risk for the entire grouping. A description and location of each individual receptor included in the multi-pathway risk assessment is found in **Appendix F**.

Table 3-2 Receptor Types Used in the Multi-Pathway Exposure Assessment

Multi Pathway Receptor Groupings	Number of Receptors
Bowmanville Subdivision	11
Courtice Road	8
Courtice Subdivision	11
Maple Grove	10
Oshawa Subdivision	10
Port Darlington	11
Solina Road	11
Tooley	4
Farms	17
Daycares	2
Recreation User– Sport	8
Recreation User- Camping	1

Additional exposures from swimming and hunting/angling were also evaluated in the multi-pathway risk assessment (Table 3-3). To ensure a conservative estimate of risk, the maximum air concentration and 95th UCLM concentration from a location within each receptor grouping was used to calculate the level of risk for the entire grouping. Note, the 18 Additional Exposure from Swimming receptors are the same as the Recreation User – Camping receptors; additionally, one of the Additional Exposure from Hunting or Angling receptors is also represented in the Recreation User – Camping/Additional Exposure from Swimming groupings. A description and location of each individual receptor included in the multi-pathway risk assessment can be found in **Appendix F**.

Table 3-3 Additional Exposure Pathways

Additional Exposure Pathway	Number of Receptors in Grouping
Additional Exposure from Swimming	18
Additional Exposure from Hunting or Angling	13

YORK REGION AND DURHAM REGION
RESIDUAL WASTE STUDY

Locations Considered in the Human Health Multi-Pathway Risk Assessment

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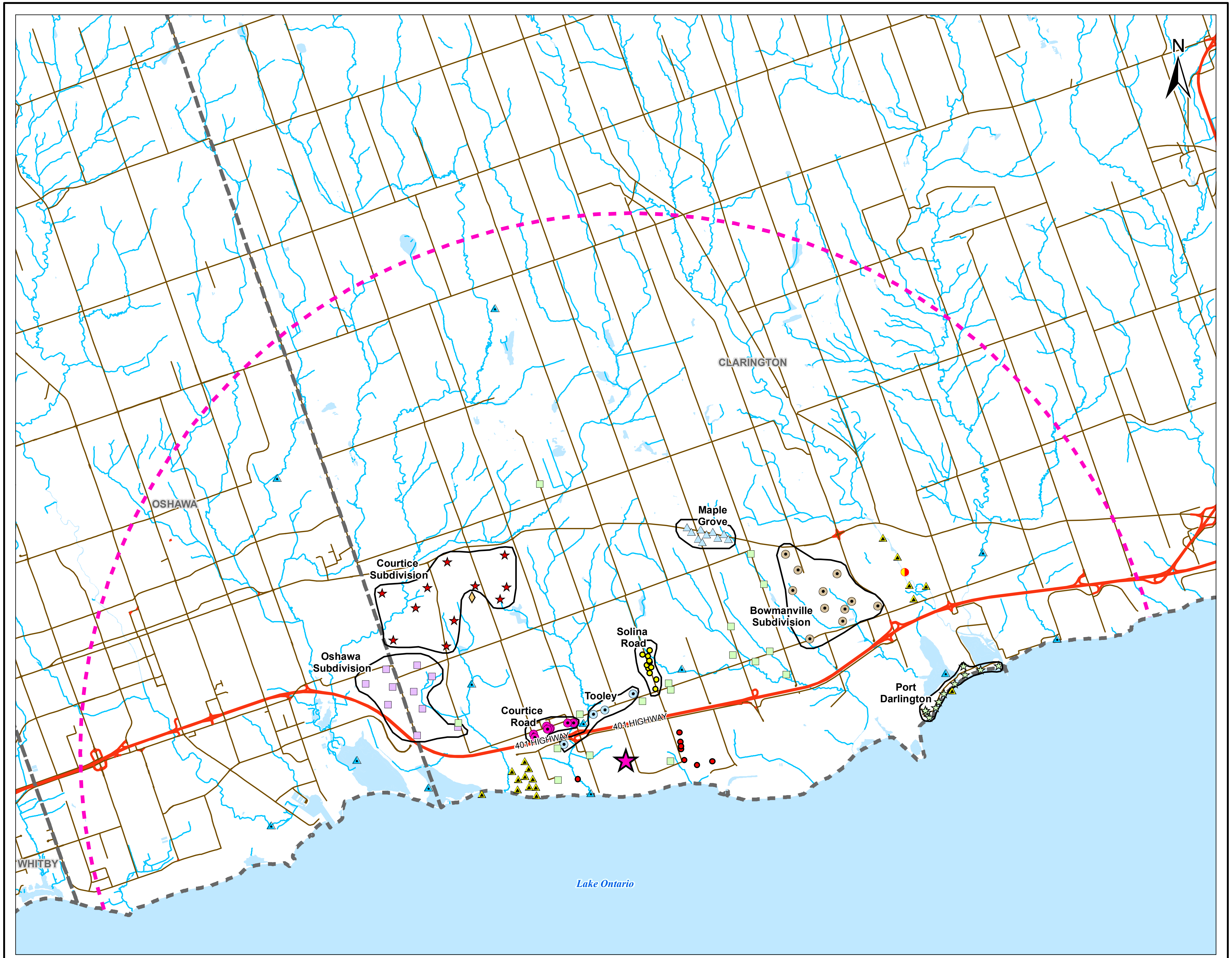

Clarington 01 Site

Human Health Multi-Pathway Receptors

- Additional Exposure from Hunting or Fishing and Swimming
- Daycare and Courtice Subdivision
- Farmer
- Maple Grove
- Oshawa Subdivision
- Recreation User - Camping with Additional Exposure From Swimming
- Additional Exposure from Hunting or Fishing
- Bowmanville Subdivision
- Courtice Road
- Tooley
- Courtice Subdivision
- Port Darlington
- Recreation User - Sport
- Solina Road
- Aurora_Water_Poly
- 10km Local Risk Assessment Study Area
- Road
- Highway
- Watercourse
- Receptor Area
- Municipal Lower tier Boundaries

0 0.5 1 1.5
Kilometres - 1:68,678

1009497-036

FIGURE NO.
3-6

Last Modified: June 9, 2009 By: S.Allen

3.3.3 Ecological Receptor Locations

Twenty-two ecological receptor locations within the Local Risk Assessment Study Area were chosen for the ERA. Table 3-4 lists the ecological receptor locations and Figure 3-7 provides a map of the ecological receptor locations. Refer to Section 8.3.4 for a detailed description of each ecological receptor location as well as a rationale for its selection.

Table 3-4 Ecological Receptor Locations

ECO Label	Description	Watershed
ECO 1	Darlington Provincial Park	Robinson Creek
ECO 2	Second Marsh Wildlife Area	Second Marsh
ECO 3	Darlington Waterfront Trail Entrance	Drainage - Lake Ontario
ECO 4	McLaughlin Bay Wildlife Reserve	McLaughlin Bay
ECO 5	Bowmanville Valley Conservation Area	Bowmanville Creek
ECO 6	Eco Baseline	Lower Tooley Creek
ECO 7	Baseline Rd / Rundle Rd	Darlington
ECO 8	Baseline Rd/Courtice Rd	Upper Tooley Creek
ECO 9	Soper Creek	Soper Creek
ECO 10	Bowmanville Marsh	Westside Marsh
ECO 11	South of Site	Lower Tooley Creek
ECO 12	Sports Fields/ Recreational	Drainage - Lake Ontario
ECO 13	Water pollution control plant	Lower Tooley Creek
ECO 14	Future Industrial	Lower Tooley Creek
ECO 15	Harmony Creek	Harmony Creek
ECO 16	Farewell Creek	Farewell/Black Creek
ECO 17	Farm A	Drainage - Lake Ontario
ECO 18	Farm B	Darlington
ECO 19	Farm C	Farewell/Black Creek
ECO 20	Robinson Creek	Soper Creek
ECO 21	Bennett Creek	Bennett Creek
ECO 22	Oshawa Creek Conservation Area	Oshawa Creek

YORK REGION AND DURHAM REGION
RESIDUAL WASTE STUDY

Ecological Receptor Locations

Imagery: Apruil 2009, Google Earth Pro, Commercial License, 2008
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Clarington 1 Site Area
Ecological Receptor Location
Collector
Highway
10km Local Risk Assessment Study Area

0 0.5 1 1.5
Metres - 1:65,000

1009497-061

FIGURE NO.
3-7

Last Modified: June 9, 2009 By: S.Allen

3.3.4 Watersheds

In addition to the receptor locations described above, 14 watersheds within the LRASA were also identified and modeled as part of the HHERA. It is recognized that people do not necessarily hunt and fish in forested areas or streams located closest to their residence. To address this issue a hunter receptor was placed in the watershed with the highest COPC concentration in wild game (Lower Tooley); additionally, an angler was placed within the watershed with the highest COPC concentration in fish (McLaughlin Bay). These receptors will represent the risk for each hunter/angler within the entire Assessment Area. The watersheds associated with these streams are illustrated in Figure 3-8 and described briefly in Table 3-5. Additional details on the modeling associated with the watersheds are provided in Section 6.0.

Table 3-5 Watersheds Used in the Risk Assessment

Name	Description
Bennett Creek	The Bennett Creek watershed is located approximately 8 km east of the Site. This watershed is likely a habitat for local game.
Bowmanville Creek	The Bowmanville Creek watershed is east of the Site. It is 9 km in length from north to south. The watershed encompasses forested areas, agricultural fields and Bowmanville suburban communities. This watershed is likely a habitat for local fish and game.
Darlington	The Darlington watershed is east of the Site. It includes small creeks, forested areas and agricultural fields. These areas are assumed to be habitat for local fish and game.
Drainage – Lake Ontario	The Lake Ontario drainage watershed is located immediately east of the Site. This area is considered Lake Ontario drainage and is assessed in the HHERA as a watershed. It consists of forested areas and ponds which are used for recreational purposes. The Darlington Nuclear Generating Station owned by Ontario Power Generation is also located within this watershed.
Farewell/Black Creek	The Farewell and Black Creek watershed is located directly north of the Site. The watershed consists of rural agricultural fields and the town of Courtice. There are forested areas as well as Farewell and Black Creek. This watershed is assumed to be a habitat for local fish and game.
Harmony Creek	The Harmony Creek watershed is located northwest of the Site. The area consists of rural agricultural fields, forested areas and the City of Oshawa. Harmony Creek runs through this watershed. Harmony Watershed is assumed to be a habitat for local fish and game.
McLaughlin Bay	The McLaughlin Bay watershed is located west of the Site on the shore of Lake Ontario. It is a relatively small but important watershed. The watershed is bordered by Darlington Provincial Park and the Second Marsh Wildlife Reserve. The watershed consists of McLaughlin Bay, forested areas, marshland, and agricultural fields; therefore this watershed is known to be a thriving habitat for local fish and game. The angler receptor

Name	Description
	was located within this watershed because COPC concentrations in fish were estimated to be the highest at this location.
Oshawa Creek	The Oshawa Creek watershed is located at the far west of the LRASA. It consists of residential and commercial developments within the City of Oshawa. It encompasses Oshawa Creek and the forested areas surrounding this waterway. Oshawa Creek and the surrounding areas are assumed to be habitat for local fish and game.
Robinson Creek	The Robinson Creek watershed is located immediately west of the Site. It encompasses part of the Town of Courtice, agricultural fields, Robinson Creek, small forested areas, and Darlington Provincial Park. This watershed is assumed to be a habitat for local fish and game.
Second Marsh	The Second Marsh Wildlife Area is located at the south end of the Farewell/Black Creek watershed. It is a “Provincially Significant Wetland” and is a habitat for a vast amount of fish and wildlife species. It is known that this watershed is a successful habitat for local fish and game.
Soper Creek	Soper Creek watershed is located east of the Site. Is encompasses the City of Bowmanville, several agricultural fields and forested areas, and Soper Creek. These areas are assumed to be habitats for local fish and game.
Lower Tooley Creek	The Lower Tooley watershed is relatively small and encompasses the Site. It is located North of Highway 401. At present there are two large industrial/commercial buildings but much of the watershed remains vacant land which is reserved for future commercial or industrial development. There are four residential/farming properties located on this watershed. Tooley Creek runs through the watershed. This watershed is assumed to be a habitat for local fish and game. The hunter receptor was placed within this watershed because COPC concentrations in wild game were estimated to be the highest at this location.
Upper Tooley Creek	The Upper Tooley watershed is located directly north of the Site. It consists mainly of farming properties with large agricultural fields. There is also the presence of light industry within the southern portion of the watershed. Tooley Creek runs within the watershed. This area is assumed to be a habitat for local fish and game.
Westside Marsh	The Westside March watershed is located east of the Site. It consists of a section of the City of Bowmanville, the town of Port Darlington, the Bowmanville Harbour Conservation Area (BHCA) and Westside Creek. The BHCA is located at the South of the watershed and is home to various plant, wildlife and fish species. Westside Creek is also assumed to be a habitat for local fish. The Westside Marsh watershed is known to be a habitat for local fish and game.

YORK REGION AND DURHAM REGION
RESIDUAL WASTE STUDY

Watersheds Considered in the Human Health and Ecological Risk Assessment

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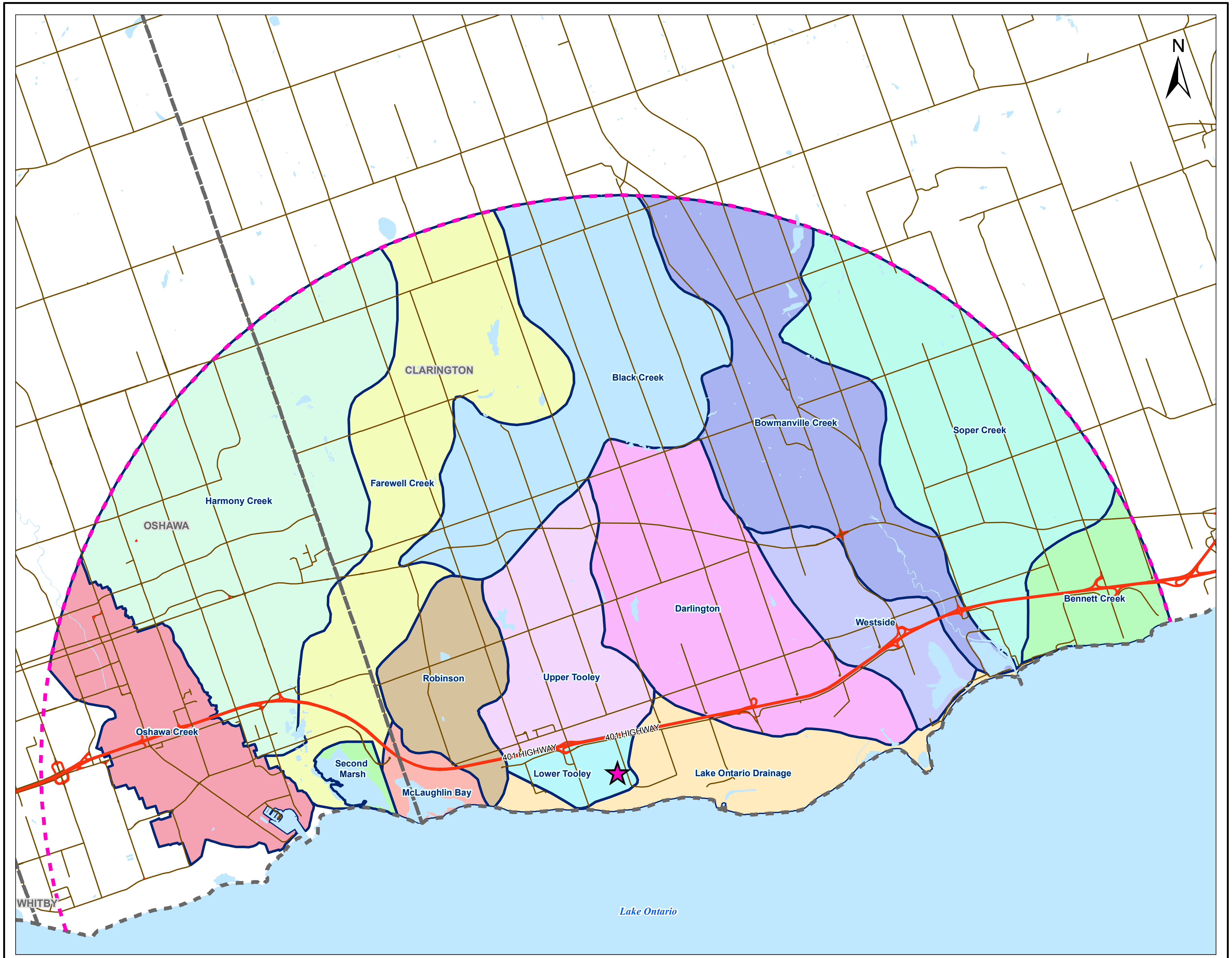
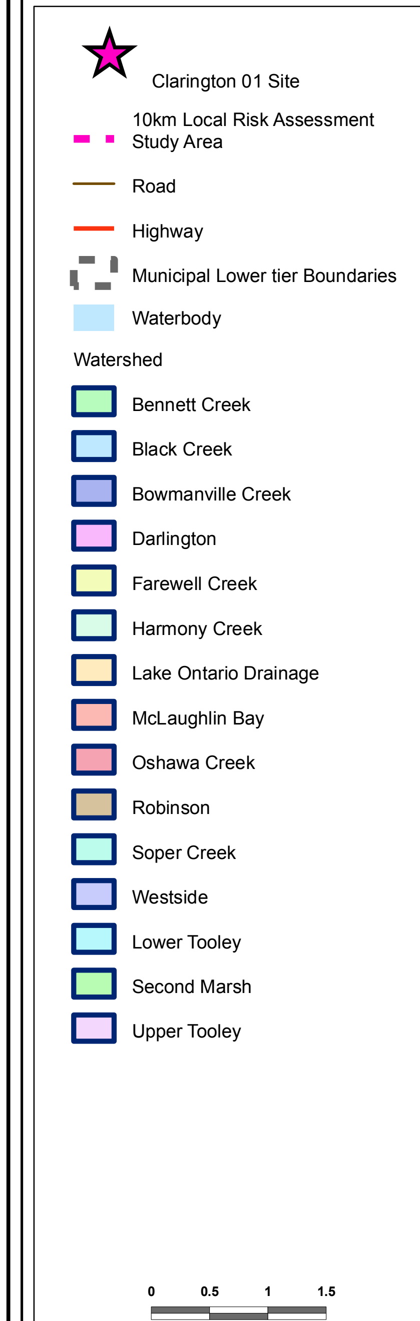




1009497-035

FIGURE NO.
3-8

Last Modified: June 9, 2009 By: S.Allen

3.4 Assessment Scenarios

Four main Assessment scenarios were evaluated as part of this HHERA:

- Existing Conditions Scenarios: The baseline or current day environmental conditions within the assessment area of the Facility;
- Construction Scenario: The time in which the Facility would be constructed and commissioned;
- Operational Scenarios: The time during which the Facility would be operated. The Facility is being designed for a 20 year operating life with a possibility of two, five year extensions; therefore, a 30 year lifespan was appropriate; and,
- Decommissioning Scenarios: The time the Facility would cease to operate.

All operational scenarios were evaluated individually at both the initial operating design capacity of 140,000 tpy and the maximum design capacity of 400,000 tpy. This was done to evaluate exposures to Thermal Treatment Facility related emissions during all possible operating conditions.

As shown in Table 3-6 the four scenarios of the Facility were modeled as 10 cases to evaluate the potential risk of exposure of human and ecological receptors to Project-related chemical emissions.

Table 3-6 Summary of Scenarios Assessed In the HHERA

roject Scenarios	Case	Description
Existing conditions	Baseline Case	Evaluation of the Baseline Case involved the quantitative assessment of existing conditions in the assessment area. Health risks were assessed using measured concentrations of chemicals of potential concern (COPC) in air and in other environmental media (e.g. soil, water, food). No project related emissions or exposure were monitored in this assessment case.
	Baseline Traffic Case	Evaluation of the Baseline Traffic Case involved the quantification of existing offsite vehicle traffic emissions prior to the start-up of the Facility.
Construction	Construction Case	Evaluation of the Construction Case involved the qualitative assessment of the potential health risks associated with air emissions during construction and commissioning of the Project.

roject Scenarios	Case	Description
Operational Cases	Project Alone Case	Evaluation of the Project Alone Case during operation for the Facility involved the quantitative assessment of COPC emissions from the Facility. The assessment was completed at the point of maximum ground level concentration as well as individual HHERA receptor locations. This case was evaluated for 140,000 t/y and 400,000 t/y
	Project Case (Baseline + Project)	Evaluation of the Project Case during operation for the Facility involved the quantitative assessment of COPC emissions from the Facility in combination with existing/baseline conditions. The assessment was completed at the point of maximum ground level concentration as well as individual HHERA receptor locations. . This case was evaluated for 140,000 t/y and 400,000 t/y
	Process Upset Case	Evaluation of the Process Upset Case involved the quantitative assessment of COPC emissions from the Facility operating at upset conditions for 20% of the year. For the remaining 80% of the year, the Facility was assumed to be operating at normal conditions. The assessment was completed at the point of maximum ground level concentration as well as individual HHERA receptor locations. . This case was evaluated for 140,000 t/y and 400,000 t/y
	Process Upset Project Case (Baseline+ Upset Conditions)	Evaluation of the Process Upset Project Case involved the quantitative assessment of COPC emissions from the Facility operating at upset conditions for 20% of the year. For the remaining 80% of the year, the Facility was assumed to be operating at normal conditions. These upset conditions were evaluated in combination with existing/baseline conditions. The assessment was completed at the point of maximum ground level concentration as well as individual HHERA receptor locations. . This case was evaluated for 140,000 t/y and 400,000 t/y
	Traffic Case	Evaluation of the Traffic Case involved the assessment of emissions from offsite and onsite traffic associated with the Facility and baseline traffic conditions in combination with onsite stationary source emissions for the Facility. . This case was evaluated for 140,000 t/y and 400,000 t/y

roject Scenarios	Case	Description
	Future and Existing Conditions Case	Evaluation of the Future and Existing Conditions Case involved the qualitative evaluation of the Facility emissions in combination with future or existing sources of air emissions. This case is addressed qualitatively in the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e). . This case was evaluated for 140,000 t/y and 400,000 t/y
Decommissioning	Decommissioning (Closure Period) Case	Evaluation of the Decommissioning Case involved the qualitative assessment of air emissions related to the removal of infrastructure and rehabilitation of the area.

The existing conditions are also referred to as the Baseline. As discussed in Section 4.0, baseline concentrations for a number of environmental media (e.g. air, soil, water, plants, wildlife) were established through the collection and analysis of field samples (Jacques Whitford, 2009a). This information was carried forward in the modeled scenarios as "Baseline".

As per section 3.1.1.4 (Residue Handling) both the bottom ash and fly ash would be contained on site and disposed of at an appropriate offsite Facility; therefore, it is not assessed in this HHERA.

3.4.1 Existing Conditions Scenarios

3.4.1.1 Baseline Case

Pre-Project baseline conditions for the HHERA against which the Project-related and cumulative environmental effects were measured are based in two separate technical studies:

- *Environment Baseline Report* (Jacques Whitford, 2009a)
- *Ambient Air Monitoring Report* (Jacques Whitford, 2009b)

Since limited specific ambient air quality data exists in the immediate vicinity of the Site; therefore a supplementary ambient air monitoring program was conducted (Jacques Whitford, 2009b). The ambient air monitoring station for the Site was located on the west side of Courtice Road, approximately 1.5 km South of Highway 401, and was located within the fenced area of the Project office for the new water pollution control plant. It was approximately 2 km southwest from the Site. Between-September 2007 and December 2008, the Courtice Road monitoring station has measured the following Criteria Air Contaminants (CACs), which are common air pollutants with known human health and environmental effects:

- Sulfur Dioxide (SO_2);
- Nitrogen Oxides (NO_x);
- Carbon Monoxide (CO);
- Ozone (O_3); and,
- Particulate Matter smaller than 2.5 microns ($PM_{2.5}$).

A 10 metre meteorological tower at the station measured wind speed, wind direction, and temperature.

On December 26, 2007, hi-volume air samplers were installed at the Courtice Road monitoring station to measure:

- Total Suspended Particulate (TSP) matter and metals;
- Polycyclic Aromatic Hydrocarbons (PAHs); and,
- Dioxins and Furans.

A separate environmental sampling program was conducted in concurrence with the ambient air monitoring program. US EPA (2005) provides guidance on evaluating environmental effects to human health caused by air emissions from proposed facilities at the design stage. The guidance identifies a number of environmental media that need to be included in the assessment. US EPA (1998, 1999) also provides guidance on environmental media to be considered in the evaluation of environmental effects to ecological receptors. These same media were targeted as media of interest for the *Environmental Baseline Report* (Jacques Whitford, 2009a). This included soil, forage and browse, terrestrial invertebrates, small mammals, wild fruit, produce, sediment, water, and fish. The list of COPC (discussed in greater detail in Section 4.0) for which sampled media were analyzed included, but is not limited to:

- Metals;
- Dioxins and Furans;
- Polycyclic Aromatic Hydrocarbons (PAH); and,
- Volatile Organic Compounds (VOC).

The sampling program for ambient air is presented in the *Ambient Air Monitoring Report* (Jacques Whitford, 2009b) and the sampling program for environmental media is presented in the *Environmental Baseline Report* (Jacques Whitford, 2009a). Specific baseline concentrations selected for use in this HHERA are provided in **Appendix B**.

3.4.1.2 Baseline Traffic Case

Current offsite vehicle emissions prior to the start up of the Facility were based on traffic volume estimates provided by URS Canada Inc. These traffic estimates were combined with the existing baseline ambient air conditions in the airshed to produce the baseline traffic case.

3.4.2 Construction Scenarios

3.4.2.1 Construction Case

Evaluation of Construction involved the qualitative assessment of the potential health risks associated with air emissions during construction and commissioning of the Facility. Construction activities for the Facility would include:

- Site preparation (e.g. clearing, cut and fill, site leveling);
- Foundation and building construction; and,
- Assembly of plant components.

Dust emissions from construction activities could have a temporary effect on local air quality. These emissions are associated with land clearing, ground excavation, cut-and-fill operations and equipment traffic on site. In general, fugitive dust emissions are:

- Proportional to the disturbed land area and the level of construction activity;
- Limited to periods of the day and well when the construction activities take place; and,
- Vary substantially from day to day with differences in meteorological conditions.

Vehicles on the construction site would be a source of exhaust emissions from fuel combustion. Construction activities such as welding, use of solvents, sand blasting and painting can also affect air quality in the construction area. These activities are typically localized and can be mitigated through implementation of vehicle and equipment maintenance programs; therefore, the construction case was qualitatively assessed for this project.

3.4.3 Operational Scenarios

All operational scenarios were evaluated individually at both 140,000 tpy and 400,000 tpy. This was done to estimate exposures to Thermal Treatment Facility related emissions during all possible operating conditions.

3.4.3.1 Project Alone Case

Evaluation of the Project Alone Case was based on modeled emissions of air contaminants during Operation that originate from point source at the Facility (i.e. the stack). Air modeling was conducted to understand how stack emissions from the Facility would be deposited in the environment. The air modeling methods are discussed in further detail in the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009b).

Assessment of the Project Alone considered only chemical emissions from the Facility. The Project Alone Case was used to assess the health risks associated with chemical emissions from the Facility on human and ecological receptors.

3.4.3.2 Project Case (Baseline + Project Alone)

Evaluation of the Project Case during Operation consisted of the assessment of health risks to human and ecological receptors due to exposure to the total concentrations of COPC in the environment. This includes the health risks from the existing concentrations of COPC in the environmental media (i.e., Baseline Case) and the predicted increases in chemical concentrations from the operation of the Facility (i.e. the Project Alone Case). These health risks represent the potential cumulative environment effects (risks) of human and ecological receptor exposure to atmospheric emissions (above existing concentrations) with the addition of the Facility in the LRASA.

3.4.3.3 Process Upset Case

It is possible for emissions levels to be higher than those during normal operation as a result of various process upsets such as start-ups, shut-downs and malfunctions of the combustion units or the air pollution control (APC) equipment. These events would be expected to occur infrequently and be of relatively short duration.

Process upsets that are listed by the US EPA include:

- Start-up and shut-down events;
- Automatic waste feed cut-offs (AWFCOs); or,
- Air Pollution Control upsets, including:
  - baghouse pressure drop;
  - acid gas scrubber flow upset;
  - upsets in the selective non catalytic reduction unit; and,
  - upset in the very low NO_x (VLN) system.

At the time of preparation of the HHERA, only little information was available from the vendor on their technology specific upset conditions (e.g., the number of start-up and shut-down events expected in a year). The following are examples provided by the vendor of potential malfunctions or that could occur at a typical EFW facility, however emission factors for these upset conditions were not available:

- Baghouse Broken (torn) bags

Broken bags will be detected by emissions monitoring equipment, and the operator alerted by an alarm. The operator will immediately attempt to determine the location of the failed bag by isolating baghouse cells one by one until the particulate emissions level drops. Once the cell is identified, it will be kept isolated until the failed bag is replaced. Typically, there is no environmental exceedance associated with a failed bag.

- Loss of slurry to the scrubber

Loss of slurry will be detected by the control system and the operator alerted by an alarm. An operator will be sent to investigate and resolve the problem. Built-in redundancy can be used to restore slurry flow quickly in most cases. Usually, the slurry flow can be restarted without an environmental exceedance. Typical duration is less than an hour.

- Interruption in the ammonia system

Loss of ammonia flow will be detected by the control system and the operator alerted by an alarm. An operator will be sent to investigate and resolve the issue. Built-in redundancy can be used to restore flow quickly in most cases. The ammonia flow can virtually always be restored without an environmental exceedance.

- Slug of wet fuel on the grate

The combustion system is designed to automatically accommodate a wide range of fuel conditions, but a heavy load of wet fuel can require manual intervention by the operator. Excessive wet fuel will be indicated by rising oxygen levels and dropping temperature and steam flow. Potential operator responses include stopping fuel feed, increasing grate agitation, and increasing or redistributing underfire air flow. The operator will be watching CO levels, and if CO is excessive the operator will start the auxiliary burner to maintain temperature in the furnace, in order to prevent a CO exceedance. As the wet fuel dries out and begins to ignite, the operator will restore the settings. Duration depends on the particular circumstances, but typically does not result in an exceedance.

- Turbine failure/blackout

Loss of electrical power to the facility will prevent controlled shutdown procedures from being followed. The control system and emissions monitoring equipment will continue to operate on backup power, but combustion air fans will shutdown. CO exceedances cannot be avoided in this condition, and will likely persist for approximately 6 to 12 hours, unless power is restored.

- Boiler tube failure

Depending on the size and location of the tube failure, it may be possible to shut the boiler down without exceedances. If the failure does not permit water level to be maintained in the boiler, then a controlled shutdown cannot be accomplished, and high CO levels will occur, typically for a period of less than 6 hours, but certainly less than 12 hours.

- Boiler feedwater pump failure

The backup feedwater pump will automatically start upon loss of the main pump. Complete boiler feedwater pump failure will be identical to an uncontrolled shutdown with a boiler tube failure as described above.

- Combustion air flow failure

Loss of a combustion air fan is similar to the loss of water condition, with the exception that it may be possible to operate the auxiliary burner to minimize CO during the shutdown process.

To examine the potential changes in air quality due to process upsets, the U.S. EPA "*Guidance Document on Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities*" (U.S. EPA, 2005b) recommends that when site specific data are not available or are inappropriate for deriving an upset factor, that upset emissions be estimated by using a procedure based on work by the California Air Resources Board (CARB) (1990):

> *"Estimating Emissions from Process Upsets: To represent stack emission rates during process upsets, multiply the emission rate developed from the trial burn data by 2.8 for organics and 1.45 for metals. These factors are derived by assuming that emissions during process upsets are 10 times greater than emissions measured during the trial burn. Since the unit does not operate under upset conditions continually, the factor must be adjusted to account for only the period of time, on an annual basis, which the units operate under upset conditions. For organic compounds, the Facility is assumed to operate as measured during the trial burn 80 percent of the year and operate under upset conditions 20 percent of the year [(0.80)(1)+(0.20)(10)=2.8]. For metals, the combustion unit is assumed to operate as measured during the trial burn 95 percent of the year and operate under upset conditions the remaining 5 percent of the year [(0.95)(1)+(0.05)(10)=1.45]."*

Based on this discussion, the following approach was used to estimate emissions from the 140,000 tpy Facility during process upsets:

- For determining short-term (1-hour to 24-hour average) ground level CoPC concentrations, the emission rates for the Facility under normal operation were conservatively increased by a factor of ten. This factor was applied to all CoPCs except for SO_2 and NO_x for which manufacturer data on uncontrolled flue gas concentrations were available. SO_2 and NO_x emissions were increased by factors of 16 and 1.63 respectively, as specified in the data received from the manufacturer.
- For calculating annual average concentrations, the emission rates of metals and CACs were increased by the EPA recommended factor of 1.45 noted above, with the exception of SO_2 and NO_x. For these contaminants the emission rates were increased by factors of 1.75 and 1.03 respectively, based the increased flue gas concentrations noted above and operating under upset conditions 5% of the year.
- For calculating annual average concentrations of all other CoPCs, the emission rates were increased by the EPA recommended factor of 2.8.

These process upset emission rates will provide a conservative estimate of worst-case emission rates (particularly for HAPs) that could be expected to be encountered over the course of an operating year. On an annual basis, the factor of 2.8 utilized for most CoPCs is based on the assumption that the Facility operates under process upset conditions 20% of the time. The Project Team believes that this is a conservative assumption; however, it should be confirmed in the future by the vendor.

To predict maximum short-term (1-hour to 24-hour average) ground level concentrations from the 400,000 tpy Facility, emissions during process upsets were estimated by conservatively assuming a process upset occurring simultaneously in two out of three exhaust streams and associated processing trains. A process upset was assumed to occur for in the APC and/or processing trains of the base 140,000 tpy Facility (Stack 1: Flue 1) as well as Phase II of the expanded 400,000 tpy Facility (Stack 2). The process trains and/or APC associated with Phase I of the expanded 400,000 tpy Facility (Stack 1: Flue 2) were assumed to be functioning normally. Emissions from the units assumed to be experiencing process upsets were calculated using the same methodology applied for the 140,000 tpy Facility.

To predict maximum long-term (annual average) concentrations during process upsets at the 400,000 tpy Facility, it was conservatively assumed that each stack would be under process upset conditions 20% of the time on an annual basis. Emissions were increased for all three exhaust streams using the same methodology applied for process upsets from 140,000 tpy Facility on an annual basis.

3.4.3.4 Process Upset Project Case (Baseline + Process Upset Case)

Evaluation of the Process Upset Project Case consisted of the assessment of health risks to human and ecological receptors due to exposure to the total concentrations of COPC in the environment during process upset conditions. This Case modelled existing conditions (i.e. the Baseline Case, Section 3.4.1.1) in combination with EFW facility emissions during process upset conditions (i.e. Process Upset Case, Section 3.4.3.3). These health risks represent the potential cumulative environmental effects (risks) of human and ecological receptor exposure to atmospheric emissions (above existing concentrations) with the addition of the Facility operating during upset conditions in the LRASA.

3.4.3.5 Traffic Case

Emissions from vehicle operation (e.g., onsite vehicles and waste/ash trucks) associated with the Facility and existing/baseline vehicular traffic were assessed in conjunction with the Facility air emissions to determine the net impact from all potential emissions onsite and offsite.

During the preparation of this Report, the number of vehicles and their operating hours were developed using the same methodology as was used in the "*Durham/York Residual Waste Study – Report on Air Dispersion Modelling*", (Genivar and Jacques Whitford, 2007). Based on these conservative numbers, it was assumed that a total number of 87 waste trucks and 10 ash trucks would be operating on the site between 8 a.m. and 4 p.m., with the majority of deliveries occurring between the hours of 8 a.m. to 10 a.m. and 2 p.m. to 4 p.m. It was also assumed that 32 employee passenger vehicles would be driven onsite at different hours of the day corresponding to the beginning of each shift at the Facility. Since the operating hours and number and type of vehicles at each hour during the day was not constant, emission rates for each hour were estimated separately based on the number and type of the vehicles during that hour.

However recently, during the completion of the Technical Study Reports associated with this Project, a Traffic Impact Assessment was completed based on an analysis of the waste materials that would be transfer-hauled and direct-hauled and the materials required for Facility operations (chemical supply etc.) that provides a more accurate estimate of the potential operational vehicles that would access the Site. These estimates indicate that a total of 25 waste trucks (transfer trailer or compactors) and 9 additional trucks (ash, chemical supply, ferrous, and non-ferrous metal trucks) would be received on Site Monday through Saturday during normal operating hours along with approximately 33 employee passenger vehicles.

The estimates of the vehicle emissions in this Draft Report are based on the conservative numbers noted above (87 waste trucks, 10 ash trucks, 32 passenger vehicles daily), and thus represent a conservative estimate of the contribution of vehicle emissions to the net impact from all potential emissions onsite. This will be adjusted to reflect the most recent vehicle estimates (25 waste trucks, 9 additional trucks, and 33 passenger vehicles) as this Report is finalized.

The offsite vehicle emissions were modelled in the *Air Quality Assessment Technical Study Report* using the US EPA CAL3QHCR traffic dispersion model (Jacques Whitford, 2009e). Emissions of SO_2, NO_2, CO, and $PM_{2.5}$ were assessed. Maximum GLC predictions from the CAL3QHCR model for offsite vehicle traffic were conservatively combined with the maximum GLC predictions for the Facility air emissions and measured background concentrations. The assessment was conducted for the receptor locations in close proximity to the roads on which traffic into the Facility would travel. This methodology is expected to be conservative as it assumes that the maximum predicted concentration due to vehicle traffic occurs simultaneously with the maximum predicted concentration from onsite emissions (Jacques Whitford, 2009e).

3.4.3.6 Future and Existing Conditions Case

Evaluation of the Future and Existing Conditions Case involved the qualitative evaluation of the Facility emissions in combination with future or existing sources of air emissions. This case is not addressed in the HHERA, but rather is addressed qualitatively in the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e), and is provided here for information purposes.

The following section describes emissions of chemicals of potential concern (COPC) from industrial and residential sources other than the Facility in the local study area.

Existing Industrial Point Sources

To assess the potential cumulative environmental effect of the Facility on local air quality, emissions from other local industrial facilities were examined in combination with the Facility's assumed emissions.

Emissions data for industrial land sources within a 20 km radius of the Facility were compiled from Environment Canada's National Pollutant Release Inventory (NPRI) for 2007 (the most recent year with published data). Thirty-five existing industrial sources were identified in a review of the NPRI data. These include:

A.G.Simpson Automotive Oshawa
Andrew Canada
Atlantic Packaging Products Ltd. Whitby
Ball Packaging Whitby
Canada Building Materials Whitby, Plant No. 84
College Woodwork, Kingsway College
Corbett Creek W.P.C.P.
Darlington Nuclear
Delphi Trilink Plant
Detox Environmental Ltd. Bowmanville
Dufferin Aggregates, Mosport Pit
Dufferin Concrete, Bowmanville
Dufferin Concrete, Whitby
EHC Global Oshawa
Exopack Whitby
Gerdau Ameristeel Whitby
Hanson Pipe & Products Canada, Whitby
Harmony Creek W.P.C.P.
Hydro One Bowmanville Switching Station
Lafarge Canada Inc. Property No. 20 Agg Site
Lofthouse Brass Whitby
Mcasphalt Industries Oshawa
Nemato Corp. Whitby
Oshawa Car Assembly Plant, GM Of Canada
Oshawa Metal Centre, GM Of Canada
Oshawa Truck Assembly Centre, GM Of Canada
Permacon Oshawa
Port Darlington W.P.C.P.
Pringle Creek W.P.C.P.
Safety-Kleen Canada Inc. Oshawa
Smurfit-MBI Whitby
St. Marys Cement Bowmanville
Veyance Technologies Canada Inc. Bowmanville
Whitby Cogeneration L.P.
Woodbridge Foam Whitby

In most cases, they Project contribution to the study area industrial emissions was found to be minimal. Further discussion is available in the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e).

Existing Non-Industry Emissions

Non-industrial emission sources such as transportation, residential, and commercial operations contribute to local air quality, as do industrial emissions. Community emissions (industrial plus non-industrial emissions) will be greater than industrial source emissions alone. A study on the Clarkson airshed published by the MOE (MOE, 2008) showed non-industrial sources to be significant contributors to airshed emissions. Based on this data, it would be reasonable to estimate that community emissions are at least a factor of two greater than industrial point source emissions alone for criteria air contaminants (CACs) in the study area.

Future Developments

A summary of proposed development projects identified for the LRASA is presented in Table 3-7.

Of these projects, the aggregate transfer station and GO transit line/station are expected to have little potential to substantively affect regional air quality. The impact of additional development in the Clarington Energy Business Park will be dependent on the type of future development, which is uncertain at this time, and therefore could not be assessed further. The Highway 401 widening may affect air quality as this would allow for increased vehicle use on the highway, but additional details were not available at this time to evaluate these changes; therefore, no assessment of potential risk from these future developments could be made.

Table 3-7 Proposed Developments within the LRASA

Proposed Development Project	Estimated Start Date	Potential to Change Air Quality
St. Mary's Alternate Fuels Demonstration	unknown	Yes
Darlington B Nuclear Generating Station	2010-2026	Yes
Aggregate Transfer Station and Asphalt plant (Baseline Road and Solina Road)	unknown	No
Clarington Energy Business Park	Ongoing development	Yes (Thermal Treatment Facility)
Highway 401 widening	Conceptual, unknown	Yes
Proposed 401-407 Eastlink	2012	Yes
Planned GO Transit Line, Station and Rail Maintenance Facility	2020	No

The following were considered major developments and evaluated for their potential to impact ambient air quality in the AQSA.

Ontario Power Generation – New Nuclear Units

In June 2006, Ontario Power Generation (OPG) started the federal approvals process for the construction of new nuclear units at the Darlington Nuclear Generating Station. If approved, construction will begin mid-2011, to be completed and operational by 2018. This project involves the addition of up to four nuclear reactors next to the Darlington nuclear station. When complete, the Darlington site hopes to be able to meet the base-load electricity requirements of the Province of Ontario.

Over the past year, OPG has undertaken a number of environmental baseline studies, including studies on traffic patterns, cultural heritage, and the effect of additional proposed facilities in the Region, including the Project.

Air contaminant emissions from the proposed nuclear units will be comprised of different substances than those emitted by the Facility. For that reason, there are no substantive emission sources to consider in conjunction with the Facility emissions.

St Marys Cement Alternate Fuel Demonstration Project

The St Marys Cement Plant, located approximately 4.2 km east of the Facility in Bowmanville, is currently evaluating the economic and environmental feasibility of using alternative fuels as a potential substitute for fossil fuels. Prior to permanently utilizing the alternative fuel, St Marys Cement wishes to obtain the necessary permits to proceed with an Alternative Fuel Demonstration Project and to use this information to consider the viability of permanent use of alternative fuels. The alternative fuel demonstration would substitute alternative fuel for a portion of the fossil fuel used at the St Marys cement plant over approximately 24 days, in order to gather site-specific air emission data from the plant to determine the environmental feasibility of using three alternative fuel types. Preliminary data supplied by St Marys in its application for the required Air permits suggests that the changes in air quality associated with the use of alternative fuels would be negligible. Therefore, it is not anticipated that this proposed project will change background ambient air quality.

407 Electronic Toll Route (ETR) Expansion Link

The Ontario Ministry of Transportation is currently carrying out an Environmental Assessment study to cope with long-term transportation needs in the Region of Durham and surrounding areas. As such, in 2006, a new highway was recommended extending Highway 407 in an easterly direction from Brock Road in Pickering to Highway 35/115 in Clarington, with two north-south links connecting Highway 401 to the proposed extension of Highway 407. One of the proposed links runs north-south, connecting the proposed segment of Highway 407 at Taunton and Rundle Rd, to Highway 401 between Hancock Rd and Solina Rd (called the 407 Durham East Link). The proposed link terminates approximately one kilometre northeast of the Project site.

Future traffic volumes will add additional tailpipe emissions to the local area. While the proposed 407 expansion has the potential to cause changes in air quality in the LRASA, the magnitude of emissions are small compared to existing regional emissions. Table 3-8 is a reproduction of Table 4-9 of the Air Quality Technical Study report that shows these results. As can be seen from Table 3-8, the proposed Highway 407 may potentially contribute to CO emissions in the area, while the Facility CO emissions for either capacity are relatively small. Facility NOx emissions are higher in magnitude than Highway 407 emissions, but both are small relative to the community and industrial emissions. For particulate and VOC emissions, the Facility and Highway 407 emissions are small relative to community/industrial emissions. Thus, while the proposed 407 expansion has the potential to cause changes in air quality in the area, the magnitude of emissions are small compared to existing regional emissions. As such, the potential cumulative changes in air quality due emissions from the 407 expansion in addition to emissions from the Facility were assessed, considered nominal and therefore assessed qualitatively (not modeled) in this study.

Table 3-8 Comparison of Emissions – Facility and Highway 407 Expansion (Table 4-9 of Air Quality Assessment Technical Study Report)

Contaminant	407 Emissions 2013 (tpy)	407 Emissions 2031 (tpy)	140,000 tpy Facility Emissions (tpy)	400,000 tpy Facility Emissions (tpy)	Community and Industrial Emissions (tpy)
Carbon Monoxide (CO)	777	1,271	56	159	40,512
Nitrogen Oxides (NO_2)	97	159	151	428	10,950
Particulate <10 µm (PM_{10})	2	4	11	32	15,805
Particulate <2.5 µm ($PM_{2.5}$)	1	2	11	32	3,765
Volatile Organic Compounds (VOC)	33	54	61	173	11,884

Further discussion on potential future conditions is available in the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e).

3.4.4 Decommissioning Scenario

3.4.4.1 Decommissioning Case

Facility decommissioning would entail removal of process units and related facilities and re-vegetation of the area. Decommissioning emissions are expected to be no greater than construction emissions and there therefore only assessed qualitatively.

4.0 IDENTFICATION OF CHEMICALS OF POTENTIAL CONCERN

Selection of the chemicals of potential concern (COPC) to be evaluated is a critical step in any risk assessment. It is standard practice in HHERA to limit the number of chemicals evaluated to those representing the greatest potential to affect health. It is preferable to comprehensively evaluate a smaller number of chemicals that represent the greatest potential concern, than it is to conduct a less detailed risk assessment on a larger number of chemicals that are of lesser potential concern. The COPC selection process is designed such that if no unacceptable health risks are predicted for the chemicals evaluated, then health risks would not be expected for any of the chemicals not included in the evaluation (i.e., those that are present at lower environmental concentrations, emitted at lower rates, or possessing a lower toxic potency). A number of screening methods can be used to narrow a list of chemicals for further analysis. These include:

- relative toxic potency determinations using emission rates and exposure limits;
- bioaccumulative and persistent in the environment based on Log K_{ow} and soil half-life values, respectively;
- identifying chemicals viewed as a concern by regulatory authorities for the industry in question; and,
- identifying chemicals perceived as a concern by the public.

The following is a summary of the evaluation processes for the derivation of COPC for the Facility.

4.1 Sources of Emissions and Development of the Emissions Inventory

A primary route for COPC release to the environment during Operation is via airborne dispersion of particulates and vapours. Existing air quality standards tend to focus on a specific group of chemicals referred to as criteria air contaminants (CAC). Criteria air contaminants are generally defined as a group of air pollutants that cause smog, acid rain, and other health hazards. The Ministry of Environment (MOE) considers carbon monoxide (CO), hydrogen sulphide (H_2S), nitrogen dioxide (NO_2), Sulfur dioxide (SO_2), and particulate matter (PM) as CAC. While CAC are considered COPC, the development of the COPC list for the Facility was far more comprehensive, and included a review of the processes and activities that are expected to have substantive air emissions.

Emissions during Operation of the Facility would occur primarily from the Facility stack as a result of the combustion process. It should be noted that as per Request for Proposals (RFP) Addendum #21 (November 20, 2008) any hazardous or radioactive waste found within the in waste stream would be removed and *not* processed at the Facility.

4.2 Chemicals of Potential Concern

The identification of COPC began with the development of an inventory of chemicals that could potentially be released by the Facility to the atmosphere. In brief, the comprehensive list of COPC developed for this study was developed by reviewing:

- COPC evaluated in the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e)
- contaminants included in MOE Guideline A-7: Combustion and Air pollution Control Requirements for New Municipal Incinerators;
- contaminants requested to have guaranteed emissions limits placed on them by the Regions of Durham/York in the project request for proposals (RFP) (Table 4-1);
- contaminants contained in the generic risk assessment report (Jacques Whitford, 2007), which were based on stack testing of the Region of Halton, Algonquin Power Thermal Treatment Incinerator; and
- Review of contaminants included in the National Pollutant Release Inventory (NPRI) for waste incinerators; and,
- contaminants with O. Reg. 419 criteria that may be emitted during construction, operational and post-closure periods.

Table 4-1 Emissions Limits Specified by the Regions in the RFP

PARAMETER	TEST METHOD	OPERATING LIMIT
Dioxins	arithmetic average of three stack tests	60 pg/Rm^3 measured as TEQ
Cadmium	arithmetic average of three stack tests	7 µg/Rm^3
Cadmium + Thallium	arithmetic average of three stack tests	46 µg/Rm^3
Lead	arithmetic average of three stack tests	50 µg/Rm^3
Mercury	arithmetic average of three stack tests	15 µg/Rm^3
Sum of (As, Ni, Co, Pb, Cr, Cu, V, Mn, Sb)	arithmetic average of three stack tests	460 µg/Rm^3
Total Particulate Matter	arithmetic average of three stack tests	9 mg/Rm^3
Hydrogen Chloride	arithmetic average of 24 hours of data from a continuous emission monitoring system	9 mg/Rm^3

PARAMETER	TEST METHOD	OPERATING LIMIT
Sulfur Dioxide	arithmetic average of 24 hours of data from a continuous emission monitoring system	35 mg/Rm^3
Hydrogen Fluoride	arithmetic average of 24 hours of data from a continuous emission monitoring system	0.92 mg/Rm^3
Nitrogen Oxides	arithmetic average of 24 hours of data from a continuous emission monitoring system	180 mg/Rm^3
Carbon Monoxide	arithmetic average of 24 hours of data from a continuous emission monitoring system	45 mg/Rm^3
Organic Matter (as Methane)	arithmetic average of three stack tests	49 mg/Rm^3

From this review, a preliminary COPC list was developed and consisted of:

- Criteria Air Contaminants (CACs) – substances with regulatory limits including SO_2, NO_2, CO, PM and ammonia (NH_3); and,
- Non-CAC COPCs - Substances that are capable of causing environmental or health effects including VOCs, PAHs, and metals.

Each compound in this preliminary list was considered in light of the plan for the Facility and screened to arrive at a final list to be used for this risk assessment.

Estimates of the magnitude and rate of emission for each COPC were made on the basis of engineering design data from Covanta Energy Corporation and supplemented by accepted emissions estimation techniques and other sources of information (e.g., from other similar Thermal Treatment facilities). In developing the emissions estimates, several factors such as Facility processes, equipment and emissions control efficiencies, operating schedules, as well as equipment manufacturer specifications were considered. Engineering calculations were then performed to estimate emission rates from each potential emission source for each applicable COPC being released from the Facility. Emissions estimates were developed for normal operation of the Facility at maximum operating capacity based on credible modes of operation for the Facility as a whole, as well as for unplanned events.

The full list of COPC evaluated in this risk assessment can be found in Table 4-2 and are described in detail within the following subsections.

4.2.1 Inhalation Pathway Assessment

Baseline air concentrations were established for most of the COPC, these concentrations are further elaborated in Section 5.1. The baseline air concentrations were used to evaluate the existing health risks associated with the existing air quality in the LRASA.

The potential changes in air quality for each of the COPC listed in Table 4-2 were assessed using the emissions data and air dispersion modeling. The CALPUFF model was chosen as the primary model to be used in this assessment. A description of the model selection, methodology, and validation is provided in the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e).

Total air concentrations for each of the assessment scenarios described in Section 3.3 were reported and included in estimates for 1-hour, 24-hour and annual averaging periods. For the inhalation pathway, COPC were modeled without deposition or plume depletion to consider worst-case maximum ground level concentrations. The concentrations were reported for each receptor location. These air concentrations were used to evaluate the health risks to receptors from direct inhalation of the COPC emitted from the Facility.

4.2.2 Screening of Chemicals for the Multi-Pathway Assessment

In addition to the total air concentrations, total deposition into the environment (e.g., soil) was provided in total, wet, and dry deposition per year for receptor locations specified in Section 3.2.2. These deposition fluxes were then used to estimate the concentrations in multiple environmental media. These environmental media concentrations were then used to estimate the health risks to receptors from oral and dermal contact with these media in a multi-pathway risk assessment.

Not all COPC presented in Table 4-2 were considered relevant to the multi-pathway assessment, due to the physical-chemical properties of the COPC. Specifically not all COPC released from the Facility will persist or accumulate in the environment. To identify the COPC that were considered in the multi-pathway exposure assessment, the physical-chemical properties of each of the COPC in Table 4-2 were compared to accepted national and international criteria for the classification of persistent and bio-accumulative substances (Environment Canada 2006; Rodan *et al.* 1999).

The characterization of persistence and bio-accumulation is provided in detail within Environment Canada's Existing Substances Program and the Health Canada and Environment Canada's Domestic Substances List Categorization, under the *Canadian Environmental Protection Act* (*CEPA*).

Persistence refers to the length of time a chemical resides in the environment and is measured by its half-life. This is the time required for the quantity of a chemical to diminish or degrade to half of its original amount within a particular environment or medium. For the purposes of this HHERA, a chemical was considered persistent if its half-life in soil was greater than or equal to (≥) six months (182 days).

Bio-accumulation is a general term used to describe the process by which chemicals are accumulated in an organism directly from exposure to water, soil, or through consumption of food containing the substances. A chemical's potential to bio-accumulate is related to its octanol-water partition coefficient (K_{ow}). The K_{ow} refers to the ratio of distribution of a substance in octanol compared to that in water. For the purposes of this HHERA, a chemical was considered bio-accumulative if its Log K_{ow} was greater than or equal to five; therefore, all COPC retained for full multi-pathway assessment in both the HHRA and ERA had:

- A half-life in soil greater than or equal to six months; and/or
- An octanol-water partition coefficient (Log K_{ow}) greater than or equal to five (5).

The rationale behind this exercise was that if a chemical released to the air does not meet either of these criteria, only a limited opportunity exists for human or ecological exposure via secondary exposure pathways (i.e., those other than inhalation), as the potential for that chemical to persist and/or accumulate in the environment is negligible. However, if a chemical meets one or both of these criteria, sufficient opportunity could be present for human or ecological exposure. The screening completed on the COPC to evaluate persistence and bio-accumulation is provided in **Appendix A.**

The list of COPC evaluated in this assessment is provided in Table 4-2.

Table 4-2 COPC Considered for the Human Health and Ecological Risk Assessment

COPC	Human Health Risk Assessment		Ecological Risk Assessment
	Inhalation	Multi-Pathway	
Criteria Air Contaminants			
Sulfur Dioxide (SO_2)	✓		✓
Hydrogen Chloride (HCl)	✓		
Hydrogen Fluoride (HF)	✓		✓
Nitrogen Dioxide (NO_2)	✓		✓
Particulate Matter (PM_{10})	✓		
Particulate Matter ($PM_{2.5}$)	✓		
Total Particulate Matter (TSP)	✓		
Ammonia (Slip at Stack)	✓		

COPC	Human Health Risk Assessment		Ecological Risk Assessment
	Inhalation	Multi-Pathway	
Chlorinated Polycyclic Aromatics			
Dioxins and Furans as Toxic Equivalents (TEQ)	✓	✓	✓
Total PCBs (as Aroclor 1254)	✓	✓	✓
Metals			
Antimony	✓	✓	✓
Arsenic [b]	✓	✓	✓
Barium	✓	✓	✓
Beryllium [b]	✓	✓	✓
Boron	✓	✓	✓
Cadmium (Cd) [b]	✓	✓	✓
Chromium (hexavalent) [b]	✓	✓	✓
Total Chromium (and compounds) [b]	✓	✓	✓
Cobalt	✓	✓	✓
Lead (Pb)	✓	✓	✓
Mercury (Hg)[a]	✓	✓	✓
Nickel	✓	✓	✓
Phosphorus	✓	✓	✓
Silver	✓	✓	✓
Selenium	✓	✓	✓
Thallium	✓	✓	✓
Tin	✓	✓	✓

COPC	Human Health Risk Assessment		Ecological Risk Assessment
	Inhalation	Multi-Pathway	
Vanadium	✓	✓	✓
Zinc	✓	✓	✓
Chlorinated Monocyclic Aromatics			
1,2-Dichlorobenzene	✓	✓	✓
1,2,4,5-Tetrachlorobenzene	✓	✓	✓
1,2,4 – Trichlorobenzene	✓	✓	✓
2,3,4,6-Tetrachlorophenol	✓		
2,4,6-Trichlorophenol [b]	✓		
2,4-Dichlorophenol	✓		
Pentachlorophenol [b]	✓	✓	✓
Hexachlorobenzene [b]	✓	✓	✓
Pentachlorobenzene	✓	✓	✓
Poly Aromatic Hydrocarbons			
Acenaphthylene [b]	✓	✓	✓
Acenaphthene [b]	✓	✓	✓
Anthracene	✓	✓	✓
Benzo(a)anthracene [b]	✓	✓	✓
Benzo(b)fluoranthene [b]	✓	✓	✓
Benzo(k)fluoranthene [b]	✓	✓	✓
Benzo(a)fluorene	✓	✓	✓
Benzo(b)fluorene	✓	✓	✓
Benzo(ghi)perylene [b]	✓	✓	✓

COPC	Human Health Risk Assessment		Ecological Risk Assessment
	Inhalation	Multi-Pathway	
Benzo(a)pyrene TEQ [b]	✓	✓	✓
Benzo(e)pyrene [b]	✓	✓	✓
Chrysene [b]	✓	✓	✓
Dibenzo(a,c)anthracene [b]	✓	✓	✓
Dibenzo(a,h)anthracene [b]	✓	✓	✓
Fluoranthene [b]	✓	✓	✓
Fluorene	✓	✓	✓
Indeno(1,2,3 – cd)pyrene [b]	✓	✓	✓
1 – methylnaphthalene	✓		
2 – methylnaphthalene	✓		
Naphthalene	✓		
Perylene [b]	✓	✓	✓
Phenanthrene [b]	✓	✓	✓
Pyrene [b]	✓	✓	✓
Volatile Organic Chemicals (VOC)			
Acetaldehyde [b]	✓		
Benzene [b]	✓		
Biphenyl	✓		
Bromodichloromethane	✓		
Bromoform (tribromomethane)	✓	✓	✓
Bromomethane	✓		
Carbon tetrachloride [b]	✓	✓	✓

COPC	Human Health Risk Assessment		Ecological Risk Assessment
	Inhalation	Multi-Pathway	
Chloroform [b]	✓	✓	✓
Dichlorodifluoromethane	✓		
Dichloroethene, 1,1 -	✓		
Dichloromethane [b]	✓	✓	✓
Ethylbenzene	✓		
Ethylene Dibromide (1,2-dibromoethane) [b]	✓		
Formaldehyde [b]	✓		
O-terphenyl	✓	✓	✓
Tetrachloroethylene [b]	✓		
Toluene	✓		
Trichloroethane, 1,1,1 -	✓	✓	✓
Trichloroethylene, 1,1,2 [b]	✓		
Trichlorofluoromethane	✓	✓	✓
Vinyl chloride (chloroethene) [b]	✓		
Xylenes, m-, p- and o-	✓		

Notes:

[a] – Inorganic and methylmercury

[b] – This chemical was evaluated as a non-carcinogen and a carcinogen

During the peer review process, a question was posed about the exclusion of acrolien and 1,3-butadiene from the COPC list. Acrolein is released to the environment through the incomplete combustion of organic matter. The main combustion source of acrolein is from gas and diesel motor vehicle emissions (CEPA, 1999). It is likely that acrolein would be emitted from a Thermal Treatment Facility; however, the Air Quality Team was unable to locate any emission factors for acrolein for incineration facilities during their review of Canadian, US EPA or CalEPA data sources. Given that motor vehicle emissions to the environment far exceed those that would be expected from a Thermal Treatment Facility (CEPA, 1999), it is not anticipated that its exclusion from the HHRA would alter the overall conclusions of the report.

Although 1,3-butadiene was identified as a COPC in the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e), no credible sources of emissions data for this contaminant were found during the extensive literature review performed for the assessment. Therefore, 1,3-butadiene was considered, but not modelled by the Air Quality Team.

4.3 Ozone

Where a proposed Facility emits NO_x and/or VOC, there may be a potential for augmentation of ozone concentrations due to precursor NO_x and VOC emissions, particularly in warmer months in midday. This occurs when the precursor chemicals are present in conjunction with the appropriate meteorological conditions (i.e. strong solar radiation, high temperatures and low wind speeds). In the immediate vicinity of NO_x emission sources, ozone concentrations may be decreased due to the NO to NO_2 conversion reaction in which ozone is consumed. Photochemical production of ozone tends to occur at larger distances downwind (on the order of tens to hundreds of kilometres).

Annual average Project NO_2 and VOC emissions are small relative to other sources of emissions in the vicinity of the Facility (*Air Quality Assessment Technical Study Report*, Jacques Whitford, 2009e). Additionally, current baseline ozone concentrations are generally high and indicate that ozone is a regional, rather than local air quality issue.

Table 4-3 compares the AQ study area and Project annual average precursor NO_2 and VOC emissions. The Project emissions presented in this table are expected to be conservative as they are based on the manufacturer guarantees, which are upper limits on emissions, and assume the Facility runs continuously at its maximum rating throughout the entire year. The total annual Project NO_2 and VOC emissions are small relative to the AQ study area emissions. As a result, ozone was not assessed as a COPC in the ensuing risk assessment. This qualitative assessment methodology is consistent with that used for other environmental assessments in Ontario and Canada.

Table 4-3 Comparison of Annual Average Ozone Precursor Emissions

Case	NO_2	VOC
AQ Study Area Emissions- (tonnes) (1)	10,950	11,884
Facility (tonnes) (2)	151	61
Facility Relative to AQ Study area emissions (%)	1.4%	0.5%

Notes:

1 – 2005 NPRI emissions for commercial and residential emissions and 2007 industrial source emissions

2 – Conservative estimate

4.4 Dioxins and Furans and Dioxin-like PCB Congeners

Emission factors from Thermal Treatment Facilities were not provided on a congener-specific basis, rather as a total 2,3,7,8-TCDD toxic equivalent (TEQ). Therefore, dioxin and furan emissions from the Project used in this risk assessment were reported on a 2,3,7,8-TCDD TEQ basis. They represent the suite of dioxin and furan congeners that are used to assess the toxicity of these chemicals as a mixture (Table 4-4).

Only a very low level of dioxin and furans would be expected in the municipal solid waste that is to be the feedstock material for the Thermal Treatment Facility. These chemicals are formed in the Facility as a result of incomplete combustion of organic material and will be emitted to the environment in low concentrations.

There is a potential that low level concentrations of polychlorinated biphenyls (PCBs) could still be present in the waste that is to be incinerated in the Thermal Treatment Facility. There are 209 potential PCB congeners that could be emitted from the Thermal Treatment Facility and they were assessed as total PCB Aroclor 1254 mixture in the HHERA.

Of the 209 possible PCB congeners, there are 12 which have dioxin-like properties. Recent scientific studies have demonstrated that some of these dioxin-like PCB congeners could be present in the emissions from an incineration Facility (Kim et al, 2004 and Shin et al, 2006) at low levels. However, at the time of conduct of this risk assessment there were no Thermal Treatment Facility emission factors available for these compounds.

Although the concentration of these PCB dioxin-like congeners was not included in the emissions estimates, their relative toxicity to 2,3,7,8-TCDD is quite low (Table 4-4). With the exception of PCB 126, they are orders of magnitude less toxic than the 2,3,7,8-TCDD; therefore, it is unlikely that inclusion of the likely low level concentrations of these dioxin-like PCB congeners in the HHERA would result in a change in the overall conclusions of the report. However, it is recommended that the dioxin-like PCB congeners be analyzed and included in the overall 2,3,7,8-TCDD reporting for the proposed continuous sampling at the stack of the Project.

Table 4-4 WHO (2005b) TEF Scheme for Dioxin-Like Congeners

Compound	WHO (2005b) TEF
Chlorinated dibenzo-p-dioxins	
2,3,7,8-TCDD	1
1,2,3,7,8-PeCDD	1
1,2,3,4,7,8-HxCDD	0.1
1,2,3,6,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDD	0.1
1,2,3,4,6,7,8-HpCDD	0.01
OCDD	0.0003
Chlorinated dibenzofurans	
2,3,7,8-TCDF	0.1
1,2,3,7,8-PeCDF	0.03
2,3,4,7,8-PeCDF	0.3
1,2,3,4,7,8-HxCDF	0.1
1,2,3,6,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDF	0.1
2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDF	0.01
1,2,3,4,7,8,9-HpCDF	0.01
OCDF	0.0003

Compound	WHO (2005b) TEF
Non-ortho substituted PCBs	
PCB 77	0.0001
PCB 81	0.0003
PCB 126	0.1
PCB 169	0.03
Mono-ortho substituted PCBs	
105	0.0003
114	0.0003
118	0.0003
123	0.0003
156	0.0003
157	0.0003
167	0.0003
189	0.0003

4.5 Emissions for Emergency Back-up Diesel Generators

The *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e) examined emissions from the Thermal Treatment Facility during routine testing of diesel powered emergency equipment (a 300-kW diesel generator and two 130 kW diesel fire pumps, twice as many for the maximum design capacity of 400,000 tpy scenario). Routine testing of all the diesel powered equipment would not normally be conducted concurrently. Evaluation of only the worst case diesel emissions source (the diesel generator) was, therefore, required to determine maximum off-property changes in air quality. The diesel generator, in addition to having higher emission rates than the diesel fire pumps, would also be located closer to the property line (about 70 m from the nearest property line versus 116 m for the fire pumps) therefore would be expected to result in higher off-property impacts.

A summary of the maximum predicted GLCs during routine testing of the Facility emergency diesel generator (concurrent with the Facility operating at MCR – the normal operating condition) is presented in the *Air Quality Assessment Technical Study Report*. The values presented in this table are the maximum predicted values over all the off-property and fence line receptors included in the modeling. Estimated background concentrations, were added to the maximum model-predicted values and compared to applicable regulatory limits to assess potential cumulative changes in air quality.

The dispersion modeling demonstrated that the maximum predicted ground level concentrations of CoPCs from the routine testing of the emergency diesel generator as well as normal operation of the Thermal Treatment process will be below their applicable MOE criteria. Note that the MOE has specified a NO_2 point of impingement criteria of 1880 μg/m^3 on a half-hour averaging period and this ½-hour criteria was used rather than an hourly criteria for NO_2. Given that this is a unique, short-term event and that the MOE has specific diesel generator-specific criteria, this scenario was not considered further in the HHERA.

5.0 DESCRIPTION OF BASELINE CONDITIONS

To effectively assess risks to potential human and ecological receptors in the local risk assessment study area, baseline chemical concentrations in soil, biota and air must be established to evaluate risks attributable to Project related emissions. To accomplish this Jacques Whitford conducted two baseline studies.

- *Environmental Baseline Report* (Jacques Whitford, 2009a).
- *Ambient Air Monitoring at the Courtice Road Site Report* (Jacques Whitford, 2009b).

5.1 Baseline Soil and Biota Conditions

The US EPA (2005) has provided guidance on evaluating human health environmental effects caused by air emissions from proposed facilities at the design stage. The guidance identified a number of media that were included in the assessment. The following lists the media and the rationale for inclusion in the baseline sampling program:

- **Soil**: Soil is one of the most important of the media considered. Both human (persons that reside in or visit the area surrounding the proposed Facility, including members of the general public) and ecological receptors (living organisms other than humans, the habitat which supports such organisms, or natural resources which could be adversely affected by environmental contaminations resulting by a release at or migration from the Project) are exposed directly to soil. Also the models used in the risk assessment (chemical fate and transport models, human and ecological risk evaluation models) rely on the soil concentrations to predict concentrations in various other media. In addition, existing soil concentrations represent the current conditions associated with any historical deposition. 23 soil samples were collected at all (17) sampling locations.
- **Forage**: Forage is considered to be green herbaceous vegetation from non-woody plants such as grasses and wildflowers. Forage ingestion is a direct pathway for many ecological receptors. 11 samples were collected (including a duplicate) from ten locations. All samples were analyzed for metals. Some of the COPCs such as SVOCs, PCBs, PCDD/PCDF, PAHs, and VOCs do not commonly accumulate in vegetation. Nevertheless, five (5) forage samples were selected for analysis of the above listed chemicals.
- **Browse**: Browse is considered to be woody growth from shrubs and trees, such as willows, alders, birches, poplars, and conifers. Browse ingestion is a direct pathway for many ecological receptors. 11 samples were collected (including a duplicate) from 10 locations. All samples were analyzed for metals. As in the case of forage, some of the COPCs such as SVOCs, PCBs, PCDD/PCDF, PAHs, and VOCs do not commonly accumulate in vegetation. Furthermore, in the case of browse these chemicals are expected to accumulate even less than in the forage vegetation, as chemical

transport of these chemicals to the woody parts of shrubs and trees is less likely to occur. Nevertheless three (3) browse samples were selected for analysis of the above listed chemicals (with the exception of VOCs).

- **Small Mammals**: Small mammals such as mice, voles, and shrews, are exposed directly to soil and forage/browse media as well as forming an exposure pathway for other ecological receptors. 11 small mammal samples were collected from five (5) sampling locations within the study area.
- **Surface Water**: Water quality is considered one of the primary indicators of the quality of aquatic habitats. In addition, water ingestion is a direct exposure pathway for all ecological receptors. Six (6) surface water samples were collected from five (5) sampling locations within the study area.
- **Sediment**: Sediment ingestion is an exposure pathway for ecological receptors. Four (4) sediment samples were collected from four (4) sampling locations within the study area.
- **Fish**: Fish ingestion is an exposure pathway for both human and ecological receptors. Six (6) fish samples were collected from three (3) sampling locations from within the study area.
- **Produce**: Produce ingestion is an exposure pathway for human receptors, and is broadly classified as above ground exposed, above ground protected, below ground and fruit. 28 produce samples were collected from various locations within the study area.
- **Crops**: The consumption of crops is a potential exposure pathway for human receptors. Crops are defined as corn in the baseline assessment. Five (5) crop samples were collected from four (4) sampling locations within the study area.
- **Agricultural Products**: The consumption of agricultural products is an exposure pathway for human receptors. This category consists of beef, chicken, pork, dairy and eggs. Ten (10) agricultural product samples were collected from various locations within the study area.

Several environmental media – soil, terrestrial vegetation (forage, browse, and crops), small mammals, surface water, sediment and fish – were sampled within a 1 km radius of the Site; however, in the case of agricultural products and local produce samples were collected from farms and markets located outside a 1 km radius of the proposed site due to limited availability. Every effort was made to ensure that the farms were as close as possible to the Site. Sampling garden produce from the backyards of residents within the area surrounding the Site was limited to one location; however, garden produce was obtained from local farmers' fields and markets. General inquiries were made to confirm that the produce acquired had been grown locally. The produce collected is considered to be sufficient to represent baseline conditions of the area surrounding the Site.

The sampling locations, coordinates and media sampled at each location can be found in the *Environmental Baseline Report* (Jacques Whitford, 2009a). A summary of the sampling program, including number of samples collected and the chemical analysis required is also provided in the Report (Jacques Whitford, 2009a).

5.1.1 Baseline Concentrations

The baseline exposure point concentrations (EPCs) established in the *Environmental Baseline Report* (Jacques Whitford, 2009a) represent the maximum concentration, the 95th percentile, or the 95th upper confidence limit of the arithmetic or geometric mean of the concentrations of each chemical within each media type. These are generally considered as conservative approaches for estimating potential exposures for the purposes of completing human health or ecological risk assessments (Health Canada 2004).

A review of the results of the data quality (i.e*.,* method blanks, surrogate recoveries, matrix spikes, laboratory duplicates, and field duplicates) was completed. The results indicated that the data are acceptable for the purposes of establishing the baseline EPC for the HHERA.

Laboratory data results were used to determine the baseline EPC of the chemical parameters analyzed in the various media. Data not included in the establishment of the baseline EPC consisted of quality control (QC) samples, such as field duplicates and laboratory duplicates.

5.1.2 Statistical Analysis of Environmental Media Samples

Laboratory results were used to determine the baseline concentrations of the chemical parameters analyzed in the various media. Data not included in the reporting of the baseline concentrations consisted of quality control samples such as laboratory duplicates. Non-detectable values were carried forward in the statistical analysis at the method detection limit (MDL) value. The use of these values will lead to an overestimation of potential risk to receptors.

Baseline concentrations were established using statistical evaluation, provided that the chemical was detected in at least one of the samples from that medium. The statistical tests were based on the assumptions of a normal or log-normal distribution (i.e., the log-normal distribution is skewed to the right but has a normal distribution once log-transformed). However, because of the uncertainty associated with estimating the true average concentration for the study area, the following procedure was used to report baseline values used in the HHERA:

- If a chemical was not detected in any of the samples, the baseline concentration was presented as the method detection limit (MDL). Where multiple detection limits were encountered, the maximum detection limit was carried forward;
- With certain exceptions the maximum detected concentration was assessed in the HHERA regardless of sample size;
- For soil samples and inorganics in small mammals the sample sizes were sufficient to conduct statistical analysis. Where appropriate the 95th UCLM was used for these media-chemical combinations.

For the calculation of the 95th UCLM values, the distribution of chemical data sets as assessed for each medium was evaluated to identify if data conforms to either a normal or a log-normal distribution using the SAS^{TM} statistical software package program. If the p-value of the Shapiro-Wilk normality test was greater than 0.05, then the measure was deemed to be from a normal distribution. If the measures were identified as not normal, then the data were log transformed using the natural log. If the Shapiro-Wilk test still indicated the data to be not normal, then histograms of the un-transformed data were created and visual observation was conducted for identifying the outliers. Where applicable, outliers were removed and the same procedure described above was applied on the new set of data. If the data set continued not to conform to a normal or log-normal distribution, no statistical tests were further applied.

If the means were calculated using the log-transformed data, the resulting UCLM or 95th percentile was back-transformed using the EXP function in Excel for communication purposes.

As indicated above, the baseline values used in this assessment represent the maximum detected concentration, maximum method detection limit concentration, or the 95th UCLM of the concentrations of each detected chemical within each media type. These are generally considered as conservative approaches for estimating potential exposures for the purposes of completing human health or ecological risk assessments (Health Canada, 2004).

5.1.3 Baseline Soil and Biota Results

In general, results indicated that generally there were no exceedances of the relevant guidelines. It is important to note that some COPCs had a detection limit greater than regulatory standards. For the baseline soil and biota results relevant to the HHERA, please refer to **Appendix B**.

5.2 Baseline Air Quality

For the purposes of the EA, an air monitoring station was set up on the west side of Courtice Road, approximately 1.5 km South of Highway 401, and was located within the fenced area of the Project office for the new water pollution control plant. It was approximately 2 km southwest from the Site for the specific purpose of collecting ambient air data surrounding the proposed Facility location and for use in the HHERA. At the time of preparation of the Report, data had been collected and analyzed from September 2007 to December 2008. The station continuously monitored Criteria Air Contaminants (CACs), which are common air pollutants with known human health and environmental effects were measured at the Courtice Road station. CACs monitored were Sulfur Dioxide (SO_2), Nitrogen Oxides (NO_x), Carbon Monoxide (CO), Ozone (O_3), and Particulate Matter smaller than 2.5 microns ($PM_{2.5}$). Hi-volume air samplers were installed to collect 24-hour average samples of Total Suspended Particulate (TSP) and metals, Polycyclic Aromatic Hydrocarbons (PAHs), and Dioxins and Furans (PCDD/F).

5.2.1 Baseline Ambient Air Quality Results

In general, ambient air quality within the vicinity of the LRASA is typical of any area in Canada surrounded by urban centers. Ambient air quality in Clarington is influenced by emissions from local industrial sources, vehicular traffic as well as longer range transport of secondary contaminants such as O_3 and fine particulates. For a detailed description of the Ambient Air Monitoring Program methodology and results, please see the *Air Monitoring at the Courtice Road Site Report* (Jacques Whitford, 2009b), summaries of the individual contaminants are provided in the subsections below.

5.2.1.1 SO_2

Based on ambient monitoring at the Courtice monitoring station, hourly, daily and annual average SO_2 concentrations were well below the applicable ambient air quality criteria. The maximum hourly, 24-hour and annual average concentrations measured at the station were 115, 63 and 6 $\mu g/m^3$ respectively which are 17%, 23% and 10% of the applicable ambient air quality criteria. The measured annual average SO_2 concentration of 6 $\mu g/m^3$ at the Courtice station is relatively low (less than 55%) when compared with MOE monitoring stations at various Ontario cities including Sarnia, Hamilton and Windsor. SO_2 monitoring at the MOE Oshawa station was discontinued in 2000.

5.2.1.2 NO_2

NO_2 concentrations measured at the Courtice monitoring station were below the applicable ambient air quality criteria (AAQC) for all averaging periods. The maximum hourly and 24-hour concentrations measured at the station were 202 and 105 $\mu g/m^3$, respectively, which are 51% and 53% of the MOE air quality criteria. Elevated NO_2 levels occur infrequently - hourly average NO_2 concentrations above 150 $\mu g/m^3$ occurred less than 0.1% of the time during the monitoring period, and daily NO_2 concentrations above 100 $\mu g/m^3$ occurred approximately 0.2% of the time.

The measured annual NO_2 level at the Courtice Road station was similar to that in other urbanized area of Ontario such as Toronto, Hamilton and Windsor, and was well below the annual national ambient air quality objectives (NAAQO) maximum desirable level of 60 $\mu g/m^3$. The Courtice monitoring station was situated about 1.5 km south of Highway 401, whose vehicle traffic is a significant source of nitrogen oxides. It is likely that the NO_2 levels measured at the station reflect its proximity to the highway.

5.2.1.3 $PM_{2.5}$

$PM_{2.5}$ monitoring was conducted at the Courtice Road monitoring station, and has been conducted at the MOE Oshawa station since 2001. The maximum daily average concentration measured at the MOE Oshawa station in 2007 was 38 $\mu g/m^3$ while the average concentration was 6.8 $\mu g/m^3$. The 98th percentile, annual ambient measurement averaged over 3 years (2005 to 2007) for the MOE Oshawa station is 29 $\mu g/m^3$ and is just less than the Canada Wide Standards (CWS) criteria of 30 $\mu g/m^3$.

The 98th percentile, annual ambient measurement averaged over the 15 month monitoring period at the Courtice Road station is 29 µg/m^3, which is indicative that $PM_{2.5}$ levels in the vicinity of the Facility are slightly below the CWS.

5.2.1.4 O_3

Ground level O_3 concentrations in Oshawa are generally high. The maximum measured O_3 concentration measured at the MOE Oshawa station was above the eight hour average CWS during 2007. Annual mean levels have an increasing trend from 1998 to 2007 and have exceeded the NAAQC of 30 µg/m^3, varying from 42 to 56 µg/m^3.

The maximum hourly, 24-hour and annual average concentrations measured at the station were 115.7, 78.0 and 29.9 µg/m^3 respectively which are 72%, 156% and 99.7% of the NAAQO maximum acceptable ambient air quality criteria. The daily average O_3 concentrations were above the NAAQO approximately 6% of the time.

The MOE also reports that in 2007 the 24-hour NAAQO maximum acceptable level of 50 µg/m^3 was exceeded at all 40 stations where ozone measurements were taken. There were no exceedances recorded for the hourly NAAQO. As ozone is generated by complex chemical reactions in the atmosphere which occur over distances of 10s to 100s of kilometres from precursor emissions sources, this points to ozone as being a regional rather than local air quality issue.

5.2.1.5 PCDD/F

PCDD/F were monitored at the Courtice Station using a using a manually operated hi-volume sampler to collect 24-hour average samples. The total maximum measured toxic equivalent PCDD/F concentration (0.077 pg TEQ/m^3) was well below the applicable criteria (less than 2% of the criteria).

5.2.1.6 PAHs

PAHs were monitored at the Courtice Station using a hi-volume sampler to collect 24-hour average samples. All PAHs were below their respective MOE criteria, and at the most 0.3% of the criteria (Acenaphthylene).

5.2.1.7 Metals

Metals and TSP were monitored at the Courtice Station using a hi-volume sampler to collect 24-hour average samples. The maximum measured concentrations of all metals with MOE air quality criteria were below their applicable criteria, with iron having the highest percentage (27% of the criteria).

5.2.1.8 VOCs

VOCs data from the years 2006 to 2008, primarily from three National Air Pollution Surveillance (NAPS) Toronto stations and the NAPS Newmarket station, were reviewed and used to characterise ambient

VOC levels in the vicinity of the Facility. All maximum measured VOC concentrations were below their applicable air quality criteria.

5.2.1.9 CMAs

Data for CMAs from the years 2006 to 2008 were extracted from three NAPS Toronto stations and the NAPS Newmarket station and used to conservatively characterise ambient CMA levels in the vicinity of the Facility. Hexachlorobenzene and pentachlorophenol data were only available at one of the Toronto NAPS station. All maximum measured CMA concentrations were below their applicable air quality criteria.

5.2.1.10 PCBs

PCB monitoring data from the years 2006 to 2008 were extracted from two Toronto NAPS stations for use in conservatively representing ambient PCB levels in the vicinity of the Facility. The maximum measured PCB concentrations were below their applicable air quality criteria.

In general, ambient air quality within the vicinity of the LRASA is typical of any area in Canada surrounded by urban centers, and the results of the ambient air quality monitoring program were not unexpected by the Air Quality Team. **Appendix B** provides a summary of data used in the HHERA collected to date for 1-hour, 24-hour and annual concentrations of chemicals

6.0 FATE AND TRANSPORT MODELING OF COPC EXPOSURE POINT CONCENTRATIONS

In this section the methodologies used in estimating exposure point concentrations (EPCs) of COPC for each exposure pathway for human and ecological receptors are briefly described. Full details, equations and references used in calculating COPC-specific EPCs are presented in **Appendices E and M**. In accordance with US EPA (2005), COPC are grouped into three broad categories for the assessment of potential exposure pathways, as follows:

- Organics (e.g., polycyclic aromatic hydrocarbons [PAHs]);
- Metals (excluding mercury); and,
- Mercury compounds (Hg^0, Hg^{2+}, MeHg).

Each COPC category is evaluated on an exposure pathway specific basis. For instance, elemental mercury (Hg^0) is assessed for direct inhalation exposure but is not included in possible food chain uptakes as it does not bio-accumulate; note, Hg^0 is not considered a COPC in this assessment. Further discussion on mercury methylation, bio-accumulation factors and mercury speciation is found in **Appendix C**. There are substantial data requirements in order to predict the EPCs from Project-related emissions. Site-specific physical information is required in order to complete the multi-pathway modeling. This information includes, but is not limited to:

- Climate data (such as precipitation, wind speed, and temperature);
- Topographic data (such as surface slopes, watershed areas, surface water areas, and surface cover);
- Hydrologic data (such as streamflows, stream velocities, and substrate type); and,
- Soils data (such as type, grain size, soil moisture, and organic content).

In addition, the fate and mobility of each COPC is dependent on its physical and chemical properties. Physical data includes density and solubility, while chemical data includes Henry‘s Law constants, sorption coefficients, and bio-accumulation rates. The site-specific and chemical specific data requirements are provided in **Appendix D**. Once the physical and chemical data are compiled, and the results of the air dispersion and deposition modeling obtained, the modeled concentrations of the COPC in the various media are determined. The overall approach to the exposure modeling to derive EPCs is described in the sections below.

For all relevant media, loading tables have been provided which outline the predicted loading of COPC in addition to current baseline conditions. COPC assessed in these loading tables are only those which were determined to be persistent and have bioaccumulative properties (i.e. those carried forward into the multi-pathway assessment) as per the COPC screening outlined in Table 4-2.

One of the cornerstones of risk assessment is the concept of "conservatism". Throughout this section and the entire HHERA, the use of the term conservatism is meant to convey a preference for erring on the side of overstating, as opposed to understating, risk under conditions of uncertainty. For example, the HHERA study team selected analytical values or approaches that would result in an overestimation of exposure or potential risk to humans and the environment, as opposed to understating the risk.

6.1 Ambient Air Exposure Point Concentrations

When emitted from the stack of the Facility, COPC will mix with the surrounding air, or fall to the ground over time. These processes are referred to as dispersion and deposition, respectively. Deposition can occur in two forms: dry deposition, when the COPC fall to the ground on their own; and wet deposition, when COPC are deposited when mixed with precipitation. The COPC concentration in ambient air is directly inhaled by the receptor and deposition of the COPC affects the concentration of the COPC in the other environmental media that is ingested or absorbed though the skin of the receptor.

As described in Section 5.0, baseline air concentrations were established using ambient air monitoring data and are considered representative of the entire study area. Changes in the COPC concentrations in ambient air caused by Project-related emissions were obtained directly from the air dispersion modeling results (Jacques Whitford, 2009e). The air modeling was conducted using the CALPUFF model to predict ground level concentrations (GLC) of COPCs and is appropriate for short and long-range dispersion predictions The assessment area for the air quality dispersion modeling was comprised of a 30 km by 40 km domain surrounding the Site. For a full description of the methodology used for the modeling of Project emissions, please see the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e). For receptor locations that are represented by more than one receptor point (*e.g*., residential subdivisions), the receptor point with the maximum GLC is conservatively chosen as representative for the entire receptor location. In addition, health risks are evaluated for short-term (*i.e*., 1-hour and 24-hour) exposures at the location within the LRASA with the highest GLC.

6.1.1 Ground Level Concentrations at 140,000 Tpy

Contour plots of the maximum predicted ground level concentrations for a unit emission rate (1 g/s) from the Facility stack (1) are presented in Figures 6-1 to 6-3 for hourly, 24-hour and annual averaging periods. Since for the majority of contaminants, the Facility emissions are emitted entirely through the APC stack, the plotted ground level concentrations in µg/m^3 per g/s can be multiplied by the contaminant emission rate in g/s to arrive at the ground level concentration of the contaminant.

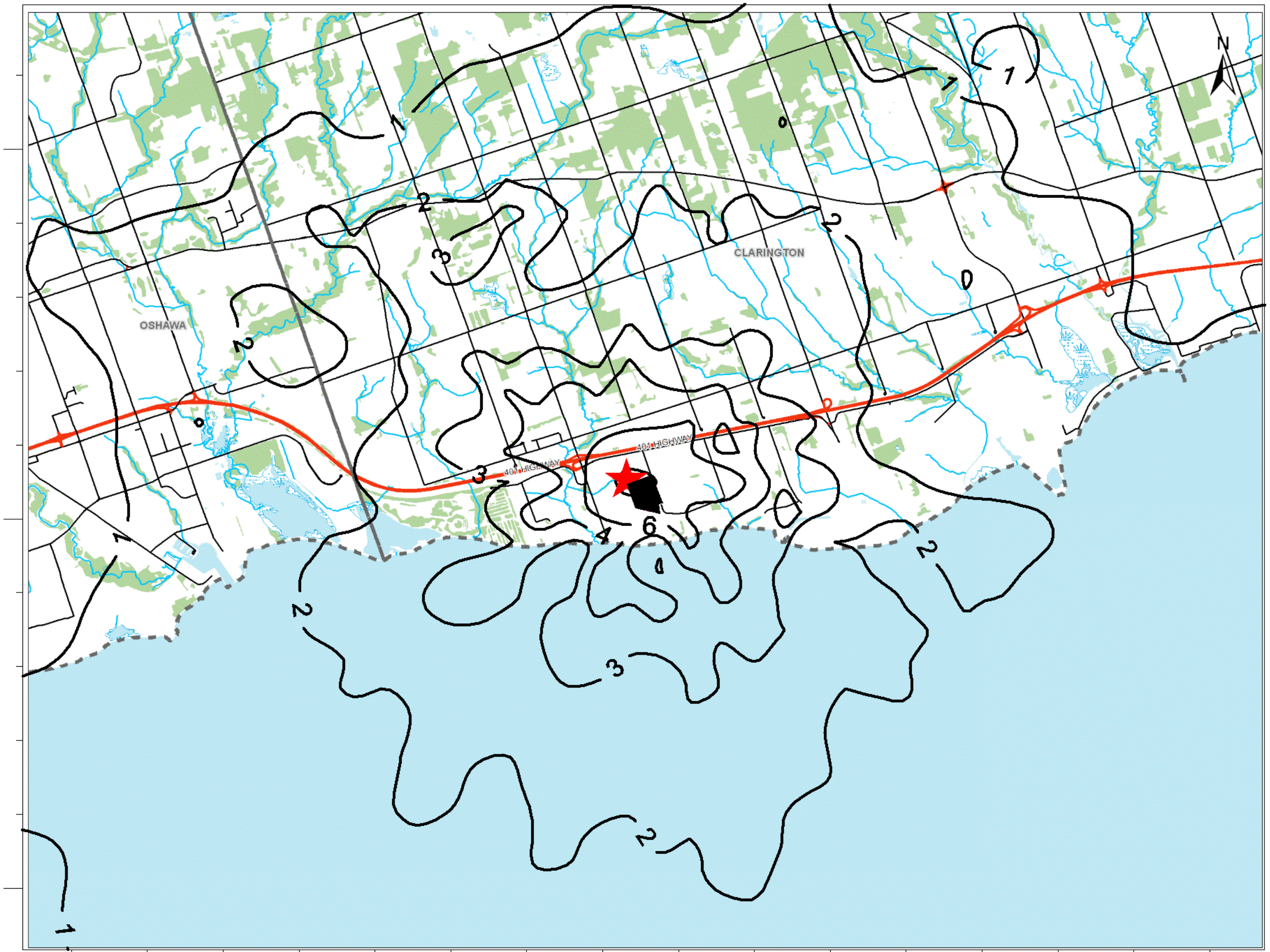
The 1-hour maximum predicted ground-level concentrations for a unit emission rate (1 g/s) is presented in Figure 6-1. The maximum predicted ground level concentration occurred to the northwest of the proposed Facility near the property line (approximately 250m).

The contour plot of the maximum predicted 24-hour average ground level concentrations for a unit emission rate (1 g/s) is presented in Figure 6-2. As with the hourly prediction, the 24-hour average model predictions show similar concentration contour patterns. The max GLC occurred approximately 400m to the northwest of the proposed Facility.

The contour plot of maximum annual average concentrations (maximum year over the 5-year data set) for a unit emission rate (1 g/s) which is the expected long-term operating level of the Facility is presented in Figure 6-3. The maximum predicted ground level concentration occurs about 1.5 km northeast of the Facility.

Using the unit emission rate results, the maximum predicted ground level concentrations of specific contaminants from the Facility stack were calculated by multiplying the predicted concentrations for a unit emission rate by the actual emission rate of that contaminant.

Contour plots of maximum predicted ground level concentrations (including background concentrations to account for cumulative effects) of several specific COPCs are presented in the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e).



Predicted Statistical Maximum GLC = 8.65 ($\mu g/m^3$)/(g/s)

YORK REGION AND DURHAM REGION RESIDUAL WASTE STUDY

Maximum Predicted 1-Hour Ground Level Concentrations 140,000 Tonnes/Year

Maximum GLC

Facility Location

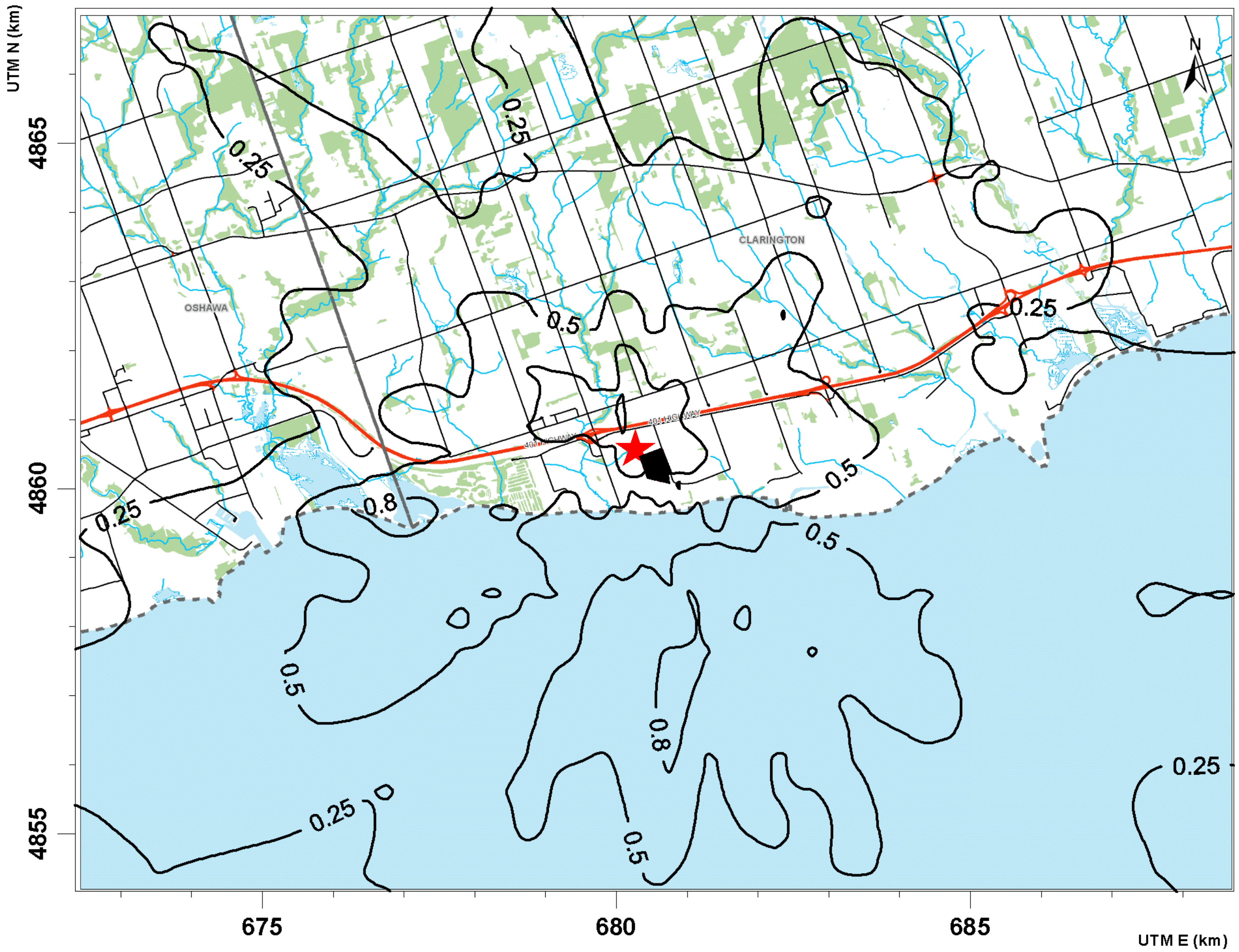
Map Parameters
Projection: UTM
Datum: NAD 83
Zone: 17
Map Units: m
DATE: 6/9/2009
PROJECT: 1009497

Jacques Whitford

FIGURE NO. 6-1

YORK REGION AND DURHAM REGION
RESIDUAL WASTE STUDY

Maximum Predicted 24-Hour Ground Level Concentrations 140,000 Tonnes/Year



Predicted Statistical Maximum GLC = 1.22 (μg/m^3)/(g/s)

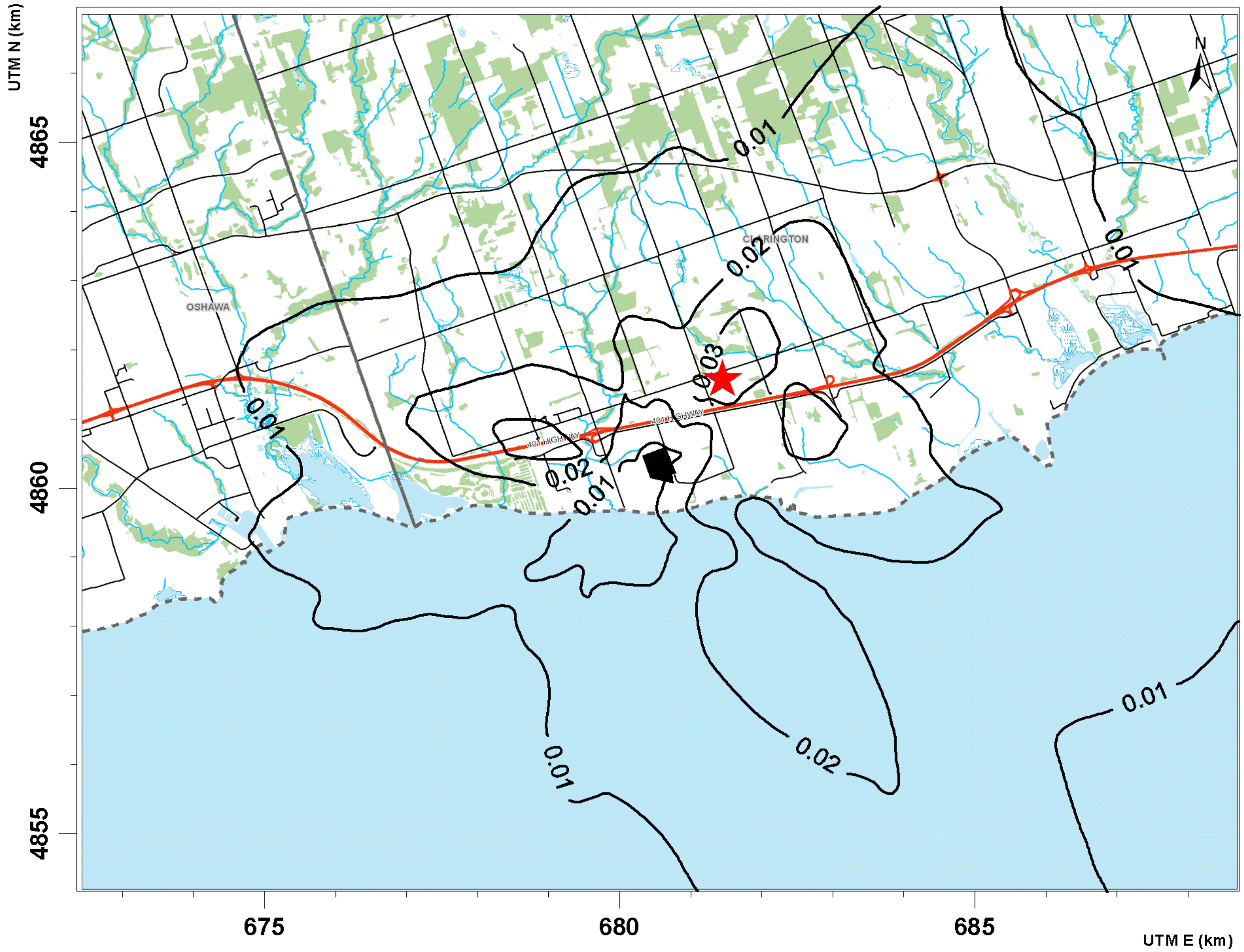
Maximum GLC

Facility Location

Map Parameters
Projection: UTM
Datum: NAD 83
Zone: 17
Map Units: m
DATE: 6/9/2009
PROJECT: 1009497

Jacques Whitford

FIGURE NO.
6-2



Predicted Statistical Maximum GLC = 0.035 (μg/m^3)/(g/s)

YORK REGION AND DURHAM REGION RESIDUAL WASTE STUDY

Maximum Predicted Annual Ground Level Concentrations 140,000 Tonnes/Year

Maximum GLC

Facility Location

Map Parameters
Projection: UTM
Datum: NAD 83
Zone: 17
Map Units: m
DATE: 6/9/2009
PROJECT: 1009497

Jacques Whitford

FIGURE NO.
6-3

6.1.2 Ground Level Concentrations at 400,000 Tpy

Contour plots of the maximum predicted ground level concentrations for a unit emission rate (1 g/s) from the Facility stacks (2) are presented in Figures 6-4 to 6-6 for hourly, 24-hour and annual averaging periods. Since, for the majority of contaminants, the Thermal Treatment Facility emissions are emitted entirely through the APC stacks, the plotted ground level concentrations in $\mu g/m^3$ per g/s can be multiplied by the contaminant emission rate in g/s to arrive at the ground level concentration of the contaminant.

The 1-hour maximum predicted ground-level concentrations for a unit emission rate (1 g/s) is presented in Figure 6-4. The maximum predicted ground level concentration occurred to the northwest of the proposed Facility near the property line (approximately 250m).

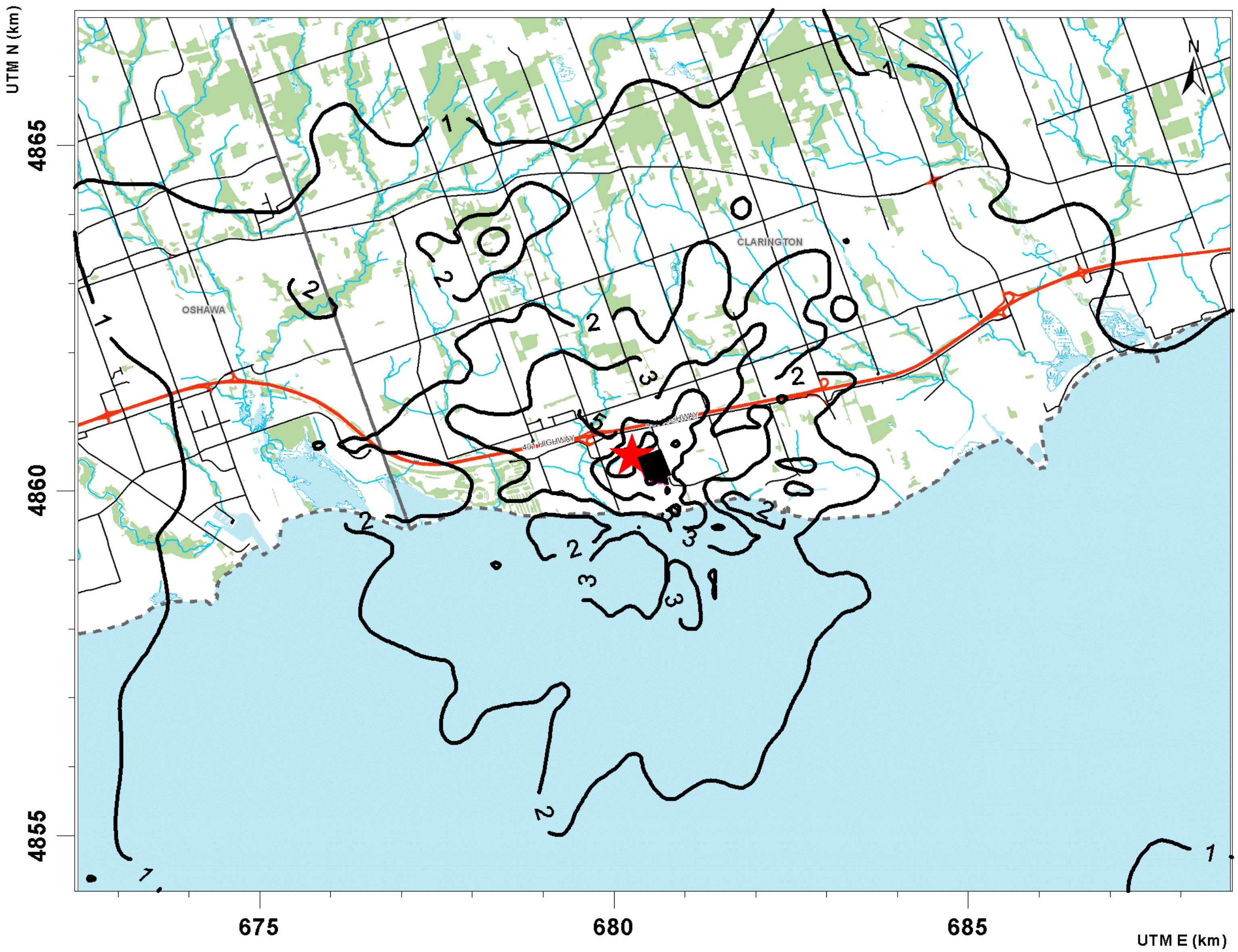
The contour plot of the maximum predicted 24-hour average ground level concentrations for a unit emission rate (1 g/s) is presented in Figure 6-5. As with the hourly prediction, the 24-hour average model predictions show similar concentration contour patterns. The max GLC occurred approximately 400m to the northwest of the proposed Facility.

The contour plot of maximum annual average concentrations (maximum year over the 5-year data set) for a unit emission rate (1 g/s) which is the expected long-term operating level of the Facility is presented in Figure 6-6. The maximum predicted ground level concentration occurs about 1.5 km northwest of the Facility.

Contour plots of maximum predicted ground level concentrations (including background concentrations to account for cumulative effects) of several specific COPCs are presented in the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e).

YORK REGION AND DURHAM REGION
RESIDUAL WASTE STUDY

Maximum Predicted 1-Hour Ground Level Concentrations 400,000 Tonnes/Year



Maximum GLC

Facility Location

Map Parameters
Projection: UTM
Datum: NAD 83
Zone: 17
Map Units: m
DATE: 6/9/2009
PROJECT: 1009497

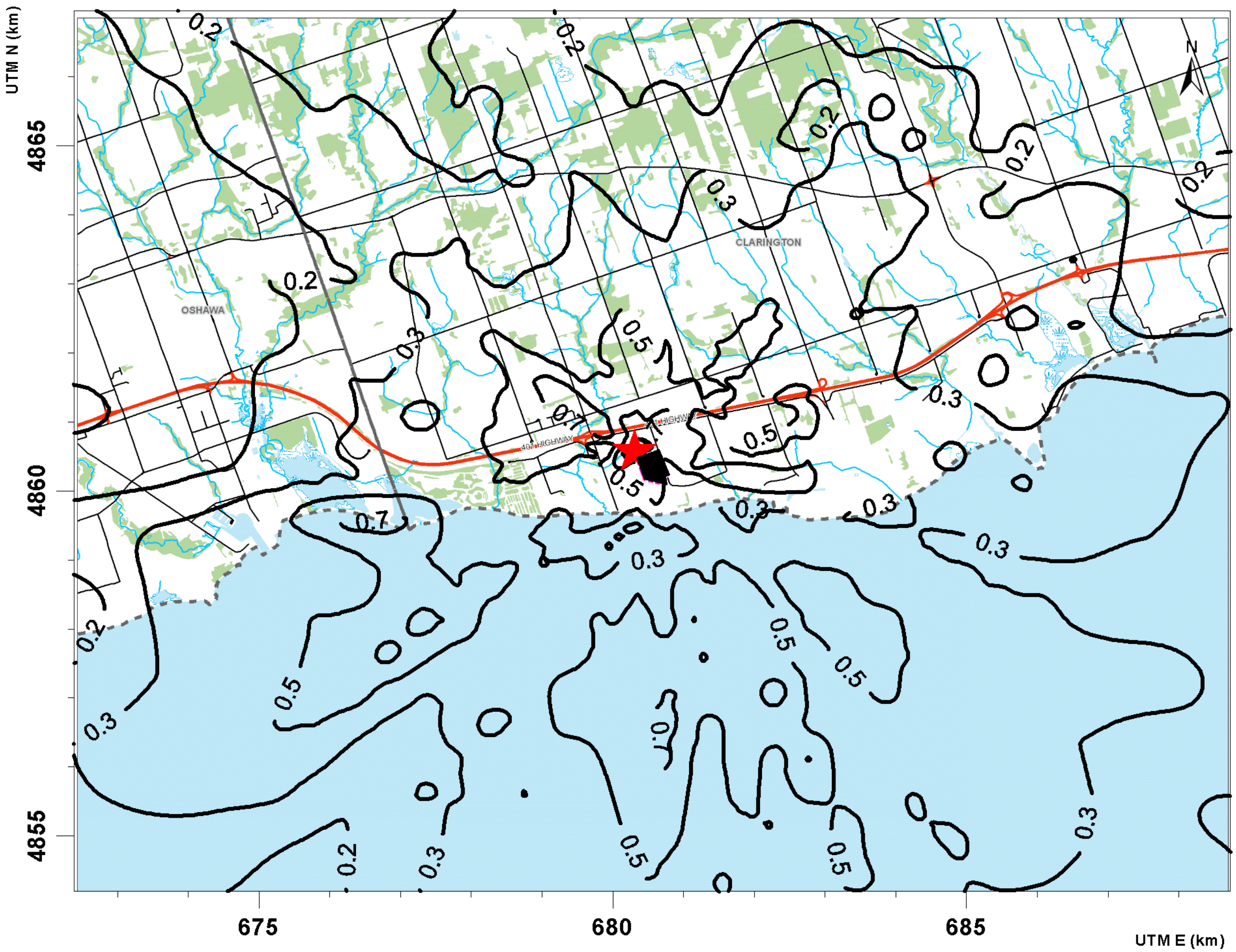
Jacques Whitford

6-4

Predicted Statistical Maximum GLC = 6.66 (μg/m^3)/(g/s)

YORK REGION AND DURHAM REGION RESIDUAL WASTE STUDY

Maximum Predicted 24-Hour Ground Level Concentrations 400,000 Tonnes/Year



Predicted Statistical Maximum GLC = 0.80 ($\mu g/m^3$)/(g/s)

Maximum GLC

Facility Location

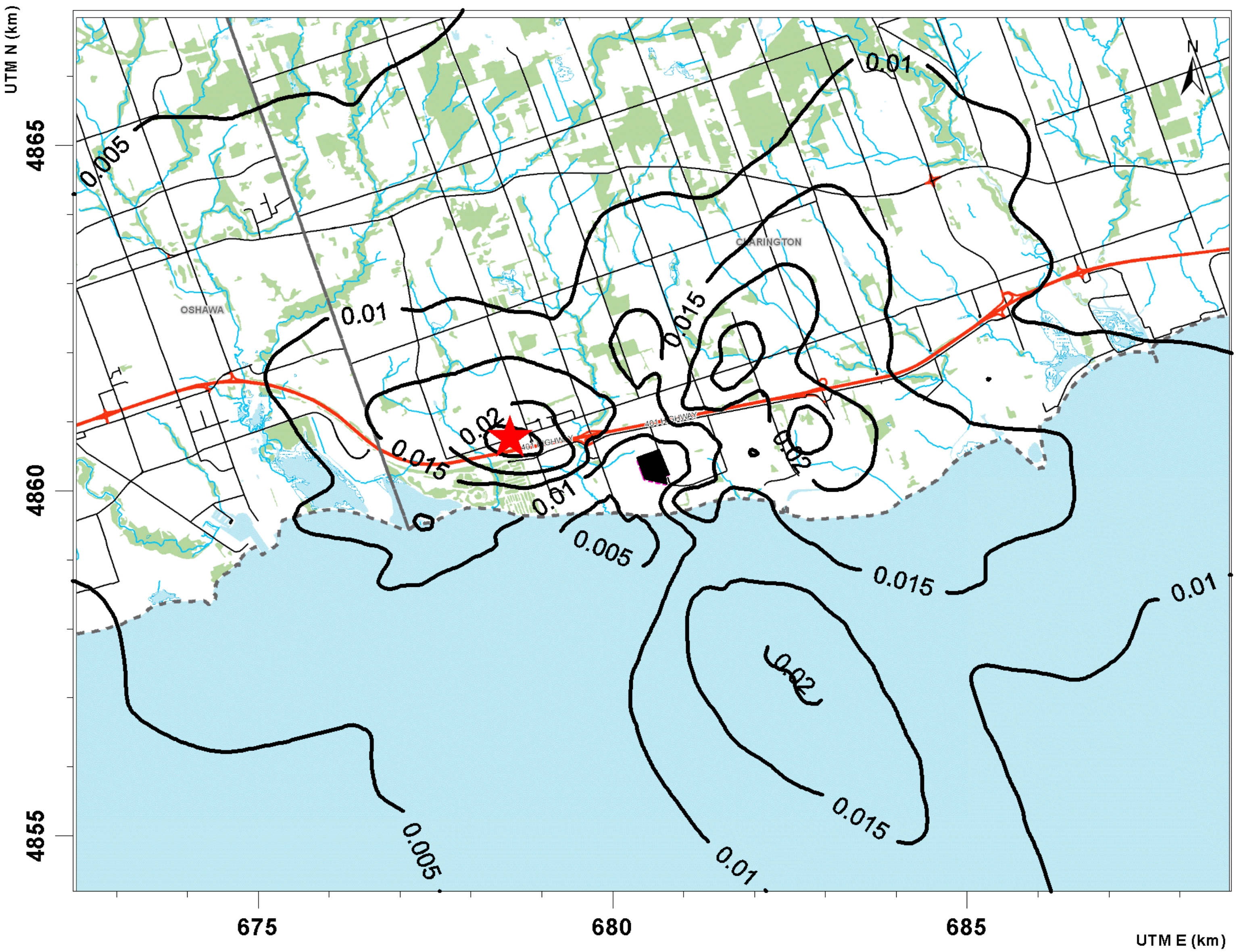
Map Parameters
Projection: UTM
Datum: NAD 83
Zone: 17
Map Units: m
DATE: 6/9/2009
PROJECT: 1009497

Jacques Whitford

FIGURE NO.
6-5

YORK REGION AND DURHAM REGION
RESIDUAL WASTE STUDY

Maximum Predicted Annual Ground Level Concentrations 400,000 Tonnes/Year



Predicted Statistical Maximum GLC = 0.028 (μg/m^3)/(g/s)

★ Maximum GLC

■ Facility Location

Map Parameters
Projection: UTM
Datum: NAD 83
Zone: 17
Map Units: m
DATE: 6/9/2009
PROJECT: 1009497

Jacques Whitford

6-6

6.2 Soil Exposure Point Concentrations

The first step in determining COPC uptake is to estimate concentrations in soil, based on results from the dispersion and deposition modeling (Figure 6-7). The COPC soil concentrations are used along with the air concentrations to calculate the COPC intakes resulting from other exposure pathways, as each pathway is influenced by the initial concentration of COPC in soil and air. Receptors are directly exposed to soils through inhalation of soil and soil-derived dust, dermal contact with soil and soil derived dust and incidental ingestion.

For the purposes of this HHERA, there are two main classes of chemicals: carcinogenic and non-carcinogenic. For the purposes of this risk assessment soil concentrations for both non-carcinogens and carcinogens were conservatively calculated as the single highest annual soil concentration throughout the operating lifetime of the Facility and loaded into the soils over the operating lifetime of the Facility. The Facility is expected to have an operating lifetime of several decades, which would be extended by active maintenance programs, refurbishment, or equipment replacement as appropriate. This assessment will assume that the Facility will have an operational lifetime of 30 years.

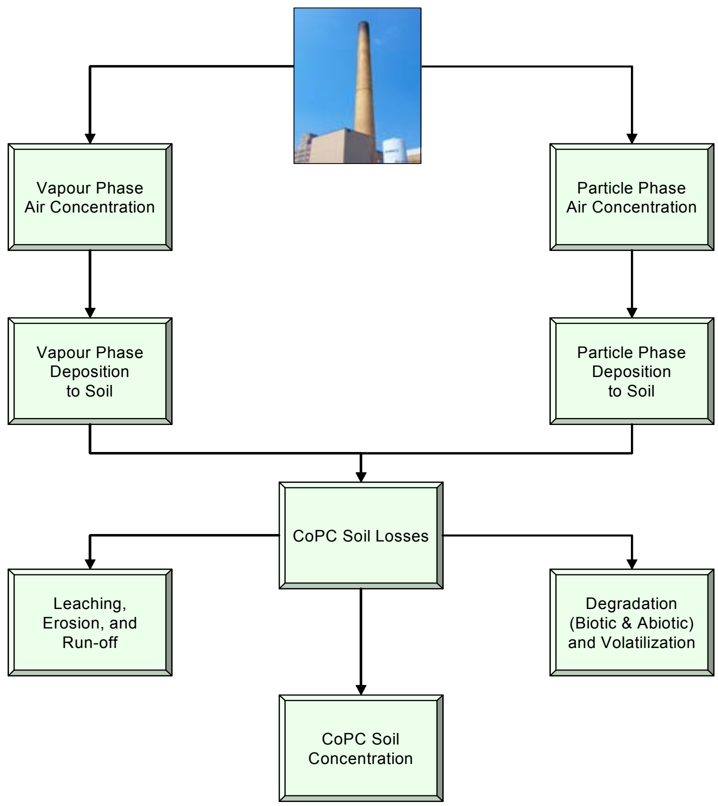


Figure 6-7 Modeling of Soil Concentrations

In this HHERA all chemicals are assessed based on the single highest annual soil concentrations throughout the operating lifetime of the Facility. This typically occurs at the end of the operating period (i.e. 30 years of accumulation) at which point the concentration is assumed to have reached steady-state in the environment (and not degrade) over the next 70 years of a person's lifetime exposure.

COPC concentrations in soil were calculated by summing the vapour and particle phase depositions to the soil. Wet and dry deposition of particles was considered, with dry deposition of vapours calculated from the vapour air concentration and the dry deposition velocity. The calculation of soil concentration also incorporated a term (ks) that accounts for loss of COPC by several mechanisms, including leaching, erosion, runoff, degradation (biotic and abiotic), and volatilization. For inorganic COPC (metals), it is assumed that soil losses due to abiotic degradation and volatilization are zero as these elements are neither biodegradable, nor volatile.

The US EPA (2005) HHRAP Guidance allows for variation of the soil mixing zone through which the contaminants would be deposited and then distributed. For all agricultural lands and garden scenarios the US EPA recommends a 20 cm mixing zone. For other land uses (e.g. residential soil exposure) and ecosystems the US EPA recommends a 2cm mixing zone. For this risk assessment the more conservative 2cm mixing zone was employed to estimate soil concentrations and subsequent fate and transport of chemicals in the environment for all land uses.

Measured baseline COPC soil concentrations collected and analyzed in the LRASA, as well as predicted soil loadings for each of the two Project scenarios over 30 years of operation, along with the percent change from the baseline concentrations, are provided in Table 6-1. Maximum modeled values for the recreation user – sport, recreation user – camper, daycare, farmer and resident receptor were presented for each scenario. With the exception of dioxins/furans and inorganic mercury, loading of COPC to soil over the 30 year operational period for the Project in both scenarios resulted in soil loadings of less than 2% of measured baseline concentrations, or only a minor contribution to existing conditions in the LRASA. A dioxin/furan soil loading of 20 and 57% for the normal operation and process upset scenarios respectively was observed, as well as a 4.6 and 6.7% loading for inorganic mercury.

Table 6-1 Predicted Soil Loading as a Result of Normal and Process Upset Operation over a 30 Year Period for 140,000 tpy and 400,000 tpy

COPC	Baseline Measured Soil Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Soil Concentration (mg/kg)	% Loading	Maximum Soil Concentration (mg/kg)	% Loading	Maximum Soil Concentration (mg/kg)	% Loading	Maximum Soil Concentration (mg/kg)	% Loading
PAHs									
Anthracene	0.010	3.08E-07	0.0031	8.62E-07	0.0086	9.13E-07	0.0091	2.56E-06	0.026
Benzo(a)fluorene	-	3.35E-07	-	9.38E-07	-	9.93E-07	-	2.78E-06	-
Benzo(a)pyrene TEQ	0.061	8.73E-07	0.0014	2.44E-06	0.0040	2.59E-06	0.0042	7.24E-06	0.012
Benzo(b)fluorene	-	2.31E-07	-	6.47E-07	-	6.86E-07	-	1.92E-06	-
Fluorene	0.010	3.11E-07	0.0031	8.70E-07	0.0087	9.21E-07	0.0092	2.58E-06	0.026
PCBs									
Aroclor 1254 (Total PCBs)	0.010	5.80E-05	0.58	1.62E-04	1.6	1.72E-04	1.7	4.82E-04	4.8
Dioxins and Furans									
2,3,7,8-TCDD TEQ	1.76E-06	4.59E-08	2.6	1.28E-07	7.3	1.42E-07	8.1	2.06E-07	12
VOCs									
1,1,1-Trichloroethane	0.0030	1.79E-10	5.95E-06	5.00E-10	1.67E-05	5.29E-10	1.76E-05	1.48E-09	4.94E-05
Bromoform	0.020	6.78E-10	3.39E-06	1.90E-09	9.49E-06	1.47E-09	7.37E-06	4.13E-09	2.06E-05
Carbon Tetrachloride	0.010	4.86E-11	4.86E-07	1.36E-10	1.36E-06	1.06E-10	1.06E-06	2.96E-10	2.96E-06
Chloroform	0.010	8.00E-11	8.00E-07	2.24E-10	2.24E-06	2.37E-10	2.37E-06	6.64E-10	6.64E-06
Dichloromethane	0.2	1.43E-08	7.17E-06	4.01E-08	2.01E-05	4.25E-08	2.13E-05	1.19E-07	5.95E-05
O-Terphenyl	-	9.88E-07	-	2.77E-06	-	2.93E-06	-	8.20E-06	-
Trichlorofluoromethane (FREON 11)	0.020	3.69E-09	1.85E-05	1.03E-08	5.17E-05	1.10E-08	5.48E-05	3.07E-08	1.53E-04
Chlorinated Monocyclic Aromatics									
1,2,4,5-Tetrachlorobenzene	0.010	1.40E-07	0.0014	3.93E-07	0.0039	4.16E-07	0.0042	1.17E-06	0.012
1,2,4-Trichlorobenzene	0.10	3.31E-09	0	9.27E-09	0	9.81E-09	9.81E-06	2.75E-08	2.75E-05

COPC	Baseline Measured Soil Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Soil Concentration (mg/kg)	% Loading	Maximum Soil Concentration (mg/kg)	% Loading	Maximum Soil Concentration (mg/kg)	% Loading	Maximum Soil Concentration (mg/kg)	% Loading
1,2-Dichlorobenzene	0.020	4.45E-08	2.23E-04	1.25E-07	6.23E-04	1.32E-07	6.60E-04	3.70E-07	0.0018
Hexachlorobenzene	0.010	6.03E-08	6.03E-04	1.69E-07	0.0017	1.79E-07	0.0018	5.00E-07	0.0050
Pentachlorobenzene	0.010	2.18E-06	0.022	6.11E-06	0.061	6.47E-06	0.065	1.81E-05	0.18
Pentachlorophenol	5.00E-04	1.03E-06	0	2.87E-06	1	3.04E-06	0.61	8.52E-06	1.7
Inorganics									
Antimony	1.0	5.58E-04	0.056	8.10E-04	0.081	0.0017	0.17	0.0025	0.25
Arsenic	8.0	5.54E-05	6.93E-04	8.03E-05	0.0010	1.72E-04	0.0021	2.49E-04	0.0031
Barium	89	3.93E-04	4.41E-04	5.70E-04	6.40E-04	0.0012	0.0014	0.0018	0.0020
Beryllium	0.70	3.51E-04	0.050	5.10E-04	0.073	0.0011	0.16	0.0016	0.23
Boron	13	0.0022	0.016	0.0032	0.024	0.0067	0.051	0.0098	0.074
Cadmium	0.50	0.0023	0.46	0.0034	0.67	0.0072	1.4	0.010	2.1
Chromium (Total)	22	1.95E-04	8.80E-04	2.83E-04	0.0013	6.05E-04	0.0027	8.77E-04	0.0040
Chromium VI	-	2.77E-05	-	4.02E-05	-	8.60E-05	-	1.25E-04	-
Cobalt	7.0	0.0012	0.017	0.0017	0.024	0.0037	0.052	0.0053	0.076
Lead	17	0.054	0.32	0.078	0.46	0.17	0.99	0.24	1.4
Mercury - Inorganic	0.070	0.0032	4.6	0.0047	6.7	0.0087	12	0.013	18
Methyl Mercury	-	1.41E-04	-	2.04E-04	-	4.37E-04	-	6.34E-04	-
Nickel	12	0.025	0.21	0.037	0.30	0.078	0.64	0.11	0.93
Phosphorus	753	7.59E-04	1.01E-04	0.0011	1.46E-04	0.0024	3.12E-04	0.0034	4.53E-04
Selenium	1.0	1.12E-05	0.0011	1.62E-05	0.0016	3.47E-05	0.0035	5.02E-05	0.0050
Silver	0.20	1.28E-04	0.064	1.86E-04	0.093	3.97E-04	0.20	5.76E-04	0.29

COPC	Baseline Measured Soil Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Soil Concentration (mg/kg)	% Loading	Maximum Soil Concentration (mg/kg)	% Loading	Maximum Soil Concentration (mg/kg)	% Loading	Maximum Soil Concentration (mg/kg)	% Loading
Thallium	1.0	0.012	1.2	0.018	1.8	0.038	3.8	0.055	5.5
Tin	10	0.013	0.13	0.019	0.19	0.041	0.41	0.060	0.60
Vanadium	28	0.0013	0.0046	0.0018	0.0066	0.0039	0.014	0.0057	0.020
Zinc	79	0.055	0.070	0.080	0.10	0.17	0.22	0.25	0.32

"-" – Value Not Available

Red Font – Detection Limit

6.3 Surface Water Exposure Point Concentrations

The Facility will be designed to be a zero wastewater discharge Facility, with the exception of the Facility's sanitary uses. The process wastewater generated throughout the Facility will be collected and reused wherever possible. Floor trenches will drain to a settling basin and collected wastewater will be used for quenching residue in the ash dischargers. Boiler blowdown and runoff refuse water will be used as scrubber slaking and dilution water, fly ash conditioning water and supplementary water supply to the settling basin. Sanitary wastewater will be discharged to the sewer. There are no planned releases of COPC to the surface water bodies.

Since there are no planned discharges to surface water, the most likely means for a change in COPC concentrations in surface water (and hence potential for health risks) are via aerial deposition of chemicals on land.

The total concentration of each COPC is partitioned between the sediment and the water column. For calculation of COPC concentrations in fish and surface water, the US EPA (2005) recommends the use of the dissolved water concentration minus any suspended particulates. For the human health risk assessment, surface water concentrations are used only for the swimming scenario, which includes dermal absorption and incidental ingestion. Residents and farmers were assumed to get their water supply from municipal supply services.

To complete the modeling of the effects of airborne deposition to a watershed and waterbodies information in climate factors (e.g. precipitation) and hydrology (e.g. stream flow rates) were obtained from various resources and site specified studies. A description of the watersheds included in the modeling is provided in Table 3-5.

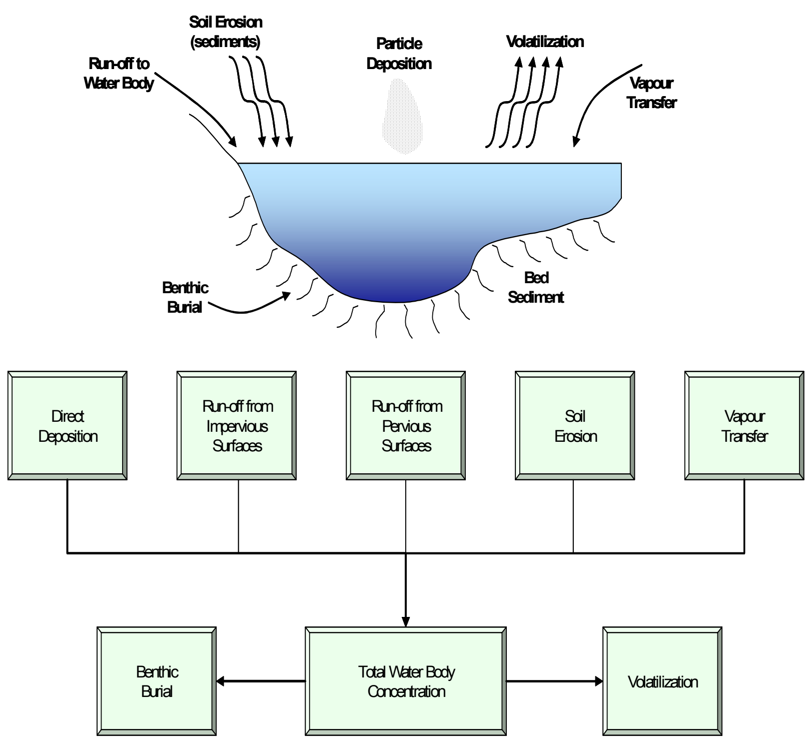


Figure 6-8 Modeling of Surface Water Concentrations

Fish exposure to COPC in each watershed is modeled by a variety of mechanisms, including direct deposition to the water body, surface runoff, and soil erosion into the water body to generate a final water concentration.

A primary factor to be considered when addressing the consumption of aquatic life as an exposure pathway is the propensity of COPC to bio-accumulate and/or biomagnify. These factors can elevate concentrations of substances in aquatic life, resulting in exposures to top consumers, such as hunter/anglers who eat fish from local water bodies. Bioconcentration/bio-accumulation factors for fish (BCF/BAF_{fish}) represent the ratio of the COPC concentration in fish to the COPC concentration in the water column/body where the fish is exposed.

Measured baseline COPC surface water and sediment concentrations collected and analyzed in the LRASA, as well as predicted surface water and sediment loadings for each of the two Project scenarios over 30 years of operation, along with the percent change from the baseline concentrations, are provided inTable 6-2 and 6-3, respectively. Maximum modeled values for the McLaughlin Bay watershed were presented for the surface water results while maximum modeled values were presented for the sediment results. Surface water values were based on the Recreation User – Swimmer, while sediment values were based on ecological receptors. With the exception of pentachlorophenol and various metals, loading of COPC to surface water over the 30 year operational period for the Project in both scenarios resulted in loadings of less than 1% of measured baseline concentrations. Similarly, with certain exceptions (including PCBs, dioxin/furans, mercury, and chlorinated monocyclic aromatics), loading of COPC to sediment over the 30 year operational period for the Project in both scenarios also resulted in loadings of less than 1% of measured baseline concentrations.

Table 6-2 Predicted Surface Water Loading as a Result of Normal and Process Upset Operation over a 30 Year Period for 140,000 tpy and 400,000 tpy

COPC	Baseline Measured Surface Water Concentration (mg/L)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operations		Process Upsets	
		McLaughlin Bay Surface Water Concentration (mg/L)	% Loading	McLaughlin Bay Surface Water Concentration (mg/L)	% Loading	McLaughlin Bay Surface Water Concentration (mg/L)	% Loading	McLaughlin Bay Surface Water Concentration (mg/L)	% Loading
PAHs									
Anthracene	1.00E-05	5.94E-11	5.94E-04	1.66E-10	0.0017	1.54E-10	0.0015	4.31E-10	0.0043
Benzo(a)fluorene	-	2.30E-10	-	6.45E-10	-	5.96E-10	-	1.66E-09	-
Benzo(a)pyrene TEQ	3.44E-05	4.74E-10	0.0014	1.33E-09	0.0039	1.23E-09	0.0036	3.42E-09	0.0100
Benzo(b)fluorene	-	1.86E-10	-	5.20E-10	-	4.80E-10	-	1.34E-09	-
Fluorene	1.00E-05	4.55E-10	0.0023	1.27E-09	0.0064	1.18E-09	0.0059	3.30E-09	0.017
PCBs									
Aroclor 1254 (Total PCBs)	2.00E-05	4.84E-10	0.0024	1.35E-09	0.0068	1.26E-09	0.0063	3.52E-09	0.018
Dioxins and Furans									
2,3,7,8-TCDD TEQ	3.24E-09	3.58E-13	0.011	1.00E-12	0.031	9.51E-13	0.029	1.44E-12	0.044
VOCs									
1,1,1-Trichloroethane	5.00E-04	6.65E-09	0.0013	1.86E-08	0.0037	1.73E-08	0.0035	4.84E-08	0.0097
Bromoform	5.00E-04	2.89E-07	0.058	8.11E-07	0.16	5.52E-07	0.11	1.55E-06	0.31
Carbon Tetrachloride	5.00E-04	2.00E-09	4.01E-04	5.61E-09	0.0011	3.82E-09	7.65E-04	1.07E-08	0.0021
Chloroform	5.00E-04	2.19E-09	4.38E-04	6.13E-09	0.0012	5.69E-09	0.0011	1.59E-08	0.0032
Dichloromethane	0.0015	6.82E-07	0.045	1.91E-06	0.13	1.77E-06	0.12	4.96E-06	0.33
O-Terphenyl		5.83E-10	-	1.63E-09	-	1.51E-09	-	4.23E-09	-
Trichlorofluoromethane (FREON 11)	0.0010	7.51E-07	0.075	2.10E-06	0.21	1.95E-06	0.20	5.47E-06	0.55
Chlorinated Monocyclic Aromatics									
1,2,4,5-Tetrachlorobenzene	5.00E-05	2.63E-10	5.27E-04	7.37E-10	0.0015	6.84E-10	0.0014	1.92E-09	0.0038
1,2,4-Trichlorobenzene	5.00E-04	2.56E-10	5.12E-05	7.17E-10	1.43E-04	6.65E-10	1.33E-04	1.86E-09	3.72E-04

COPC	Baseline Measured Surface Water Concentration (mg/L)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operations		Process Upsets	
		McLaughlin Bay Surface Water Concentration (mg/L)	% Loading	McLaughlin Bay Surface Water Concentration (mg/L)	% Loading	McLaughlin Bay Surface Water Concentration (mg/L)	% Loading	McLaughlin Bay Surface Water Concentration (mg/L)	% Loading
1,2-Dichlorobenzene	5.00E-04	1.03E-08	0.0021	2.89E-08	0.0058	2.68E-08	0.0054	7.51E-08	0.015
Hexachlorobenzene	5.00E-05	3.15E-10	6.30E-04	8.82E-10	0.0018	8.18E-10	0.0016	2.29E-09	0.0046
Pentachlorobenzene	5.00E-05	8.00E-10	0.0016	2.24E-09	0.0045	2.08E-09	0.0042	5.82E-09	0.012
Pentachlorophenol	1.00E-05	2.60E-07	2.6	7.28E-07	7.3	6.71E-07	6.7	1.87E-06	19
Inorganics									
Antimony	0.0050	3.69E-06	0.074	5.36E-06	0.11	9.85E-06	0.20	1.43E-05	0.29
Arsenic	0.0020	5.68E-07	0.028	8.23E-07	0.041	1.51E-06	0.076	2.20E-06	0.11
Barium	0.089	2.85E-06	0.0032	4.14E-06	0.0046	7.61E-06	0.0085	1.10E-05	0.012
Beryllium	0.0010	2.17E-07	0.022	3.14E-07	0.031	5.78E-07	0.058	8.38E-07	0.084
Boron	0.060	2.07E-04	0.35	3.00E-04	0.50	5.53E-04	0.92	8.01E-04	1.3
Cadmium	1.00E-04	9.27E-06	9.3	1.34E-05	13	2.47E-05	25	3.59E-05	36
Chromium (Total)	0.0060	3.04E-06	0.051	4.41E-06	0.074	8.12E-06	0.14	1.18E-05	0.20
Chromium VI	0.010	4.33E-07	0.0043	6.28E-07	0.0063	1.15E-06	0.012	1.67E-06	0.017
Cobalt	5.00E-04	7.81E-06	1.6	1.13E-05	2.3	2.08E-05	4.2	3.02E-05	6.0
Lead	0.0010	3.09E-05	3.1	4.47E-05	4.5	8.23E-05	8.2	1.19E-04	12
Mercury - Inorganic	1.00E-04	3.04E-07	0.30	4.40E-07	0.44	7.67E-07	0.77	1.11E-06	1.1
Methyl Mercury	-	1.28E-09	-	1.86E-09	-	3.42E-09	-	4.96E-09	-
Nickel	0.0060	1.16E-04	1.9	1.69E-04	2.8	3.10E-04	5.2	4.50E-04	7.5
Phosphorus	0.16	6.23E-05	0.039	9.04E-05	0.056	1.66E-04	0.10	2.41E-04	0.15
Selenium	0.0050	6.50E-07	0.013	9.42E-07	0.019	1.73E-06	0.035	2.51E-06	0.050
Silver	1.00E-04	4.54E-06	4.5	6.58E-06	6.6	1.21E-05	12	1.75E-05	18

COPC	Baseline Measured Surface Water Concentration (mg/L)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operations		Process Upsets	
		McLaughlin Bay Surface Water Concentration (mg/L)	% Loading	McLaughlin Bay Surface Water Concentration (mg/L)	% Loading	McLaughlin Bay Surface Water Concentration (mg/L)	% Loading	McLaughlin Bay Surface Water Concentration (mg/L)	% Loading
Thallium	3.00E-04	5.18E-05	17	7.51E-05	25	1.38E-04	46	2.00E-04	67
Tin	0.0010	1.81E-05	1.8	2.62E-05	2.6	4.82E-05	4.8	6.98E-05	7.0
Vanadium	0.0080	6.88E-07	0.0086	9.98E-07	0.012	1.84E-06	0.023	2.66E-06	0.033
Zinc	0.045	2.67E-04	0.59	3.87E-04	0.86	7.12E-04	1.6	0.0010	2.3

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Red Font – Detection Limit

Table 6-3 Predicted Sediment Loading as a Result of Normal and Process Upset Operation over a 30 Year Period for 140,000 tpy and 400,000 tpy

		140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
COPC	Baseline Measured Sediment Concentration (mg/kg)	Maximum Sediment Concentration (mg/kg)	% Loading	Maximum Sediment Concentration (mg/kg)	% Loading	Maximum Sediment Concentration (mg/kg)	% Loading	Maximum Sediment Concentration (mg/kg)	% Loading
PAHs									
Anthracene	0.050	1.16E-06	0.0023	3.26E-06	0.0065	3.27E-06	0.0065	9.15E-06	0.018
Benzo(a)fluorene	-	3.17E-05	-	8.86E-05	-	8.90E-05	-	2.49E-04	-
Benzo(a)pyrene TEQ	0.14	2.36E-05	0.017	6.62E-05	0.047	6.65E-05	0.047	1.86E-04	0.13
Benzo(b)fluorene	-	2.22E-05	-	6.23E-05	-	6.25E-05	-	1.75E-04	-
Fluorene	0.050	2.95E-06	0.0059	8.26E-06	0.017	8.29E-06	0.017	2.32E-05	0.046
PCBs									
Aroclor 1254 (Total PCBs)	0.050	7.70E-04	1.5	0.0022	4.3	0.0022	4.3	0.0061	12
Dioxins and Furans									
2,3,7,8-TCDD TEQ	1.96E-06	6.44E-07	33	1.80E-06	92	1.98E-06	101	2.87E-06	146
VOCs									
1,1,1-Trichloroethane	0.0030	1.50E-06	0.050	4.19E-06	0.14	4.21E-06	0.14	1.18E-05	0.39
Bromoform	0.020	6.26E-05	0.31	1.75E-04	0.88	1.29E-04	0.65	3.62E-04	1.8
Carbon Tetrachloride	0.010	4.99E-07	0.0050	1.40E-06	0.014	1.03E-06	0.010	2.89E-06	0.029
Chloroform	0.010	2.30E-07	0.0023	6.43E-07	0.0064	6.46E-07	0.0065	1.81E-06	0.018
Dichloromethane	0.10	1.59E-05	0.016	4.47E-05	0.045	4.48E-05	0.045	1.26E-04	0.13
O-Terphenyl		1.62E-04	-	4.54E-04	-	4.56E-04	-	0.0013	-
Trichlorofluoromethane (FREON 11)	0.020	1.45E-04	0.72	4.05E-04	2.0	4.07E-04	2.0	0.0011	5.7
Chlorinated Monocyclic Aromatics									

COPC	Baseline Measured Sediment Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Sediment Concentration (mg/kg)	% Loading	Maximum Sediment Concentration (mg/kg)	% Loading	Maximum Sediment Concentration (mg/kg)	% Loading	Maximum Sediment Concentration (mg/kg)	% Loading
1,2,4,5-Tetrachlorobenzene	0.010	3.71E-06	0.037	1.04E-05	0.10	1.04E-05	0.10	2.92E-05	0.29
1,2,4-Trichlorobenzene	0.10	8.43E-07	8.43E-04	2.36E-06	0.0024	2.37E-06	0.0024	6.63E-06	0.0066
1,2-Dichlorobenzene	0.020	7.35E-06	0.037	2.06E-05	0.10	2.07E-05	0.10	5.79E-05	0.29
Hexachlorobenzene	0.010	3.95E-05	0.40	1.11E-04	1.1	1.11E-04	1.1	3.11E-04	3.1
Pentachlorobenzene	0.010	1.63E-04	1.6	4.55E-04	4.6	4.57E-04	4.6	0.0013	13
Pentachlorophenol	6.00E-04	5.40E-06	0.77	1.51E-05	2.2	1.67E-05	2.4	4.68E-05	6.7
Inorganics									
Antimony	1.0	1.44E-04	0.014	2.08E-04	0.021	4.82E-04	0.048	6.99E-04	0.070
Arsenic	2.0	1.42E-05	7.11E-04	2.06E-05	0.0010	4.77E-05	0.0024	6.92E-05	0.0035
Barium	94	1.01E-04	1.08E-04	1.47E-04	1.56E-04	3.39E-04	3.61E-04	4.92E-04	5.24E-04
Beryllium	0.50	1.13E-04	0.023	1.63E-04	0.033	3.51E-04	0.070	5.10E-04	0.10
Boron	14	5.36E-04	0.0038	7.77E-04	0.0056	0.0018	0.013	0.0026	0.019
Cadmium	0.50	5.99E-04	0.12	8.68E-04	0.17	0.0020	0.40	0.0029	0.58
Chromium (Total)	32	4.99E-05	1.56E-04	7.24E-05	2.26E-04	1.68E-04	5.24E-04	2.43E-04	7.59E-04
Chromium VI	2.0	7.10E-06	3.55E-04	1.03E-05	5.15E-04	2.38E-05	0.0012	3.46E-05	0.0017
Cobalt	6.0	3.04E-04	0.0051	4.41E-04	0.0073	0.0010	0.017	0.0015	0.025
Lead	13	0.018	0.14	0.026	0.20	0.055	0.42	0.080	0.61
Mercury - Inorganic	0.050	0.027	54	0.039	78	0.066	132	0.096	192
Methyl Mercury	-	1.76E-05	-	2.55E-05	-	5.90E-05	-	8.55E-05	-

COPC	Baseline Measured Sediment Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Sediment Concentration (mg/kg)	% Loading	Maximum Sediment Concentration (mg/kg)	% Loading	Maximum Sediment Concentration (mg/kg)	% Loading	Maximum Sediment Concentration (mg/kg)	% Loading
Nickel	10	0.0065	0.065	0.0095	0.095	0.022	0.22	0.032	0.32
Phosphorus	680	1.88E-04	2.77E-05	2.73E-04	4.01E-05	6.32E-04	9.29E-05	9.16E-04	1.35E-04
Selenium	1.0	2.80E-06	2.80E-04	4.06E-06	4.06E-04	9.41E-06	9.41E-04	1.36E-05	0.0014
Silver	0.20	3.25E-05	0.016	4.71E-05	0.024	1.09E-04	0.055	1.58E-04	0.079
Thallium	1.0	0.0032	0.32	0.0046	0.46	0.011	1.1	0.015	1.5
Tin	5.0	0.0036	0.071	0.0052	0.10	0.012	0.24	0.017	0.35
Vanadium	29	4.53E-04	0.0016	6.57E-04	0.0023	0.0013	0.0046	0.0019	0.0066
Zinc	81	0.014	0.018	0.021	0.026	0.048	0.059	0.070	0.086

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6.4 Backyard Garden/Farm Produce and Fruit Exposure Point Concentrations

Indirect exposure resulting from ingestion of produce depends on the total concentration of COPC in the leafy, fruit, and tuber portions of the plant. Because differences exist in contamination mechanisms, consideration of indirect produce exposure was separated into two broad categories – aboveground and belowground produce (e.g. potatoes, carrots, beets). Aboveground produce was further stratified into exposed (lettuce, tomatoes, sprouts, beans) and protected (peas, corn, squash) categories.

Aboveground exposed produce was assumed to become contaminated through three possible mechanisms: direct deposition on particles, vapour transfer and root uptake, whole aboveground protected produce and belowground produce were assumed to become contaminated through root uptake alone (Figure 6-9).

It is assumed in the risk assessment that backyard garden produce grown in the summer is preserved or frozen and is consumed year-round. It is recognized that, normally, an individual's entire intake of produce does not come from their own garden.

Baseline concentrations of COPC in aboveground and belowground produce and fruit are presented in Table 6-4 through Table 6-7. In addition, modeled COPC loading on produce and fruit for each of the two scenarios over the operational period for the Project are provided, along with the percent change from the baseline concentrations. Maximum modeled values are presented for each case scenario and were based on the residential and farmer receptors. With certain exceptions (including dioxin/furans and specific metals), loading of COPC to each of the various media over the operational period for the Project in all cases resulted in loadings of less than 1% of baseline concentrations.

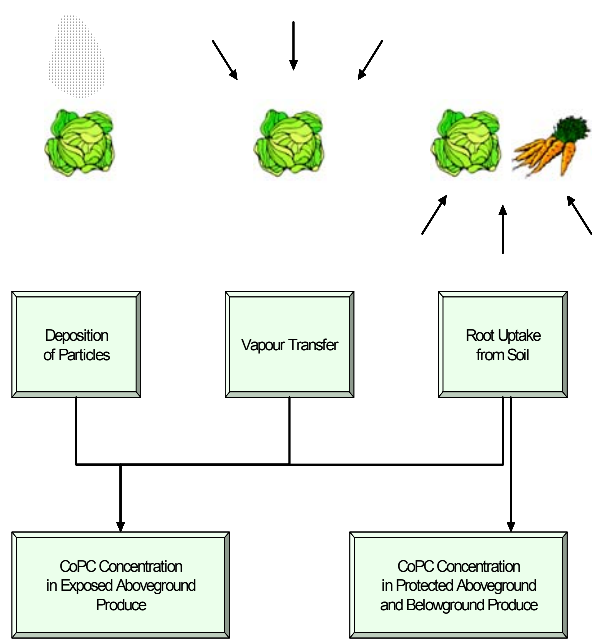

Figure 6-9 Modeling of Backyard/Garden Produce Concentrations

Table 6-4 Predicted Aboveground Protected Produce Loading as a Result of Normal and Process Upset Operation over a 30 Year Period for 140,000 tpy and 400,000 tpy

COPC	Baseline Measured Aboveground Protected Produce Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operations		Process Upset	
		Maximum Aboveground Protected Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Protected Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Protected Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Protected Produce Concentration (mg/kg)	% Loading
PAHs									
Anthracene	2.00E-04	2.99E-08	0.015	8.37E-08	0.042	8.87E-08	0.044	2.48E-07	0.12
Benzo(a)fluorene	-	9.81E-09	-	2.75E-08	-	2.91E-08	-	8.14E-08	-
Benzo(a)pyrene TEQ	6.89E-04	9.75E-09	0.0014	2.73E-08	0.0040	2.89E-08	0.0042	8.10E-08	0.012
Benzo(b)fluorene	-	4.25E-09	-	1.19E-08	-	1.26E-08	-	3.53E-08	-
Fluorene	2.00E-04	4.50E-08	0.023	1.26E-07	0.063	1.34E-07	0.067	3.74E-07	0.19
PCBs									
Aroclor 1254 (Total PCBs)	0.010	3.93E-07	0.0039	1.10E-06	0.011	1.17E-06	0.012	3.27E-06	0.033
Dioxins and Furans									
2,3,7,8-TCDD TEQ	2.66E-07	2.09E-10	0.078	5.85E-10	0.22	6.48E-10	0.24	9.39E-10	0.35
VOCs									
1,1,1-Trichloroethane	-	2.48E-10	-	6.95E-10	-	7.36E-10	-	2.06E-09	-
Bromoform	-	1.12E-09	-	3.13E-09	-	2.43E-09	-	6.81E-09	-
Carbon Tetrachloride	-	4.53E-11	-	1.27E-10	-	9.85E-11	-	2.76E-10	-
Chloroform	-	2.16E-10	-	6.04E-10	-	6.40E-10	-	1.79E-09	-
Dichloromethane	-	9.83E-08	-	2.75E-07	-	2.92E-07	-	8.16E-07	-
O-Terphenyl		2.47E-08	-	6.91E-08	-	7.32E-08	-	2.05E-07	-
Trichlorofluoromethane (FREON 11)	-	5.13E-09	-	1.44E-08	-	1.52E-08	-	4.26E-08	-

COPC	Baseline Measured Aboveground Protected Produce Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operations		Process Upset	
		Maximum Aboveground Protected Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Protected Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Protected Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Protected Produce Concentration (mg/kg)	% Loading
Chlorinated Monocyclic Aromatics									
1,2,4,5-Tetrachlorobenzene	0.010	9.14E-09	9.14E-05	2.56E-08	2.56E-04	2.71E-08	2.71E-04	7.59E-08	7.59E-04
1,2,4-Trichlorobenzene	-	6.25E-10	-	1.75E-09	-	1.85E-09	-	5.19E-09	-
1,2-Dichlorobenzene	-	1.92E-08	-	5.37E-08	-	5.69E-08	-	1.59E-07	-
Hexachlorobenzene	0.010	2.02E-09	2.02E-05	5.66E-09	5.66E-05	5.99E-09	5.99E-05	1.68E-08	1.68E-04
Pentachlorobenzene	0.010	8.68E-08	8.68E-04	2.43E-07	0.0024	2.57E-07	0.0026	7.21E-07	0.0072
Pentachlorophenol	-	4.48E-08	-	1.26E-07	-	1.33E-07	-	3.72E-07	-
Inorganics									
Antimony	0.010	1.78E-05	0.18	2.58E-05	0.26	5.52E-05	0.55	8.01E-05	0.80
Arsenic	0.010	3.51E-07	0.0035	5.09E-07	0.0051	1.09E-06	0.011	1.58E-06	0.016
Barium	0.32	1.27E-05	0.0040	1.84E-05	0.0058	3.93E-05	0.012	5.69E-05	0.018
Beryllium	0.10	9.07E-07	9.07E-04	1.31E-06	0.0013	2.81E-06	0.0028	4.08E-06	0.0041
Boron	3.1	0.0049	0.16	0.0071	0.23	0.015	0.49	0.022	0.71
Cadmium	0.0063	2.90E-04	4.6	4.20E-04	6.7	8.99E-04	14	0.0013	21
Chromium (Total)	0.10	9.52E-07	9.52E-04	1.38E-06	0.0014	2.95E-06	0.0030	4.28E-06	0.0043
Chromium VI	-	1.35E-07	-	1.96E-07	-	4.20E-07	-	6.09E-07	-
Cobalt	0.020	1.02E-05	0.051	1.48E-05	0.074	3.17E-05	0.16	4.59E-05	0.23
Lead	0.020	7.32E-04	3.7	0.0011	5.3	0.0023	11	0.0033	16
Mercury - Inorganic	0.0010	4.69E-05	4.7	6.80E-05	6.8	1.26E-04	13	1.83E-04	18

COPC	Baseline Measured Aboveground Protected Produce Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operations		Process Upset	
		Maximum Aboveground Protected Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Protected Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Protected Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Protected Produce Concentration (mg/kg)	% Loading
Methyl Mercury	-	4.14E-06	-	6.01E-06	-	1.28E-05	-	1.86E-05	-
Nickel	0.10	2.35E-04	0.24	3.41E-04	0.34	7.30E-04	0.73	0.0011	1.1
Phosphorus	974	0.0027	2.73E-04	0.0038	3.95E-04	0.0082	8.45E-04	0.012	0.0012
Selenium	0.054	2.18E-07	4.03E-04	3.16E-07	5.85E-04	6.76E-07	0.0013	9.80E-07	0.0018
Silver	0.011	1.77E-05	0.16	2.56E-05	0.23	5.48E-05	0.50	7.95E-05	0.72
Thallium	0.010	1.05E-05	0.11	1.53E-05	0.15	3.27E-05	0.33	4.74E-05	0.47
Tin	0.062	1.20E-04	0.19	1.75E-04	0.28	3.74E-04	0.60	5.42E-04	0.87
Vanadium	0.10	4.22E-06	0.0042	6.11E-06	0.0061	1.31E-05	0.013	1.90E-05	0.019
Zinc	6.8	0.0054	0.079	0.0078	0.11	0.017	0.25	0.024	0.36

"-" – Value Not Available

Red Font – Detection Limit

Table 6-5 Predicted Aboveground Exposed Produce Loading as a Result of Normal and Process Upset Operation over a 30 Year Period for 140,000 tpy and 400,000 tpy

COPC	Baseline Measured Aboveground Exposed Produce Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operations		Process Upsets	
		Maximum Aboveground Exposed Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Exposed Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Exposed Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Exposed Produce Concentration (mg/kg)	% Loading
PAHs									
Anthracene	2.00E-04	6.00E-11	3.00E-05	1.68E-10	8.40E-05	1.72E-10	8.62E-05	4.83E-10	2.41E-04
Benzo(a)fluorene	-	1.63E-09	-	4.56E-09	-	4.68E-09	-	1.31E-08	-
Benzo(a)pyrene TEQ	0.0037	5.20E-08	0.0014	1.46E-07	0.0039	1.50E-07	0.0040	4.19E-07	0.011
Benzo(b)fluorene	-	1.12E-09	-	3.12E-09	-	3.20E-09	-	8.97E-09	-
Fluorene	2.00E-04	-	-	-	-	-	-	-	-
PCBs									
Aroclor 1254 (Total PCBs)	0.010	-	-	-	-	-	-	-	-
Dioxins and Furans									
2,3,7,8-TCDD TEQ	4.50E-07	1.42E-10	0.031	3.97E-10	0.088	4.37E-10	0.097	6.33E-10	0.14
VOCs									
1,1,1-Trichloroethane	0.020	-	-	-	-	-	-	-	-
Bromoform	0.10	-	-	-	-	-	-	-	-
Carbon Tetrachloride	0.050	-	-	-	-	-	-	-	-
Chloroform	0.050	-	-	-	-	-	-	-	-
Dichloromethane	0.50	-	-	-	-	-	-	-	-
O-Terphenyl	-	-	-	-	-	-	-	-	-
Trichlorofluoromethane (FREON 11)	0.10	-	-	-	-	-	-	-	-

COPC	Baseline Measured Aboveground Exposed Produce Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operations		Process Upsets	
		Maximum Aboveground Exposed Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Exposed Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Exposed Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Exposed Produce Concentration (mg/kg)	% Loading
Chlorinated Monocyclic Aromatics									
1,2,4,5-Tetrachlorobenzene	0.010	-	-	-	-	-	-	-	-
1,2,4-Trichlorobenzene	0.50	-	-	-	-	-	-	-	-
1,2-Dichlorobenzene	0.10	-	-	-	-	-	-	-	-
Hexachlorobenzene	0.010	-	-	-	-	-	-	-	-
Pentachlorobenzene	0.010	-	-	-	-	-	-	-	-
Pentachlorophenol	-	-	-	-	-	-	-	-	-
Inorganics									
Antimony	0.010	1.92E-05	0.19	2.79E-05	0.28	5.94E-05	0.59	8.61E-05	0.86
Arsenic	0.010	2.95E-06	0.030	4.28E-06	0.043	9.10E-06	0.091	1.32E-05	0.13
Barium	0.42	1.49E-05	0.0036	2.15E-05	0.0052	4.58E-05	0.011	6.64E-05	0.016
Beryllium	0.10	2.34E-06	0.0023	3.39E-06	0.0034	7.22E-06	0.0072	1.05E-05	0.010
Boron	6.0	0.0011	0.018	0.0016	0.026	0.0033	0.055	0.0048	0.080
Cadmium	0.011	4.92E-05	0.47	7.13E-05	0.68	1.52E-04	1.4	2.20E-04	2.1
Chromium (Total)	0.10	1.58E-05	0.016	2.29E-05	0.023	4.88E-05	0.049	7.07E-05	0.071
Chromium VI	-	2.25E-06	-	3.26E-06	-	6.93E-06	-	1.01E-05	-
Cobalt	0.020	4.07E-05	0.20	5.90E-05	0.30	1.26E-04	0.63	1.82E-04	0.91
Lead	0.020	3.51E-04	1.8	5.09E-04	2.5	0.0011	5.4	0.0016	7.9
Mercury - Inorganic	0.0016	4.73E-06	0.30	6.86E-06	0.43	1.46E-05	0.91	2.12E-05	1.3

COPC	Baseline Measured Aboveground Exposed Produce Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operations		Process Upsets	
		Maximum Aboveground Exposed Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Exposed Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Exposed Produce Concentration (mg/kg)	% Loading	Maximum Aboveground Exposed Produce Concentration (mg/kg)	% Loading
Methyl Mercury	-	1.34E-06	-	1.94E-06	-	4.12E-06	-	5.97E-06	-
Nickel	0.10	6.12E-04	0.61	8.87E-04	0.89	0.0019	1.9	0.0027	2.7
Phosphorus	676	3.23E-04	4.78E-05	4.69E-04	6.94E-05	9.98E-04	1.48E-04	0.0014	2.14E-04
Selenium	0.040	3.37E-06	0.0084	4.89E-06	0.012	1.04E-05	0.026	1.51E-05	0.038
Silver	0.010	2.35E-05	0.24	3.41E-05	0.34	7.26E-05	0.73	1.05E-04	1.1
Thallium	0.010	2.74E-04	2.7	3.97E-04	4.0	8.45E-04	8.5	0.0012	12
Tin	0.12	1.24E-04	0.10	1.79E-04	0.15	3.81E-04	0.31	5.53E-04	0.45
Vanadium	0.10	8.17E-06	0.0082	1.18E-05	0.012	2.52E-05	0.025	3.65E-05	0.037
Zinc	5.4	0.0014	0.026	0.0020	0.038	0.0043	0.080	0.0063	0.12

"-" – Value Not Available

Red Font – Detection Limit

Table 6-6 Predicted Belowground Produce Loading as a Result of Normal and Process Upset Operation over a 30 Year Period for 140,000 tpy and 400,000 tpy

		140,000 Tpy				400,000 Tpy			
COPC	Baseline Measured Belowground Produce Concentration (mg/kg)	Normal Operation		Process Upset		Normal Operations		Process Upsets	
		Maximum Belowground Produce Concentration (mg/kg)	% Loading	Maximum Belowground Produce Concentration (mg/kg)	% Loading	Maximum Belowground Produce Concentration (mg/kg)	% Loading	Maximum Belowground Produce Concentration (mg/kg)	% Loading
PAHs									
Anthracene	2.00E-04	4.64E-10	2.32E-04	1.30E-09	6.50E-04	1.38E-09	6.88E-04	3.85E-09	0.0019
Benzo(a)fluorene	-	1.13E-08	-	3.16E-08	-	3.35E-08	-	9.38E-08	-
Benzo(a)pyrene TEQ	0.0007	1.10E-08	0.0016	3.08E-08	0.0045	3.27E-08	0.0047	9.15E-08	0.013
Benzo(b)fluorene	-	1.41E-08	-	3.96E-08	-	4.19E-08	-	1.17E-07	-
Fluorene	2.00E-04	5.89E-10	2.94E-04	1.65E-09	8.24E-04	1.74E-09	8.72E-04	4.89E-09	0.0024
PCBs									
Aroclor 1254 (Total PCBs)	0.010	5.56E-07	0.0056	1.56E-06	0.016	1.65E-06	0.016	4.61E-06	0.046
Dioxins and Furans									
2,3,7,8-TCDD TEQ	4.47E-07	4.72E-10	0.11	1.32E-09	0.30	1.46E-09	0.33	2.12E-09	0.47
VOCs									
1,1,1-Trichloroethane	-	1.58E-08	-	4.43E-08	-	4.69E-08	-	1.31E-07	-
Bromoform	-	8.33E-09	-	2.33E-08	-	1.81E-08	-	5.08E-08	-
Carbon Tetrachloride	-	4.62E-09	-	1.29E-08	-	1.01E-08	-	2.81E-08	-
Chloroform	-	8.05E-09	-	2.25E-08	-	2.39E-08	-	6.68E-08	-
Dichloromethane	-	5.16E-06	-	1.45E-05	-	1.53E-05	-	4.28E-05	-
O-Terphenyl	-	2.22E-08	-	6.22E-08	-	6.58E-08	-	1.84E-07	-
Trichlorofluoromethane (FREON 11)	-	3.00E-07	-	8.40E-07	-	8.90E-07	-	2.49E-06	-

COPC	Baseline Measured Belowground Produce Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operations		Process Upsets	
		Maximum Belowground Produce Concentration (mg/kg)	% Loading	Maximum Belowground Produce Concentration (mg/kg)	% Loading	Maximum Belowground Produce Concentration (mg/kg)	% Loading	Maximum Belowground Produce Concentration (mg/kg)	% Loading
Chlorinated Monocyclic Aromatics									
1,2,4,5-Tetrachlorobenzene	0.010	1.47E-07	0.0015	4.12E-07	0.0041	4.36E-07	0.0044	1.22E-06	0.012
1,2,4-Trichlorobenzene	-	2.56E-09	-	7.18E-09	-	7.60E-09	-	2.13E-08	-
1,2-Dichlorobenzene	-	1.09E-06	-	3.06E-06	-	3.24E-06	-	9.07E-06	-
Hexachlorobenzene	0.010	1.53E-08	1.53E-04	4.30E-08	4.30E-04	4.55E-08	4.55E-04	1.27E-07	0.0013
Pentachlorobenzene	0.010	4.01E-08	4.01E-04	1.12E-07	0.0011	1.19E-07	0.0012	3.33E-07	0.0033
Pentachlorophenol	-	1.68E-05	-	4.70E-05	-	4.98E-05	-	1.39E-04	-
Inorganics									
Antimony	0.010	1.68E-05	0.17	2.43E-05	0.24	5.20E-05	0.52	7.53E-05	0.75
Arsenic	0.011	4.43E-07	0.004	6.43E-07	0.006	1.37E-06	0.012	1.99E-06	0.018
Barium	4.3	5.90E-06	0.0001	8.55E-06	0.0002	1.83E-05	4.25E-04	2.65E-05	6.17E-04
Beryllium	0.10	5.27E-07	0.0005	7.64E-07	0.0008	1.64E-06	0.0016	2.37E-06	0.0024
Boron	3.7	0.0043	0.12	0.0063	0.17	0.013	0.36	0.020	0.53
Cadmium	0.058	1.48E-04	0.26	2.15E-04	0.37	4.60E-04	0.80	6.67E-04	1.2
Chromium (Total)	0.10	8.78E-07	0.001	1.27E-06	0.001	2.72E-06	0.0027	3.95E-06	0.0039
Chromium VI	-	1.25E-07	-	1.81E-07	-	3.87E-07	-	5.61E-07	-
Cobalt	0.020	8.26E-06	0.04	1.20E-05	0.06	2.56E-05	0.13	3.72E-05	0.19
Lead	0.026	4.85E-04	1.9	7.03E-04	2.7	0.0015	5.8	0.0022	8.4
Mercury - Inorganic	0.0010	1.17E-04	12	1.69E-04	17	3.14E-04	31	4.55E-04	45

COPC	Baseline Measured Belowground Produce Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operations		Process Upsets	
		Maximum Belowground Produce Concentration (mg/kg)	% Loading	Maximum Belowground Produce Concentration (mg/kg)	% Loading	Maximum Belowground Produce Concentration (mg/kg)	% Loading	Maximum Belowground Produce Concentration (mg/kg)	% Loading
Methyl Mercury	-	1.39E-05	-	2.02E-05	-	4.33E-05	-	6.27E-05	-
Nickel	0.10	2.02E-04	0.20	2.93E-04	0.29	6.27E-04	0.63	9.10E-04	0.91
Phosphorus	523	0.0027	5.08E-04	0.0038	7.36E-04	0.0082	0.0016	0.012	0.0023
Selenium	0.050	2.46E-07	0.0005	3.56E-07	0.001	7.62E-07	0.0015	1.11E-06	0.0022
Silver	0.010	1.28E-05	0.13	1.86E-05	0.19	3.97E-05	0.40	5.76E-05	0.58
Thallium	0.010	4.91E-06	0.0	7.13E-06	0.1	1.52E-05	0.15	2.21E-05	0.22
Tin	0.26	7.99E-05	0.03	1.16E-04	0.04	2.48E-04	0.096	3.59E-04	0.14
Vanadium	0.10	3.81E-06	0.0038	5.53E-06	0.006	1.18E-05	0.012	1.71E-05	0.017
Zinc	3.8	0.050	1.3	0.072	1.9	0.15	4.0	0.22	5.9

"-" – Value Not Available

Table 6-7 Predicted Fruit Loading as a Result of Normal and Process Upset Operation over a 30 Year Period for 140,000 tpy and 400,000 tpy

COPC	Baseline Measured Fruit Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Fruit Concentration (mg/kg)	% Loading	Maximum Fruit Concentration (mg/kg)	% Loading	Maximum Fruit Concentration (mg/kg)	% Loading	Maximum Fruit Concentration (mg/kg)	% Loading
PAHs									
Anthracene	2.00E-04	2.64E-12	1.32E-06	7.40E-12	3.70E-06	5.55E-12	2.78E-06	1.51E-11	7.55E-06
Benzo(a)fluorene	-	3.96E-10	-	1.11E-09	-	8.33E-10	-	2.26E-09	-
Benzo(a)pyrene TEQ	0.0051	5.41E-08	0.0011	1.51E-07	0.0030	1.14E-07	0.0023	3.09E-07	0.0061
Benzo(b)fluorene	-	1.04E-09	-	2.92E-09	-	2.19E-09	-	5.96E-09	-
Fluorene	2.60E-04	9.93E-12	3.82E-06	2.78E-11	1.07E-05	2.09E-11	8.03E-06	5.67E-11	2.18E-05
PCBs									
Aroclor 1254 (Total PCBs)	0.010	1.46E-09	1.46E-05	4.07E-09	4.07E-05	3.06E-09	3.06E-05	8.32E-09	8.32E-05
Dioxins and Furans									
2,3,7,8-TCDD TEQ	5.20E-07	3.18E-11	0.0061	8.91E-11	0.017	6.69E-11	0.013	1.82E-10	0.035
VOCs									
1,1,1-Trichloroethane	0.020	2.63E-12	1.31E-08	7.36E-12	3.68E-08	5.53E-12	2.76E-08	1.50E-11	7.51E-08
Bromoform	0.10	2.42E-13	2.42E-10	6.77E-13	6.77E-10	3.73E-13	3.73E-10	3.73E-13	3.73E-10
Carbon Tetrachloride	0.050	9.40E-13	1.88E-09	2.63E-12	5.26E-09	1.45E-12	2.90E-09	1.45E-12	2.90E-09
Chloroform	0.060	1.27E-12	2.12E-09	3.55E-12	5.92E-09	2.67E-12	4.45E-09	7.25E-12	1.21E-08
Dichloromethane	0.50	1.32E-10	2.65E-08	3.70E-10	7.41E-08	2.78E-10	5.56E-08	7.56E-10	1.51E-07
O-Terphenyl	-	6.91E-10	-	1.93E-09	-	1.45E-09	-	3.95E-09	-
Trichlorofluoromethane (FREON 11)	0.10	5.57E-11	5.57E-08	1.56E-10	1.56E-07	1.17E-10	1.17E-07	3.18E-10	3.18E-07
Chlorinated Monocyclic Aromatics									

COPC	Baseline Measured Fruit Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Fruit Concentration (mg/kg)	% Loading	Maximum Fruit Concentration (mg/kg)	% Loading	Maximum Fruit Concentration (mg/kg)	% Loading	Maximum Fruit Concentration (mg/kg)	% Loading
1,2,4,5-Tetrachlorobenzene	0.010	1.75E-12	1.75E-08	4.89E-12	4.89E-08	3.67E-12	3.67E-08	9.98E-12	9.98E-08
1,2,4-Trichlorobenzene	-	4.57E-13	-	1.28E-12	-	9.60E-13	-	2.61E-12	-
1,2-Dichlorobenzene	0.10	2.92E-10	2.92E-07	8.17E-10	8.17E-07	6.14E-10	6.14E-07	1.67E-09	1.67E-06
Hexachlorobenzene	0.010	1.19E-11	1.19E-07	3.34E-11	3.34E-07	2.51E-11	2.51E-07	6.82E-11	6.82E-07
Pentachlorobenzene	0.010	4.16E-11	4.16E-07	1.16E-10	1.16E-06	8.74E-11	8.74E-07	2.38E-10	2.38E-06
Pentachlorophenol	-	1.58E-06	-	4.43E-06	-	3.33E-06	-	9.04E-06	-
Inorganics									
Antimony	0.010	-	-	-	-	-	-	-	-
Arsenic	0.010	-	-	-	-	-	-	-	-
Barium	0.9	-	-	-	-	-	-	-	-
Beryllium	0.10	-	-	-	-	-	-	-	-
Boron	6.0	-	-	-	-	-	-	-	-
Cadmium	0.0050	-	-	-	-	-	-	-	-
Chromium (Total)	0.10	-	-	-	-	-	-	-	-
Chromium VI	-	-	-	-	-	-	-	-	-
Cobalt	0.020	-	-	-	-	-	-	-	-
Lead	0.020	-	-	-	-	-	-	-	-
Mercury - Inorganic	0.0010	1.05E-05	1.0	1.52E-05	1.5	2.20E-05	2.2	3.10E-05	3.1
Methyl Mercury	-	2.96E-06	-	4.29E-06	-	6.22E-06	-	8.75E-06	-

		140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
COPC	Baseline Measured Fruit Concentration (mg/kg)	Maximum Fruit Concentration (mg/kg)	% Loading	Maximum Fruit Concentration (mg/kg)	% Loading	Maximum Fruit Concentration (mg/kg)	% Loading	Maximum Fruit Concentration (mg/kg)	% Loading
Nickel	0.17	-	-	-	-	-	-	-	-
Phosphorus	521	-	-	-	-	-	-	-	-
Selenium	0.040	-	-	-	-	-	-	-	-
Silver	0.010	-	-	-	-	-	-	-	-
Thallium	0.010	-	-	-	-	-	-	-	-
Tin	0.38	-	-	-	-	-	-	-	-
Vanadium	0.10	-	-	-	-	-	-	-	-
Zinc	4.1	-	-	-	-	-	-	-	-

"-" – Value Not Available

6.5 Agriculture and Country Foods (Hunting) Exposure Point Concentrations

For the purposes of this assessment, agriculture includes produce, beef, pork, poultry, eggs and dairy, while country foods include wild game and fish (Figure 6-10).

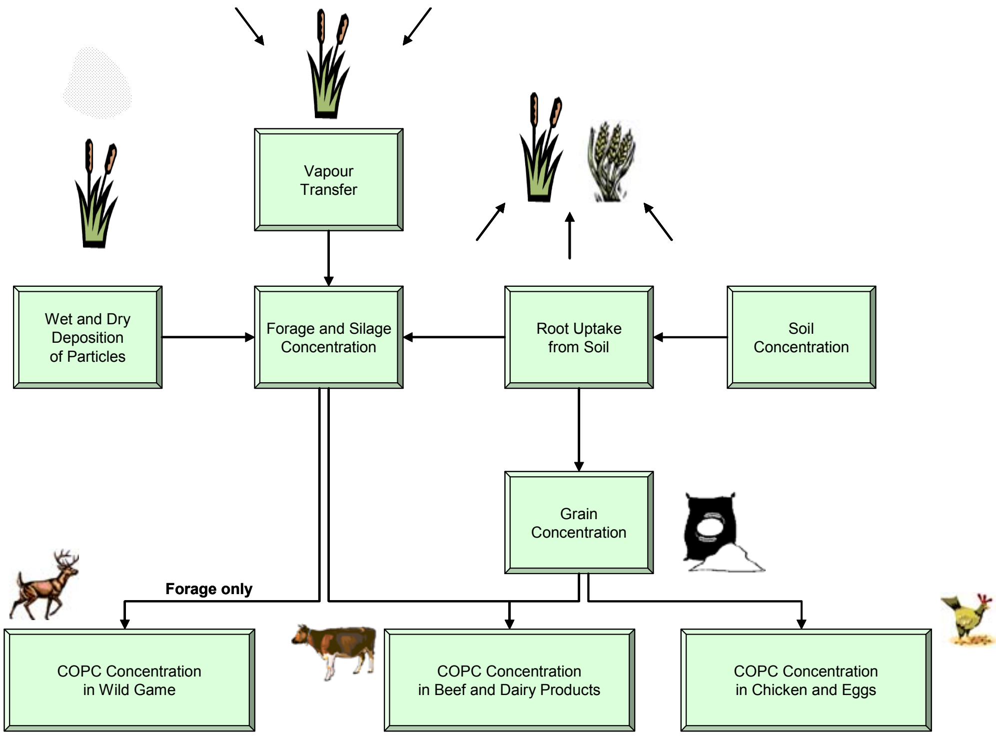

Figure 6-10 Modeling of Agriculture and Country Foods

In the agricultural food chain, cattle, pigs and chicken are assumed to be exposed to COPC through impacted feed produce (grain, silage and forage) and through incidental ingestion of impacted soil. Cattle are assumed to spend six (6) months per year in pasture and another six (6) months in the barn. During the summer months, the cattle consume forage that is assumed to be impacted by wet and dry particle deposition, vapour transfer, and root uptake of COPC. During the winter months, the cattle consume silage and grain that has been impacted by COPC uptake prior to harvest. Chickens are assumed to be fed only grain.

Wild game is assumed to forage and consume incidental COPC-affected soil in the vicinity of the Facility. Wild game is also assumed to spend its entire lifetime in the vicinity of the Facility and not range into other regions that would be subject to less deposition, resulting in a conservative estimation of wild game tissue concentrations for those animals with a large home range.

It is conservatively assumed that all COPC are 100% bioavailable to cattle, pigs, chicken, and wild game. In addition, it is assumed that the animals are not able to metabolize any of their COPC intakes. Both of these assumptions would tend to overestimate the uptake of COPC through the agricultural food chain, as there is no mechanism to offset the amount of bio-accumulation suggested by the biotransfer factors.

For modeling purposes, primary literature uptake factors for predicting animal tissue concentrations are available for beef. In accordance with US EPA (2005) guidance, to predict the uptake of COPC into wild game and pork, the beef uptake factor is adjusted based on the relative lipid content of the game animal or pig. Whole body lipid contents for representative game species were obtained from Stephenson (2003), Wirsing *et al*. (2002), Stephenson *et al*. (1999), and Knott *et al.* (2005).

Fish are assumed to be exposed to COPC by a variety of mechanisms including direct deposition to the water body, surface runoff and soil erosion into the water body. It is assumed that all locally caught fish consumed by area residents come from water bodies that are in the depositional ranges of the Facility.

A primary factor to be considered when addressing the consumption of aquatic life as an exposure pathway is the propensity of COPC to bioaccumulate and biomagnify (i.e. when chemicals accumulate in body tissue and biomagnify in the food chain). These factors can elevate concentrations of substances in aquatic life, resulting in exposures to top consumers, such as residents who fish from local water bodies. Bioconcentration/Bioaccumulation factors (BCF/BAF_{FISH}) for fish represent the ration of the COPC concentration in fish to the COPC concentration in the water column/body where the fish is exposed.

Baseline concentrations of COPC in agricultural and country foods are presented in Table 6-8 through 6-15. In addition, modeled COPC loading on agricultural and country foods for each of the two scenarios over the operational period for the Project are provided, along with the percent change from the baseline concentrations. Maximum modeled values are presented for each case scenario except fish – modeled data from the McLaughlin Bay watershed was used for this media. Modeled values for agricultural products were based on Farmers, while values for fish were based on the hunter/angler receptor. Maximum modeled values for small mammals and forage were based on ecological receptors. With the exception of certain COPC (including PCBs, dioxin/furans, chlorinated monocyclic aromatics and specific metals), loading of COPC to each of the various media over the operational period for the Project in all cases resulted in loadings of less than 1% of baseline concentrations.

Table 6-8 Predicted Forage Loading as a Result of Normal and Process Upset Operation over a 30 Year Period for 140,000 tpy and 400,000 tpy

COPC	Baseline Measured Forage Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Forage Concentration (mg/kg)	% Loading	Maximum Forage Concentration (mg/kg)	% Loading	Maximum Forage Concentration (mg/kg)	% Loading	Maximum Forage Concentration (mg/kg)	% Loading
PAHs									
Anthracene	0.0027	2.57E-08	9.40E-04	7.21E-08	0.0026	8.13E-08	0.0030	2.28E-07	0.0083
Benzo(a)fluorene	-	5.25E-08	-	1.47E-07	-	1.17E-07	-	3.21E-07	-
Benzo(a)pyrene TEQ	0.0046	2.43E-07	0.0053	6.80E-07	0.015	5.53E-07	0.012	1.52E-06	0.033
Benzo(b)fluorene	-	1.12E-07	-	3.13E-07	-	2.39E-07	-	6.52E-07	-
Fluorene	0.017	3.84E-08	2.30E-04	1.07E-07	6.43E-04	1.21E-07	7.24E-04	3.39E-07	0.0020
PCBs									
Aroclor 1254 (Total PCBs)	0.010	3.83E-07	0.0038	1.07E-06	0.011	1.16E-06	0.012	3.25E-06	0.032
Dioxins and Furans									
2,3,7,8-TCDD TEQ	3.41E-07	4.03E-09	1.2	1.13E-08	3.3	9.07E-09	2.7	2.16E-08	6.4
VOCs									
1,1,1-Trichloroethane	0.030	2.10E-10	7.01E-07	5.89E-10	1.96E-06	6.65E-10	2.22E-06	1.86E-09	6.20E-06
Bromoform	0.20	9.44E-10	4.72E-07	2.64E-09	1.32E-06	2.19E-09	1.10E-06	6.13E-09	3.07E-06
Carbon Tetrachloride	0.050	3.85E-11	3.85E-08	1.08E-10	1.08E-07	8.92E-11	8.92E-08	2.49E-10	2.49E-07
Chloroform	0.050	1.83E-10	1.83E-07	5.11E-10	5.11E-07	5.77E-10	5.77E-07	1.62E-09	1.62E-06
Dichloromethane	0.50	8.31E-08	8.31E-06	2.33E-07	2.33E-05	2.63E-07	2.63E-05	7.35E-07	7.35E-05
O-Terphenyl		8.16E-08	-	2.28E-07	-	1.79E-07	-	4.89E-07	-
Trichlorofluoromethane (FREON 11)	0.10	4.35E-09	2.18E-06	1.22E-08	6.09E-06	1.37E-08	6.87E-06	3.85E-08	1.92E-05
Chlorinated Monocyclic Aromatics									

COPC	Baseline Measured Forage Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Forage Concentration (mg/kg)	% Loading	Maximum Forage Concentration (mg/kg)	% Loading	Maximum Forage Concentration (mg/kg)	% Loading	Maximum Forage Concentration (mg/kg)	% Loading
1,2,4,5-Tetrachlorobenzene	0.010	7.77E-09	7.77E-05	2.18E-08	2.18E-04	2.45E-08	2.45E-04	6.87E-08	6.87E-04
1,2,4-Trichlorobenzene	0.50	5.44E-10	5.44E-08	1.52E-09	1.52E-07	1.71E-09	1.71E-07	4.77E-09	4.77E-07
1,2-Dichlorobenzene	0.10	1.63E-08	8.15E-06	4.56E-08	2.28E-05	5.14E-08	2.57E-05	1.44E-07	7.20E-05
Hexachlorobenzene	0.010	2.20E-09	2.20E-05	6.16E-09	6.16E-05	6.24E-09	6.24E-05	1.74E-08	1.74E-04
Pentachlorobenzene	0.010	7.47E-08	7.47E-04	2.09E-07	0.0021	2.35E-07	0.0023	6.58E-07	0.0066
Pentachlorophenol	-	1.58E-04	-	4.43E-04	-	3.33E-04	-	9.04E-04	-
Inorganics									
Antimony	1.0	2.29E-04	0.023	3.32E-04	0.033	7.42E-04	0.074	0.0011	0.11
Arsenic	0.029	2.22E-05	0.077	3.22E-05	0.11	7.20E-05	0.25	1.04E-04	0.36
Barium	16	1.54E-04	9.60E-04	2.23E-04	0.0014	4.97E-04	0.0031	7.21E-04	0.0045
Beryllium	0.20	1.93E-05	0.0096	2.80E-05	0.014	6.24E-05	0.031	9.05E-05	0.045
Boron	16	0.015	0.093	0.022	0.14	0.048	0.30	0.070	0.44
Cadmium	0.30	0.0011	0.36	0.0015	0.52	0.0034	1.2	0.0050	1.7
Chromium (Total)	0.91	1.11E-04	0.012	1.61E-04	0.018	3.60E-04	0.040	5.22E-04	0.057
Chromium VI	-	1.58E-05	-	2.29E-05	-	5.12E-05	-	7.43E-05	-
Cobalt	0.095	3.03E-04	0.32	4.40E-04	0.46	9.82E-04	1.0	0.0014	1.5
Lead	0.30	0.0045	1.5	0.0065	2.2	0.015	4.9	0.021	7.1
Mercury - Inorganic	0.011	3.66E-05	0.34	5.31E-05	0.49	1.15E-04	1.1	1.66E-04	1.5
Methyl Mercury	-	1.03E-05	-	1.50E-05	-	3.24E-05	-	4.69E-05	-

COPC	Baseline Measured Forage Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Forage Concentration (mg/kg)	% Loading	Maximum Forage Concentration (mg/kg)	% Loading	Maximum Forage Concentration (mg/kg)	% Loading	Maximum Forage Concentration (mg/kg)	% Loading
Nickel	0.60	0.0049	0.82	0.0072	1.2	0.016	2.7	0.023	3.9
Phosphorus	1830	0.0045	2.47E-04	0.0065	3.58E-04	0.015	7.99E-04	0.021	0.0012
Selenium	0.13	2.36E-05	0.018	3.42E-05	0.026	7.65E-05	0.059	1.11E-04	0.085
Silver	0.020	2.08E-04	1.0	3.01E-04	1.5	6.72E-04	3.4	9.74E-04	4.9
Thallium	0.020	0.0019	9.7	0.0028	14	0.0063	32	0.0091	46
Tin	0.18	0.0012	0.67	0.0017	0.97	0.0039	2.2	0.0056	3.1
Vanadium	0.29	6.28E-05	0.022	9.11E-05	0.031	2.03E-04	0.070	2.95E-04	0.10
Zinc	30	0.022	0.071	0.031	0.10	0.070	0.23	0.10	0.33

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Table 6-9 Predicted Fish Loading as a Result of Normal and Process Upset Operation over a 30 Year Period for 140,000 tpy and 400,000 tpy

COPC	Baseline Measured Fish Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		McLaughlin Bay Fish Concentration (mg/kg)	% Loading	McLaughlin Bay Fish Concentration (mg/kg)	% Loading	McLaughlin Bay Fish Concentration (mg/kg)	% Loading	McLaughlin Bay Fish Concentration (mg/kg)	% Loading
PAHs									
Anthracene	3.00E-04	9.41E-11	3.14E-05	2.63E-10	8.78E-05	2.44E-10	8.14E-05	6.84E-10	2.28E-04
Benzo(a)fluorene	-	2.90E-09	-	8.11E-09	-	7.50E-09	-	2.10E-08	-
Benzo(a)pyrene TEQ	0.0010	6.51E-08	0.0062	1.82E-07	0.017	1.68E-07	0.016	4.70E-07	0.045
Benzo(b)fluorene	-	5.23E-09	-	1.46E-08	-	1.35E-08	-	3.77E-08	-
Fluorene	0.0012	3.61E-10	2.80E-05	1.01E-09	7.84E-05	9.38E-10	7.27E-05	2.62E-09	2.03E-04
PCBs									
Aroclor 1254 (Total PCBs)	0.010	1.24E-04	1.2	3.48E-04	3.5	3.23E-04	3.2	9.03E-04	9.0
Dioxins and Furans									
2,3,7,8-TCDD TEQ	8.16E-07	1.11E-08	1.4	3.12E-08	3.8	2.96E-08	3.6	4.47E-08	5.5
VOCs									
1,1,1-Trichloroethane	-	1.05E-08	-	2.95E-08	-	2.74E-08	-	7.67E-08	-
Bromoform	-	3.40E-07	-	9.52E-07	-	6.49E-07	-	1.82E-06	-
Carbon Tetrachloride	-	6.34E-09	-	1.77E-08	-	1.21E-08	-	3.39E-08	-
Chloroform	-	1.10E-09	-	3.07E-09	-	2.85E-09	-	7.98E-09	-
Dichloromethane	-	6.82E-08	-	1.91E-07	-	1.77E-07	-	4.96E-07	-
O-Terphenyl	-	9.66E-07	-	2.71E-06	-	2.51E-06	-	7.01E-06	-
Trichlorofluoromethane (FREON 11)	-	1.19E-06	-	3.33E-06	-	3.09E-06	-	8.67E-06	-
Chlorinated Monocyclic Aromatics									

COPC	Baseline Measured Fish Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		McLaughlin Bay Fish Concentration (mg/kg)	% Loading	McLaughlin Bay Fish Concentration (mg/kg)	% Loading	McLaughlin Bay Fish Concentration (mg/kg)	% Loading	McLaughlin Bay Fish Concentration (mg/kg)	% Loading
1,2,4,5-Tetrachlorobenzene	0.010	8.33E-08	0.0008	2.33E-07	0.0023	2.16E-07	0.0022	6.06E-07	0.0061
1,2,4-Trichlorobenzene	-	1.61E-08	-	4.52E-08	-	4.20E-08	-	1.17E-07	-
1,2-Dichlorobenzene	-	1.24E-07	-	3.47E-07	-	3.22E-07	-	9.02E-07	-
Hexachlorobenzene	0.010	3.15E-07	0.0031	8.82E-07	0.0088	8.18E-07	0.0082	2.29E-06	0.023
Pentachlorobenzene	0.010	5.93E-07	0.0059	1.66E-06	0.017	1.54E-06	0.015	4.31E-06	0.043
Pentachlorophenol	-	1.46E-04	-	4.09E-04	-	3.77E-04	-	0.0011	-
Inorganics									
Antimony	0.010	7.39E-04	7.4	0.0011	11	0.0020	20	0.0029	29
Arsenic	0.17	2.84E-05	0.017	4.12E-05	0.025	7.57E-05	0.046	1.10E-04	0.066
Barium	2.0	2.85E-05	0.0012	4.14E-05	0.0017	7.61E-05	0.0031	1.10E-04	0.0045
Beryllium	0.10	2.17E-05	0.022	3.14E-05	0.031	5.78E-05	0.058	8.38E-05	0.084
Boron	6.0	0.0000	0.00	0.0000	0.00	-	-	-	-
Cadmium	0.022	0.011	52	0.016	75	0.030	138	0.043	200
Chromium (Total)	0.33	6.09E-04	0.18	8.83E-04	0.27	0.0016	0.49	0.0024	0.71
Chromium VI	-	1.60E-05	-	2.32E-05	-	4.27E-05	-	6.19E-05	-
Cobalt	0.028	7.81E-04	2.8	0.0011	4.0	0.0021	7.4	0.0030	11
Lead	0.070	0.0032	4.6	0.0047	6.7	0.0086	12	0.012	18
Mercury - Inorganic	0.094	-	0	-	0	-	-	-	-
Methyl Mercury	-	8.17E-04	-	0.0012	-	0.0021	-	0.0030	-

		140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
COPC	Baseline Measured Fish Concentration (mg/kg)	McLaughlin Bay Fish Concentration (mg/kg)	% Loading	McLaughlin Bay Fish Concentration (mg/kg)	% Loading	McLaughlin Bay Fish Concentration (mg/kg)	% Loading	McLaughlin Bay Fish Concentration (mg/kg)	% Loading
Nickel	0.48	0.018	3.8	0.026	5.5	0.048	10	0.070	15
Phosphorus	6090	0.0000	-	0.0000	-	-	-	-	-
Selenium	1.3	1.10E-04	0.0086	1.60E-04	0.013	2.95E-04	0.023	4.27E-04	0.033
Silver	0.010	4.02E-04	4.0	5.83E-04	5.8	0.0011	11	0.0016	16
Thallium	0.010	-	0.0	-	0.0	-	-	-	-
Tin	0.050	0.054	108	0.079	157	0.14	289	0.21	419
Vanadium	0.21	1.10E-04	0.052	1.60E-04	0.076	2.94E-04	0.14	4.26E-04	0.20
Zinc	38	0.25	0.6	0.36	0.9	0.66	1.7	0.96	2.5

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Table 6-10 Predicted Small Mammal Loading as a Result of Normal and Process Upset Operation over a 30 Year Period for 140,000 tpy and 400,000 tpy

		140,000 Tpy				400,000 Tpy			
COPC	Baseline Measured Small Mammal Concentration (mg/kg)	Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Small Mammal Concentration (mg/kg)	% Loading	Maximum Small Mammal Concentration (mg/kg)	% Loading	Maximum Small Mammal Concentration (mg/kg)	% Loading	Maximum Small Mammal Concentration (mg/kg)	% Loading
PAHs									
Anthracene	4.00E-04	1.47E-10	3.68E-05	4.12E-10	1.03E-04	4.65E-10	1.16E-04	1.30E-09	3.25E-04
Benzo(a)fluorene	-	3.17E-10	-	8.86E-10	-	7.85E-10	-	2.18E-09	-
Benzo(a)pyrene TEQ	0.0014	9.40E-10	6.82E-05	2.63E-09	1.91E-04	2.15E-09	1.56E-04	5.93E-09	4.30E-04
Benzo(b)fluorene	-	4.89E-10	-	1.37E-09	-	1.07E-09	-	2.92E-09	-
Fluorene	4.00E-04	2.07E-10	5.18E-05	5.80E-10	1.45E-04	5.80E-10	1.45E-04	1.62E-09	4.06E-04
PCBs									
Aroclor 1254 (Total PCBs)	0.010	8.97E-07	0.0090	2.51E-06	0.025	2.82E-06	0.028	7.90E-06	0.079
Dioxins and Furans									
2,3,7,8-TCDD TEQ	5.90E-07	1.38E-09	0.23	3.86E-09	0.65	3.31E-09	0.56	7.00E-09	1.2
VOCs									
1,1,1-Trichloroethane	-	6.36E-08	-	1.78E-07	-	1.79E-07	-	5.01E-07	-
Bromoform	-	2.39E-06	-	6.69E-06	-	4.93E-06	-	1.38E-05	-
Carbon Tetrachloride	-	2.75E-08	-	7.69E-08	-	5.67E-08	-	1.59E-07	-
Chloroform	-	1.22E-08	-	3.43E-08	-	3.44E-08	-	9.63E-08	-
Dichloromethane	-	1.35E-06	-	3.77E-06	-	3.78E-06	-	1.06E-05	-
O-Terphenyl		6.91E-08	-	1.94E-07	-	1.77E-07	-	4.92E-07	-
Trichlorofluoromethane (FREON 11)	-	7.26E-06	-	2.03E-05	-	2.04E-05	-	5.72E-05	-
Chlorinated Monocyclic Aromatics									

COPC	Baseline Measured Small Mammal Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Small Mammal Concentration (mg/kg)	% Loading	Maximum Small Mammal Concentration (mg/kg)	% Loading	Maximum Small Mammal Concentration (mg/kg)	% Loading	Maximum Small Mammal Concentration (mg/kg)	% Loading
1,2,4,5-Tetrachlorobenzene	0.010	2.10E-08	2.10E-04	5.87E-08	5.87E-04	5.89E-08	5.89E-04	1.65E-07	0.0016
1,2,4-Trichlorobenzene	-	1.28E-08	-	3.59E-08	-	3.61E-08	-	1.01E-07	-
1,2-Dichlorobenzene	-	3.01E-07	-	8.43E-07	-	8.46E-07	-	2.37E-06	-
Hexachlorobenzene	0.010	2.09E-08	2.09E-04	5.86E-08	5.86E-04	5.85E-08	5.85E-04	1.64E-07	0.0016
Pentachlorobenzene	0.010	9.53E-08	9.53E-04	2.67E-07	0.0027	2.67E-07	0.0027	7.47E-07	0.0075
Pentachlorophenol	-	1.06E-07	-	2.96E-07	-	2.23E-07	-	6.06E-07	-
Inorganics									
Antimony	0.010	2.67E-06	0.027	3.87E-06	0.039	8.63E-06	0.086	1.25E-05	0.13
Arsenic	0.072	4.99E-07	6.92E-04	7.23E-07	0.0010	1.61E-06	0.0022	2.34E-06	0.0032
Barium	5.2	2.67E-07	5.13E-06	3.86E-07	7.43E-06	8.63E-07	1.66E-05	1.25E-06	2.41E-05
Beryllium	0.10	3.45E-07	3.45E-04	5.00E-07	5.00E-04	1.12E-06	0.0011	1.62E-06	0.0016
Boron	8.0	1.29E-04	0.0016	1.88E-04	0.0023	4.19E-04	0.0052	6.07E-04	0.0076
Cadmium	0.23	1.51E-06	6.73E-04	2.19E-06	9.76E-04	4.90E-06	0.0022	7.11E-06	0.0032
Chromium (Total)	0.26	6.62E-06	0.0025	9.59E-06	0.0037	2.14E-05	0.0082	3.11E-05	0.012
Chromium VI	-	9.41E-07	-	1.36E-06	-	3.05E-06	-	4.42E-06	-
Cobalt	0.063	7.16E-05	0.11	1.04E-04	0.16	2.32E-04	0.37	3.36E-04	0.53
Lead	0.26	2.12E-05	0.0081	3.07E-05	0.012	6.86E-05	0.026	9.95E-05	0.038
Mercury - Inorganic	0.10	8.72E-06	0.0085	1.26E-05	0.012	2.66E-05	0.026	3.86E-05	0.038
Methyl Mercury	-	1.27E-07	-	1.84E-07	-	4.03E-07	-	5.83E-07	-

COPC	Baseline Measured Small Mammal Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Small Mammal Concentration (mg/kg)	% Loading	Maximum Small Mammal Concentration (mg/kg)	% Loading	Maximum Small Mammal Concentration (mg/kg)	% Loading	Maximum Small Mammal Concentration (mg/kg)	% Loading
Nickel	0.58	3.69E-04	0.064	5.34E-04	0.092	0.0012	0.21	0.0017	0.30
Phosphorus	10500	0.0027	2.60E-05	0.0040	3.77E-05	0.0088	8.41E-05	0.013	1.22E-04
Selenium	1.2	5.49E-07	4.43E-05	7.96E-07	6.42E-05	1.78E-06	1.43E-04	2.58E-06	2.08E-04
Silver	0.010	6.60E-06	0.066	9.57E-06	0.096	2.14E-05	0.21	3.10E-05	0.31
Thallium	0.010	9.95E-04	9.9	0.0014	14	0.0032	32	0.0047	47
Tin	0.096	0.0015	1.5	0.0021	2.2	0.0047	4.9	0.0068	7.1
Vanadium	0.11	2.93E-06	0.0027	4.25E-06	0.0039	9.49E-06	0.0086	1.38E-05	0.013
Zinc	34	2.31E-05	6.83E-05	3.35E-05	9.90E-05	7.47E-05	2.21E-04	1.08E-04	3.20E-04

"-" – Value Not Available

Red Font – Detection Limit

Table 6-11 Predicted Chicken Loading as a Result of Normal and Process Upset Operation over a 30 Year Period for 140,000 tpy and 400,000 tpy

COPC	Baseline Measured Chicken Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Chicken Concentration (mg/kg)	% Loading	Maximum Chicken Concentration (mg/kg)	% Loading	Maximum Chicken Concentration (mg/kg)	% Loading	Maximum Chicken Concentration (mg/kg)	% Loading
PAHs									
Anthracene	2.00E-04	3.18E-10	1.59E-04	8.91E-10	4.45E-04	9.43E-10	4.72E-04	2.64E-09	0.0013
Benzo(a)fluorene	-	2.83E-10	-	7.91E-10	-	8.38E-10	-	2.35E-09	-
Benzo(a)pyrene TEQ	6.89E-04	5.30E-10	7.67E-05	1.48E-09	2.15E-04	1.57E-09	2.28E-04	4.40E-09	6.37E-04
Benzo(b)fluorene	-	1.75E-10	-	4.91E-10	-	5.19E-10	-	1.45E-09	-
Fluorene	2.00E-04	3.44E-10	1.72E-04	9.62E-10	4.81E-04	1.02E-09	5.09E-04	2.85E-09	0.0014
PCBs									
Aroclor 1254 (Total PCBs)	0.010	3.09E-08	3.09E-04	8.66E-08	8.66E-04	9.17E-08	9.17E-04	2.57E-07	0.0026
Dioxins and Furans									
2,3,7,8-TCDD TEQ	2.69E-07	2.02E-11	0.0075	5.67E-11	0.021	6.28E-11	0.023	9.10E-11	0.034
VOCs									
1,1,1-Trichloroethane	0.60	1.73E-10	2.89E-08	4.85E-10	8.08E-08	4.87E-10	8.12E-08	1.36E-09	2.27E-07
Bromoform	4.0	6.50E-09	1.63E-07	1.82E-08	4.55E-07	1.34E-08	3.36E-07	3.76E-08	9.40E-07
Carbon Tetrachloride	2.0	7.48E-11	3.74E-09	2.09E-10	1.05E-08	1.54E-10	7.72E-09	4.32E-10	2.16E-08
Chloroform	2.0	3.33E-11	1.67E-09	9.33E-11	4.66E-09	9.37E-11	4.68E-09	2.62E-10	1.31E-08
Dichloromethane	20	3.67E-09	1.83E-08	1.03E-08	5.13E-08	1.03E-08	5.15E-08	2.89E-08	1.44E-07
O-Terphenyl	-	8.05E-10	-	2.26E-09	-	2.39E-09	-	6.69E-09	-
Trichlorofluoromethane (FREON 11)	4.0	1.98E-08	4.94E-07	5.53E-08	1.38E-06	5.56E-08	1.39E-06	1.56E-07	3.89E-06

COPC	Baseline Measured Chicken Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Chicken Concentration (mg/kg)	% Loading	Maximum Chicken Concentration (mg/kg)	% Loading	Maximum Chicken Concentration (mg/kg)	% Loading	Maximum Chicken Concentration (mg/kg)	% Loading
Chlorinated Monocyclic Aromatics									
1,2,4,5-Tetrachlorobenzene	0.010	1.40E-10	1.40E-06	3.93E-10	3.93E-06	4.16E-10	4.16E-06	1.16E-09	1.16E-05
1,2,4-Trichlorobenzene	20	3.64E-11	1.82E-10	1.02E-10	5.10E-10	1.02E-10	5.12E-10	2.87E-10	1.43E-09
1,2-Dichlorobenzene	4.0	8.42E-10	2.10E-08	2.36E-09	5.89E-08	2.37E-09	5.91E-08	6.62E-09	1.66E-07
Hexachlorobenzene	0.010	7.83E-11	7.83E-07	2.19E-10	2.19E-06	2.20E-10	2.20E-06	6.17E-10	6.17E-06
Pentachlorobenzene	0.010	1.95E-09	1.95E-05	5.45E-09	5.45E-05	5.77E-09	5.77E-05	1.62E-08	1.62E-04
Pentachlorophenol	-	2.56E-12	-	7.16E-12	-	6.83E-12	-	1.91E-11	-
Inorganics									
Antimony	0.010	1.16E-08	1.16E-04	1.69E-08	1.69E-04	3.61E-08	3.61E-04	5.23E-08	5.23E-04
Arsenic	0.011	1.89E-09	1.72E-05	2.75E-09	2.50E-05	5.88E-09	5.34E-05	8.52E-09	7.75E-05
Barium	0.40	1.10E-09	2.73E-07	1.59E-09	3.96E-07	3.41E-09	8.48E-07	4.94E-09	1.23E-06
Beryllium	0.10	5.78E-09	5.78E-06	8.38E-09	8.38E-06	1.79E-08	1.79E-05	2.60E-08	2.60E-05
Boron	2.0	5.46E-07	2.73E-05	7.91E-07	3.96E-05	1.69E-06	8.46E-05	2.45E-06	1.23E-04
Cadmium	0.0050	8.51E-06	0.17	1.23E-05	0.25	2.64E-05	0.53	3.83E-05	0.77
Chromium (Total)	2.5	1.86E-08	7.32E-07	2.70E-08	1.06E-06	5.76E-08	2.27E-06	8.36E-08	3.29E-06
Chromium VI	-	2.64E-09	-	3.83E-09	-	8.20E-09	-	1.19E-08	-
Cobalt	0.020	4.12E-07	0.0021	5.97E-07	0.0030	1.28E-06	0.0064	1.85E-06	0.0093
Lead	0.020	2.83E-07	0.0014	4.11E-07	0.0021	8.79E-07	0.0044	1.27E-06	0.0064
Mercury - Inorganic	0.0010	1.85E-06	0.18	2.68E-06	0.27	4.98E-06	0.50	7.21E-06	0.72

COPC	Baseline Measured Chicken Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Chicken Concentration (mg/kg)	% Loading	Maximum Chicken Concentration (mg/kg)	% Loading	Maximum Chicken Concentration (mg/kg)	% Loading	Maximum Chicken Concentration (mg/kg)	% Loading
Methyl Mercury	-	1.30E-08	-	1.88E-08	-	4.03E-08	-	5.84E-08	-
Nickel	0.12	2.61E-06	0.0022	3.79E-06	0.0032	8.11E-06	0.0068	1.18E-05	0.0098
Phosphorus	4170	2.23E-05	5.35E-07	3.23E-05	7.75E-07	6.91E-05	1.66E-06	1.00E-04	2.40E-06
Selenium	0.28	3.11E-07	1.11E-04	4.50E-07	1.61E-04	9.63E-07	3.44E-04	1.40E-06	4.99E-04
Silver	0.010	1.23E-08	1.23E-04	1.78E-08	1.78E-04	3.81E-08	3.81E-04	5.53E-08	5.53E-04
Thallium	0.010	8.06E-06	0.081	1.17E-05	0.12	2.50E-05	0.25	3.62E-05	0.36
Tin	0.050	1.82E-05	0.036	2.64E-05	0.053	5.66E-05	0.11	8.20E-05	0.16
Vanadium	0.10	5.29E-08	5.29E-05	7.68E-08	7.68E-05	1.64E-07	1.64E-04	2.38E-07	2.38E-04
Zinc	15	1.60E-05	1.05E-04	2.32E-05	1.52E-04	4.96E-05	3.24E-04	7.19E-05	4.70E-04

"-" – Value Not Available

Red Font – Detection Limit

Table 6-12 Predicted Beef Loading as a Result of Normal and Process Upset Operation over a 30 Year Period for 140,000 tpy and 400,000 tpy

COPC	Baseline Measured Beef Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Beef Concentration (mg/kg)	% Loading	Maximum Beef Concentration (mg/kg)	% Loading	Maximum Beef Concentration (mg/kg)	% Loading	Maximum Beef Concentration (mg/kg)	% Loading
PAHs									
Anthracene	2.00E-04	1.74E-10	8.72E-05	4.88E-10	2.44E-04	5.16E-10	2.58E-04	1.45E-09	7.23E-04
Benzo(a)fluorene	-	3.17E-10	-	8.86E-10	-	7.85E-10	-	2.18E-09	-
Benzo(a)pyrene TEQ	6.89E-04	1.81E-08	0.0026	5.06E-08	0.0073	3.70E-08	0.0054	1.01E-07	0.015
Benzo(b)fluorene	-	5.04E-10	-	1.41E-09	-	1.08E-09	-	2.94E-09	-
Fluorene	2.00E-04	2.10E-10	1.05E-04	5.87E-10	2.93E-04	6.19E-10	3.10E-04	1.73E-09	8.67E-04
PCBs									
Aroclor 1254 (Total PCBs)	0.010	1.07E-06	0.011	2.99E-06	0.030	3.13E-06	0.031	8.77E-06	0.088
Dioxins and Furans									
2,3,7,8-TCDD TEQ	1.24E-08	1.41E-09	1.1	3.96E-09	3.2	3.65E-09	3.0	6.78E-09	5.5
VOCs									
1,1,1-Trichloroethane	0.020	6.36E-08	3.18E-04	1.78E-07	8.91E-04	1.79E-07	8.95E-04	5.01E-07	0.0025
Bromoform	0.1	2.39E-06	0.0024	6.69E-06	0.0067	4.93E-06	0.0049	1.38E-05	0.014
Carbon Tetrachloride	0.1	2.75E-08	5.49E-05	7.69E-08	1.54E-04	5.67E-08	1.13E-04	1.59E-07	3.18E-04
Chloroform	0.1	1.22E-08	2.45E-05	3.43E-08	6.85E-05	3.44E-08	6.88E-05	9.63E-08	1.93E-04
Dichloromethane	1	1.35E-06	2.69E-04	3.77E-06	7.54E-04	3.78E-06	7.57E-04	1.06E-05	0.0021
O-Terphenyl		6.91E-08	-	1.94E-07	-	1.77E-07	-	4.92E-07	-
Trichlorofluoromethane (FREON 11)	0.10	7.26E-06	0.0073	2.03E-05	0.020	2.04E-05	0.020	5.72E-05	0.057

COPC	Baseline Measured Beef Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Beef Concentration (mg/kg)	% Loading	Maximum Beef Concentration (mg/kg)	% Loading	Maximum Beef Concentration (mg/kg)	% Loading	Maximum Beef Concentration (mg/kg)	% Loading
Chlorinated Monocyclic Aromatics									
1,2,4,5-Tetrachlorobenzene	0.010	2.10E-08	2.10E-04	5.87E-08	5.87E-04	5.89E-08	5.89E-04	1.65E-07	0.0016
1,2,4-Trichlorobenzene	1	1.28E-08	2.57E-06	3.59E-08	7.18E-06	3.61E-08	7.21E-06	1.01E-07	2.02E-05
1,2-Dichlorobenzene	0.10	3.01E-07	3.01E-04	8.43E-07	8.43E-04	8.46E-07	8.46E-04	2.37E-06	0.0024
Hexachlorobenzene	0.010	2.09E-08	2.09E-04	5.86E-08	5.86E-04	5.85E-08	5.85E-04	1.64E-07	0.0016
Pentachlorobenzene	0.010	9.53E-08	9.53E-04	2.67E-07	0.0027	2.67E-07	0.0027	7.47E-07	0.0075
Pentachlorophenol	-	1.06E-07	-	2.96E-07	-	2.13E-07	-	5.79E-07	-
Inorganics									
Antimony	0.010	3.14E-06	0.031	4.56E-06	0.046	9.72E-06	0.097	1.41E-05	0.14
Arsenic	0.010	5.90E-07	0.0059	8.55E-07	0.0085	1.82E-06	0.018	2.64E-06	0.026
Barium	0.065	3.14E-07	4.84E-04	4.56E-07	7.01E-04	9.72E-07	0.0015	1.41E-06	0.0022
Beryllium	0.10	4.07E-07	4.07E-04	5.89E-07	5.89E-04	1.26E-06	0.0013	1.82E-06	0.0018
Boron	4.0	1.52E-04	0.0025	2.21E-04	0.0037	4.71E-04	0.0079	6.83E-04	0.011
Cadmium	0.0050	1.78E-06	0.04	2.58E-06	0.05	5.51E-06	0.11	7.99E-06	0.16
Chromium (Total)	0.10	7.83E-06	0.0078	1.14E-05	0.011	2.42E-05	0.024	3.50E-05	0.035
Chromium VI	-	1.11E-06	-	1.62E-06	-	3.44E-06	-	4.98E-06	-
Cobalt	0.020	8.47E-05	0.42	1.23E-04	0.61	2.61E-04	1.3	3.79E-04	1.9
Lead	0.020	2.49E-05	0.12	3.62E-05	0.18	7.72E-05	0.39	1.12E-04	0.56
Mercury - Inorganic	0.0010	1.08E-05	1.1	1.57E-05	1.6	2.96E-05	3.0	4.29E-05	4.3

COPC	Baseline Measured Beef Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Beef Concentration (mg/kg)	% Loading	Maximum Beef Concentration (mg/kg)	% Loading	Maximum Beef Concentration (mg/kg)	% Loading	Maximum Beef Concentration (mg/kg)	% Loading
Methyl Mercury	-	1.53E-07	-	2.21E-07	-	4.52E-07	-	6.54E-07	-
Nickel	0.10	4.35E-04	0.44	6.31E-04	0.63	0.0013	1.3	0.0020	2.0
Phosphorus	1160	0.0032	2.77E-04	0.0047	4.02E-04	0.0099	8.57E-04	0.014	0.0012
Selenium	0.20	6.50E-07	3.25E-04	9.43E-07	4.71E-04	2.01E-06	0.0010	2.91E-06	0.0015
Silver	0.010	7.80E-06	0.078	1.13E-05	0.11	2.41E-05	0.24	3.49E-05	0.35
Thallium	0.010	0.0012	12	0.0017	17	0.0036	36	0.0053	53
Tin	0.050	0.0017	3.4	0.0025	5.0	0.0053	11	0.0077	15
Vanadium	0.10	3.45E-06	0.0035	5.01E-06	0.0050	1.07E-05	0.011	1.55E-05	0.015
Zinc	20	2.72E-05	1.34E-04	3.94E-05	1.94E-04	8.41E-05	4.14E-04	1.22E-04	6.00E-04

"-" – Value Not Available

Red Font – Detection Limit

Table 6-13 Predicted Pork Loading as a Result of Normal and Process Upset Operation over a 30 Year Period for 140,000 tpy and 400,000 tpy

COPC	Baseline Measured Pork Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operations		Process Upsets	
		Maximum Pork Concentration (mg/kg)	% Loading	Maximum Pork Concentration (mg/kg)	% Loading	Maximum Pork Concentration (mg/kg)	% Loading	Maximum Pork Concentration (mg/kg)	% Loading
PAHs									
Anthracene	3.00E-04	1.04E-10	3.48E-05	2.93E-10	9.75E-05	3.10E-10	1.03E-04	8.67E-10	2.89E-04
Benzo(a)fluorene	-	9.64E-11	-	2.70E-10	-	2.75E-10	-	7.68E-10	-
Benzo(a)pyrene TEQ	0.0010	1.60E-09	0.0002	4.47E-09	0.0004	3.32E-09	3.21E-04	9.05E-09	8.75E-04
Benzo(b)fluorene	-	7.30E-11	-	2.05E-10	-	1.88E-10	-	5.24E-10	-
Fluorene	5.00E-04	1.17E-10	2.34E-05	3.28E-10	6.55E-05	3.47E-10	6.93E-05	9.71E-10	1.94E-04
PCBs									
Aroclor 1254 (Total PCBs)	0.010	8.77E-07	0.009	2.45E-06	0.025	2.60E-06	0.026	7.27E-06	0.073
Dioxins and Furans	8.67E-08								
2,3,7,8-TCDD TEQ	1.21E-07	6.27E-10	0.5	1.75E-09	1.5	1.88E-09	1.6	2.80E-09	2.3
VOCs									
1,1,1-Trichloroethane	0.30	1.02E-08	3.38E-06	2.84E-08	9.47E-06	2.85E-08	9.51E-06	7.99E-08	2.66E-05
Bromoform	2.0	3.81E-07	0.0000	1.07E-06	0.0001	7.87E-07	3.93E-05	2.20E-06	1.10E-04
Carbon Tetrachloride	1.0	4.38E-09	4.38E-07	1.23E-08	1.23E-06	9.05E-09	9.05E-07	2.53E-08	2.53E-06
Chloroform	1.0	1.95E-09	1.95E-07	5.47E-09	5.47E-07	5.49E-09	5.49E-07	1.54E-08	1.54E-06
Dichloromethane	10	2.15E-07	2.15E-06	6.01E-07	6.01E-06	6.04E-07	6.04E-06	1.69E-06	1.69E-05
O-Terphenyl		2.54E-08	-	7.11E-08	-	7.33E-08	-	2.05E-07	-
Trichlorofluoromethane (FREON 11)	2.0	1.16E-06	0.0001	3.24E-06	0.000	3.26E-06	1.63E-04	9.12E-06	4.56E-04
Chlorinated Monocyclic Aromatics									

COPC	Baseline Measured Pork Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operations		Process Upsets	
		Maximum Pork Concentration (mg/kg)	% Loading	Maximum Pork Concentration (mg/kg)	% Loading	Maximum Pork Concentration (mg/kg)	% Loading	Maximum Pork Concentration (mg/kg)	% Loading
1,2,4,5-Tetrachlorobenzene	0.010	4.91E-09	4.91E-05	1.38E-08	1.38E-04	1.38E-08	1.38E-04	3.87E-08	3.87E-04
1,2,4-Trichlorobenzene	10	2.09E-09	2.09E-08	5.85E-09	5.85E-08	5.88E-09	5.88E-08	1.65E-08	1.65E-07
1,2-Dichlorobenzene	2.0	4.87E-08	2.44E-06	1.36E-07	6.82E-06	1.37E-07	6.85E-06	3.83E-07	1.92E-05
Hexachlorobenzene	0.010	3.90E-09	3.90E-05	1.09E-08	1.09E-04	1.09E-08	1.09E-04	3.06E-08	3.06E-04
Pentachlorobenzene	0.010	5.98E-08	5.98E-04	1.67E-07	0.0017	1.77E-07	0.0018	4.96E-07	0.0050
Pentachlorophenol	-	8.97E-09	-	2.51E-08	-	1.81E-08	-	4.93E-08	-
Inorganics									
Antimony	0.010	6.20E-07	0.006	8.99E-07	0.009	1.92E-06	0.019	2.78E-06	0.028
Arsenic	0.010	9.30E-08	0.0009	1.35E-07	0.0013	2.88E-07	0.0029	4.17E-07	0.0042
Barium	0.061	5.81E-08	9.52E-05	8.42E-08	1.38E-04	1.80E-07	2.95E-04	2.61E-07	4.28E-04
Beryllium	0.10	1.79E-07	1.79E-04	2.59E-07	2.59E-04	5.54E-07	5.54E-04	8.04E-07	8.04E-04
Boron	4.0	3.15E-05	0.0005	4.57E-05	0.0008	9.77E-05	0.0016	1.42E-04	0.0024
Cadmium	0.0050	5.27E-07	0.01	7.64E-07	0.02	1.63E-06	0.033	2.37E-06	0.047
Chromium (Total)	0.10	1.03E-06	0.0010	1.49E-06	0.001	3.18E-06	0.0032	4.60E-06	0.0046
Chromium VI	-	1.46E-07	-	2.12E-07	-	4.52E-07	-	6.55E-07	-
Cobalt	0.051	1.68E-05	0.03	2.44E-05	0.05	5.21E-05	0.10	7.56E-05	0.15
Lead	0.020	9.65E-06	0.05	1.40E-05	0.07	2.99E-05	0.15	4.34E-05	0.22
Mercury - Inorganic	0.0010	4.49E-08	0.0	6.51E-08	0.0	1.21E-07	0.012	1.75E-07	0.018
Methyl Mercury	-	3.46E-10	-	5.02E-10	-	1.06E-09	-	1.54E-09	-

		140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operations		Process Upsets	
COPC	Baseline Measured Pork Concentration (mg/kg)	Maximum Pork Concentration (mg/kg)	% Loading	Maximum Pork Concentration (mg/kg)	% Loading	Maximum Pork Concentration (mg/kg)	% Loading	Maximum Pork Concentration (mg/kg)	% Loading
Nickel	0.10	1.01E-04	0.10	1.47E-04	0.15	3.14E-04	0.31	4.56E-04	0.46
Phosphorus	1310	0.0010	7.29E-05	0.0014	1.06E-04	0.0030	2.26E-04	0.0043	3.27E-04
Selenium	0.20	3.92E-06	0.0020	5.69E-06	0.0028	1.21E-05	0.0061	1.76E-05	0.0088
Silver	0.010	1.00E-06	0.010	1.45E-06	0.01	3.10E-06	0.031	4.50E-06	0.045
Thallium	0.010	0.0003	3	0.0004	4	8.95E-04	8.9	0.0013	13
Tin	0.050	0.0006	1.2	0.0009	1.8	0.0019	3.8	0.0028	5.5
Vanadium	0.10	1.61E-06	0.0016	2.33E-06	0.0023	4.98E-06	0.0050	7.22E-06	0.0072
Zinc	13	7.23E-06	5.39E-05	1.05E-05	7.82E-05	2.24E-05	1.67E-04	3.25E-05	2.42E-04

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Table 6-14 Predicted Dairy Loading as a Result of Normal and Process Upset Operation over a 30 Year Period for 140,000 tpy and 400,000 tpy

COPC	Baseline Measured Dairy Concentration (mg/L)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Dairy Concentration (mg/L)	% Loading	Maximum Dairy Concentration (mg/L)	% Loading	Maximum Dairy Concentration (mg/L)	% Loading	Maximum Dairy Concentration (mg/L)	% Loading
PAHs									
Anthracene	2.00E-04	5.29E-11	2.65E-05	1.48E-10	7.41E-05	1.57E-10	7.83E-05	4.38E-10	2.19E-04
Benzo(a)fluorene	-	8.85E-11	-	2.48E-10	-	2.03E-10	-	5.59E-10	-
Benzo(a)pyrene TEQ	6.89E-04	5.76E-09	0.0008	1.61E-08	0.0023	1.18E-08	0.0017	3.21E-08	0.0047
Benzo(b)fluorene	-	1.55E-10	-	4.33E-10	-	3.26E-10	-	8.91E-10	-
Fluorene	2.00E-04	6.61E-11	3.30E-05	1.85E-10	9.25E-05	1.95E-10	9.75E-05	5.46E-10	2.73E-04
PCBs									
Aroclor 1254 (Total PCBs)	0.010	2.12E-07	0.002	5.93E-07	0.006	6.16E-07	0.0062	1.72E-06	0.017
Dioxins and Furans									
2,3,7,8-TCDD TEQ	1.39E-07	3.94E-10	0.3	1.10E-09	0.8	8.97E-10	0.64	1.94E-09	1.4
VOCs									
1,1,1-Trichloroethane	0.20	1.34E-08	6.70E-06	3.75E-08	1.88E-05	3.77E-08	1.88E-05	1.05E-07	5.27E-05
Bromoform	1.0	5.03E-07	0.0001	1.41E-06	0.0001	1.04E-06	1.04E-04	2.91E-06	2.91E-04
Carbon Tetrachloride	0.50	5.78E-09	1.16E-06	1.62E-08	3.24E-06	1.19E-08	2.39E-06	3.34E-08	6.69E-06
Chloroform	0.50	2.58E-09	5.15E-07	7.21E-09	1.44E-06	7.24E-09	1.45E-06	2.03E-08	4.06E-06
Dichloromethane	5.0	2.83E-07	5.67E-06	7.94E-07	1.59E-05	7.97E-07	1.59E-05	2.23E-06	4.46E-05
O-Terphenyl		1.70E-08	-	4.76E-08	-	4.22E-08	-	1.17E-07	-
Trichlorofluoromethane (FREON 11)	1.0	1.53E-06	0.0002	4.28E-06	0.000	4.30E-06	4.30E-04	1.20E-05	0.0012
Chlorinated Monocyclic Aromatics									

COPC	Baseline Measured Dairy Concentration (mg/L)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Dairy Concentration (mg/L)	% Loading	Maximum Dairy Concentration (mg/L)	% Loading	Maximum Dairy Concentration (mg/L)	% Loading	Maximum Dairy Concentration (mg/L)	% Loading
1,2,4,5-Tetrachlorobenzene	0.010	4.66E-09	4.66E-05	1.31E-08	1.31E-04	1.31E-08	1.31E-04	3.67E-08	3.67E-04
1,2,4-Trichlorobenzene	5.0	2.71E-09	5.43E-08	7.60E-09	1.52E-07	7.63E-09	1.53E-07	2.14E-08	4.27E-07
1,2-Dichlorobenzene	1.0	6.37E-08	6.37E-06	1.78E-07	1.78E-05	1.79E-07	1.79E-05	5.01E-07	5.01E-05
Hexachlorobenzene	0.010	4.49E-09	4.49E-05	1.26E-08	1.26E-04	1.25E-08	1.25E-04	3.50E-08	3.50E-04
Pentachlorobenzene	0.010	2.33E-08	2.33E-04	6.53E-08	0.0007	6.87E-08	6.87E-04	1.92E-07	0.0019
Pentachlorophenol	-	3.37E-08	-	9.43E-08	-	6.78E-08	-	1.84E-07	-
Inorganics									
Antimony	0.010	4.60E-07	0.005	6.67E-07	0.007	1.42E-06	0.014	2.06E-06	0.021
Arsenic	0.010	2.55E-08	0.0003	3.69E-08	0.0004	7.86E-08	7.86E-04	1.14E-07	0.0011
Barium	0.050	1.06E-06	0.0021	1.54E-06	0.0031	3.29E-06	0.0066	4.77E-06	0.0095
Beryllium	0.10	4.42E-10	4.42E-07	6.41E-10	6.41E-07	1.37E-09	1.37E-06	1.98E-09	1.98E-06
Boron	2.0	5.02E-05	0.0025	7.28E-05	0.0036	1.55E-04	0.0078	2.25E-04	0.011
Cadmium	0.0050	1.43E-07	0.00	2.08E-07	0.00	4.44E-07	0.0089	6.44E-07	0.013
Chromium (Total)	0.10	3.11E-06	0.0031	4.51E-06	0.005	9.59E-06	0.0096	1.39E-05	0.014
Chromium VI	-	4.42E-07	-	6.41E-07	-	1.36E-06	-	1.98E-06	-
Cobalt	0.020	2.51E-05	0.13	3.64E-05	0.18	7.76E-05	0.39	1.12E-04	0.56
Lead	0.020	2.70E-05	0.14	3.92E-05	0.20	8.36E-05	0.42	1.21E-04	0.61
Mercury - Inorganic	0.0010	4.64E-06	0.5	6.73E-06	0.7	1.28E-05	1.3	1.85E-05	1.9
Methyl Mercury	-	8.52E-08	-	1.24E-07	-	2.50E-07	-	3.62E-07	-

		140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
COPC	Baseline Measured Dairy Concentration (mg/L)	Maximum Dairy Concentration (mg/L)	% Loading	Maximum Dairy Concentration (mg/L)	% Loading	Maximum Dairy Concentration (mg/L)	% Loading	Maximum Dairy Concentration (mg/L)	% Loading
Nickel	0.10	1.01E-04	0.10	1.46E-04	0.15	3.11E-04	0.31	4.51E-04	0.45
Phosphorus	814	0.0011	1.34E-04	0.0016	1.95E-04	0.0034	4.16E-04	0.0049	6.03E-04
Selenium	0.040	2.50E-06	0.0063	3.63E-06	0.0091	7.72E-06	0.019	1.12E-05	0.028
Silver	0.010	7.81E-05	0.78	1.13E-04	1.1	2.41E-04	2.4	3.50E-04	3.5
Thallium	0.010	0.0001	1	0.0001	1	2.46E-04	2.5	3.57E-04	3.6
Tin	0.050	0.0005	0.9	0.0007	1.4	0.0014	2.9	0.0021	4.2
Vanadium	0.10	8.66E-07	0.0009	1.26E-06	0.0013	2.68E-06	0.0027	3.88E-06	0.0039
Zinc	3.5	1.45E-05	4.15E-04	2.10E-05	6.01E-04	4.48E-05	0.0013	6.49E-05	0.0019

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Table 6-15 Predicted Eggs Loading as a Result of Normal and Process Upset Operation over a 30 Year Period for 140,000 tpy and 400,000 tpy

		140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
COPC	Baseline Measured Eggs Concentration (mg/kg)	Maximum Eggs Concentration (mg/kg)	% Loading	Maximum Eggs Concentration (mg/kg)	% Loading	Maximum Eggs Concentration (mg/kg)	% Loading	Maximum Eggs Concentration (mg/kg)	% Loading
PAHs									
Anthracene	2.00E-04	1.82E-10	9.09E-05	5.09E-10	2.54E-04	5.39E-10	2.69E-04	1.51E-09	7.54E-04
Benzo(a)fluorene	-	1.61E-10	-	4.52E-10	-	4.79E-10	-	1.34E-09	-
Benzo(a)pyrene TEQ	6.89E-04	3.03E-10	4.39E-05	8.47E-10	1.23E-04	8.97E-10	1.30E-04	2.51E-09	3.65E-04
Benzo(b)fluorene	-	1.00E-10	-	2.80E-10	-	2.97E-10	-	8.31E-10	-
Fluorene	2.00E-04	1.96E-10	9.82E-05	5.50E-10	2.75E-04	5.82E-10	2.91E-04	1.63E-09	8.15E-04
PCBs									
Aroclor 1254 (Total PCBs)	0.010	1.77E-08	1.77E-04	4.95E-08	4.95E-04	5.24E-08	5.24E-04	1.47E-07	0.0015
Dioxins and Furans									
2,3,7,8-TCDD TEQ	2.84E-07	1.16E-11	0.0041	3.24E-11	0.011	3.59E-11	0.013	5.20E-11	0.018
VOCs									
1,1,1-Trichloroethane	0.20	9.90E-11	4.95E-08	2.77E-10	1.39E-07	2.78E-10	1.39E-07	7.79E-10	3.90E-07
Bromoform	1.0	3.72E-09	3.72E-07	1.04E-08	1.04E-06	7.67E-09	7.67E-07	2.15E-08	2.15E-06
Carbon Tetrachloride	0.50	4.27E-11	8.54E-09	1.20E-10	2.39E-08	8.82E-11	1.76E-08	2.47E-10	4.94E-08
Chloroform	0.50	1.90E-11	3.81E-09	5.33E-11	1.07E-08	5.35E-11	1.07E-08	1.50E-10	3.00E-08
Dichloromethane	5.0	2.10E-09	4.19E-08	5.87E-09	1.17E-07	5.89E-09	1.18E-07	1.65E-08	3.30E-07
O-Terphenyl		4.60E-10	-	1.29E-09	-	1.36E-09	-	3.82E-09	-
Trichlorofluoromethane (FREON 11)	1.0	1.13E-08	1.13E-06	3.16E-08	3.16E-06	3.17E-08	3.17E-06	8.89E-08	8.89E-06
Chlorinated Monocyclic Aromatics									

COPC	Baseline Measured Eggs Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Eggs Concentration (mg/kg)	% Loading	Maximum Eggs Concentration (mg/kg)	% Loading	Maximum Eggs Concentration (mg/kg)	% Loading	Maximum Eggs Concentration (mg/kg)	% Loading
1,2,4,5-Tetrachlorobenzene	0.010	8.02E-11	8.02E-07	2.25E-10	2.25E-06	2.38E-10	2.38E-06	6.66E-10	6.66E-06
1,2,4-Trichlorobenzene	5.0	2.08E-11	4.16E-10	5.83E-11	1.17E-09	5.85E-11	1.17E-09	1.64E-10	3.28E-09
1,2-Dichlorobenzene	1.0	4.81E-10	4.81E-08	1.35E-09	1.35E-07	1.35E-09	1.35E-07	3.79E-09	3.79E-07
Hexachlorobenzene	0.010	4.48E-11	4.48E-07	1.25E-10	1.25E-06	1.26E-10	1.26E-06	3.52E-10	3.52E-06
Pentachlorobenzene	0.010	1.11E-09	1.11E-05	3.11E-09	3.11E-05	3.30E-09	3.30E-05	9.23E-09	9.23E-05
Pentachlorophenol	-	1.46E-12	-	4.09E-12	-	3.90E-12	-	1.09E-11	-
Inorganics									
Antimony	0.010	6.64E-09	6.64E-05	9.63E-09	9.63E-05	2.06E-08	2.06E-04	2.99E-08	2.99E-04
Arsenic	0.010	1.08E-09	1.08E-05	1.57E-09	1.57E-05	3.36E-09	3.36E-05	4.87E-09	4.87E-05
Barium	0.40	6.28E-10	1.58E-07	9.10E-10	2.29E-07	1.95E-09	4.89E-07	2.82E-09	7.09E-07
Beryllium	0.10	3.30E-09	3.30E-06	4.79E-09	4.79E-06	1.02E-08	1.02E-05	1.49E-08	1.49E-05
Boron	2.0	3.12E-07	7.79E-06	4.52E-07	1.13E-05	9.67E-07	2.42E-05	1.40E-06	3.51E-05
Cadmium	0.0050	2.00E-07	0.0040	2.90E-07	0.0058	6.21E-07	0.012	9.01E-07	0.018
Chromium (Total)	0.10	1.06E-08	1.06E-05	1.54E-08	1.54E-05	3.29E-08	3.29E-05	4.78E-08	4.78E-05
Chromium VI	-	1.51E-09	-	2.19E-09	-	4.68E-09	-	6.79E-09	-
Cobalt	0.020	2.35E-07	0.0012	3.41E-07	0.0017	7.30E-07	0.0036	1.06E-06	0.0053
Lead	0.020	1.62E-07	8.10E-04	2.35E-07	0.0012	5.02E-07	0.0025	7.28E-07	0.0036
Mercury - Inorganic	0.0010	1.85E-06	0.18	2.68E-06	0.27	4.98E-06	0.50	7.21E-06	0.72
Methyl Mercury	-	1.30E-08	-	1.88E-08	-	4.03E-08	-	5.84E-08	-

COPC	Baseline Measured Eggs Concentration (mg/kg)	140,000 Tpy				400,000 Tpy			
		Normal Operation		Process Upset		Normal Operation		Process Upset	
		Maximum Eggs Concentration (mg/kg)	% Loading	Maximum Eggs Concentration (mg/kg)	% Loading	Maximum Eggs Concentration (mg/kg)	% Loading	Maximum Eggs Concentration (mg/kg)	% Loading
Nickel	0.10	1.49E-06	0.0015	2.17E-06	0.0022	4.63E-06	0.0046	6.72E-06	0.0067
Phosphorus	1740	1.27E-05	7.32E-07	1.85E-05	1.06E-06	3.95E-05	2.27E-06	5.73E-05	3.29E-06
Selenium	0.21	3.11E-07	1.48E-04	4.50E-07	2.14E-04	9.63E-07	4.59E-04	1.40E-06	6.65E-04
Silver	0.010	7.02E-09	7.02E-05	1.02E-08	1.02E-04	2.18E-08	2.18E-04	3.16E-08	3.16E-04
Thallium	0.010	4.60E-06	0.046	6.67E-06	0.067	1.43E-05	0.14	2.07E-05	0.21
Tin	0.050	1.04E-05	0.021	1.51E-05	0.030	3.23E-05	0.065	4.69E-05	0.094
Vanadium	0.10	3.02E-08	3.02E-05	4.39E-08	4.39E-05	9.38E-08	9.38E-05	1.36E-07	1.36E-04
Zinc	13	1.60E-05	1.27E-04	2.32E-05	1.84E-04	4.96E-05	3.94E-04	7.19E-05	5.71E-04

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6.6 Breast Milk

The potential for COPC to accumulate in breast milk, and be transferred to infants, was evaluated as part of the human health risk assessment. This pathway has been evaluated for the local resident and farmer receptor and for all organic COPC (i.e., excluding metals). Unlike organics, metals do not bind to fat and so do not usually accumulate to higher concentrations in breast milk than in blood (Golding, 1997). As a result, infants are likely to be exposed to higher levels before birth and as a toddler than during breast-feeding.

The infant is assumed to be exclusively breast fed for six (6) months, which is consistent with Health Canada's (2004a) definition of an infant and both Health Canada and the World Health Organization's current recommendations (Health Canada, 2004c, WHO, 2001). Although it is recognized that breast feeding practices vary widely, Health Canada (2004c) recommends that infants should be introduced to nutrient-rich, solid foods with particular attention to iron at six (6) months of age.

The primary factor in the transfer to the infant is the operating life of the Facility. For dioxins and furans and PCBs, specifically, the concentration in breast milk is also a function of the maternal fat content, and the percentage of dioxin (or dioxin-like PCBs) that is stored in fat. During the first six (6) months of breast feeding greater than 60% of a mothers fat-sequesters organic load is likely transferred to the infant. So it is during this lifestage that a breast fed infant would be at the greatest risk of exposure to these contaminants. Equations were adopted from McKone (1993) and US EPA (2005).

In this risk assessment the breastmilk exposure pathway was evaluated for farmer infants and residential infants. COPCs evaluated include all organic COPC excluding metals because they do not bind to fat and so do not usually accumulate to higher concentrations in breast milk. Although metals were not assessed for infant exposure to breast milk, infants were assumed to also be exposed metal and organic concentrations in indoor dust and soil. It is this exposure pathway that leads to the HQs presented for metals in the infant risk assessment.

6.7 Groundwater

US EPA (2005) guidance on evaluating the changes in environmental media from air emissions states that groundwater is not a substantive exposure pathway for combustion emissions. Aerial deposition of COPC is expected to occur in surficial soil layers of the LRASA. Given the concentration of COPC emitted, leaching of these chemicals to groundwater is not considered a feasible pathway.

Based on the above, the potential for the Project to result in measurable changes to the potable groundwater aquifers is considered very low. It was also determined that a large proportion of residents in the LRASA obtain their drinking water from municipal supply services that will be unaffected by air emissions from the Facility. As a result, the groundwater ingestion pathway has not been considered this HHERA.

7.0 HUMAN HEALTH RISK ASSESSMENT

7.1 Introduction

The purpose of this HHRA is to determine whether chemical emissions associated with operations of the Facility have the potential to cause adverse health effects in human receptors living within the Local Risk Assessment Study Area (LRASA). The HHRA was conducted following the following regulatory guidance documents:

- Procedures for the Use of Risk Assessment under Part XV.1 of the *Environmental Protection Act* (MOE, 2005);
- Federal Contamination Sites Risk Assessment in Canada. Part I: Guidance on Human Health Risk Preliminary Quantitative Risk Assessment (PQRA) (Health Canada, 2004); and,
- The US EPA Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities. (US EPA, 2005).

Within each assessment case, with the exception of the baseline traffic case, construction case, traffic case, future and existing conditions case and the decommissioning case, the HHRA evaluated both short-term (acute) and long-term (chronic) inhalation exposures to COPC. A separate multi-pathway assessment was also conducted to evaluate the potential risks to receptors resulting from long-term oral and dermal exposure to soil, water and local foods in the LRASA.

7.2 Human Health Risk Assessment Methodology

In order to scientifically and appropriately assess the risks to receptors from chemical exposure to Facility emissions the HHRA followed the fundamental risk assessment paradigm. This process was previously outlined in detail in Section 2.0 and consists of the following five steps:

- Problem Formulation;
- Exposure Assessment;
- Hazard Assessment;
- Risk Characterization; and,
- Uncertainty Analysis.

7.3 Problem Formulation

Problem formulation is the first step in the risk assessment process. Information is gathered on the proposed Facility and its potential interactions with the environment to provide focus for the subsequent phases of the risk assessment. Key factors that were evaluated include:

- Site, Local Risk Assessment Study Area, and/or Facility characterization;
- Identification of COPC;
- Receptor identification and characterization - identification of receptors, which includes those persons with the greatest probability of exposure to chemicals and/or those that have the greatest sensitivity to these chemicals; and,
- Identification of exposure pathways and routes.

The outcome of these tasks forms the basis of the approach taken in the HHRA. The following subsections describe the methodological details and outcomes of problem formulation, specific to identification of the assessment area, chemicals, receptors and pathways.

7.3.1 Assessment Area

The identification of the assessment area is an integral step in the problem formulation stage. The data collected and evaluated in this step provides important information about the physical attributes and characteristics of assessment area and the Facility.

The identification of the Site and the local risk assessment study area allows for the identification of human receptors that have the potential to be affected by Facility emissions. Once the receptors have been identified, they can be screened for inclusion in the HHRA.

Establishing the physical attributes of the Facility will identify the possible emissions from the stack and allow for the identification of COPC to be used in the HHRA.

7.3.2 Chemical Screening

Evaluating all potential chemicals emitted from the Facility in the HHRA is neither feasible nor practical; therefore, the chemicals quantitatively evaluated in the HHRA included those representing the greatest potential concern to people residing in the LRASA. Section 4.0 provides a detailed discussion of the methods used during the chemical screening and selection process and lists the chemicals included in both the inhalation and multi-pathway assessment.

7.3.3 Receptor Screening

A human receptor is a hypothetical person (e.g., infant, toddler, child, adolescent, or adult) who resides, visits, or works in the LRASA and is, or could potentially be, exposed to chemical emissions from the Project. General physical and behavioral characteristics specific to the receptor type (e.g., body weight, breathing rate, amount of food consumed) are used to estimate the amount of chemical exposure received by each receptor.

Non-carcinogenic COPC are assumed to act via a threshold mechanism and exposures are assessed within specific life stages. Generally, the toddler life stage, defined as 6 months to 4 years, is considered the most sensitive life stage based on receptor characteristics (e.g., lower body weights) combined with behavioural patterns (e.g., higher soil ingestion rates).

Carcinogenic COPC are assumed to act via a non-threshold mechanism and exposures are assessed over a lifetime as cancer may take many years to manifest. Health Canada (2004) recommends that a full lifetime of exposure be adopted as the most sensitive approach, based on combining exposures from the following five individual life stages:

- Infant (0 to 6 months);
- Toddler (7 months to 4 years);
- Child (5 years to 11 years);
- Adolescent (12 to 19 years); and
- Adult (20 years to 75 years).

The combination of these five life stages creates a “composite” receptor which is used to evaluate lifetime exposures to carcinogenic COPC.

Based on the information above the list of local human receptor types evaluated as part of this HHRA includes:

- Local Residents (Infant, Toddler, Composite)
- Local Farmers (Infant, Toddler, Composite)
- Daycare/ Schools (Toddler, Adult)
- Recreation User – Sport (Toddler, Composite)
- Recreation User – Camper (Toddler, Composite)
- Additional exposure from Swimming (Toddler, Composite)
- Additional exposure from Hunting and Angling (Toddler, Composite)

The Receptor Characterization (Section 7.4.1) provides a detailed discussion of the methods and sources of information used to characterize each life stage and receptor type.

7.3.4 Exposure Pathways and Conceptual Site Model

The main sources of non-occupational human chemical exposure associated with the Project are emissions of air contaminants from the stack of the Facility. People can come into contact with chemicals in their environment in a variety of ways, depending on their daily activities and land use patterns.

The means by which a person comes into contact with a chemical in an environmental medium are referred to as *exposure pathways*. The means by which a chemical enters the body from environmental medium are referred to as *exposure routes*. There are three major environmental exposure routes through which chemicals can enter the body:

- Inhalation;
- Ingestion; or
- Dermal absorption (*i.e.*, uptake through the skin).

Exposure pathways may require direct contact between receptors and the media of concern (e.g., incidental ingestion of soil), or may be indirect, requiring the movement of the chemical from one environmental medium to another (e.g., the uptake and/or transfer of a chemical from soil into home garden vegetables that are then ingested by an individual). The potential for adverse health risks is directly related to the exposure pathways. If there is no pathway of exposure to a chemical, regardless of its toxic potency, there would be no potential for the development of adverse health outcomes from that chemical. Therefore, it is important to select relevant exposure pathways for each receptor and scenario evaluated in the HHRA.

Relevant human exposure pathways and routes of exposure were selected based on review of available data and reports (including the Generic Risk Assessment prepared for the Residual Waste Study), consideration of the potential sources of chemical exposure associated with the Project, discussions/consultation with the Regions, Environmental Assessment team members, and the professional judgment and experience of the Study Team.

7.3.4.1 Exposure Pathways Considered for the HHRA

Inhalation of Vapours and Particulate Emissions

The only direct exposure pathway to the project emissions is via vapour or particulate inhalation in ambient air.

COPC concentrations in air are calculated by summing the vapour phase and particle phase (particle and particle-bound) air concentrations of COPC. Air concentrations used in the evaluation of chronic health risks were calculated using annual average values; whereas air concentrations used in the evaluation of acute health risks were calculated using 1-hour or 24-hour values.

As indicated, receptors can be directly exposed to vapours and particulates both outside in the ambient air and within their homes.

All COPC are assessed for this exposure pathway except for methylmercury. Mercury is not emitted from the Facility in this form.

Ingestion and Dermal Exposure to Soil and/or Dust

Surface soil surrounding the Facility will be subject to particulate deposition and may accumulate levels of various COPC over the operating life of the Facility (30 years).

COPC concentrations in soil are calculated by summing the vapour phase and particle phase deposition of COPC to the soil. Both wet and dry deposition of particles and vapours are considered. In addition, COPC loss mechanisms such as leaching, erosion, runoff, degradation, and volatilization are incorporated.

Direct exposure to contaminants in soil can be via three potential exposure mechanisms: people can incidentally ingest soil, soil can become adhered to an individual's hands (e.g., during gardening) and contaminants can be absorbed through the skin. Particulate matter or dust and vapours can be re-suspended from the surface soil and inhaled by a receptor.

Exposed skin surface areas were adopted from Health Canada (2004a) and Richardson (1997). For summer exposure, the exposed surface area – body parameter assumes the head, arms and legs are exposed. For winter exposure, the exposed surface area – body parameter assumes only the head is exposed. Soil ingestion rates for all receptors were taken from the Ontario Ministry of the Environment (2008c) as this facility is to be built in Ontario and MOE (2008c) soil ingestion rate values are more conservative than soil ingestion rate values presented by Health Canada (1994a). Dust ingestion rates were calculated based on the methodology presented in *Appendix A of Appendix B.5 of the Rationale for the Development and Application of Generic Soil, Groundwater and Sediment Criteria for Use at Contaminated Sites in Ontario* (MOE, 1996).

Food Chain Uptakes

Garden Produce

We have assumed that all local residents and famers will grow vegetable gardens. Indirect exposure resulting from ingestion of produce depends on the total concentration of COPC in the leafy, fruit, and tuber portions of the plant. Because of general differences in uptake mechanisms, garden produce is divided into four broad categories:

- Exposed aboveground vegetables (e.g., lettuce, sprouts);

- Protected aboveground vegetables (e.g., squash, beans, peas);
- Below ground vegetables (e.g., potatoes, carrots); and
- Exposed aboveground fruits (e.g., strawberries, blueberries).

There is no Canadian-specific guidance for produce ingestions rates for this grouping of garden produce. Therefore garden produce ingestion rates for all four categories were taken from the US EPA (2005). US EPA (2005) presents resident and farmer produce ingestions rates. Note, ingestion rates are only specific to children and adult receptors.

The portion of a person's produce intake that comes from their garden was based on the Exposure Factors Handbook (US EPA, 1997). The US EPA estimates of home-grown produce consumption as a portion of total produce consumption are applicable to the United States and likely provide an overestimation of home-grown produce consumption at northern latitudes that have much shorter growing seasons.

Agriculture

We have assumed that the farmer receptor obtains the majority of their agricultural products (e.g. beef, pork, poultry, eggs, and milk) from their farm.

In the agricultural food chain, cattle, pigs, and chicken are assumed to be exposed to COPC through impacted feed products (forage, silage, and grain) and through incidental ingestion of impacted soil.

There is no Canadian-specific guidance for ingestion rates for this group of agricultural products; therefore, ingestion rates for all beef, chicken, pork, dairy and eggs were taken from the EPA (2005). Note, ingestion rates are only specific to children and adult farmer receptors.

Breast Milk

The infant (as defined by Health Canada (2004a)) was assumed to be exclusively breast fed (meaning their intake of all other foods and water is set to zero) from age zero to six months. However, infants were also modelled to be exposure to indoor dust and soil in the risk assessments, in particular for exposure to metals.

Maternal body burden is the most important factor in the determination of transfer to the infant. Researchers have estimated that maternal body burden (specifically PCB/dioxin) decreases as much as 20% to 70% during six months of exclusive breastfeeding (Kreuzer et. al (1997) and Rogan et. al (1986)). Breast milk consumption rates for the infant were taken from US EPA (2005) for an exclusively breast fed infant.

7.3.4.2 Additional Exposure Pathways Considered for the HHRA

Hunting or Angling

It was assumed that hunters and anglers use the land in the local risk assessment study area. The risks incurred from this exposure pathway can be added to any receptor. As an example the risks incurred from hunting or fishing can be added to the risks to a residential receptor to characterize a receptor who resides in the local risk assessment study area and also hunts or fishes in local water bodies.

Swimming

On occasion, individuals may use the local water bodies to swim wade or play during the summer months. Exposures may occur through incidental ingestion and dermal contact from the surface water. The risks incurred from this exposure pathway can be added to any receptor. As an example the risks incurred from swimming can be added to the risks to a residential receptor to characterize a receptor who resides in the local risk assessment study area and also swims in local water bodies.

7.3.4.3 Exposure Pathways not Considered in the HHRA

A number of potential exposure pathways could not be evaluated in the current assessment. These include consumption of local drinking water and consumption of local grocery store items.

Consumption of Local Drinking Water

Ingestion of potable water obtained from local surface water resources is a potential exposure pathway evaluated in many HHRAs; however, after evaluation of the LRASA it was found that residents obtain drinking water from municipal water supply services. It is therefore assumed that depositions from the Project are not likely to be a significant contribution to COPC concentrations in drinking water within the LRASA and this pathway was not evaluated in the current assessment.

Consumption of Grocery Store Bought Foods (Market Basket)

While not produced in the area, grocery store bought foods can be a background (i.e., not Facility-related) exposure pathway for many COPC; however, as there is little available data on COPC concentrations from local grocery store bought foods, these exposures are only relevant for the Baseline Case scenario. Since consumption of grocery store bought foods is not expected to be influenced by the Project, this particular pathway was not evaluated in the current assessment.

Table 7-1 summarizes the exposure pathways for all receptors evaluated in this assessment.

7.3.5 Conceptual Model

Figure 7-1 and Figure 7-2 provide the conceptual models for the HHRA.

Table 7-1 Exposure Pathways Evaluated for Receptors in the HHRA

Exposure Pathway	Receptor Type					Additional Exposure Pathways	
	Resident	Farmer	Recreation User – Sport	Recreation User - Camping	Daycare	Additional Risk from Swimming	Additional Risk from Hunting/Angling
Direct Inhalation	✓	✓	✓	✓	✓		
Soil Ingestion	✓	✓	✓	✓	✓		
Dermal Contact – Soil	✓	✓	✓	✓	✓		
Dermal Water						✓	
Incidental Surface Water Ingestion						✓	
Garden Produce	✓	✓					
Fish							✓
Breast Milk	✓	✓					
Wild Game							✓
Agriculture		✓					

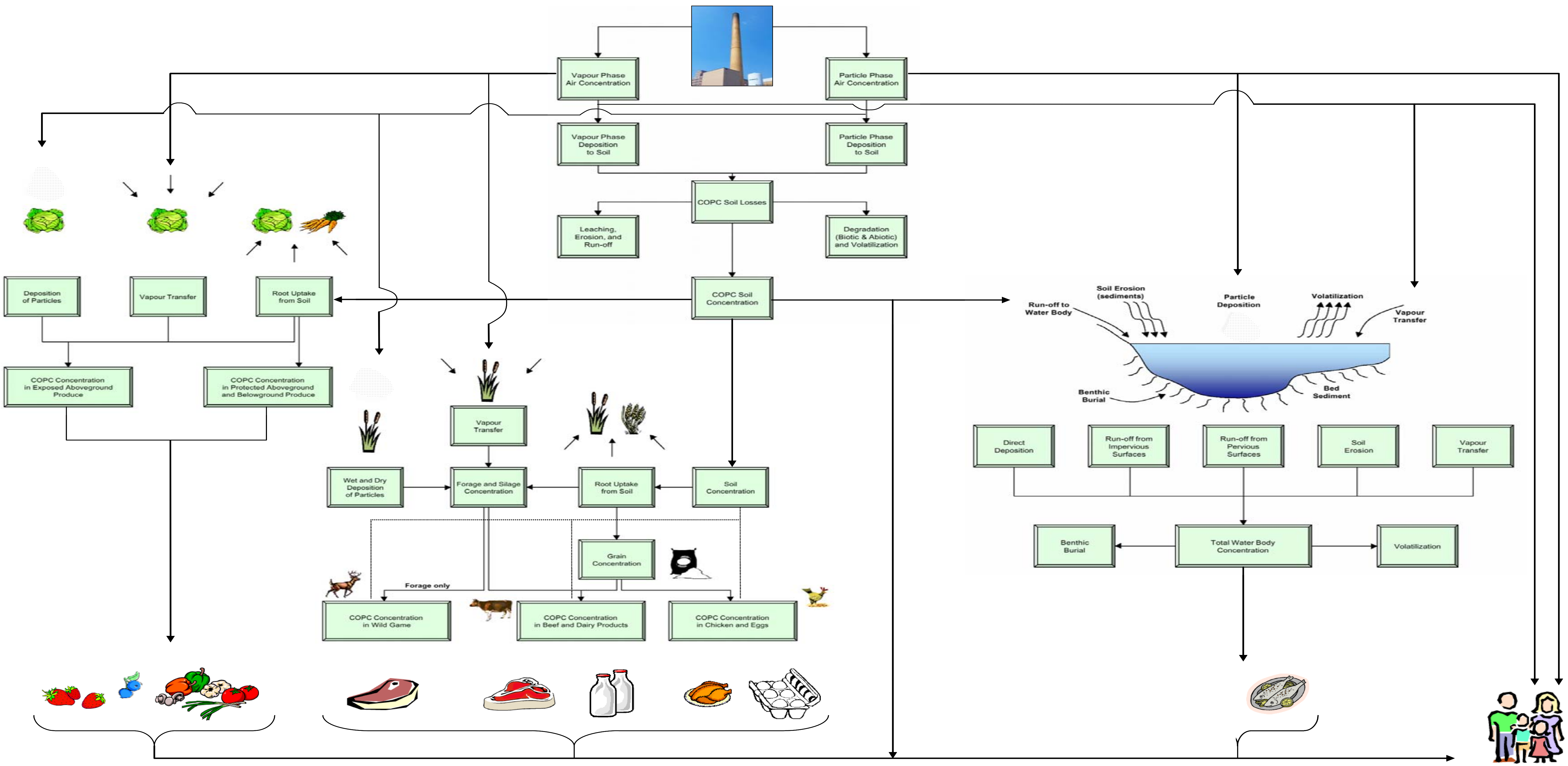


Figure 7-1 Exposure Pathway Conceptual Model

7.4 Exposure Assessment

The exposure assessment incorporates information about Project-related chemical emissions, activities and land use in the area, receptor characteristics, and the exposure pathways identified during the problem formulation phase of the HHRA. Given the nature of the Project and that the primary source of COPC to the environment will be via emissions to the atmosphere from the stack of the Facility, the primary route of exposure for people will be inhalation; however, for a subset of the COPC, there is the potential for deposition onto soils throughout the LRASA over time, resulting in impacts to other exposure media (refer to Section 4.0 for a detailed discussion of the screening process involved in the selection of this COPC subset). For these COPC, a multi-pathway assessment of potential risks related to oral and dermal exposures was conducted, in addition to the inhalation assessment.

For the inhalation exposure assessment, all 309 receptor locations were evaluated. Specific rates of exposure were not calculated; rather, human exposures were conservatively assumed to be equal to ambient air concentrations (measured or modeled) of these substances (in µg/m^3). The inhalation assessment evaluates health risks from acute and chronic exposures (*via* direct air inhalation only) for all of the COPC at each of the 309 receptor locations identified in **Appendix F**.

A subset of 133 unique receptor locations in 14 receptor groupings within the LRASA were selected to undergo a multi-pathway exposure assessment to evaluate chronic exposure to COPC through contact with different local environmental media including soil, air, local produce, agricultural products, wild game and fish. The rate of exposure of the selected receptors to the COPC *via* the various exposure scenarios, pathways, and routes identified in the problem formulation step is estimated. The overall objective of the multi-pathway assessment is to predict, using a series of conservative assumptions, the rate of exposure (in µg chemical/kg body weight/day) to the COPC *via* the oral and dermal exposure routes identified in the problem formulation. The multi-pathway assessment evaluates chronic exposures of people to COPC present in different local environmental media, including: soil, air, water, and local foods; however, as air exposures are evaluated as part of the inhalation assessment, the multi-pathway assessment focused on exposures arising from the oral and dermal pathways.

Every effort was made to include the “worst case” receptor locations, while at the same time ensuring an appropriate mix of different land use categories and an even spatial distribution within the LRASA.

7.4.1 Receptor Characterization

This HHRA uses current guidance documents to define receptor characteristics, including:

- Procedures for the Use of Risk Assessment under Part XV.1 of the Environmental Protection Act. (MOE, 2005);
- Federal Contaminated Sites Risk Assessment in Canada, PART I: Guidance on Human Health Risk Preliminary Quantitative Risk Assessment (PQRA). (Health Canada, 2004);
- Compendium of Canadian Human Exposure Factors for Risk Assessment. O'Connor Associates Environmental Inc. 1155-2720 Queensview Dr., Ottawa Ontario (Richardson, 1997);
- Human Health Risk Assessment for Priority Substances: *Canadian Environmental Protection Act* ISBN: 0-622-22126-5 (Health Canada, 1994);
- US EPA Exposure Factors Handbook (US EPA, 1997); and,
- The US EPA Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities (US EPA, 2005).

Whenever possible, preference was given to Canadian guidance documents and literature (e.g., Health Canada 2004, Richardson, 1997). It is recognized, however, that the US EPA publishes guidance material containing receptor characterization data not currently available in Canadian literature and, therefore, certain US EPA documents are used as a primary source of human receptor characterization data. The US EPA (2005) HHRAP document serves as a primary source for many of the fate and transport methods and general exposure scenarios. The receptor data published in the HHRAP (US EPA, 2005) has been designed to work with these fate and transport methods and the general exposure approaches; therefore, the HHRAP document was also used to help characterize human receptors.

Assumptions, input parameters and calculations used in each exposure pathway are provided in **Appendix G**.

7.4.1.1 Local Residents

Local residents are assumed to live within the LRASA and be exposed to COPC through direct contact with air, soil, dust, and the consumption of local produce while living in the area (Figure 7-2). The following exposure pathways were evaluated for local residential receptors:

- Direct air inhalation – Outdoors (gaseous and particulate);
- Direct air inhalation – Indoors;
- Incidental soil ingestion;
- Incidental indoor dust ingestion;
- Direct dermal contact with the soil/dust;

- Ingestion of home grown exposed vegetables/fruit;
- Ingestion of home grown protected vegetables;
- Ingestion of home grown root vegetables; and,
- Breast milk consumption (infants only).

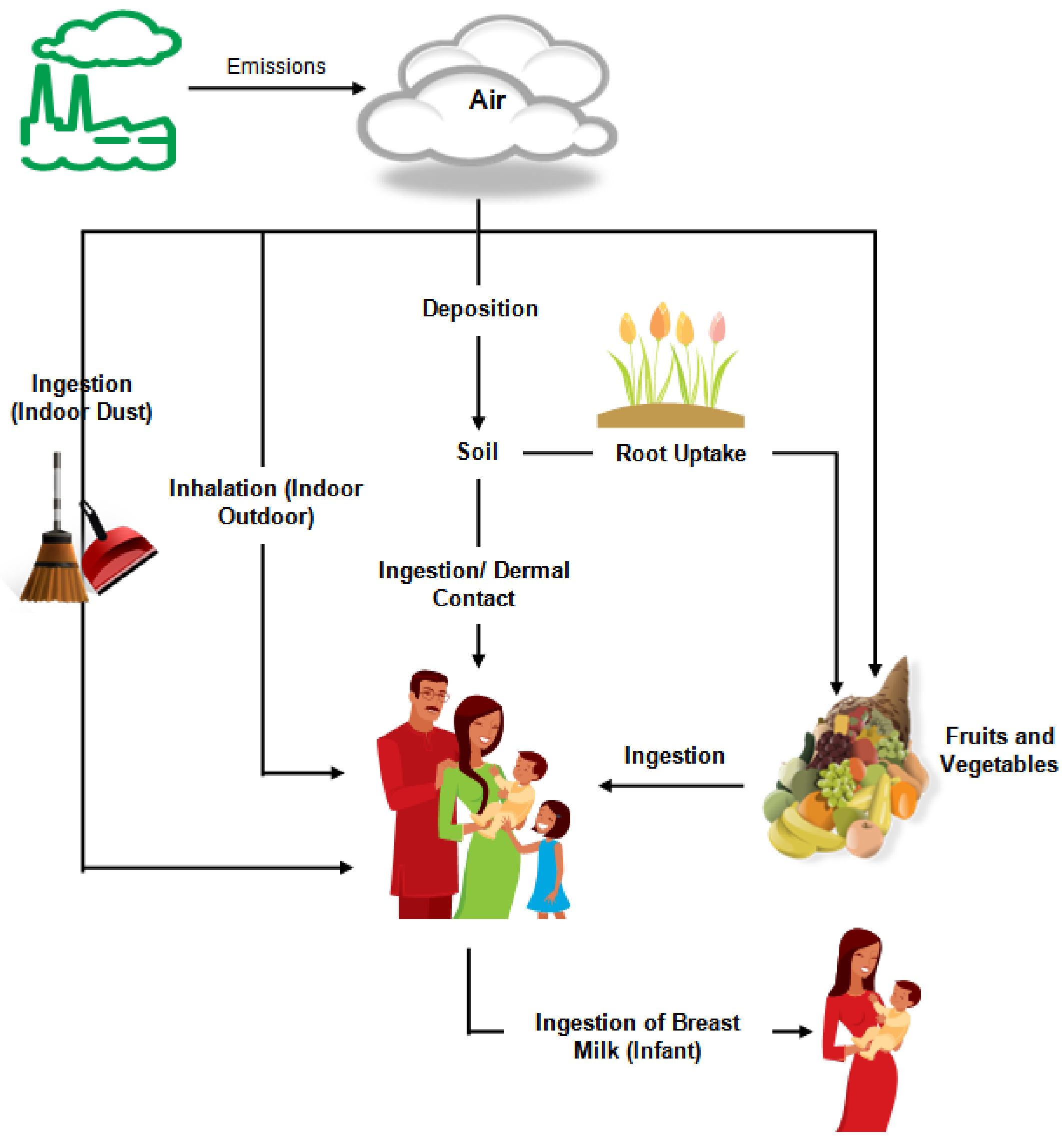


Figure 7-2 Exposure Pathway for Local Residents

7.4.1.2 Local Farmers

To ensure sufficient conservatism within the HHRA, potential health risks related to residents who are farmers were evaluated. This receptor group was assumed to live and farm in the LRASA and is exposed to COPC through air inhalation, direct contact with soil (Figure 7-3). They were also assumed to consume locally derived agricultural foods (*e.g.*, produce, beef, dairy, poultry) hypothetically raised and grown at their farm. The following exposure pathways were evaluated for such local agricultural families:

- Direct air inhalation – Outdoors (gaseous and particulate);
- Direct air inhalation – Indoors;
- Incidental soil ingestion;
- Incidental indoor dust ingestion;
- Direct dermal contact with the soil/dust;
- Ingestion of farm grown exposed vegetables/fruit;
- Ingestion of farm grown protected vegetables;
- Ingestion of farm grown root vegetables;
- Ingestion of agricultural products (beef, chicken, pork, dairy, eggs); and
- Breast milk consumption (infants only).

Given the lack of empirical data specific to farmers from the MOE or Health Canada, consumption rates of all farm-produced foods are taken from the US EPA (2005) HHRAP Document. The HHRAP Document reports consumption rates of farmers and their children, based on data from Chapter 13 of the US EPA‘s Exposure Factors Hand Book (US EPA, 1997). The ingestion rates were originally derived from the National Food Consumption Survey conducted in 1987/1988 by the US Department of Agriculture. These data, according to the US EPA (1997), may be used to evaluate exposures to chemicals in foods raised at a specific location. The HHRAP Document adjusted the ingestion rates for cooking and preparation loss, as recommended by the US EPA (1997), and represent mean "consumer only" home-produced intake rates weighted by age group.

In the case of children, ingestion rates represent a time-weighted mean across several age groups. Where data were lacking for a specific age group, intake rates have been extrapolated in the HHRAP Document using data from the general population. Consumption rates from the

HHRAP Document were not available for each of the five receptor age classes (i.e., infant, toddler, children, adolescent, and adult) defined by Health Canada (2004a). As a result, toddlers and children are assumed to have the same consumption rates as those reported for “children” by the HHRAP Document. Adolescents and adults are assumed to have the same consumption rates as those reported for “adults” by the US EPA (2005).

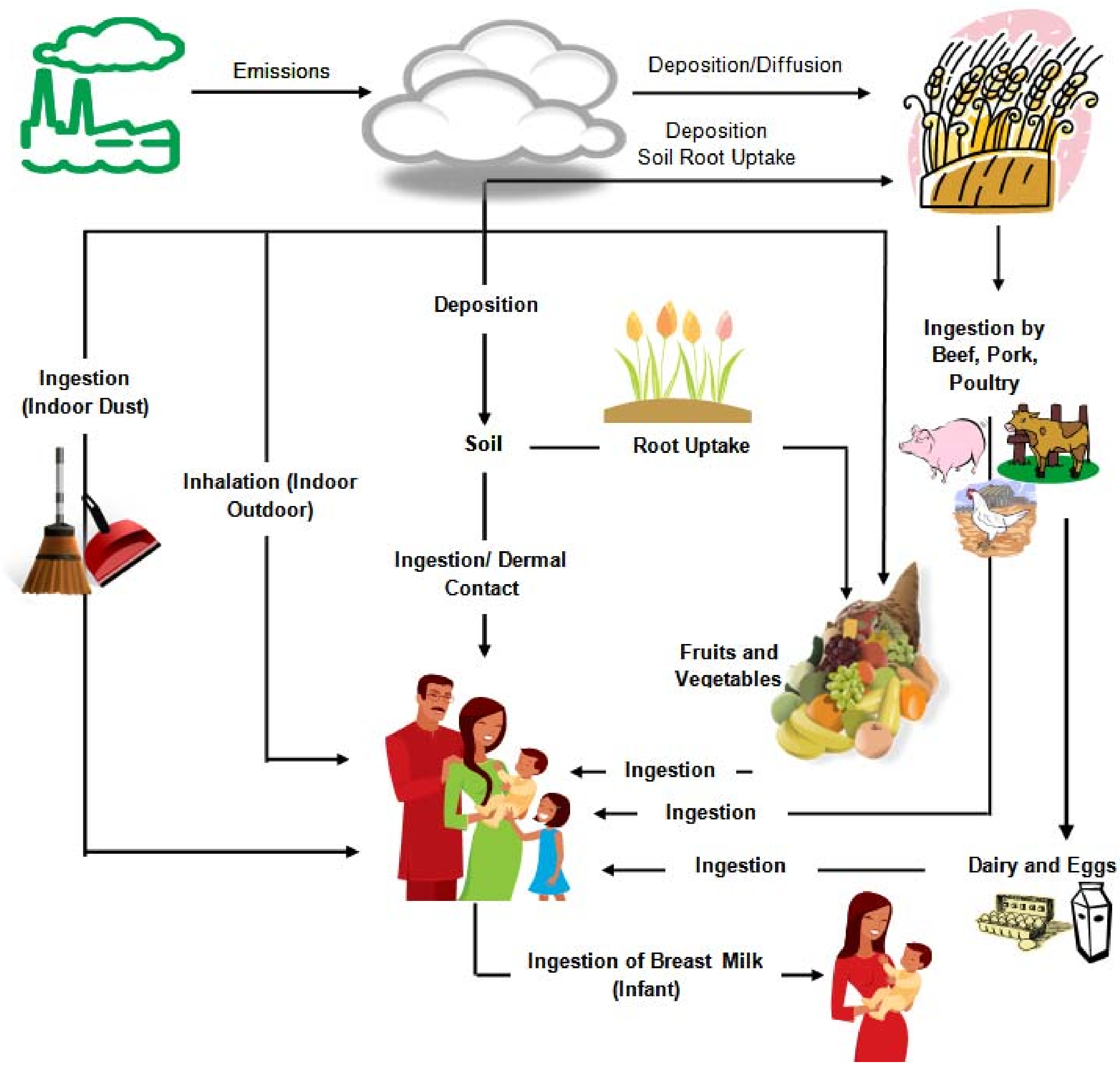


Figure 7-3 Exposure Pathway for Farmers

7.4.1.3 Daycares/Schools

Due to the presence of numerous daycares and schools within the assessment area, this receptor was chosen for evaluation in the HHRA. The following exposure pathways were evaluated in the HHRA:

- Direct air inhalation;
- Incidental soil ingestion; and,
- Direct dermal contact with the soil/dust.

Recommended values from recognized regulatory bodies were unavailable for daycare receptors. As a result a number of assumptions were made for these activity pattern parameters. A daycare receptor is assumed to spend five days a week, 52 weeks a year, and eight hours a day in the local daycare centre. An exposure pathway schematic for this receptor group is provided in Figure 7-4.

Note that schools (both primary and secondary) were only evaluated in the inhalation assessment. This was based on the assumption that if no risks to daycare workers or attendees were found in the multi-pathway assessment, then no risks to primary or secondary school workers or attendees would be expected. A full list of schools evaluated in the inhalation assessment is found in **Appendix F**.

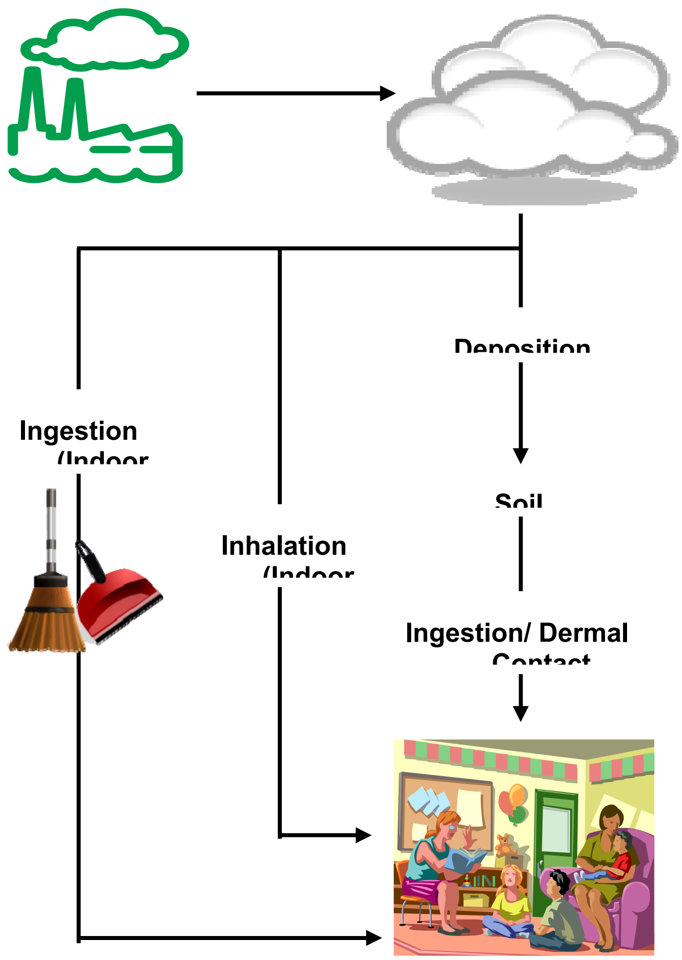


Figure 7-4 Exposure Pathway for Daycare Receptor

7.4.1.4 Recreation User – Sport

Since there are various recreational sports fields within the LRASA, the potential health risks to users of these fields were evaluated in the HHRA. The Recreation User – Sport receptor is assumed to spend four months in the summer, two days a week at four hours per event on the recreational fields in the LRASA (Figure 7-5). The following exposure pathways were examined for this receptor:

- Direct air inhalation – Outdoors (gaseous and particulate);
- Incidental soil ingestion; and
- Direct dermal contact with the soil/dust

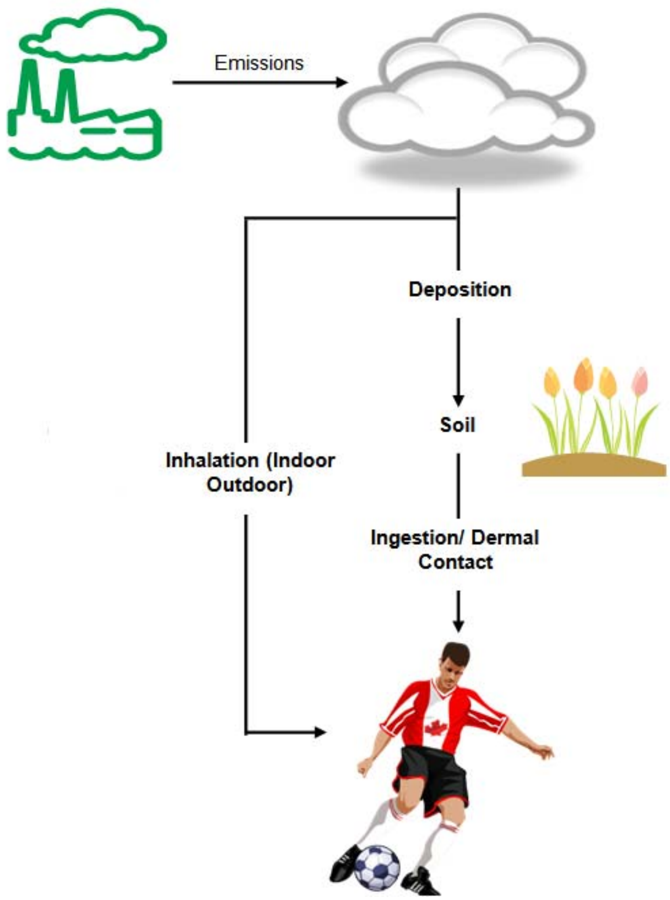


Figure 7-5 Exposure Pathway for Recreation User -Sport Receptor

7.4.1.5 Recreation User - Camping

These individuals were assumed to use specific areas in the immediate vicinity of the Facility (e.g. Darlington Provincial Park, Bowmanville Conservation Area etc.) for general recreation purposes (e.g. hiking, running, camping etc.). The Recreation User – Camper was conservatively assumed to camp within the assessment area for 14 days during the summer (Figure 7-6). The following exposure pathways were evaluated in the HHRA.

- Direct air inhalation – Outdoors (gaseous and particulate);
- Incidental soil ingestion; and
- Direct dermal contact with the soil/dust

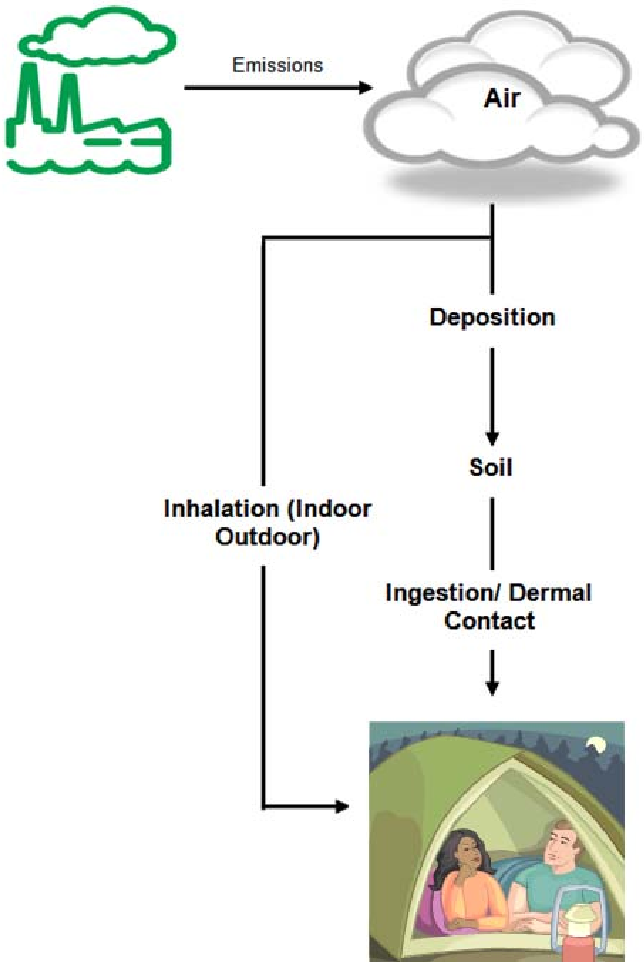


Figure 7-6 Exposure Pathway for Recreation User – Camping Receptor

7.4.1.6 Additional Exposure from Swimming

On occasion, individuals may use the local water bodies to swim wade or play during the summer months. Exposures may occur through incidental ingestion and dermal contact from the surface water. The risks incurred from this exposure pathway can be added to any receptor.

Individuals were assumed to use specific areas in the immediate vicinity of the Facility (e.g. Darlington Provincial Park, Port Darlington Area etc.) for swimming activities. The following exposure pathways were evaluated in the HHRA:

- Incidental ingestion of surface water; and
- Dermal contact with surface water.

Recommended values from recognized regulatory bodies were unavailable for a number of input parameters including the number of swimming events per year and the duration of each event. As a result a number of assumptions were made for these parameters. For swimming events, the receptor is assumed to have 16 swimming events (i.e., once a week for 4 months in the summer) and spend four hours per event. An exposure schematic for this receptor can be found in Figure 7-7.

To ensure potential risks would not be under-estimated, swimmers were assumed to swim in the watershed with the highest overall COPC concentrations for surface water (i.e. McLaughlin Bay).

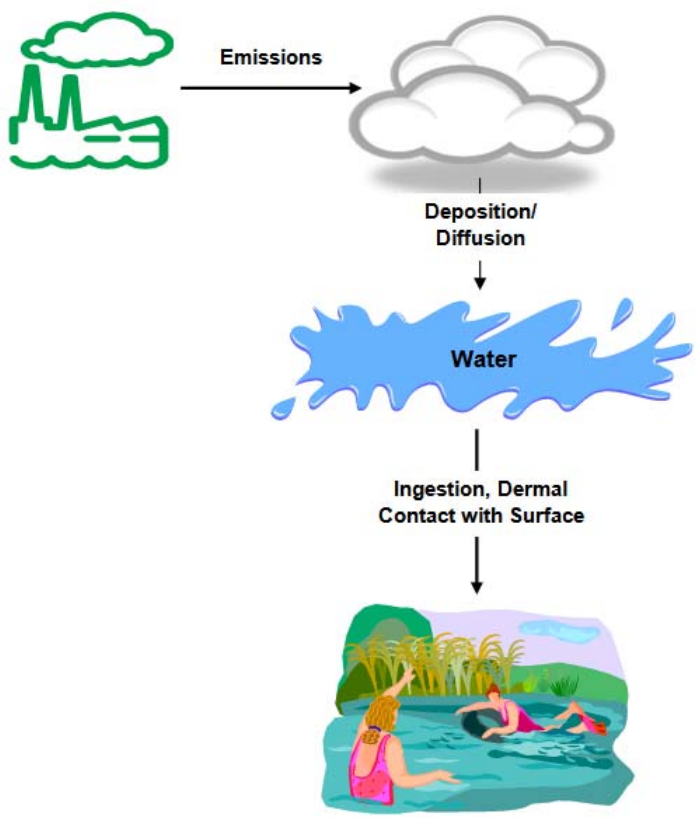


Figure 7-7 Additional Exposure Pathway for Swimmers

7.4.1.7 Additional Exposure from Hunting and Angling

We have assumed that hunters and anglers use the land in the local risk assessment study area. The risks incurred from this exposure pathway can be added to any receptor. It is assumed that they may be exposed to COPC through the consumption of local wild game and fish caught within the local risk assessment study area. To ensure potential risks would not be under-estimated, hunting and angling locations were defined in watersheds with the highest COPC concentrations for wild game and fish, respectively. Accordingly, hunting activity was modeled to occur in the Lower Tooley Watershed and fishing activity was modeled to occur in the McLaughlin Bay Watershed.

The following exposure pathways were evaluated for this potential group of hunters and anglers:

- Ingestion of local wild game; and
- Ingestion of local fish

Wild game and fish consumption rates for hunters and anglers respectively were taken from the US EPA Exposure Factors Handbook (US EPA, 1997). See Tables 1-15 and 1-16 in **Appendix G** for consumption rates for the hunter/angler receptor scenario.

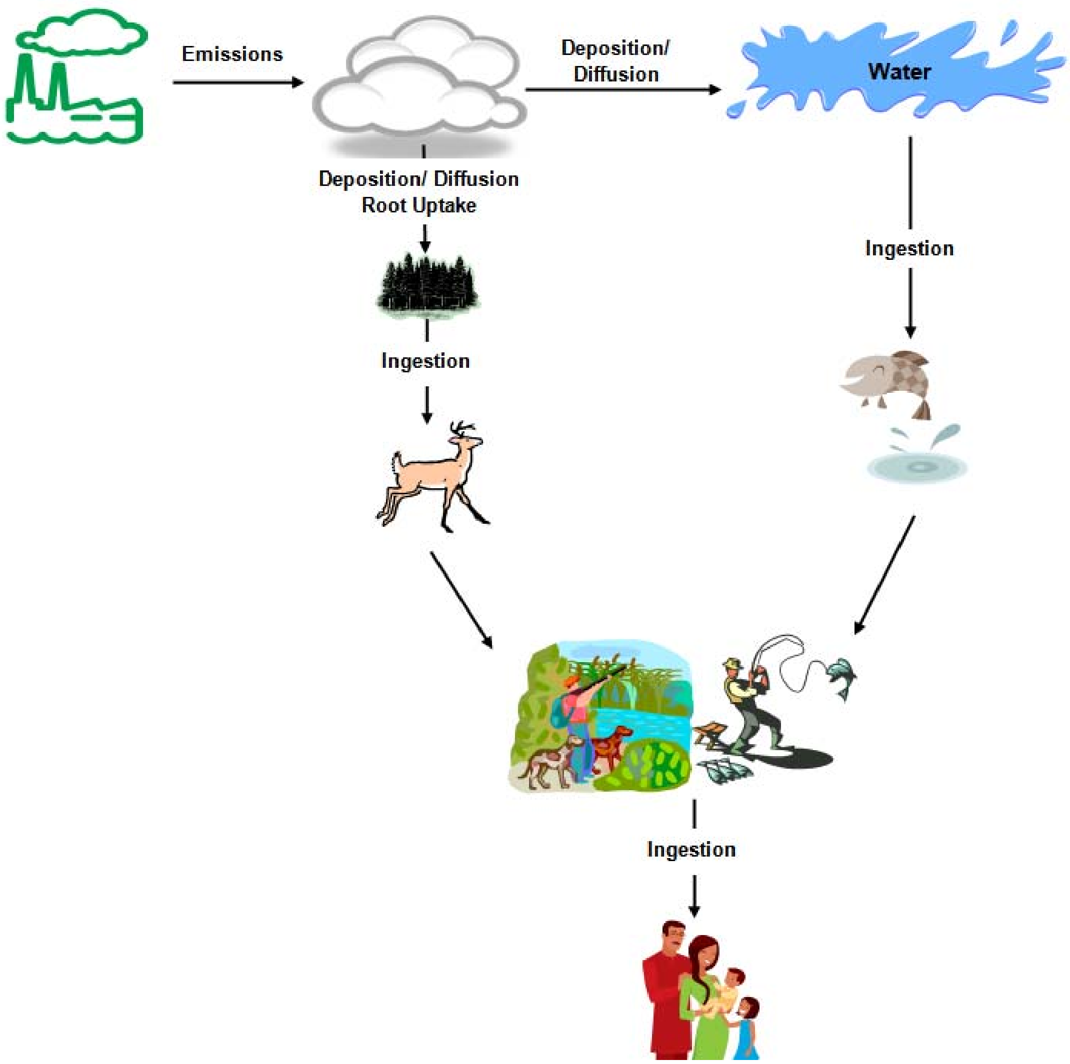


Figure 7-8 Additional Exposure Pathway for Hunters and Anglers

7.4.2 Chemical Characterization

The second major component required to quantify potential human exposures to COPC is the characterization of Exposure Point Concentrations (EPCs) in various environmental media. As previously discussed, potential human health risks related to inhalation (for each COPC) and full multi-pathway exposures (for a subset of COPC) were estimated at each of the 14 human health receptor grouping locations within the LRASA.

The assessment scenarios and resulting EPCs in ambient air used in the HHRA are described in Section 3.0. EPCs in all other environmental media (e.g., soil, dust, water, vegetation) resulting from the Facility's emissions were developed using the results of the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e) and the procedures recommended by the US EPA HHRAP as outlined in Section 3.0. Refer to **Appendix E** for a complete listing of EPC data used in the multi-pathway exposure assessment for each COPC, receptor location, and exposure scenario.

7.4.3 Exposure Analysis

The objective of the exposure assessment is to predict the rate of exposure (in µg/kg body weight/day) of human receptors to the COPC through various exposure pathways identified in the problem formulation. The degree of exposure to chemicals from the environment can depend on the interactions of a number of parameters including:

- The concentrations of chemicals in various environmental media (as determined by the quantities of chemicals entering the environment from various sources, their persistence, fate and behaviour in these media, and the normal ambient, or background concentrations that exist independent of a specific source);
- The physical-chemical characteristics of the chemicals of concern, which affect their environmental fate, transport, behaviour and persistence, and determine the degree or extent by which chemicals can be absorbed into the body;
- The influence of site-specific environmental characteristics, such as geology, soil type, topography, hydrology, hydrogeology, local meteorology and climatology, etc., on a chemical's fate, transport and behaviour within environmental media;
- The physiological and behavioural characteristics of the receptors (e.g., respiration rate, soils/dusts intake rate, food ingestion rates, time spent at various activities and in different areas); and,
- The various exposure pathways for the transfer of the chemicals from the different environmental media to humans (e.g., inhalation of indoor and outdoor air, soil particles and dusts; ingestion of food items, water, soils/dusts; skin penetration of various chemicals from dermal contact with soil/dust, water, sediments).

As discussed in Section 2.1.2, this HHRA was conducted using reasonable worst case assumptions, parameters, and reasonable upper bound concentrations of COPC in environmental media and biota were used to ensure a conservative and protective assessment (US EPA 2004; 2005).

Exposure estimation in the HHRA was facilitated through the use of an integrated multi-pathway environmental risk assessment model developed by the Study Team. The model is spreadsheet based (Microsoft Excel™) with a number of more advanced add-ons or features. Models of this type have been used on numerous peer-reviewed human health risk assessments in Canada, including those conducted for incinerators, contaminated sites, mines, smelters, refineries, and a variety of other industrial facilities. The current model version incorporates the techniques and procedures for exposure modeling developed by the MOE and Health Canada, the US EPA and published scientific literature sources. The equations used in this current model, as well as a "worked example" of calculations, are provided in **Appendix G.**

7.4.3.1 Exposure Analysis of Particulate Matter

The inhalation of ambient air is the only pathway where receptors can be directly exposed to Facility emissions of airborne Particulate Matter. Concurrently, the size of the airborne particles to which people are exposed is one of the most important aspects in determining the potential for health risk resulting from particulate matter (PM) exposure. Size is directly related to where particles will be deposited in specific parts of the respiratory tract. Particles larger than approximately 10µm in aerodynamic diameter (>PM_{10}) are deposited almost exclusively in the nose, throat, and upper respiratory tract, and tend to be coughed out over a very short period of time. This size range is considered outside the inhalable range for people, since these particles are too large to be deposited in the lung. Particles greater than PM_{10} are therefore not considered as critical as the fractions less than PM_{10} since they are not absorbed into the body. A schematic of this phenomena is presented in Figure 7-9.

Fine particles are defined as having an aerodynamic diameter of <2.5µm and ultrafine particulate matter have been defined as particles which are less than 0.1µm in aerodynamic diameter. Fine and ultrafine particulate matter have the potential to cause adverse health effects due to their small size, high surface area, and their ability to reach the alveoli and penetrate the deepest part of the lung structure. Unlike PM_{10}, fine and ultrafine particulate matter are not likely to be coughed out. Ultrafine particles (also commonly referred to as nanoparticles) also have a greater tendency than larger particles to carry bound chemical components into the lung (e.g. gases, organic compounds and metals). Due to their small size these particles also tend to be present in greater numbers, and they possess a greater total surface area than larger particles of the same mass. As a result, ultrafine particles have the capacity to produce potentially serious respiratory and cardiovascular complications.

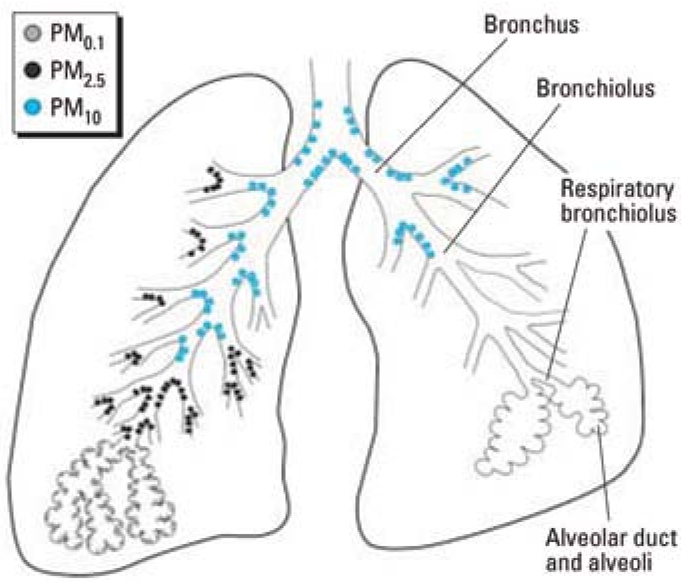


Figure 7-9 Deposition of Particulate Matter (Source: Cormier et al., 2006)

Thus, when examining the potential impacts of exposure to PM on human populations, the emphasis in an HHRA is typically focused on the fine and/or ultrafine fractions, as opposed to the broader size fraction represented by total suspended particulate (TSP), which comprises particles ranging up to 44 µm. PM_{10} is also widely used to evaluate potential health issues, since this size of particle can also travel deep into the lung. When both sets of data are available (PM_{10} and $PM_{2.5}$), the $PM_{2.5}$ data tends to carry more weight in determining the potential for health risks, due to the finer size of the particles.

The US EPA no longer recommends the use of either TSP or PM_{10} as monitoring metrics for human health evaluations, since $PM_{2.5}$ provides a stronger linkage to answer health-related questions (Federal Register, 2006). However, Ontario (as well as other Provinces) continues to have air quality benchmarks for both PM_{10} and $PM_{2.5}$. While TSP also includes the very fine fractions (as it represents the broad range of particle sizes <44 µm), the presence of the larger sized particles in this fraction (which are not carried deep into the lung and therefore are not toxicologically significant) precludes the use of TSP as an air quality parameter in a HHRA.

TSP is considered to be an indicator of aesthetic concerns (such as visibility or soiling), rather than an indicator that is relevant to human health. Therefore, while exposures and risks related to TSP has been included in the current assessment, for the exposure assessment of particulate matter in this HHRA, both $PM_{2.5}$ and PM_{10} data were considered to be the primary metrics for evaluating exposure and any resulting potential human health risks arising from PM.

Ultrafine particulate matter have been evaluated in the HHRA and are assessed as part of the vapour phase.

The Air Quality modeling predicts both particulate phase and vapour phase concentrations of COPC from the stack of the Facility. For some COPC they are emitted as both a vapour (gas) and a particulate. By accounting for both phases of emissions the Study Team has captured the ultrafine (nanoparticle) phase of emissions; however, it is recognized that this is a source of uncertainty in the HHRA.

7.4.3.2 Secondary Particulate Matter Formation

Secondary Particulate Matter (SPM) formation results from a series of chemical reactions between precursor gases, and can be an important constituent of Particulate Matter (PM). In some cases, compounds such as ammonium nitrate have be shown to make up more than 50% of $PM_{2.5}$ in urban areas, and even more in non-urban areas (Watson and Chow 2002). As concentrations for both nitrates and sulphates can be estimated RIVAD/ARM3 Chemical Mechanism, model output was used to estimate the effect the proposed project might have on SPM formation.

For the purposes of this study, SPM formation was considered by assuming that sufficient ammonium was present in the atmosphere to react with all the sulphate and nitrate in the atmosphere. The resultant products (ammonium sulphate and ammonium nitrate) were assumed to constitute all SPM in the region of interest. This is a conservative assumption as in reality, where a fraction of either the sulphate and nitrate aerosols may not combine with the ammonium ion to form SPM, the relative concentration could be much smaller. The model-predicted ground-level concentrations of sulphate and nitrate were used to estimate Secondary Particulate Matter as follows:

$$[\mathrm{SPM}]_{\mathrm{conc}} = 1.376\,[\mathrm{SO_4}]_{\mathrm{conc}} + 1.291\,[\mathrm{NO_3}]_{\mathrm{conc}}$$

Where the concentrations in the equations above are expressed in units of $\mu g/m^3$, and the leading constants are the respective ratios of the molecular mass of ammonium to those of sulphate/nitrate (Malm, 2000).

All $PM_{2.5}$ data reported in the HHERA includes secondary particulate matter.

7.5 Hazard Assessment

All chemicals (anthropogenic and natural) have the potential to cause toxicological effects in people who are exposed to them; however, it is the chemical concentration, the route of exposure, the duration of exposure, and the inherent toxicity of the chemical that determines the level of effect and subsequent potential for unacceptable risk to the exposed receptor. In this stage of the risk assessment, literature on the toxic potential of each COPC was reviewed and toxicity reference values (TRVs) were selected for use in the HHRA. For the purpose of this assessment, TRVs are defined as doses of chemicals (generally derived from animal laboratory studies or based on results of actual human exposure) or regulatory benchmarks (e.g., also health-based but often policy derived) that receptors can be exposed to without the development of unacceptable health effects. Details regarding TRV derivation for each COPC are described in the toxicity profiles found in **Appendix H**.

Two basic and quite different chemical categories are commonly recognized by regulatory agencies and applied when estimating toxicological criteria for humans (FDA 1982; US EPA 1989). These are the threshold approach, typically used to evaluate non-carcinogens, and the non-threshold approach (or the mathematical model-unit risk estimation approach), typically used for carcinogenic compounds.

For chemicals that follow a threshold dose-response, a benchmark or threshold level must be exceeded in order for toxicity to occur, and lowest observable adverse effect level (LOAEL) and no-observable adverse effect level (NOAEL), can be determined. The addition of uncertainty factors (or safety factors) to LOAELs or NOAELs results in the derivation of a TRV that is expected to be “safe” to sensitive subjects following exposure for a prescribed period of time. Uncertainty factors are generally 10-fold factors used to account for a number of extrapolations that may be required to derive a TRV (e.g., to account for individual sensitivity towards a chemical, extrapolations that need to be made when applying animal toxicity data to human TRVs; US EPA 1993; 2002).

For chemicals that follow non-threshold dose-responses, a specific dose where toxic effects manifest themselves cannot be identified. Such is the case for carcinogenic chemicals. Regulatory agencies such as Health Canada and the US EPA assume that any level of long-term exposure to carcinogenic chemicals is associated with some “hypothetical cancer risk”. As a result, regulatory agencies have typically employed acceptable incremental lifetime cancer risk (ILCR) levels.

The terminology used to define threshold and non-threshold TRVs differs according to the source and type of exposure and often varies between regulatory jurisdictions. For the assessment, generic nomenclature has been developed, with the following terms and descriptions commonly used:

- **Reference Concentration (RfC):** an RfC can be defined as (i.e., inhalation NOAEL or LOAEL with uncertainty factors applied) the acceptable level of an airborne chemical for which the primary route of exposure is inhalation. It is expressed as a concentration of the chemical in air (i.e., µg/m^3) and applies only to threshold chemicals.

- **Benchmark (Inhalation):** Similar to reference concentrations, regulatory benchmarks are also health-based but often policy derived exposure limits. For this assessment only health-based benchmarks were used (with the exception of those used for particulate matter). Benchmarks are acceptable levels of airborne chemicals and are generally expressed as a concentration of chemical in air (i.e., µg/m^3) and apply only to threshold chemicals.
- **Reference Dose (RfD):** A RfD refers to the acceptable level or dose of a chemical for which exposure occurs through multiple pathways (i.e., inhalation, ingestion and dermal). It is most commonly expressed in terms of the total intake of the chemical per unit of body weight (i.e., micrograms per kilogram of body weight per day, µg/kg bw/d). This term applies only to threshold chemicals.
- **Unit Risk:** The US EPA defines a unit risk value as "…the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 µg/L in water, or 1 µg/m^3 in air…". A unit risk value of 3.0 x 10^{-6} per µg/m^3 would mean that under a upper worst-case estimate, three excess cancer cases are expected to develop per one million (1,000,000) people, if exposed every day for a lifetime to 1 µg of the chemical per m^3 of air.
- **Cancer Slope Factor (SF):** The US EPA defines the SF as "[a]n upper bound, approximating a 95% confidence limit, on the increased cancer risk from a lifetime exposure to an agent. This estimate, usually expressed in units of proportion (of a population) affected per mg/kg-day, is generally reserved for use in the low-dose region of the dose-response relationship, that is, for exposures corresponding to risks less than 1 in 100."

The toxicity of a chemical often depends on whether or not exposure has been acute (short-term) or chronic (long-term) and TRVs need to be differentiated accordingly.

- **Acute:** The amount or dose of a chemical that can be tolerated without evidence of adverse health outcomes on a short-term basis. These limits are routinely applied to conditions in which exposures extend from minutes through several hours or several days only (ATSDR, 2006). For the current HHRA, risks will be evaluated based upon 1- or 24-hour exposure periods.
- **Chronic:** The amount of a chemical that is expected to be without health outcomes, even when exposure occurs continuously or regularly over extended periods, possibly lasting for periods of at least a year, and possibly extending over an entire lifetime (ATSDR, 2006).

When TRVs or inhalation benchmarks for a particular COPC were available from multiple regulatory agencies, all of the TRVs were reviewed and professional judgment of an experienced toxicologist was used to select the most appropriate TRV. The most critical considerations in selecting TRVs were the source (it must be derived by a reputable agency), the data used to derive the limit, the date the TRV was derived (it must be as up to date as possible) and its relevance in terms of duration and route of exposure. The TRVs and inhalation benchmarks employed in the HHRA have been obtained from regulatory agencies including:

- Ontario Ministry of the Environment (MOE);
- Health Canada;
- US EPA Integrated Risk Information System (IRIS);
- Agency for Toxic Substances and Disease Registry (ATSDR);
- Canadian Council of the Ministers of the Environment (CCME);
- World Health Organization (WHO);
- California Environmental Protection Agency (CalEPA);
- Texas Commission on Environmental Quality (TCEQ); and,
- Alberta Environment (AENV).

A summary of the non-carcinogenic and carcinogenic TRVs used in both the inhalation and multi-pathway exposure assessment are presented in Tables 7-2 through 7-4.

In addition to the list of TRVs complied for this risk assessment, bioavailability factors (specifically oral and dermal) were also compiled from either Health Canada (2004a) or the US Department of Energy's Oak Ridge National Laboratory Risk Assessment Information System (RAIS) database. Bioavailability refers to the amount of a chemical that reaches the bloodstream once it has entered the body through a specific route. Oral bioavailability, then, refers to the fraction of a chemical that reaches the bloodstream after ingestion and its partial passage through the gastrointestinal tract. Similarly, dermal bioavailability refers to the fraction of chemical that reaches the bloodstream after being coming in contact with the skin. Bioavailability factors used in this risk assessment are summarized in Section 7.5.2.1.

The approach used to assess chemical mixtures in this HHRA, and particularly additivity, is outlined in Section 7.5.2.2.

7.6 Inhalation Toxicity Reference Values

Inhalation TRVs for each CAC and COPC (where available), as well as key critical health outcome and regulatory source for each TRV, are provided in Table 7-2 and Table 7-3 respectively. Refer to the toxicological profile for each COPC provided in **Appendix H** for a detailed discussion of the relevant background information supporting the selected TRV.

Table 7-2 Summary of TRVs and Inhalation Benchmarks Selected for CACs in the HHRA

CAC	Duration	Value ($\mu g/m^3$)	Critical Effect	Reference Type	Source
Sulfur Dioxide (SO_2)	1-Hour	690	Health-Based	Benchmark	MOE AAQC, 2008b
	24-Hour	275	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	29	Health-Based	Benchmark	Health Canada, 2006
Hydrogen Chloride (HCl)	1-Hour	75	Health-Based	Benchmark	AENV AAQO, 2007
	24-Hour	20	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	20	Hyperplasia of nasal mucosa larynx and trachea	RfC	US EPA, 1995c
Hydrogen Fluoride (HF)	1-Hour	25	Redness of the skin and some burning and irritation of the nose and eyes	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	NV			
Nitrogen Dioxide (NO_2)	1-Hour	400	Respiratory Irritation	Benchmark	MOE AAQC, 2008b
	24-Hour	200	Respiratory Irritation	Benchmark	MOE AAQC, 2008b
	Annual Average	60	Health-Based	Benchmark	Health Canada, 2006
Carbon Monoxide	1-Hour	15,000	carboxyhaemoglobin (COHb) blood level of less than 1%.	Benchmark	Health Canada, 1994b
	24-Hour	NV			
	Annual Average	NV			

CAC	Duration	Value (µg/m³)	Critical Effect	Reference Type	Source
Particulate Matter (PM_{10})	1-Hour	NV			
	24-Hour	50	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	NV			
Particulate Matter ($PM_{2.5}$)	1-Hour	NV			
	24-Hour	30	Health-Based	Benchmark	CCME, 2006b
	Annual Average	NV			
Total Particulate Matter	1-Hour	NV			
	24-Hour	120	Health-Based	Benchmark	Health Canada, 2006
	Annual Average	60	Health-Based	Benchmark	Health Canada, 2006
Ammonia (Slip at Stack)	1-Hour	3200	Eye and respiratory irritation	Benchmark	CalEPA REL, 2008a
	24-Hour	100	Eye and respiratory irritation	Benchmark	MOE AAQC, 2008b
	Annual Average	100	Lack of evidence of decreased pulmonary function or changes in subjective symptomatology	RfC	US EPA, 1991h

Note: NV – No Value, AAQC – Ambient Air Quality Criteria, AAQO - Ambient Air Quality Objective, ESL- Effects Screening Level, REL – Reference Effect Level, MOE- Ontario Ministry of Environment, RfC – Reference Concentration, TC- Tolerable Concentration, TCEQ – Texas Commission on Environmental Quality, CalEPA – California Environmental Protection Agency, CCME – Canadian Council of Ministers of the Environment, AENV – Alberta Environment, US EPA – United States Environmental Protection Agency

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
Chlorinated Polycyclic Aromatics					
Dioxins as Toxic Equivalents (TEQ) [d]	1-Hour	NV			
	24-Hour	5 pg_{TEQ}/m^3	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	1.03 pg_{TEQ}/m^3	Route-to-Route extrapolation from oral dose	RfD	Health Canada 2004b
Polychlorinated Biphenyls (PCB)	1-Hour	0.1	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	0.15	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	NV			
Metals					
Antimony	1-Hour	5	Skin and upper respiratory tract irritation	Benchmark	TCEQ ESL, 2008
	24-Hour	25	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	0.2	Pulmonary Toxicity, Chronic Interstitial Inflammation	RfC	US EPA, 1995a
Arsenic	1-Hour	0.2	Decreased fetal weight in mice	Benchmark	CalEPA REL, 2008a
	24-Hour	0.3	Irritation, sensitization, immune suppression, teratogenesis, genotoxicity, and carcinogenicity in exposed individuals	Benchmark	MOE AAQC, 2008b
	Annual Average	0.015	Decreased intellectual function in 10 year old children	Benchmark	CalEPA REL, 2008a

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
	Carcinogenic Annual Average	0.0043	Lung Cancer	UR	US EPA, 1998a
Barium	1-Hour	5	Eye, Skin and Gastrointestinal Tract irritation; muscular stimulation	Benchmark	TCEQ ESL, 2008
	24-Hour	10	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	1	Cardiovascular Effects	RfC	RIVIM, 2001
Beryllium	1-Hour	0.02	lung cancer and beryliosis	Benchmark	TCEQ ESL, 2008
	24-Hour	0.01	Respiratory Irritation	Benchmark	MOE AAQC, 2008b
	Annual Average	0.007	Beryllium sensitization and progression to chronic beryllium disease	Benchmark	CalEPA REL, 2008a
	Carcinogenic Annual Average	0.0024	Lung Cancer	UR	US EPA, 1998b
Boron	1-Hour	50	Eye and respiratory tract irritation	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	5	Eye and respiratory tract irritation	Benchmark	TCEQ ESL, 2008
Cadmium	1-Hour	0.1	Kidney Damage	Benchmark	TCEQ ESL, 2008
	24-Hour	0.025	Respiratory Irritation	Benchmark	MOE AAQC, 2008b
	Annual Average	0.005	Kidney Effects	Benchmark	MOE AAQC, 2007

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
	Carcinogenic Annual Average	0.0098	Detection of Lung Tumors	UR	Health Canada 2004b
Chromium (VI)	1-Hour	0.1	Lung Cancer	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	0.1	Respiratory Effects	RfC	US EPA, 1998
	Carcinogenic Annual Average	0.076	Increased incidence of lung cancer	UR	Health Canada 2004b
Chromium (Total)	1-Hour	1	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	60	Kidney effects in humans	RfC	RIVM, 2001
	Carcinogenic Annual Average	0.0109	Increased incidence of lung cancer	UR	Health Canada 2004b
Cobalt	1-Hour	0.2	Asthma; pulmonary function, myocardial effects	Benchmark	TCEQ ESL, 2008
	24-Hour	0.1	Respiratory Irritation	Benchmark	MOE AAQC, 2008b
	Annual Average	0.1	Respiratory Irritation	RfC	WHO, 2006a
Lead	1-Hour	1.5	Impairment of hematopoietic system	Benchmark	AENV AAQO, 2007
	24-Hour	0.5	Neurological effects in children	Benchmark	MOE AAQC, 2008b
	Annual Average	0.5	Blood lead levels	RfC	WHO, 2000

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
Mercury (Inorganic)	1-Hour	0.6	CNS disturbances in rat offspring	Benchmark	CalEPA REL, 2008a
	24-Hour	2	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	0.3	Neurotoxicity	Benchmark	CalEPA REL, 2008a
Nickel	1-Hour	6	Small decrements in airway function tests, especially in asthmatics	Benchmark	CalEPA REL, 2008a
	24-Hour	NV			
	Annual Average	0.05	Respiratory system; hematopoietic system	Benchmark	CalEPA REL, 2008c
Phosphorus [d]	1-Hour	NV			
	24-Hour	NV			
	Annual Average	6.4×10^7	Route-to-route extrapolation from oral reference dose	RfD	Health Canada, 1990
Silver	1-Hour	0.1	Argyria	Benchmark	TCEQ ESL, 2008
	24-Hour	1	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	0.01	Argyria	Benchmark	TCEQ ESL, 2008
Selenium	1-Hour	2	Eye and Upper Respiratory Tract Irritation	Benchmark	TCEQ ESL, 2008
	24-Hour	10	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	0.2	Eye and Upper Respiratory Tract Irritation	Benchmark	TCEQ ESL, 2008
Thallium	1-Hour	1	Alopecia	Benchmark	TCEQ ESL, 2008

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
	24-Hour	NV			
	Annual Average	0.1	Alopecia	Benchmark	TCEQ ESL, 2008
Tin	1-Hour	20	Pneumoconiosis, eye and upper respiratory tract irritation, headache and nausea	Benchmark	TCEQ ESL, 2008
	24-Hour	10	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	2	Pneumoconiosis, eye and upper respiratory tract irritation, headache and nausea	Benchmark	TCEQ ESL, 2008
Vanadium	1-Hour	0.5	Lung irritation	Benchmark	TCEQ ESL, 2008
	24-Hour	1	Chronic upper respiratory tract symptoms	RfC	WHO, 2000
	Annual Average	1	Chronic upper respiratory tract symptoms	RfC	WHO, 2000
Zinc	1-Hour	50	Metal Fume Fever	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	5	Metal Fume Fever	Benchmark	TCEQ ESL, 2008
Chlorinated Monocyclic Aromatics					
1,2-Dichlorobenzene	1-Hour	30,500	Health-Based	Benchmark	MOE AAQC, 2008b
	24-Hour	NV			
	Annual Average	600	NOAEL from various semichronic animal studies	RfC	RIVM, 2001

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
1,2,4,5-Tetrachlorobenzene [d]	1-Hour	NV			
	24-Hour	NV			
	Annual Average	0.94	Route-to-route extrapolation from oral reference dose	RfD	Heath Canada, 2004
1,2,4 – Trichlorobenzene	1-Hour	400	Eye and Upper Respiratory Tract Irritation	Benchmark	TCEQ ESL, 2008
	24-Hour	400	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	7	Increase in the excretion of porphyrins	RfC	Health Canada 2004b
2,3,4,6-Tetrachlorophenol [d]	1-Hour	NV			
	24-Hour	NV			
	Annual Average	44.7	Route-to-route extrapolation from oral reference dose	RfD	Health Canada 2004b
2,4,6-Trichlorophenol	1-Hour	NV			
	24-Hour	NV			
	Annual Average	NV			
	Carcinogenic Annual Average	3.1×10^{-6}	Lymphomas or leukemias in male rats and hepatocellular adenomas or carcinomas in male and female mice.	UR	US EPA, 1994a
2,4-Dichlorophenol	1-Hour	530	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	53	Health-Based	Benchmark	TCEQ ESL, 2008

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
Pentachlorophenol	1-Hour	5	Eye and upper respiratory tract irritation; CNS impairment; and cardiac system impairment	Benchmark	TCEQ ESL, 2008
	24-Hour	20	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	0.5	Cardiac system impairment	Benchmark	TCEQ ESL, 2008
Hexachlorobenzene	1-Hour	0.25	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	0.025	Health-Based	Benchmark	TCEQ ESL, 2008
	Carcinogenic Annual Average	0.00046	Liver and renal tumours	UR	US EPA, 1996a
Pentachlorobenzene	1-Hour	1000	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	100	Health-Based	Benchmark	TCEQ ESL, 2008
Polycyclic Aromatic Hydrocarbons					
Acenaphthylene	1-Hour	1	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	NV			
	Carcinogenic Annual Average	TEF = 0.01			RIVM, 2001
Acenaphthene	1-Hour	1	Health-Based	Benchmark	TCEQ ESL, 2008

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
	24-Hour	NV			
	Annual Average	NV			
	Carcinogenic Annual Average	TEF = 0.001			RIVM, 2001; ATSDR 1995
Anthracene	1-Hour	0.5	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	0.05	Health-Based	Benchmark	TCEQ ESL, 2008
Benzo(a)anthracene	1-Hour	0.5	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	NV			
	Carcinogenic Annual Average	TEF = 0.1			Health Canada, 2007
Benzo(b)fluoranthene	1-Hour	0.5	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	NV			
	Carcinogenic Annual Average	TEF = 0.1			Health Canada, 2007
Benzo(k)fluoranthene	1-Hour	0.5	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	NV			

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
	Carcinogenic Annual Average	TEF = 0.1			Health Canada, 2007
Benzo(a)fluorene	1-Hour	0.5	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	0.05	Health-Based	Benchmark	TCEQ ESL, 2008
Benzo(b)fluorene	1-Hour	0.5	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	0.05	Health-Based	Benchmark	TCEQ ESL, 2008
Benzo(ghi)perylene	1-Hour	0.5	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	NV			
	Carcinogenic Annual Average	TEF = 0.01			Health Canada, 2007
Benzo(a)pyrene	1-Hour	NV			
	24-Hour	0.001	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	NV			
	Carcinogenic Annual Average	0.087	Lung and Skin Cancer	UR	WHO, 2000
Benzo(e)pyrene	1-Hour	0.5	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
	Annual Average	NV			
	Carcinogenic Annual Average	TEF = 0.01			IPCS, 1998
Chrysene	1-Hour	0.5	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	NV			
	Carcinogenic Annual Average	TEF = 0.01			Health Canada, 2007
Dibenzo(a,c)anthracene	1-Hour	NV			
	24-Hour	NV			
	Annual Average	NV			
	Carcinogenic Annual Average	TEF = 0.1			IPCS, 1998
Dibenzo(a,h)anthracene	1-Hour	0.5	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	NV			
	Carcinogenic Annual Average	TEF =1			Health Canada, 2007
Fluoranthene	1-Hour	0.5	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
	Annual Average	NV			
	Carcinogenic Annual Average	TEF = 0.001			Health Canada, 2007
Fluorene	1-Hour	10	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	1	Health-Based	Benchmark	TCEQ ESL, 2008
Indeno(1,2,3 – cd)pyrene	1-Hour	0.5	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	NV			
	Carcinogenic Annual Average	TEF = 0.1			Health Canada, 2007
1 – methylnaphthalene[c]	1-Hour	NV			
	24-Hour	NV			
	Annual Average	3	Nasal effects, hyperplasia, and metaplasia in respiratory and olfactory epithelium, respectively	RfC	US EPA, 1998c
2 – methylnaphthalene[c]	1-Hour	NV			
	24-Hour	NV			
	Annual Average	3	Nasal effects, hyperplasia, and metaplasia in respiratory and olfactory epithelium, respectively	RfC	US EPA, 1998c
Naphthalene	1-Hour	NV			

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
	24-Hour	22.5	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	3	Nasal effects, hyperplasia, and metaplasia in respiratory and olfactory epithelium, respectively	RfC	US EPA, 1998c
Perylene	1-Hour	0.5	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	NV			
	Carcinogenic Annual Average	TEF = 0.001			IPCS, 1998
Phenanthrene	1-Hour	0.5	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	NV			
	Carcinogenic Annual Average	TEF = 0.001			Health Canada, 2007
Pyrene	1-Hour	0.5	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	NV			
	Carcinogenic Annual Average	TEF = 0.001			RIVM, 2001
Volatile Organic Compounds					
Acetaldehyde	1-Hour	NV			

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
	24-Hour	500	Tissue Damage	Benchmark	MOE AAQC, 2008b
	Annual Average	9	Degeneration of olfactory epithelium	RfC	US EPA, 1991a
	Carcinogenic Annual Average	5.8×10^{-7}	Increased incidence of nasal adenocarcinomas and squamous cell carcinomas (combined)	UR	Health Canada 2004d
Benzene	1-Hour	170	Depressed peripheral lymphocytes and depressed mitogen-induced blastogenesis of femoral B-lymphocytes in mice	Benchmark	TCEQ ESL, 2008
	24-Hour	29	Reduces lymphocyte proliferation following mitogen stimulation	RfC	ATSDR, 2008
	Annual Average	30	Decreased lymphocyte count	RfC	US EPA, 2003a
	Carcinogenic Annual Average	7.8×10^{-6}	Leukemia	UR	US EPA, 2000a
Biphenyl [d]	1-Hour	NV			
	24-Hour	NV			
	Annual Average	224	Route-to-route extrapolation from oral dose	RfD	US EPA, 1989b
Bromodichloromethane	1-Hour	20	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	2	Health-Based	Benchmark	TCEQ ESL, 2008
Bromoform	1-Hour	50	Upper Respiratory Tract	Benchmark	TCEQ ESL, 2008

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
			irritation; liver damage		
	24-Hour	55	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	5	Upper Respiratory Tract irritation; liver damage	Benchmark	TCEQ ESL, 2008
Bromomethane	1-Hour	120	Health-Based	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	5	Degenerative and proliferative lesions of the olfactory epithelium of the nasal cavity	RfC	US EPA, 1992a
Carbon tetrachloride	1-Hour	130	Skin and Eye Irritation; CNS depression; liver, kidney injury; potential occupational carcinogen	Benchmark	TCEQ ESL, 2008
	24-Hour	2.4	Central Nervous System Effects	Benchmark	MOE AAQC, 2008b
	Annual Average	190	Liver Effects	RfC	ATSDR, 2005a
	Carcinogenic Annual Average	1.5×10^{-5}	Hepatocellular carcinomas/hepatomas	UR	US EPA, 1991d
Chloroform	1-Hour	100	Increase in the incidence of renal tumours	Benchmark	TCEQ ESL, 2008
	24-Hour	1	Central nervous system effects	Benchmark	MOE AAQC, 2008b
	Annual Average	100	Liver Effects	RfC	ATSDR, 1997
	Carcinogenic Annual Average	2.3×10^{-5}	Hepatocellular carcinomas	UR	US EPA, 2001

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
Dichlorodifluoromethane	1-Hour	50,000	Cardiac sensitization	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	5000	Cardiac sensitization	Benchmark	TCEQ ESL, 2008
1,1-Dichloroethene	1-Hour	210	Centrilobular swelling in liver (mice)	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	200	Liver Effects	RfC	US EPA, 2002a
Dichloromethane	1-Hour	14,000	Subtle impairment of the central nervous system.	Benchmark	CalEPA REL, 1999
	24-Hour	220	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	400	Carboxyhaemoglobin formation above 2% in human workers	Benchmark	CalEPA REL, 1999
	Carcinogenic Annual Average	4.7×10^{-7}	Increased incidence of both hepatocellular adenomas and carcinomas in mice	UR	US EPA, 1995b
Ethylbenzene	1-Hour	NV			
	24-Hour	1000	Dizziness, throat and eye irritation	Benchmark	MOE AAQC, 2008b
	Annual Average	1000	Developmental Toxicity	RfC	US EPA, 1991e
Ethylene Dibromide (1,2-dibromoethane)	1-Hour	4	Skin, Eye, Upper Respiratory Irritation; dermatitis with vesiculation; liver, heart, spleen, kidney damage; reproductive effects; potential occupational	Benchmark	TCEQ ESL, 2008

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
			carcinogen		
	24-Hour	3	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	9	Inflammation of the nasal cavity	RfC	US EPA, 2004d
	Carcinogenic Annual Average	0.0006	Nasal cavity, hemangiosarcomas, mesotheliomas	UR	US EPA, 2004d
Formaldehyde	1-Hour	15	Eye and nose irritation, symptoms of rhinitis	Benchmark	TCEQ ESL, 2008
	24-Hour	65	Chronic human health effects and short-term odor irritation	Benchmark	MOE AAQC, 2008b
	Annual Average	9	Respiratory Irritation	Benchmark	CalEPA REL, 2008a,d
	Carcinogenic Annual Average	5.3×10^{-6}	Nasal squamous tumours	UR	Environment Canada, 2001
Tetralin[b]	NV				
O-terphenyl	1-Hour	50	Upper Respiratory Tract and Eye irritation	Benchmark	TCEQ ESL, 2008
	24-Hour	NV			
	Annual Average	5	Upper Respiratory Tract and Eye irritation	Benchmark	TCEQ ESL, 2008
Tetrachloroethylene	1-Hour	20,000	Eye, nose and throat irritation. Headache high-headedness and loss of coordination	Benchmark	CalEPA REL, 2008a
	24-Hour	360	Adverse effects on the liver kidney, lungs	Benchmark	MOE AAQC, 2008b
	Annual	360	Effects on liver, kidneys	RfC	Health Canada

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
	Average		and lungs		2004b
	Carcinogenic Annual Average	5.2×10^{-6}	Nasal squamous tumours	UR	WHO, 2006b
Toluene	1-Hour	37,000	Headache, dizziness, slight eye and nose irritation	Benchmark	CalEPA REL, 2008a
	24-Hour	NV			
	Annual Average	5000	Neurological Effects	RfC	US EPA, 2005d
1,1,1 -Trichloroethane	1-Hour	9000	Neurological Effects	RfC	US EPA, 2007
	24-Hour	6000	Neurological Effects	RfC	US EPA, 2007
	Annual Average	5000	Liver Effects	RfC	US EPA, 2007
1,1,2 Trichloroethylene	1-Hour	540	CNS impairment; cognitive decrements; and renal toxicity	Benchmark	TCEQ ESL, 2008
	24-Hour	12	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	54	CNS impairment; cognitive decrements; and renal toxicity	Benchmark	TCEQ ESL, 2008
	Carcinogenic Annual Average	6.14×10^{-7}	Cancer	UR	Health Canada 2004b
Trichlorofluoromethane	1-Hour	NV			
	24-Hour	6000	Health-Based	Benchmark	MOE AAQC, 2008b
	Annual Average	NV			

Table 7-3 Inhalation TRVs and Inhalation Benchmarks for Selected COPC

COPC	Duration	Value [a]	Critical Effect	Reference Type	Agency
Vinyl chloride	1-Hour	20,000	Mild headache and dryness of eyes and nose	Benchmark	TCEQ ESL, 2009
	24-Hour	1	Angiosarcoma in rats	Benchmark	MOE AAQC, 2008b
	Annual Average	100	Liver cell polymorphism	RfC	US EPA, 2000b
	Carcinogenic Annual Average	8.8×10^{-6}	Liver Cancer	UR	US EPA, 2000b
Xylenes, m-, p- and o-	1-Hour	22,000	Irritation of the eyes, nose and throat	Benchmark	CalEPA REL, 2008a
	24-Hour	730	Neurological effects	Benchmark	MOE AAQC, 2008b
	Annual Average	100	Impaired motor coordination	RfC	US EPA, 2003b

[a] Units: Non-carcinogenic COPC ($\mu g/m^3$) , Carcinogenic COPC ($(\mu g/m^3)^{-1}$),

[b] No TRV was available for this COPC; therefore it was not evaluated in the inhalation assessment.

[c] Naphthalene used as surrogate

[d] Route-to-Route extrapolation was calculated as follows: Oral TRV was modified by multiplying by the typical adult body weight (70.7 kg) and dividing by the inhalation rate (15.8 m^3/day) as per Health Canada (2004a).

Notes: NV – No Value, AAQC – Ambient Air Quality Criteria, AAQO - Ambient Air Quality Objective, ESL- Effects Screening Level, REL – Reference Effect Level, MOE- Ontario Ministry of Environment, RfC – Reference Concentration, IPCS – International Program on Chemical Safety, TCEQ – Texas Commission on Environmental Quality, CalEPA – California Environmental Protection Agency, CCME – Canadian Council of Ministers of the Environment, AENV – Alberta Environment, US EPA – United States Environmental Protection Agency, WHO – World Health Organization, TEF – Toxic Equivalency Factor, RIVM - Rijksinstituut voor Volksgezondheit en Milieu (National Institute for Public Health and the Environment, The Netherlands)

7.6.1.1 World Health Organization Values Retained for the HHRA

In addition to the CAC and COPC values outlined in Table 7-2 and Table 7-3, WHO (2005) benchmarks for SO_2, NO_2, PM_{10} and $PM_{2.5}$ were also evaluated (Table 7-4). This was done because in some cases the benchmarks provided by the WHO (2005) are more conservative than those used for regulatory purposes in Canada. In the case of SO_2, the WHO (2005) interim value of 125 was selected because it also reflects the European Ambient Air Quality Directive (EU, 2008). The WHO (2005) benchmarks are only intended to act as support documentation for country-regulated air quality by standards; therefore, they are only provided for comparative purposes.

Table 7-4 WHO (2005) Inhalation Benchmarks Retained for the HHRA

CAC	Duration	Value (µg/m^3)	Critical Effect	Reference Type
Sulfur Dioxide (SO_2)	1-Hour	NV		
	24-Hour	125[a]	Health-Based	Benchmark
	Annual Average	NV		
Nitrogen Dioxide (NO_2)	1-Hour	200	Health-Based	Benchmark
	24-Hour	NV		
	Annual Average	40	Health-Based	Benchmark
PM_{10}	1-Hour	NV		
	24-Hour	50	Health-Based	Benchmark
	Annual Average	20	Health-Based	Benchmark
$PM_{2.5}$	1-Hour	NV		
	24-Hour	25	Health-Based	Benchmark
	Annual Average	10	Health-Based	Benchmark

[a]: WHO (2005) Interim value

7.7 Oral Toxicity Reference Values

Oral TRVs for each COPC (where available), as well as key critical health outcomes and regulatory source for each TRV, are provided in Table 7-5. Refer to the toxicological profile for each COPC provided in Appendix H for a detailed discussion of the relevant background information supporting the selected TRV.

Table 7-5 Oral TRVs for Selected COPC

COPC	Toxicity Reference Value	Value [b]	Critical Effect	Reference Type	Source
Chlorinated Polycyclic Aromatics					
Dioxins as Toxic Equivalents (TEQ)	Non-carcinogenic TRV	2.3×10^{-9}	Reproductive effects	RfD	Health Canada 2004b
	Carcinogenic Slope Factor	NA			
Polychlorinated Biphenyls (PCB)	Non-carcinogenic TRV	2.0×10^{-5}	Immunological effects	RfD	US EPA, 1996d
	Carcinogenic Slope Factor	NA			
Metals					
Antimony	Non-carcinogenic TRV	0.0004	Longevity, clinical chemistry	RfD	US EPA, 1991b
	Carcinogenic Slope Factor	NA			
Arsenic	Non-carcinogenic TRV	0.0003	Hyperpigmentation, keratosis and possible vascular complications	RfD	US EPA, 1993c
	Carcinogenic Slope Factor	1.50	Skin Cancer Prevalence	SF	US EPA, 1998a
Barium	Non-carcinogenic TRV	0.2	Nephropathy	RfD	US EPA, 2005e
	Carcinogenic Slope Factor	NA			
Beryllium	Non-carcinogenic TRV	0.002	Small intestinal lesions	RfD	US EPA, 1998b
	Carcinogenic Slope Factor	NA			
Boron	Non-carcinogenic TRV	0.2	Decreased fetal weight	RfD	US EPA, 2004c

Table 7-5 Oral TRVs for Selected COPC

COPC	Toxicity Reference Value	Value [b]	Critical Effect	Reference Type	Source
	Carcinogenic Slope Factor	NA			
Cadmium	Non-carcinogenic TRV	0.0005	Significant proteinuria	RfD	US EPA, 1994b
	Carcinogenic Slope Factor	NA			
Chromium (VI)	Non-carcinogenic TRV	0.001	Based on NOAEL from drinking water maximum acceptable concentration	RfD	Health Canada 2004b
	Carcinogenic Slope Factor	NA			
Chromium (Total)	Non-carcinogenic TRV	1.5	Kidney Effects	RfD	US EPA, 1998d
	Carcinogenic Slope Factor	NA			
Cobalt	Non-carcinogenic TRV	0.0014	Cardiomyopathy	RfD	RIVM, 2001
	Carcinogenic Slope Factor	NA			
Lead	Non-carcinogenic TRV	0.00185	Behavioural effects and learning disabilities in children	RfD	MOE, 1994
	Carcinogenic Slope Factor	NA			
Mercury (Inorganic)	Non-carcinogenic TRV	0.0003	Autoimmune effects	RfD	Health Canada 2004b
	Carcinogenic Slope Factor	NA			
Methylmercury	Non-carcinogenic TRV	0.0002	Neuropsychological dysfunctions	RfD	Health Canada, 2007b

Table 7-5 Oral TRVs for Selected COPC

COPC	Toxicity Reference Value	Value [b]	Critical Effect	Reference Type	Source
	Carcinogenic Slope Factor	NA			
Nickel	Non-carcinogenic TRV	0.02	Decreased body and organ weight	RfD	US EPA, 1996b
	Carcinogenic Slope Factor	NA			
Phosphorus	Non-carcinogenic TRV	14300	Recommended daily nutrient intake rate	RfD	Health Canada, 1990
	Carcinogenic Slope Factor	NA			
Silver	Non-carcinogenic TRV	0.005	Argyria	RfD	US EPA, 1991g
	Carcinogenic Slope Factor	NA			
Selenium	Non-carcinogenic TRV	0.005	Blood selenium levels shown to reflect clinical signs of selenium intoxication	RfD	US EPA, 1991f
	Carcinogenic Slope Factor	NA			
Thallium	Non-carcinogenic TRV	0.00008	No observed effects	RfD	US EPA, 1990b
	Carcinogenic Slope Factor	NA			
Tin	Non-carcinogenic TRV	0.3	decreased haemoglobin count	RfD	ATSDR, 2005b
	Carcinogenic Slope Factor	NA			
Vanadium	Non-carcinogenic TRV	0.009	Decreased hair cystine	RfD	US EPA, 1996c
	Carcinogenic Slope	NA			

Table 7-5 Oral TRVs for Selected COPC

COPC	Toxicity Reference Value	Value [b]	Critical Effect	Reference Type	Source
	Factor				
Zinc	Non-carcinogenic TRV	0.3	Decreased in erythrocyte Cu, Zn-superoxide dismutase	RfD	US EPA, 2005c
	Carcinogenic Slope Factor	NA			
Chlorinated Monocyclic Aromatics					
1,2-Dichlorobenzene	Non-carcinogenic TRV	0.43	Tubular regeneration in the kidney.	RfD	Health Canada 2004b
	Carcinogenic Slope Factor	NA			
1,2,4,5-Tetrachlorobenzene	Non-carcinogenic TRV	0.00021	Histopathological effects in the thyroid	RfD	Health Canada 2004b
	Carcinogenic Slope Factor	NA			
1,2,4 – Trichlorobenzene	Non-carcinogenic TRV	0.0016	Increases in the relative liver weight and absolute and relative kidney weight	RfD	Health Canada 2004b
	Carcinogenic Slope Factor	NA			
Pentachlorophenol	Non-carcinogenic TRV	0.006	Pigmentation of the liver and kidneys.	RfD	Health Canada 2004b
	Carcinogenic Slope Factor	0.12	Hepatocellular adenoma/carcinoma, pheochromocytoma/malignant pheochromocytoma, hemangiosarcoma/hemangioma	SF	US EPA, 1993e
Hexachlorobenzene	Non-carcinogenic TRV	0.0005	Liver effects	RfD	Health Canada 2004b

Table 7-5 Oral TRVs for Selected COPC

COPC	Toxicity Reference Value	Value [b]	Critical Effect	Reference Type	Source
	Carcinogenic Slope Factor	0.83	Liver and Thyroid Cancer	SF	Health Canada 2004b
Pentachlorobenzene	Non-carcinogenic TRV	0.001	Liver and Kidney effects	RfD	Health Canada 1996, 2004b
	Carcinogenic Slope Factor	NA			
Polycyclic Aromatic Hydrocarbons					
Acenaphthylene	TEF = 0.01				RIVM, 2001
Acenaphthene	Non-Carcinogenic TRV	$6x10^{-2}$	Hepatotoxicity	RfD	US EPA, 1994c
	TEF = 0.001				RIVM, 2001; ATSDR, 1995
Anthracene	Non-carcinogenic TRV	0.3	No observed Effects	RfD	US EPA, 1993d
Benzo(a)anthracene	TEF = 0.1				Health Canada, 2007
Benzo(a)fluorene[a]	NA				
Benzo(b)fluorene[a]	NA				
Benzo(b)fluoranthene	TEF = 0.1				Health Canada, 2007
Benzo(k)fluoranthene	TEF = 0.1				Health Canada, 2007
Benzo(ghi)perylene	TEF = 0.01				Health Canada, 2007
Benzo(a)pyrene	Carcinogenic Slope Factor	2.3	Stomach Tumours	SF	Health Canada 2004b

Table 7-5 Oral TRVs for Selected COPC

COPC	Toxicity Reference Value	Value [b]	Critical Effect	Reference Type	Source
Benzo(e)pyrene	TEF = 0.01				IPCS, 1998
Chrysene	TEF = 0.01				Health Canada, 2007
Dibenzo(a,c)anthracene	TEF = 0.1				IPCS, 1998
Dibenzo(a,h)anthracene	TEF = 1				Health Canada, 2007
Fluoranthene	TEF = 0.001				Health Canada, 2007
Fluorene	Non-carcinogenic TRV	0.04	Decreased RBC, packed cell volume and haemoglobin	RfD	US EPA, 1990a
Indeno(1,2,3 – cd)pyrene	TEF = 0.1				Health Canada, 2007
Perylene	TEF = 0.001				IPCS, 1998
Phenanthrene	TEF = 0.001				Health Canada, 2007
Pyrene	TEF = 0.001				RIVM, 2001
Volatile Organic Compounds					
Bromoform	Non-carcinogenic TRV	0.02	Hepatic Lesions	RfD	US EPA, 1991c
	Carcinogenic Slope Factor	0.0079	Neoplastic lesions (adenomatous polyps or adenocarcinomas)	SF	US EPA, 1991c
Carbon tetrachloride	Non-carcinogenic TRV	0.0007	Liver Lesions	RfD	US EPA, 1991d
	Carcinogenic Slope Factor	0.13	Liver Cancer	SF	US EPA, 1991d
Chloroform	Non-carcinogenic TRV	0.01	Moderate marked fatty cyst formation in the liver and elevated SGPT	RfD	US EPA, 2001

Table 7-5 Oral TRVs for Selected COPC

COPC	Toxicity Reference Value	Value [b]	Critical Effect	Reference Type	Source
	Carcinogenic Slope Factor	NA			
Dichloromethane	Non-carcinogenic TRV	0.05	Liver effects	RfD	Health Canada 2004b
	Carcinogenic Slope Factor	0.0075	Liver Cancer	SF	US EPA, 1995b
Trichloroethane, 1,1,1 -	Non-carcinogenic TRV	2	Reduced Body Weight	RfD	US EPA, 2007
	Carcinogenic Slope Factor	NA			
Trichlorofluoromethane	Non-carcinogenic TRV	0.3	Survival and histopathology	RfD	US EPA, 1992b
	Carcinogenic Slope Factor	NA			
O-Terphenyl[a]	NA				

[a]: No oral TRV was available for this COPC; therefore it was not carried forward in the HHRA

[b] Units: Non-carcinogenic COPC (mg/kg/day) , Carcinogenic COPC (mg/kg/day) $^{-1}$,

Notes: NA – Not Applicable, RfD – Reference Dose, US EPA – United States Environmental Protection Agency, WHO – World Health Organization, TEF – Toxic Equivalency Factor, RIVM- Rijksinstituut voor Volksgezondheit en Milieu (The National Institute for Public Health and the Environment, The Netherlands), IPCS- International Program on Chemical Safety

Relative dermal bioavailability factors for CoPCs are provided in Table 7-6. There were a limited number of metals and organic compounds that did not have published values. In this case the US EPA Region 3 provides guidance that default values of 1% for metals, 3% for VOCs and 10% for sVOCs (US EPA, 2008). However, to remain more conservative default values of 10% for metals and 20% for organics were selected for use in the HHRA.

Table 7-6 Relative Dermal Bioavailability Factors for Selected COPC

COPC	Relative Dermal Bioavailability
Polycyclic Aromatic Hydrocarbons	
Anthracene	0.29
Benzo(a)pyrene	0.2
Fluorene	0.2
Polychlorinated Biphenyls (PCBs)	
Aroclor 1254 (Total PCBs)	0.14[a]
Dioxins and Furans	
2,3,7,8-TCDD Equivalent	0.03[a]
Volatile Organic Compounds (VOCs)	
1,1,1-Trichloroethane	0.2[b]
Bromoform	0.11
Carbon Tetrachloride	0.2[b]
Chloroform	0.1
Dichloromethane	0.1
o-terphenyl	0.2[b]
Trichlorofluoromethane	0.2[b]
Chlorinated Monocyclic Aromatics	
1,2-Dichlorobenzene	0.1
1,2,4-Trichlorobenzene	0.08
1,2,4,5-Tetrachlorobenzene	0.1[a]
Pentachlorobenzene	0.01[a]
Hexachlorobenzene	0.13
Pentachlorophenol	0.11
Inorganics	
Antimony	0.1
Arsenic	0.03
Barium	0.1
Beryllium	0.03
Boron	0.1[b]
Cadmium	0.14
Chromium – Total	0.04

COPC	Relative Dermal Bioavailability
Chromium – VI	0.09
Cobalt	0.1
Lead	0.006
Mercury – Inorganic	0.05
Methylmercury	0.2
Nickel	0.35
Phosphorous	0.1[b]
Selenium	0.002
Silver	0.25
Thallium	0.01
Tin	0.1[b]
Vanadium	0.1
Zinc	0.02

Notes

[a] RAIS, 2006

[b] Metals, assumed 0.1
Organics, assumed 0.2

7.7.1.1 Chemical Mixtures and Additivity of Risks

In order to properly assess health risks to the human receptors, certain groups of chemicals were assessed as mixtures. For the purposes of this assessment, the carcinogenic PAHs have been assessed as a mixture, with potency based on benzo[a]pyrene, widely considered to be the most toxic and most carcinogenic of the PAHs. The modes of cancer induction of carcinogenic PAHs are all similar; however, their carcinogenic potencies are different. In this risk assessment, each of the carcinogenic PAHs has been assigned a toxic equivalency factor (TEF), relative to benzo(a)pyrene, to represent this differing potency. The TEFs were chosen based on the recommendations of the World Health Organization (WHO 1998), Health Canada (2007) and IPCS (1998), with benzo(a)pyrene being assigned a TEF of 1. PAH TEFs are summarized in Table 7-6.

Similar to the assessment of PAHs, the various dioxin and furan congeners are assessed in terms of 2,3,7,8 TCDD equivalents (Van den Berg 2006). 2,3,7,8 TCDD is considered to be the most toxic form of dioxin and dioxin-like compounds. The TCDD TEF scheme used in this assessment is summarized in Table 7-7.

Table 7-7 Toxic Equivalent Factors for PAH'S

PAH	TEF
Acenaphthylene	0.01
Acenaphthene	0.001
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Benzo(ghi)perylene	0.01
Benzo(a)pyrene	1
Benzo(e)pyrene	0.01
Chrysene	0.01
Dibenzo(a,c)anthracene	0.1
Dibenzo(a,h)anthracene	1
Fluoranthene	0.001
Indeno(1,2,3 – cd)pyrene	0.1
Perylene	0.001
Phenanthrene	0.001
Pyrene	0.001

Table 7-8 Toxic Equivalent Factors for PCDD/F'S

Congener	TCDD TEF
2,3,7,8-TCDD Equivalent	1
1,2,3,4,6,7,8-HpCDD	0.01
1,2,3,4,6,7,8-HpCDF	0.01
1,2,3,4,7,8,9-HpCDF	0.01
1,2,3,4,7,8-HxCDD	0.1
1,2,3,6,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDD	0.1
1,2,3,4,7,8-HxCDF	0.1
1,2,3,6,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDF	0.1

Congener	TCDD TEF
2,3,4,6,7,8-HxCDF	0.1
OCDD	0.003
OCDF	0.003
1,2,3,7,8-PeCDD	1
1,2,3,7,8-PeCDF	0.03
2,3,4,7,8-PeCDF	0.3
2,3,7,8-TCDF	0.1

In the assessment of toxic effects of a mixture, it is generally assumed that each component of the mixture causes the same type of adverse effects (i.e. similar mechanism of action) in a receptor, but perhaps at different potencies. It should be noted that combined toxic effects may also be produced in a receptor due to exposure to interacting COPCs. Combined effects could arise because two or more COPC target the same organs or tissues in the body, affect each others' bioavailabilities, or disturb biological processes in a similar manner. The categorized COPC and their potential endpoints in presented in Table 7-8.

Potential interactions were identified for specific COPC that may cause:

- Irritation in the eyes, nose or respiratory tract
- Liver toxicity
- Kidney toxicity;
- neurotoxicity;
- Developmental or reproductive effects; or
- Cancer (lung, skin, liver)

Table 7-9 Chemical Mixtures in the Human Health Risk Assessment

<table>
<tr><th>Exposure Characteristics</th><th>Potential Health Endpoint of Mixture</th><th colspan="2">Chemicals of Potential Concern</th></tr>
<tr><td rowspan="4">Acute Air Exposure</td><td>eye irritants</td><td colspan="2">ammonia, dichlorobenzene, ethylbenzene, naphthalene, selenium, toluene, xylenes</td></tr>
<tr><td>nasal irritants</td><td colspan="2">chromium, dichlorobenzene, ethylbenzene, toluene, xylenes</td></tr>
<tr><td>respiratory irritants</td><td colspan="2">ammonia, CO, beryllium, cadmium, cobalt, copper, hydrogen chloride, hydrogen fluoride, nickel, naphthalene, nitrogen dioxide, $PM_{2.5}$, sulfur dioxide, vanadium, tetrachloroethylene, xylenes</td></tr>
<tr><td>neurological effects (neurotoxicants)</td><td colspan="2">bromomethane, carbon tetrachloride, chloroform, ethylbenzene, dichloromethane, selenium, toluene, xylenes</td></tr>
<tr><td rowspan="7">Chronic Air Exposure</td><td>nasal irritants</td><td colspan="2">bromomethane, ethylene dibromide, naphthalene, selenium</td></tr>
<tr><td>respiratory irritants</td><td colspan="2">ammonia, barium, beryllium, cobalt, copper, hydrogen chloride, naphthalene, nickel, nitrogen dioxide, $PM_{2.5}$, selenium, sulfur dioxide, vanadium, zinc</td></tr>
<tr><td>neurological effects (neurotoxicants)</td><td colspan="2">1,1,1-trichloroethane, 1,1,2 – trichloroethylene, lead, mercury, selenium, toluene, xylenes</td></tr>
<tr><td>reproductive/developmental effects</td><td colspan="2">ethylbenzene, lead</td></tr>
<tr><td rowspan="3">cancer</td><td>lung carcinogens</td><td>arsenic, beryllium, cadmium, carcinogenic PAHs, chromium VI, total chromium</td></tr>
<tr><td>skin carcinogens</td><td>arsenic, carcinogenic PAHs</td></tr>
<tr><td>liver carcinogens</td><td>chloroform, hexachlorobenzene, methylene chloride, tetrachloroethylene, vinyl chloride</td></tr>
<tr><td rowspan="6">Chronic Oral Exposure</td><td>liver effects (hepatotoxicants)</td><td colspan="2">bromoform, chloroform, PCB’s</td></tr>
<tr><td>kidney effects (renal toxicants)</td><td colspan="2">barium, mercury</td></tr>
<tr><td>haematological effects (haematological toxicants)</td><td colspan="2">cobalt, tin, zinc</td></tr>
<tr><td>neurological effects (neurotoxicants)</td><td colspan="2">lead, methylmercury, selenium</td></tr>
<tr><td>reproductive/developmental effects</td><td colspan="2">boron, lead, methylmercury, nickel, 2,3,7,8-TCDD and related congeners</td></tr>
<tr><td>cancer</td><td>stomach carcinogens</td><td>bromoform, carcinogenic PAH groups</td></tr>
</table>

7.8 Risk Characterization

Risk characterization is the final step in a risk assessment. The purpose of the risk characterization is to combine the results from the exposure assessment (Section 7.4) and the information of the toxicity assessment (Section 7.5) to estimate the potential risks to human health from the COPC evaluated. This section briefly summarizes the general approach to the risk characterization for non-carcinogenic and carcinogenic COPC, respectively.

Risk characterization is essentially a comparison of the predicted human intake of a COPC to the TRV for that COPC. Evaluation of potential acute (short-term) and potential chronic (long-term) risks are completed in separate assessments. Potential inhalation acute health risks are evaluated using short-term intakes, based on 1-hour and 24-hour air concentrations, and compared with acute TRVs. Chronic risk is assessed both through inhalation and multiple pathway exposures; therefore risk estimates were separated as follows:

- acute inhalation (1-hr and 24-hr durations);
- chronic inhalation (annual average durations); and
- chronic multiple pathways.

The potential health effects associated with non-carcinogenic contaminants are assessed differently than those for carcinogenic contaminants. Non-carcinogenic contaminants are generally considered to act through a threshold mechanism where it is assumed that there is a dose (or concentration) that does not produce any adverse effect. As the dose or concentration increases to the point where the body can no longer process or excrete the chemical, an adverse effect may occur. This point is termed the threshold and is different for every chemical.

For contaminants for which the critical effect is assumed to have no threshold (i.e., carcinogens), it is assumed that there is some probability of harm to human health at any level of exposure. There is a dose-response relationship that converts estimated daily intakes averaged over a lifetime of exposure directly to an incremental risk of an individual developing cancer.

<u>Threshold Chemicals (Non-carcinogens)</u>

Human exposure to COPC may occur through exposure to five potential sources (air, produce, water, soil, agricultural products); therefore, CR or HQ values would need to be apportioned as appropriate. CR values are only applicable to exposure to air in the inhalation assessment; therefore because 100% of exposure is from one pathway and the TRVs and benchmark values are inhalation specific, it is appropriate to set the CR benchmark value at 1.0. HQs pertain only to assessments which have multiple routes of exposure; therefore the HQ value must be apportioned based on the number of exposure pathways evaluated in the assessment. Because this HHRA is evaluating multiple pathways a HQ value of 0.20 is allotted to represent a situation in which Project related exposures account for less than 20% of the TRV.

The following sections provide equations for the derivation of CR and HQ values.

Concentration Ratios (CR)

CR values were used to evaluate acute and chronic health risk from exposure to chemicals in air. CR values were calculated by dividing the predicted ground level air concentration (1-hour, 24-hour or annual average) by the appropriate toxicity reference value (reference concentration [RfC]) or health based inhalation benchmark (e.g. AAQC), according to the following example equation:

$$CR_{\,duration} = \frac{[Air]_{duration}}{RfC_{\,duration\ or\ health\ benchmark}}$$

Where:

$CR_{duration}$	Duration specific Concentration Ratio (unitless); calculated for 1-hr, 24-hr and chronic durations as appropriate
$[Air]_{duration}$	Predicted ground-level air concentration (µg/m^3); duration specific
$RfC_{duration}$	Reference concentration (µg/m^3); duration specific

A previously stated, a CR value of 1 is allotted because exposure in the inhalation assessment is only relevant to one exposure pathway (air); therefore the entire TRV or health based inhalation benchmark can be used. For those COPC that did not have an inhalation-route specific TRV, the values were derived using a Reference Dose (RfD). An RfD is the average daily intake, derived from multiple sources and pathways that an individual could experience that would result in no adverse health effects regardless of the source of exposure. Note, dioxins/furans and lead are treated separately as the exposure endpoint for these chemicals are consistent regardless of the exposure pathway; therefore, inhalation CR results were added to the predicted multi-pathway HQ values and compared to a benchmark of 0.2.

Hazard Quotient (HQ)

Hazard Quotient (HQ) values were used to express risk resulting from chronic exposures to non-carcinogenic chemicals, where the exposure to the chemical can occur through multiple pathways. HQ values were calculated by dividing the predicted exposure dose (via multiple pathways) by the appropriate toxicity reference value (reference dose [RfD]), according to the following example equation:

$$HQ = \frac{\sum Exp}{RfD}$$

Where:

HQ	Chronic Hazard Quotient (unitless); calculated for chronic exposures resulting from multiple pathway exposure
$\sum Exp$	Chronic exposure estimate resulting from the sum of multiple exposure pathways (µg/kg/day)
RfD	Chronic reference dose (µg/kg/day)

HQ calculated in this assessment are benchmarked to 0.2 for the purposes of effects assessment; therefore if a HQ is less than 0.2, the intake of the COPC by all routes of exposure does not exceed the tolerable intake and no adverse health effects are expected The use of a HQ benchmark of 0.2 is conservative as it allowed 80% of the tolerable daily intake of a chemical to be received from other sources including background. Note, a HQ of 1 is used to characterize methylmercury risk, because 100% of the receptors intake of methylmercury comes from the ingestion of fish pathway.

Non-Threshold Chemicals (Carcinogens)

For non-threshold carcinogenic chemicals, potential risks are expressed as incremental lifetime cancer risks (ILCRs) and lifetime cancer risks (LCRs), which represents the risk of an individual within a given population of developing cancer due to background exposures while, LCRs represent total lifetime cancer risks.

ILCR and LCR estimates were used to evaluate the increased cancer risk resulting from a lifetime of exposure to non-threshold genotoxic carcinogenic chemicals. ILCR estimates provide the incremental lifetime cancer risk resulting from emissions from the Project; while LCR estimated provide the overall background lifetime cancer risk associated with typical concentrations of the COPC within the LRASA (i.e. Baseline Case and Project Case).

Incremental Lifetime Cancer Risks (ILCR) and Lifetime Cancer Risks (LCR)

ILCR and LCR estimates were used to evaluate the cancer risk resulting from a lifetime of exposure to non-threshold genotoxic carcinogenic chemicals.

Direct Air Inhalation

ILCR/LCR estimates resulting from direct air inhalation were calculated as follows:

$$ILCR = [Air]_{project\ alone} \times UR$$

Where:

$ILCR$	Incremental (or additional) lifetime cancer risk (unitless)
$[Air]_{project\ alone}$	Predicted annual average ground-level air concentration from the Project Alone (µg/m^3)
UR	Chemical Specific unit risk (µg/m^3)$^{-1}$

$$LCR = [Air]_{all\ sources}\ x\ UR$$

Where:

LCR	Lifetime cancer risk (unitless)
$[Air]_{all\ sources}$	Predicted annual average ground-level air concentration from all sources (µg/kg/day)
UR	Chemical Specific unit risk (µg/m^3)$^{-1}$

Multi-Pathway Exposure

For those carcinogenic chemicals evaluated as part of the multi-pathway assessment, ILCR/LCR estimates resulting from a lifetime of exposure through multiple pathways were calculated as follows:

$$ILCR = \sum LADD_{project\ alone} \times CSF$$

Where:

$ILCR$	Incremental lifetime cancer risk (unitless)
$\sum LADD_{project\ alone}$	Sum of Lifetime Average Daily Doses *via* multiple pathways from the Project Alone (µg/kg/day)
CSF	Cancer Slope Factor $(\mu g/kg/day)^{-1}$

$$LCR = \sum LADD_{all\ sources} \times CSF$$

LCR	Lifetime cancer risk (unitless)
$\sum LADD_{all\ sources}$	Sum Lifetime Average Daily Dose *via* multiple pathways from all sources ($\mu g/m^3$)
CSF	Cancer Slope Factor $(\mu g/kg/day)^{-1}$

As stated, non-threshold chemicals that can alter genetic material (*i.e*., genotoxic) are capable of producing cancer. Regulatory agencies such as the MOE, Health Canada and the US EPA have therefore assumed that any level of long-term exposure to a carcinogenic compound is associated with some "hypothetical cancer risk". As a result, regulatory agencies have typically employed acceptable ILCR levels (*i.e*., incremental cancer risks over and above background cancer incidence) between 1-in-100,000 and 1-in-1,000,000. ILCRs generally consider risks related to a particular Facility (i.e. Facility alone) in that the cancer risks are expressed on an incremental or additional basis as compared to cancer risks related to all sources.

This HHRA is being conducted as part of the EA process for a Project in Ontario; therefore an ILCR benchmark of 1-in-1,000,000 or 1E-06 is being used to predict risk from the Project Case; this value is equivalent to the MOE benchmark. Any ILCR estimate less than 1E-06 indicates that predicted exposures are considered acceptable. Conversely, an ILCR greater than 1-in-1,000,000 (i.e. 1E-06) signifies that the incremental lifetime cancer risk exceeds the regulatory benchmark. This suggests that the potential for an elevated level of risk may be present for the COPC in question; further investigation may be needed to confirm the identified risk.

In the case of LCR estimates, there are no accepted regulatory benchmarks by which to evaluate an acceptable level of lifetime cancer risk. Unlike ILCRs, LCRs include the consideration of cancer risks from all sources. As such, LCRs are expressed on a total or all sources basis. Since regulators have not recommended an acceptable benchmark LCR for exposure to carcinogens associated with background or baseline conditions, interpretation of the significance of the LCR values is difficult. The only comparison one could make would be to the typical observed cancer incidence in the Canadian population. Each year, approximately 145,000 Canadians are diagnosed with cancer. Based on current cancer incidence and mortality rates, the lifetime probability of developing cancer is 38% for women and 44% for men (Canadian Cancer Society, 2007).

7.8.1 Alternative Methods of Evaluating Criteria Air Contaminants

There are alternative methods in Canada that are used on an airshed basis to evaluate the risk from exposure to the CACs. The most commonly used risk assessment approaches are the National Illness Costs of Air Pollution (ICAP) model released by the Canadian Medical Association and the Air Quality Benefits Assessment Tool (AQBAT) released by the federal government.

Both of these models were designed to evaluate potential impacts on public health as a result in changes in ambient air quality across an entire airshed. These models are useful tools to simulate such occurrences of premature mortality, hospital emissions, emergency room visits and minor illness. When used correctly these models are a useful tool in regional airshed planning of potential changes in CAC levels.

Neither of these models are suggested for use for single receptor locations or to determine the potential influence of CAC concentrations at the maximum ground level concentration. Rather emissions from an individual Facility could be averaged across an airshed and incorporated as model inputs to determine, what if any, effect they would have on public health across the regional airshed. In our experience Health Canada and the MOE have not required this type of assessment to be undertaken for Environmental Assessments of individual facilities.

The air modelling predictions for CACs from the Facility were not averaged across the entire regional airshed. However, it is believed that if one was to average the CAC concentrations over the regional airshed the concentrations of CACs in air would be almost indistinguishable from baseline conditions.

Therefore, the use of ICAP and AQBAT in the HHRA were not deemed to be necessary and that their use would not affect the conclusions of the report.

BASELINE CASE

7.9 Risk Characterization - Baseline Case

7.9.1 Baseline Case – Inhalation Risk Assessment

Evaluation of Baseline Case inhalation risks, including acute and chronic CR values and chronic LCR values at receptor locations in the LRASA, are presented in the following sections. All baseline acute and chronic inhalation risks were calculated using ground-level air concentrations that were derived based on data obtained from an ambient air quality monitoring station located 2km southwest of the Site as well as from National Air Pollution Surveillance (NAPS) Network stations managed by Environment Canada. Further information on baseline air concentrations is discussed in the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e). Acute inhalation risk estimates, expressed as CR values, were based on 1-hour and 24-hour exposure durations. Separate assessments were conducted for non-carcinogenic COPC and carcinogenic COPC with regards to chronic inhalation risk. Chronic, non-cancer inhalation risks (expressed as CR values) assume that an individual is continuously exposed to a predicted annual air concentration. In general, CR values are interpreted as follows:

- A CR less than or equal to 1 signifies that the estimated exposure is less than or equal to the exposure limit (i.e*.,* the assumed safe level of exposure); therefore, no adverse health risk is expected.
- A CR greater than 1 signifies the exposure estimate exceeds the exposure limit; consequently, the potential for adverse health effects may exist.

Human health risks resulting from baseline exposures to individual carcinogenic COPC and mixtures of COPC via inhalation were expressed as LCR estimates. Similar to ILCRs, LCR estimates represent the probability that an individual will develop cancer during his or her lifetime due to exposure to COPC. Note, LCRs differ from ILCRs in that they represent the baseline risk of cancer in individuals exposed to airborne carcinogens from all sources, not only the risk associated with the project alone, or the incremental risk. LCRs for non-threshold substances are provided for reference only as there are no accepted regulatory benchmarks to evaluate acceptable levels of lifetime cancer risk.

Inhalation risk estimates for CACs are discussed in Sections 7.9.1.1 and 7.9.1.2. Additional COPC are discussed in Section 0, while chemical mixtures are discussed in Section 7.9.1.4. Maximum CR (1-hour, 24-hour, and annual) and LCR (where applicable) values for individual COPC and mixtures of COPC, calculated assuming reasonable maximum exposure, are provided in Table 7-10 through Table 7-13.

7.9.1.1 Baseline Case – Inhalation Risk Assessment Criteria Air Contaminants (CACs)

Baseline Case acute (1-hr or 24-hr) and chronic (annual) CR risk estimates do not exceed the regulatory benchmark therefore no adverse health risk is expected from exposure to baseline air concentrations of CACs (Table 7-10). Additionally, as discussed in Section 7.6.1.1, Baseline Case CACs (including NO_2, SO_2, $PM_{2.5}$, and PM_{10}) have been compared to WHO benchmarks for informational purposes. None of the relevant Baseline Case CACs exceed the WHO benchmarks.

Table 7-10 Maximum Concentration Ratio (CR) Values using Baseline Ground Level Air Concentrations for CACs

COPC	Baseline Case Concentration Ratio (CR) Values			Baseline Case Concentration Ratio (CR) Values – WHO Benchmarks[f]		
	1-hour	24-hour	Annual	1-hour	24-hour	Annual
Ammonia[a]	-	-	-	-	-	-
Carbon Monoxide (CO)	0.069	-[c]	-[d]	-	-	-
Hydrogen Chloride (HCl)[a]	-	-	-	-	-	-
Hydrogen Fluoride (HF)[a]	-	-	-	-	-	-
Nitrogen Dioxide (NO_2)	0.16	0.29	0.62	0.32	-	0.93
Particulate Matter - PM_{10}[ae]	-	-	-	-	-	-
Particulate Matter - $PM_{2.5}$[e]	-[b]	0.68	-[d]	-	0.82	0.98
Particulate Matter – Total[e]	-[b]	0.29	0.35	-	-	-
Sulfur Dioxide (SO_2)	0.028	0.070	0.20	-	0.15	-

[a] Baseline Data Not Available

[b] 1-Hour TRV Not Available

[c] 24-Hour TRV Not Available

[d] Annual Average TRV Not Available

[e] Particulate Matter results include contribution of Secondary Particulate

[f] '-' indicates WHO benchmark not available

7.9.1.2 Baseline Case – Inhalation Risk Assessment Criteria Air Contaminants (CACs) – Traffic Case

Baseline Traffic Case acute (1-hr or 24-hr) and chronic (annual) CR risk estimates do not exceed the regulatory benchmark therefore no adverse health risk is expected from exposure to baseline air concentrations of CACs including the effect of local vehicular traffic (Table 7-11).

Additionally, as discussed in Section 7.6.1.1, Baseline Traffic Case CACs (including NO_2, SO_2, $PM_{2.5}$, and PM_{10}) have been compared to WHO benchmarks for informational purposes. With the exception of annual nitrogen dioxide (CR = 1.1), none of the relevant Baseline Traffic Case CACs exceed the WHO benchmarks. The exceedance of annual nitrogen dioxide was not unexpected as any urban area in Ontario would produce similar results. As noted, WHO benchmarks are not necessarily health-based and are only intended to act as guidelines for country-regulated air quality standards. When compared to the selected standards from Health Canada, this exceedance did not occur.

Table 7-11 Maximum Concentration Ratio (CR) Values using Baseline Traffic Case Air Concentrations for CACs

COPC	Baseline Traffic Case Concentration Ratio (CR) Values			Baseline Traffic Case Concentration Ratio (CR) Values – WHO benchmarks[e]		
	1-hour	24-hour	Annual	1-hour	24-hour	Annual
Ammonia[d]	-	-	-	-	-	-
Carbon Monoxide (CO)[bc]	0.28	-	-	-	-	-
Hydrogen Chloride (HCl)[d]	-	-	-	-	-	-
Hydrogen Fluoride (HF)[d]	-	-	-	-	-	-
Nitrogen Dioxide (NO_2)	0.39	0.53	0.77	0.78	-	**1.2**
Particulate Matter - PM_{10} [ac]	-	0.021	-	-	0.021	0.010
Particulate Matter - $PM_{2.5}$[ac]	-	0.70	-	-	0.84	0.99
Particulate Matter – Total[a]	-	0.31	0.36	-	-	-
Sulfur Dioxide (SO_2)	0.031	0.071	0.21	-	0.16	-

[a] 1-Hour TRV Not Available

[b] 24-Hour TRV Not Available

[c] Annual Average TRV Not Available

[d] Not Included in the Traffic Case Assessment

[e] '-' indicates WHO benchmark not available

The measured annual NO_2 concentration at the Courtice Road station was similar to that in other urbanized areas of Ontario such as Toronto, Hamilton and Windsor as shown in Figure 7-10.

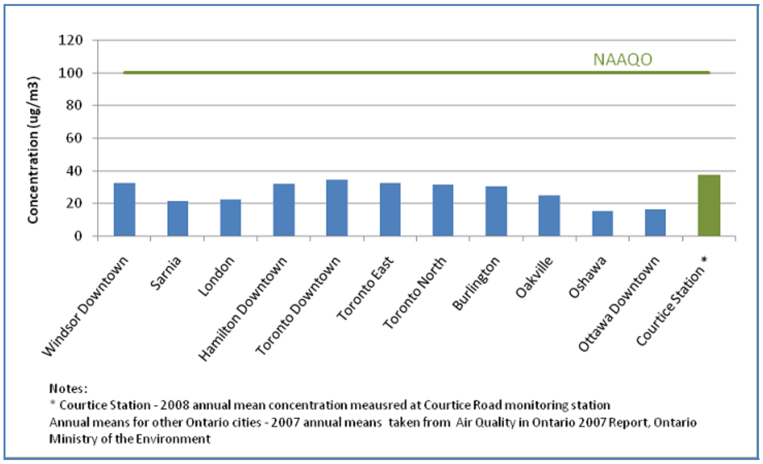


Figure 7-10 Comparison of NO2 levels in Southwestern Ontario (Figure A-2-4 of Appendix A, Air Quality Assessment Technical Study Report - July 31st, 2009)

7.9.1.3 Baseline Case – Inhalation Risk Assessment Additional COPC

Similar to the assessment of CACs, no acute (1-hr or 24-hr) or chronic (annual) CR risk estimates exceeded the regulatory benchmark for the Baseline Case, indicating that no adverse health risks are expected from exposure to baseline air concentrations of individual COPC (Table 7-12).

Table 7-12 Maximum Concentration Ratio (CR) and Lifetime Cancer Risk (LCR) Values using Baseline Ground Level Air Concentrations for Additional COPC

COPC	Baseline Case Concentration Ratio (CR) Values			Baseline Case Lifetime Cancer Risk (LCR)
	1-hour	24-hour	Annual	Annual[f]
Metals				
Antimony	0.0015	1.2E-04	0.015	-
Arsenic	0.022	0.0060	0.12	7.7E-06
Barium	0.0040	8.2E-04	0.0049	-
Beryllium	0.037	0.030	0.043	7.1E-07
Boron	0.0037	-[c]	0.0031	-
Cadmium	0.015	0.024	0.12	5.9E-06
Chromium (hexavalent)[a]	-	-	-	-
Total Chromium (and compounds)	0.0067	-[c]	2.9E-05	1.9E-05
Cobalt	0.0074	0.0060	0.0060	-
Lead[e]	0.0081	0.0100	0.0066	-
Mercury – Inorganic[a]	-	-	-	-
Nickel	0.0018	-[c]	0.045	-
Phosphorus	-[b]	-[c]	7.3E-10	-
Silver	0.0083	3.4E-04	0.034	-
Selenium	0.0037	3.0E-04	0.015	-
Thallium	0.0073	-[c]	0.029	-
Tin	3.7E-04	3.0E-04	0.0015	-
Vanadium	0.0075	0.0015	7.7E-04	-
Zinc	0.0021	-[c]	0.0051	-
Chlorinated Polycyclic Aromatics				
Dioxins and Furans (as TEQ Toxic Equivalents)[e]	-[b]	0.0047	0.0016	-
Polychlorinated Biphenyls (PCBs)	0.0010	2.8E-04	-[d]	-

COPC	Baseline Case Concentration Ratio (CR) Values			Baseline Case Lifetime Cancer Risk (LCR)
	1-hour	24-hour	Annual	Annual[f]
Chlorinated Monocyclic Aromatics				
Dichlorobenzene, 1,2-	8.6E-07	-[c]	7.8E-06	-
Dichlorophenol, 2,4- [a]	-	-	-	-
Hexachlorobenzene	6.1E-04	-[c]	0.0021	2.4E-08
Pentachlorobenzene[a]	-	-	-	-
Pentachlorophenol	4.3E-04	4.4E-05	8.2E-04	-
Tetrachlorobenzene, 1,2,4,5- [a]	-	-	-	-
Tetrachlorophenol, 2,3,4,6- [a]	-	-	-	-
Trichlorobenzene, 1,2,4-	2.8E-04	1.1E-04	0.0024	-
Trichlorophenol, 2,4,6- [a]	-	-	-	-
Polycyclic Aromatic Hydrocarbons (PAH)				
Acenaphthylene	7.5E-04	-[c]	-[d]	-
Acenaphthene	0.0030	-[c]	-[d]	-
Anthracene	7.9E-04	-[c]	0.0016	-
Benzo(a)anthracene	3.3E-04	-[c]	-[d]	-
Benzo(b)fluoranthene	6.9E-04	-[c]	-[d]	-
Benzo(k)fluoranthene	3.3E-04	-[c]	-[d]	-
Benzo(a)fluorene	6.6E-04	-[c]	0.0023	-
Benzo(b)fluorene	6.6E-04	-[c]	0.0023	-
Benzo(ghi)perylene	3.4E-04	-[c]	-[d]	-
Benzo(a)pyrene	-[b]	0.068	-[d]	-
Benzo(e)pyrene	6.6E-04	-[c]	-[d]	-
Chrysene	4.7E-04	-[c]	-[d]	-
Dibenzo(a,c)anthracene[a]	-	-	-	-

COPC	Baseline Case Concentration Ratio (CR) Values			Baseline Case Lifetime Cancer Risk (LCR)
	1-hour	24-hour	Annual	Annual[f]
Dibenzo(a,h)anthracene	3.3E-04	-[c]	-[d]	-
Fluoranthene	0.0029	-[c]	-[d]	-
Fluorene[a]	-	-	-	-
Indeno(1,2,3 – cd)pyrene	3.3E-04	-[c]	-[d]	-
1-Methylnaphthalene	-[b]	-[c]	1.5E-04	-
2-Methylnaphthalene	-[b]	-[c]	2.5E-04	-
Naphthalene	-[b]	1.1E-04	2.9E-04	-
Perylene	6.6E-04	-[c]	-[d]	-
Phenanthrene	0.013	-[c]	-[d]	-
Pyrene	0.0014	-[c]	-[d]	-
Benzo(a)pyrene TEQ	-	-	-	1.4E-05
Volatile Organic Chemicals (VOC)				
Acetaldehyde	-[b]	0.0035	0.12	6.1E-07
Benzene	0.17	0.41	0.13	3.1E-05
Biphenyl	-[b]	-[c]	2.3E-06	-
Bromodichloromethane	0.0021	-[c]	0.0053	-
Bromoform	0.0014	5.4E-04	0.0046	-
Bromomethane	0.0018	-	0.020	-
Carbon tetrachloride	0.014	0.31	0.0032	9.2E-06
Chloroform	0.0055	0.23	0.0016	3.7E-06
Dichlorodifluoromethane	1.6E-04	-[c]	5.6E-04	-
Dichloroethene, 1,1 -	2.9E-05	-[c]	2.9E-06	-
Dichloromethane	2.2E-04	0.0058	0.0019	3.6E-07
Ethylbenzene	-[b]	0.0012	6.9E-04	-

COPC	Baseline Case Concentration Ratio (CR) Values			Baseline Case Lifetime Cancer Risk (LCR)
	1-hour	24-hour	Annual	Annual[f]
Ethylene Dibromide	0.0032	0.0017	2.0E-04	1.1E-06
Formaldehyde	0.55	0.052	0.18	8.8E-06
O-terphenyl	6.6E-06	-[c]	2.3E-05	-
Tetrachloroethene	6.0E-05	0.0014	7.3E-04	1.4E-06
Tetralin	-[b]	-[c]	-[d]	-
Toluene	6.2E-04	-[c]	8.8E-04	-
Trichloroethane, 1,1,1 -	3.1E-05	1.9E-05	2.0E-05	-
Trichloroethylene, 1,1,2 -	0.0024	0.045	0.0050	1.7E-07
Trichlorofluoromethane	-[b]	3.6E-04	-[d]	-
Vinyl chloride	7.2E-07	0.0059	3.6E-05	3.2E-08
Xylenes, m-, p- and o-	5.3E-04	0.0066	0.028	-

[a] Baseline Data Not Available

[b] 1-Hour TRV Not Available

[c] 24-Hour TRV Not Available

[d] Annual Average TRV Not Available

[e] Measured against a benchmark CR of 0.2

[f] No value (-) indicates that this COPC was not evaluated as a carcinogen

7.9.1.4 Baseline Case – Inhalation Risk Assessment Chemical Mixtures

The results of the assessment of chemical mixtures are presented in Table 7-13. Interpretation of chemical mixtures results is difficult as regulators have not established standards or benchmarks for the assessment of mixtures. By adding chemical CR values together, it assumed that not only is the target organ the same, but that exposure to these chemicals actually results in a toxicological mode of action that is directly additive. To date, there have been limited to no mixture additive toxicology studies using this approach in human health risk assessment. This is a considerable source of uncertainty in any risk assessment being conducted in Ontario.

It should also be noted that these Baseline Case results would be expected for any community in Southern Ontario.

Table 7-13 Maximum Concentration Ratio (CR) and Lifetime Cancer Risk (LCR) Values using Baseline Ground Level Air Concentrations for Chemical Mixtures

COPC	Baseline Case Concentration Ratio (CR) Values			Baseline Case Lifetime Cancer Risk (LCR)
	1-hour	24-hour	Annual	Annual
Eye Irritants	0.0048	0.0083	-	-
Nasal Irritants	0.0079	0.0079	0.035	-
Respiratory Irritants	0.33	1.1	0.94	-
Neurological Effects (Neurotoxicants)	0.026	0.54	0.050	-
Reproductive/Developmental Effects	-	-	0.0073	-
Liver Carcinogens	-	-	-	5.5E-06
Lung Carcinogens	-	-	-	4.7E-05
Skin Carcinogens	-	-	-	2.1E-05

Notes:

No value (-) indicates that the mixture was not applicable to the exposure duration

In addition, the maximum CR values presented for mixtures may not represent an actual location in the LRASA, because risk estimates for each individual chemical often do not occur simultaneously at the same location.

7.9.2 Baseline Case – Multi-Pathway Risk Assessment

The following section presents the evaluation of multi-pathway risks from the Baseline Case, including chronic HQ values and chronic LCR values at receptor locations surrounding the Project. Non-carcinogenic risk estimates for COPC are discussed in Section 7.9.2.1. Risk estimates for chemical mixtures are discussed in Section 7.9.2.2, while carcinogenic COPC are discussed in Section 7.9.2.3.

7.9.2.1 Baseline Case – Multi-Pathway Risk Assessment Non-Carcinogens

Baseline chronic risk estimates (*via* multiple exposure pathways) were expressed as HQ values for all non-carcinogenic COPC. The HQs generated for the Baseline Case will provide a reference for incremental risks, if any, posed by operation of the Project. A toddler (7 months to 4 years) was considered to represent the most sensitive receptor age group. As a result, health risks associated with exposures to non-carcinogenic COPC are presented for the toddler receptor. HQ values were also derived for a resident infant and farmer infant receptor (0 to 6 months) in order to evaluate the potential health risks associated with exposure to COPC *via* the consumption of breast milk.

An HQ value of 0.2 was used as a benchmark for all COPC, except methylmercury, evaluated in the multi-pathway assessment. This ensures that an adequate proportion of the tolerable daily intake is reserved for other potential sources of exposure with the exception of regional air emissions sources – this exposure pathway is assessed in the inhalation assessment. Human exposure to methylmercury is primarily through one pathway – ingestion of fish; therefore, it is evaluated against a benchmark HQ of 1.

A single baseline exposure point concentration (i.e., the maximum detected concentration, 95th UCLM, or method detection limit) for each environmental medium collected for the Baseline Report (Jacques Whitford, 2009a), was used to model exposure to all receptor types (i.e., residential, farmer, daycare, recreational – sport, and recreational – camping receptors) considered in the HHRA. For example, the baseline concentration of a particular COPC in soil to which a resident and farmer were exposed was assumed to be identical regardless of their location in the LRASA. Although individual baseline concentrations were not obtained at the location of each receptor group evaluated, the baseline exposure point concentrations used are considered representative of reasonable maximum exposure, to all receptors, from background concentrations.

Chronic HQ values for all multi-pathway receptors in the LRASA are presented in Table 7-14. The overall multi-pathway HQ values for lead and dioxins/furans (2,3,7,8-TCDD TEQ) are presented in Table 7-15. These COPC are treated separately as the exposure endpoint for these chemicals are consistent regardless of the exposure pathway; therefore, inhalation CR results were added to the predicted multi-pathway HQ values and compared to a benchmark of 0.2. HQs are presented for the toddler life-stage unless otherwise indicated. HQ values for each exposure pathway and each receptor are provided in **Appendix I**.

Table 7-14 Maximum Hazard Quotient (HQ) Values Using Baseline Multi-Pathway Concentrations

COPC	Baseline Case Multi-Pathway Hazard Quotient (HQ) Values						
	Resident - Infant	Reside nt - Toddler	Farmer - Infant	Farmer - Toddler	Daycare	Recreation User - Sport	Recreation User - Camping
PAHs							
Acenaphthene	4.1E-06	1.3E-05	4.3E-06	3.8E-05	3.7E-06	1.6E-07	4.2E-07
Anthracene	9.5E-07	2.7E-06	1.1E-06	7.6E-06	7.6E-07	3.3E-08	8.6E-08
Fluorene	6.3E-06	2.0E-05	6.8E-06	5.8E-05	5.5E-06	2.4E-07	6.3E-07
PCBs							
Aroclor 1254 (Total PCBs)	**11**	**0.49**	**118**	**4.2**	0.011	4.7E-04	0.0012
VOCs							
1,1,1-Trichloroethane	2.1E-08	4.7E-06	1.8E-07	6.4E-04	1.8E-08	7.6E-10	2.0E-09
Bromoform	4.7E-06	0.0023	6.6E-05	**0.32**	4.3E-06	1.8E-07	4.8E-07
Carbon Tetrachloride	1.6E-04	0.033	0.0025	**4.6**	8.1E-05	3.5E-06	9.2E-06
Chloroform	4.5E-06	0.0026	3.1E-05	**0.32**	4.2E-06	1.8E-07	4.8E-07
Dichloromethane	1.7E-05	0.0047	2.8E-05	**0.65**	1.7E-05	7.4E-07	1.9E-06
Trichlorofluoromethan e (FREON 11)	3.7E-07	1.5E-04	5.9E-06	0.022	2.9E-07	1.3E-08	3.3E-08
Chlorinated Monocyclic Aromatics							
1,2,4,5-Tetrachlorobenzene	0.0020	0.045	0.020	**0.40**	2.0E-04	8.8E-06	2.3E-05
1,2,4-Trichlorobenzene	6.3E-04	0.057	**0.21**	**20**	2.6E-04	1.1E-05	3.0E-05
1,2-Dichlorobenzene	3.9E-07	1.1E-04	3.0E-05	0.015	2.0E-07	8.6E-09	2.2E-08
Hexachlorobenzene	0.0025	0.019	0.026	0.17	8.6E-05	3.7E-06	9.8E-06
Pentachlorobenzene	9.3E-04	0.0094	0.0098	0.083	4.1E-05	1.8E-06	4.7E-06
Pentachlorophenol	8.9E-07	2.3E-06	8.9E-07	2.3E-06	8.5E-07	3.7E-08	9.7E-08
Inorganics							
Antimony	0.011	0.052	0.011	**0.24**	0.011	4.6E-04	0.0012
Arsenic	0.10	**0.32**	0.10	**0.57**	0.11	0.0048	0.013
Barium	0.0019	0.0079	0.0019	0.013	0.0019	8.2E-05	2.2E-04

COPC	Baseline Case Multi-Pathway Hazard Quotient (HQ) Values						
	Resident - Infant	Reside nt - Toddler	Farmer - Infant	Farmer - Toddler	Daycare	Recreation User - Sport	Recreation User - Camping
Beryllium	0.0013	0.050	0.0013	**0.42**	0.0014	6.3E-05	1.6E-04
Boron	2.8E-04	0.022	2.8E-04	0.12	2.8E-04	1.2E-05	3.2E-05
Cadmium	0.0045	0.027	0.0045	0.10	0.0043	1.9E-04	4.9E-04
Chromium (Total)	5.7E-05	2.3E-04	5.7E-05	8.3E-04	6.1E-05	2.7E-06	7.0E-06
Chromium VI	-	-	-	-	-	-	-
Cobalt	0.021	0.070	0.021	0.18	0.021	9.2E-04	0.0024
Mercury - Inorganic	9.1E-04	0.0061	9.1E-04	0.031	9.7E-04	4.2E-05	1.1E-04
Methylmercury	-	-	-	-	-	-	-
Nickel	0.0036	0.013	0.0036	0.051	0.0028	1.2E-04	3.2E-04
Phosphorus	2.2E-07	5.1E-05	2.2E-07	5.0E-04	2.2E-07	9.7E-09	2.5E-08
Selenium	7.2E-04	0.011	7.2E-04	0.093	8.2E-04	3.5E-05	9.3E-05
Silver	2.1E-04	0.0024	2.1E-04	0.017	1.8E-04	7.8E-06	2.0E-05
Thallium	0.046	**0.25**	0.046	**1.2**	0.051	0.0022	0.0058
Tin	1.4E-04	9.2E-04	1.4E-04	0.0026	1.4E-04	6.1E-06	1.6E-05
Vanadium	0.013	0.046	0.013	0.13	0.013	5.7E-04	0.0015
Zinc	9.8E-04	0.020	9.8E-04	0.14	0.0011	4.7E-05	1.2E-04

Notes:

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

'-' - No baseline concentration was available for this COPC.

Table 7-15 Maximum Hazard Quotient (HQ) Values for Dioxins/Furans and Lead Using Baseline Multi-Pathway Concentrations

COPC	Baseline Case Multi-Pathway Hazard Quotient (HQ) Values

	Resident -Infant	Resident - Toddler	Farmer - Infant	Farmer - Toddler	Day Care	Recreation User - Sport	Recreation User - Camping
2,3,7,8-TCDD Equivalent	**3.8**	0.17	**20**	**0.72**	0.0048	0.0017	0.0020
Lead	0.040	0.12	0.040	0.20	0.044	0.0082	0.011

Notes:

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Local Residents

Chronic HQ values for both residential infant and toddler receptors are shown in Table 7-14 and Table 7-15. HQ values associated with each exposure pathway for each receptor are provided in **Appendix I**. For residential infants and toddlers, with the exception of PCBs for infant and toddler residents and dioxins/furans for the resident infant receptor, results of the assessment indicate that none of the predicted hazard quotients exceed the regulatory benchmark for the Baseline Case; therefore, it is not expected that baseline concentrations of these chemicals pose any undue risk to the health of residential infant and toddler receptors.

<u>Resident – Infant</u>

The multi-pathway assessment for exposure of the resident infant receptor to COPC indicates that potential risks may exist from exposure to baseline concentrations of PCBs and dioxins/furans – associated HQ values for these COPC were 11 and 0.94, respectively. These two classes of compounds are highly bioaccumulative in biological tissues and virtually all living organisms contain trace amounts (Health Canada, 1990; Health Canada, 2007b); as expected, the risk identified was attributed entirely to the ingestion of breast milk. Although a regulatory benchmark HQ of 0.2 was used to assess breast milk exposure, given that it was modeled to be the only source of food for the infant, a benchmark HQ of 1 could also have been selected.

Baseline breast milk concentrations were modeled based on exposure of the infant's mother to measured or estimated background concentrations in exposure media (i.e., soil) and food items (e.g., produce, poultry, etc.). The resident infant receptor exposure was directly dependent on the exposure point concentrations used for modeling total daily dose to the mother from all exposure pathways. PCBs were not detected in any media relevant to exposure of residents. The majority of dioxins/furans were not detected in food items such as vegetables and meat. 2,3,7,8-TCDD and 1,2,3,7,8,-PeCDD, which are considered the most potent dioxin compounds (Van den Berg 2006), were not detected in any food items and in approximately 35% of soil samples. For further details regarding measured baseline concentrations in food items, refer to Tables 5-1 to 5-63 in the *Baseline Report* (Jacques Whitford, 2009a).

Where COPCs were not detected in a given media, the method detection limit (MDL) was used to model exposure. An MDL does not represent a specific concentration – it is set to the smallest amount of an analyte that an analytical instrument is able to detect; consequently, it is possible that levels of PCBs in garden produce, for example, are significantly smaller than the level represented by the MDL, or not present at all. In this study, however, to assume a worst-case scenario, the MDL was used to represent the actual baseline concentration, which can result in inadvertent risk. Note, the number of samples taken is not expected to have an effect on the outcome, as further sampling would likely have produced similar non-detectable results, which would then provide the same MDL concentration as an outcome.

The use of the MDLs as baseline concentrations of PCBs and dioxins/furans was a conservative measure that overestimated the actual concentration in a particular media or food item; therefore it was expected that the use of MDLs could lead to risk. In the case of PCBs and most dioxins/furans, the total dose to an infant's mother was modeled using MDLs and conservative biotransfer factors. Subsequently, the estimated concentration in the mother's breast milk was used in conjunction with biotransfer factors to estimate the total dose to the farmer infant receptor; therefore, the risks to the resident infant receptor are considered an overestimate.

Given the baseline concentrations (or method detection limits) of these chemicals were found to be no different in the Clarington area than anywhere else in southern Ontario, these findings would be expected across Ontario and are not unique to this project.

<u>Resident – Toddler</u>

The multi-pathway assessment for exposure of the toddler resident receptor to COPC indicates that potential risks may exist from exposure to baseline concentrations of PCBs (HQ = 0.49), arsenic (HQ=0.32) and thallium (HQ=0.25).

To determine the origin of the PCB risk, apportionment of the risk into the possible pathways of exposure was conducted, and it was determined that the risk can be attributed to ingestion of homegrown produce and fruit (Figure 7-11). Much like the risk to resident infants, PCB concentrations in homegrown produce and fruit were not detected, and the MDL was used for the assessment of risk due to exposure via these pathways. This is a conservative measure that overestimated the actual concentration in homegrown produce or fruit; consequently, it was expected that the use of MDLs could lead to risk. Given the baseline concentrations (or method detection limits) of PCBs were found to be no different in the Clarington area than anywhere else in southern Ontario, these findings would be expected across Ontario and are not unique to this project.

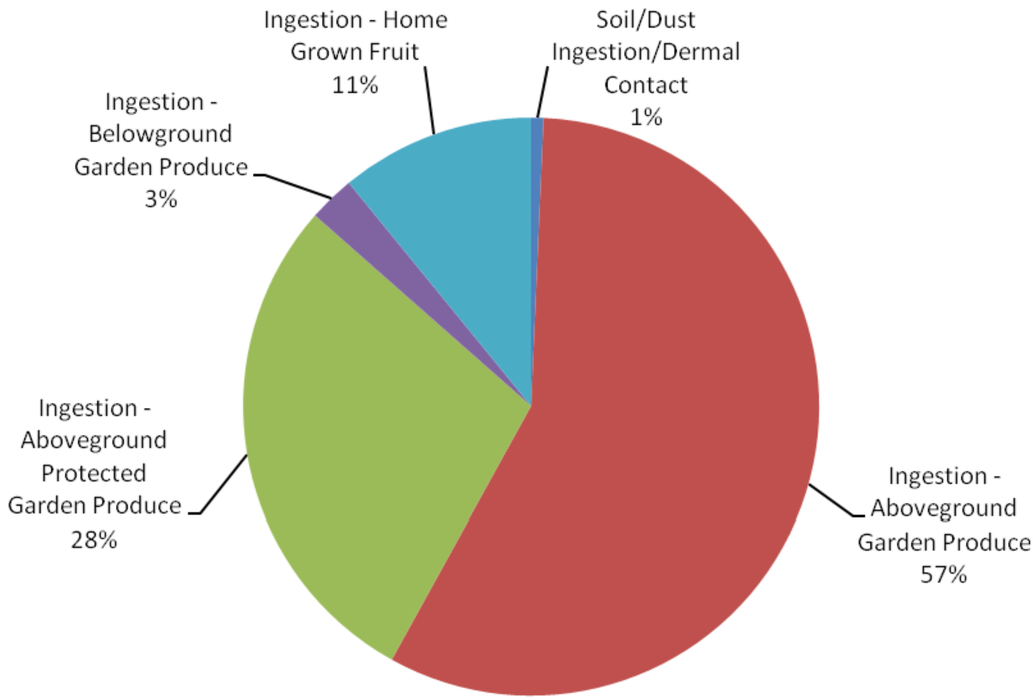


Figure 7-11 Attribution of Risk to Resident Toddler Associated with Total PCBs Exposure

When apportioned into the various exposure pathways, the arsenic risk was directly attributable incidental ingestion of soil. It is also expected that the estimated HQ for the resident toddler receptor exposed to background concentrations of arsenic were also overestimated in the Baseline Case. Since arsenic is a naturally occurring element in the Earth's crust it was not unexpected that arsenic was detected in 21 of the 23 baseline soil samples. The maximum concentration detected in the baseline soil samples was 8 mg/kg; note that the Ontario Ministry of the Environment regulatory soil chemical standard for sensitive sites (MOE O.Reg 153/04 Table 1 Standards) is 11 mg/kg. Since the soils in the LRASA contain concentrations that are lower than the regulatory guideline, it can be assumed that the higher HQ values can be attributed to conservative model assumptions. Given that the baseline concentrations of arsenic were found to be no different in the Clarington area than anywhere else in southern Ontario, these findings would be expected across Ontario and are not unique to this project.

Thallium was also found to be a potential risk to resident toddlers. The relevant exposure pathways that contributed to the potential risk are incidental soil ingestion and produce and fruit ingestion. Concentrations of thallium were not detected in any soil, produce or fruit sample collected in the study area. As such the MDL was used to estimate baseline concentrations in these media. The use of the MDL as baseline concentrations of thallium was a conservative measure that overestimated the actual concentration in soil, produce and fruit; therefore, it was expected that the use of MDLs could lead to risk. The MDL in the baseline soil samples was 1 mg/kg; note that the Ontario Ministry of the Environment regulatory soil chemical standard for sensitive sites (MOE O.Reg 153/04 Table 1 Standards) is 2.5 mg/kg. Since the soils in the LRASA contain concentrations that are lower than the regulatory guideline, it can be assumed that the higher HQ values can be attributed to conservative model assumptions. Given that the baseline concentrations of thallium were found to be no different in the Clarington area than anywhere else in southern Ontario, these findings would be expected across Ontario and are not unique to this project.

Local Farmers

Farmer - Infant

The multi-pathway assessment for exposure of the famer infant receptor to COPC indicates that potential risks may exist from exposure to baseline concentrations of PCBs, and dioxins/furans - associated HQ values for these COPC were 117 and 20, respectively. As discussed in the case of the resident infant receptor, these two classes of compounds are highly bioaccumulative in biological tissues and virtually all living organisms contain trace amounts (Health Canada, 1990; Health Canada, 2007b); as expected, the risk identified was attributed entirely to the ingestion of breast milk.

Much like the resident infant receptor, PCBs and the majority of dioxins/furans were not detected in any media relevant to exposure of farmers (i.e., soil, home-grown produce, or farm-raised livestock). For further details regarding measured baseline concentrations in food items, please refer to Tables 5-1 to 5-63 in the *Baseline Report* (Jacques Whitford, 2009a). Where COPCs were not detected in a given media, the method detection limit (MDL) was used to model exposure. This use of the MDLs as baseline concentrations of PCBs and dioxins/furans was a conservative measure that overestimated the actual concentration in a particular media or food item; therefore it was expected that the use of MDLs could lead to risk. In the case of PCBs and most dioxins/furans, the total dose to an infant's mother was modeled using MDLs and conservative biotransfer factors. Subsequently, the estimated concentration in the mother's breast milk was used in conjunction with biotransfer factors to estimate the total dose to the famer infant receptor; therefore, the risks to the farmer infant receptor are considered an overestimate.

Additionally, the HQ value associated with 1,2,4-trichlorobenzene was 0.21. Much like PCBs and dioxins/furans this potential risk was attributed entirely to the ingestion of breast milk for the aforementioned reasons associated with PCBs and dioxins/furans.

Again, similar findings would be expected across Ontario and are not unique to this Project.

Farmer - Toddler

Chronic HQ values for the toddler farmer receptor are presented in Table 7-14 and Table 7-15. HQ values associated with each exposure pathway for this receptor are provided in **Appendix I**.

Multi-pathway exposures to dioxins and furans, bromoform, chloroform, dichloromethane, 1,2,4,5-tetrachlorobenzene, antimony, arsenic, and beryllium resulted in oral/dermal HQs marginally greater than the benchmark HQ (0.2) for the Baseline Case; HQs for these COPC range between 0.2 and 0.65. Multi-pathway exposures to total PCBs, carbon tetrachloride, 1,2,4-trichlorobenzene, and thallium resulted in oral/dermal HQs greater than 1.

To further examine the causes of these exceedances, the risks to the farmer toddler from each COPC was apportioned into respective exposure pathways (Table 7-16). Results indicate that, with the exception of arsenic, ingestion of dairy was the primary exposure pathway associated with risks to the farmer toddler.

It was expected that the estimated HQs for the toddler farmer receptor exposed to background concentrations in dairy would be elevated in the Baseline Case assessment. Concentrations used to model exposure via the primary exposure pathway(s) associated with risk (e.g., ingestion of dairy, poultry and pork) to the farmer – toddler receptor were represented by MDLs for all COPC with an HQ greater than 0.2 (total PCBs, dioxins and furans, bromoform, chloroform, 1,2,4,5-tetrachlorobenzene, antimony, arsenic, beryllium, carbon tetrachloride, 1,2,4-trichlorobenzene, and thallium). In other words, these chemicals were not detected in baseline dairy, poultry, or pork, and therefore might not be present in these food items. However, to assume a worst-case scenario, the MDL was used to represent the actual concentration of these chemicals in these food items. Using this MDL for exposure modeling resulted in a potential risk from ingestion of dairy, poultry and/or pork; although these chemicals were not detected in any of the food items themselves. Consequently, the use of MDLs to represent baseline concentrations is a conservative measure that overestimates exposure and leads to an inadvertent risk. For further details regarding measured baseline concentrations in food items, refer to Tables 5-1 to 5-63 in the Baseline Report (Jacques Whitford, 2009a).

Furthermore, toddler-specific ingestion rates for food items produced on farms were not available; therefore, child-specific ingestion rates were adopted from US EPA (2005) as a conservative measure. Because ingestion rates are typically proportional to body weight (Health Canada, 2004), the use of child-specific ingestion rates will overestimate exposure to toddlers.

Based on these conservative assumptions, it is expected that actual background risks from COPC (total PCBs, dioxins and furans, bromoform, chloroform, 1,2,4,5-tetrachlorobenzene, antimony, beryllium, carbon tetrachloride, 1,2,4-trichlorobenzene, and thallium) to the toddler farmer receptor in the LRASA are below those estimated for the Baseline Case.

Again, similar findings would be expected across Ontario and are not unique to this project.

Table 7-16 Risks Associated with Dairy Ingestion to Toddler Farmers

COPC	Soil Dust Ingestion (Outdoor)	Dust Ingestion (Indoor)	Soil/Dust Dermal (Outdoor)	Ingestion - Aboveground Prot. Garden Produce	Ingestion - Belowground Garden Produce	Ingestion - Home Grown Fruit	Dairy	Beef	Pork	Poultry
Bromoform	0%	0%	0%	0%	0%	0%	**92%**	1%	3%	2%
Carbon Tetrachloride	0%	0%	0%	0%	0%	0%	**92%**	1%	3%	2%
Chloroform	0%	0%	0%	0%	0%	1%	**92%**	1%	3%	2%
Dichloromethane	0%	0%	0%	0%	0%	0%	**92%**	1%	3%	2%
Aroclor 1254 (Total PCBs)	0%	0%	0%	7%	0%	3%	**69%**	4%	1%	1%
2,3,7,8-TCDD Equivalent	1%	0%	1%	6%	1%	3%	**73%**	3%	1%	1%
1,2,4,5-Tetrachlorobenzene	0%	0%	0%	7%	0%	4%	**70%**	4%	1%	1%
1,2,4-Trichlorobenzene	0%	0%	0%	0%	0%	0%	**93%**	1%	3%	2%
Antimony	5%	1%	0%	7%	0%	3%	**66%**	4%	1%	1%
Beryllium	0%	0%	0%	7%	0%	4%	**70%**	4%	1%	1%
Thallium	5%	1%	0%	7%	0%	3%	**66%**	4%	1%	1%

Arsenic Risks to Farmer - Toddlers.

For farmer toddlers, an HQ of 0.43 was observed. To further examine the causes of this exceedance, the risk to the toddler resident from arsenic exposure was apportioned into respective exposure pathways (Figure 7-12). As shown in Figure 7-12, ingestion of dairy (47%) as well as soil and dust ingestion (26%) account for over 70% of the chronic daily intake. It is likely that the estimated HQs for the toddler farmer receptor exposed to background concentrations of arsenic were overestimated in the Baseline Case assessment due to a combination of the use of MDLs, the natural occurrence of arsenic in the environment and the use of child ingestion rates to represent toddler consumption patterns.

Again, similar findings would be expected across Ontario and are not unique to this Project.

Health Canada reviewed arsenic in food and found it is present at very low levels (low parts per billion [ppb]) in many foods, including meat and poultry, milk and dairy products, bakery goods and cereals, vegetables, and fruits and fruit juices (Health Canada, 2008). These trace levels of arsenic generally reflect normal accumulation from the environment. Both organic and inorganic forms of arsenic can be found in food. While the levels of each depend on the type of food, inorganic arsenic is not usually found at high levels. As discussed in the previous section, the rationale for the risk associated with the ingestion of dairy was due to the use of MDLs and conservative model assumptions (i.e. the use of child-specific ingestion rates for toddlers).

With respect to arsenic levels in soil, please refer to the discussion pertaining to the arsenic risks to the Resident-toddler receptor.

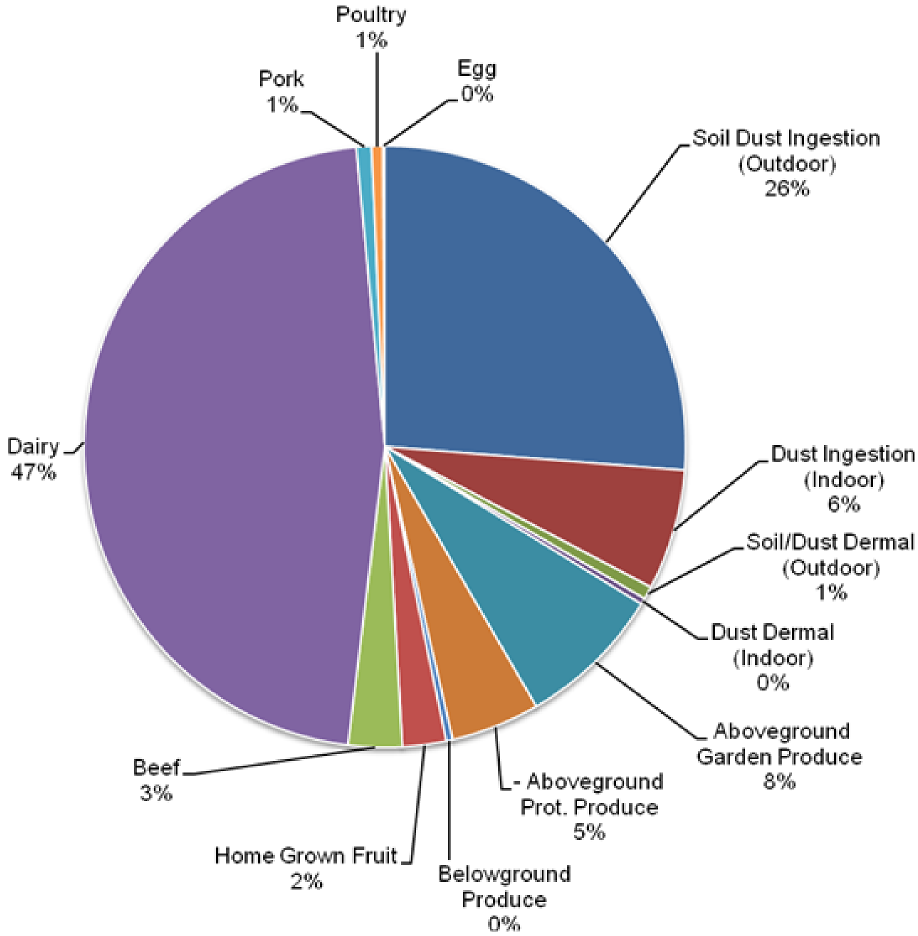


Figure 7-12 Risks to Farmer - Toddler Associated with Arsenic Exposure

Daycare, Recreation User – Sport, Recreation User - Camping

Chronic HQ values for the daycare, recreation user – sport and recreation user - camping receptors are provided in Table 7-14 and Table 7-15. HQ values associated with each exposure pathway for these receptors are provided in **Appendix I**. Results of the assessment indicate that none of the predicted hazard quotients exceed the regulatory benchmark for the Baseline Case; therefore, it is not expected that baseline conditions pose any undue risk to the health of these receptors.

Additional Risks Related to Swimming and Hunting/Angling

As previously noted, additional risks to all five receptor groups from exposure to surface water while swimming/wading/playing in surface water bodies, as well as from engaging in hunting and angling activities, within the LRASA were assessed. To ensure that risks weren't underestimated, incremental risks were calculated using reasonable maximum exposure concentrations. The incremental contributions to HQ values for COPC are shown in Table 7-17. HQs are presented for the toddler life-stage. HQ values for each surface water, hunting and angling exposure pathway associated with this scenario are provided in **Appendix I**.

Results of the swimming exposure assessment indicate that the incremental risks associated with exposure to surface water are between an order of magnitude and six orders of magnitude less than the acceptable multi-pathway HQ benchmark (i.e., 0.2).

The multi-pathway assessment for exposure of the hunter/angler toddler receptor to COPC indicates that potential risks may exist from exposure to baseline concentrations of arsenic, cadmium, total PCBs and dioxins/furans– associated HQ values for these COPC were 0.43, 0.46, 0.67, and 0.38, respectively. Dioxins/furans, PCBs and inorganics are highly bioaccumulative in biological tissues and virtually all living organisms contain trace amounts (Health Canada, 1990; Health Canada, 2007b); as expected, the risk identified was attributed entirely to the ingestion of wild game and fish. Inorganic compounds are elemental chemicals that cannot typically be broken down into simpler compounds. They are naturally present in geological formations and, by processes of weathering, can often be found in major water bodies where they may be absorbed by fish and/or animals. Dioxins/furans and PCBs are equally ubiquitous in the environment, however, in this case, dioxins/furans and PCBs were not detected in small mammals and only sparingly in fish. As stated previously, baseline risk was evaluated at the method detection limit (MDL) where a COPC was not detected in the media of interest. Although this MDL does not represent the actual concentration of a COPC in media, where in fact concentrations in fish and small mammals are likely much lower, it provides a conservative estimate. Furthermore, given that baseline concentrations (or method detection limits) of these chemicals were found to be no different in the Clarington area than anywhere else in southern Ontario, these findings would be expected across Ontario and are not unique to this project.

Table 7-17 Maximum Hazard Quotient (HQ) Values for Additional Exposures Using Baseline Concentrations

COPC	Baseline Case Additional Scenario Hazard Quotient (HQ) Values	
	Recreational-Swimming	Hunting/Angling
PAHs		
Acenaphthene	4.0E-07	1.3E-05
Anthracene	1.0E-07	1.7E-06
Fluorene	1.2E-06	2.1E-05
PCBs		
Aroclor 1254 (Total PCBs)	0.028	**0.67**
Dioxins and Furans		
2,3,7,8-TCDD Equivalent	3.5E-07	**0.38**
VOCs		
1,1,1-Trichloroethane	1.0E-03	-
Bromoform	7.0E-05	-
Carbon Tetrachloride	5.2E-05	-
Chloroform	4.6E-06	-
Dichloromethane	3.5E-07	-
Trichlorofluoromethane (FREON 11)	3.6E-05	-
Chlorinated Monocyclic Aromatics		
1,2,4,5-Tetrachlorobenzene	6.2E-04	0.064
1,2,4-Trichlorobenzene	5.9E-04	-
1,2-Dichlorobenzene	2.2E-06	-
Hexachlorobenzene	7.4E-04	0.027
Pentachlorobenzene	7.4E-05	0.013
Pentachlorophenol	4.2E-06	-
Inorganics		
Antimony	0.018	0.034

COPC	Baseline Case Additional Scenario Hazard Quotient (HQ) Values	
	Recreational-Swimming	Hunting/Angling
Arsenic	0.0095	**0.43**
Barium	6.4E-04	0.030
Beryllium	7.1E-04	0.067
Boron	4.3E-04	0.040
Cadmium	2.8E-04	**0.46**
Chromium (Total)	5.7E-06	1.9E-04
Chromium VI	0.015	-
Cobalt	5.0E-04	0.043
Lead	7.6E-04	0.037
Mercury - Inorganic	4.7E-04	0.11
Methylmercury	-	-
Nickel	4.2E-04	0.024
Phosphorus	1.6E-08	7.6E-04
Selenium	0.0014	0.16
Silver	2.8E-05	0.0027
Thallium	0.0053	0.17
Tin	4.7E-06	3.8E-04
Vanadium	0.0013	0.020
Zinc	2.1E-04	0.14

Notes:

[a] Baseline concentrations were not available for methylmercury

'-' No baseline wild game or fish concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and mixture exceeded the regulatory benchmark used in the assessment of individual COPC.

7.9.2.2 Baseline Case – Multi-Pathway Risk Assessment Chemical Mixtures

The results of the chronic, multi-pathway chemical mixtures assessment are shown in Table 7-18. Interpretation of chemical mixtures results is difficult as regulators have not established standards or benchmarks for the assessment of mixtures. By adding chemical HQ values together it assumes that not only is the target organ the same, but that exposure to these chemicals actually results in a toxicological mode of action that is directly additive. To date, there have been limited or no mixture additive toxicology studies to support using this approach in human health risk assessment. This is a considerable source of uncertainty in any risk assessment being conducted in Ontario.

Table 7-18 Maximum Hazard Quotient (HQ) Values for Chemical Mixtures using Baseline Multi-Pathway Concentrations

COPC	Baseline Case Multi-Pathway Hazard Quotient (HQ) Values								
	Resident-Infant	Resident-Toddler	Farmer-Infant	Farmer-Toddler	Daycare	Recreation User - Sport	Recreation User - Camping	Additional Exposure due to Swimming	Additional Exposure due to Hunting/ Angling
Haematological Effects	0.017	0.059	0.017	0.28	0.013	0.0011	0.0016	6.6E-04	0.18
Kidney Effects	0.0021	0.0094	0.0021	0.038	0.0017	1.4E-04	2.0E-04	0.0011	0.14
Liver Effects	11	0.47	117	4.8	0.0013	1.0E-04	1.5E-04	0.028	0.67
Neurological Effects	0.031	0.080	0.031	0.24	0.029	0.0084	0.0092	0.0022	0.19
Reproductive/Developmental Effects	0.97	0.15	12	0.73	0.034	0.010	0.011	0.0025	0.35

7.9.2.3 Baseline Case – Multi-Pathway Risk Assessment Carcinogens

A Baseline Case multi-pathway assessment was conducted to derive oral/dermal lifetime cancer risk (LCR) estimates for all carcinogenic COPC. Lifetime exposures to carcinogens considered all life stages (i.e., infant through to adult); this receptor is termed a "composite" lifetime receptor. Prediction of LCRs for daycare receptors, however, only considered the adult life stage.

There is no acceptable benchmark for comparison of LCR values, as they represent an individual's lifetime cancer risks associated with all potential exposures to a given carcinogenic COPC within the environment. For the Baseline Case, this represents the lifetime cancer risk associated with all background sources of COPC and does not include Project-related emissions.

LCR values for multi-pathway receptors in the LRASA are presented in Table 7-19. **Appendix I** provides LCR values for each exposure pathway and each receptor. LCR values for the incremental exposures resulting from activities including recreational swimming and/or hunting/angling are presented in Table 7-20. Because there are no acceptable benchmarks for comparison of LCR values, the implications of baseline results for each receptor group and scenario are not discussed in detail. However, to put these values in context, the typical observed cancer incidence in the Canadian population is 38% for women and 44% for men (Canadian Cancer Society, 2007). Additionally, incremental arsenic cancer risks from store bought foods have been found to range from 1-in-1,000 to 3-in-10,000 (CEPA, 1993; Dabeka, 1994; Hughes, 1994). The predicted values are provided for reference and were used for comparison purposes with Project-related ILCRs, discussed in Sections 7.11.2.3 and 7.12.2.3.

Table 7-19 Maximum Lifetime Cancer Risk (LCR) Values Using Baseline Multi-Pathway Concentrations

COPC	Baseline Case Multi-Pathway Lifetime Cancer Risk (LCR) Values				
	Resident	Farmer	Daycare	Recreation User – Sport	Recreation User - Camping
PAHs					
Benzo(a)pyrene TEQ	4.0E-06	1.6E-05	8.7E-08	7.1E-09	1.9E-08
VOCs					
Bromoform	2.4E-07	3.6E-05	3.4E-11	2.9E-12	7.5E-12
Carbon Tetrachloride	2.0E-06	3.0E-04	3.5E-10	2.8E-11	7.4E-11

COPC	Baseline Case Multi-Pathway Lifetime Cancer Risk (LCR) Values				
	Resident	Farmer	Daycare	Recreation User – Sport	Recreation User - Camping
Dichloromethane	1.1E-06	1.7E-04	3.1E-10	2.7E-11	7.0E-11
Chlorinated Monocyclic Aromatics					
Hexachlorobenzene	4.3E-06	4.7E-05	1.9E-09	1.6E-10	4.1E-10
Pentachlorophenol	1.6E-10	1.6E-10	3.1E-11	2.6E-12	6.8E-12
Inorganics					
Arsenic	1.9E-05	9.6E-05	2.0E-06	1.8E-07	4.7E-07
Chemical Mixtures					
Stomach Carcinogens	4.3E-06	5.2E-05	8.7E-08	7.1E-09	1.9E-08

Table 7-20 Maximum Lifetime Cancer Risk (LCR) Values For Additional Exposures Using Baseline Concentrations

COPC	Baseline Case Additional Scenario Lifetime Cancer Risk (LCR) Values	
	Swimming	Hunting/Angling
PAHs		
Benzo(a)pyrene TEQ	1.6E-07	3.6E-06
VOCs		
Bromoform	3.2E-09	-
Carbon Tetrachloride	1.0E-07	-
Dichloromethane	1.2E-08	-
Chlorinated Monocyclic Aromatics		
Hexachlorobenzene	3.4E-08	9.8E-06

COPC	Baseline Case Additional Scenario Lifetime Cancer Risk (LCR) Values	
	Swimming	Hunting/Angling
Pentachlorophenol	1.3E-09	-
Inorganics		
Arsenic	2.5E-06	1.5E-04
Chemical Mixtures		
Stomach Carcinogens	1.7E-07	3.6E-06

Notes:

'-' No baseline fish or wild game concentration was available for this COPC.

CONSTRUCTION CASE

7.10 Risk Characterization - Construction Case

A qualitative assessment of the Construction Case was undertaken. Construction activities for the Project would include:

- site preparation (e.g., clearing, cut and fill, site levelling) and foundations;
- structural steel erection and major equipment delivery; and,
- process equipment installation, piping, electrical work, etc.

Construction emissions are expected to occur intermittently during daylight hours over the duration of the construction period (about 30 months). The number of large trucks travelling on and off site during the construction period on a daily basis is expected to be less than the daily number of waste truck deliveries anticipated during normal operation of the Facility. There will likely be a greater volume of passenger vehicle traffic to and from the site during construction (from the construction labour force) relative to Facility operation; however passenger vehicles have much lower emissions than heavy trucks (Jacques Whitford, 2009e). Therefore the offsite air quality effects due to vehicle traffic during the construction period are expected to be no greater than those during normal operation of the Facility.

Dust emissions from construction activities could have a temporary effect on local air quality. These emissions are associated with land clearing, ground excavation, cut-and-fill operations and equipment traffic on the site. Generally, fugitive dust emissions are: (1) proportional to the disturbed land area and the level of construction activity; (2) limited to periods of the day and week when the construction activities take place; and (3) vary substantially from day to day with varying meteorological conditions. Under dry, windy conditions, wet suppression can be used to control these fugitive dust sources.

Vehicles on the construction site are sources of exhaust emissions from fuel combustion. Construction activities such as welding, use of solvents, sand blasting and painting can also affect air quality in the construction area. These activities are typically localized and can be mitigated through implementation of vehicle and equipment maintenance programs.

The emissions from construction of the Facility are not expected to be different from those occurring on other medium-sized construction sites in Ontario. Relative to operational emissions, construction emissions will be minor, short-term and transitory, and therefore, it is expected that the assessment of operational scenarios (Sections 7.11 and 7.12) will be protective of any potential health risks that could arise during periods of construction.

140,000 TONNES/YEAR

7.11 Risk Characterization – 140,000 tpy

7.11.1 140,000 tpy Operational Assessment Scenarios – Inhalation Risk Assessment

Assuming an initial operating design capacity of 140,000 tpy, the HHRA evaluated acute and chronic inhalation risks at 309 receptor locations, assessed as 15 receptor groupings, within the LRASA for Traffic Case, Project Alone Case, Project Case, Process Upset Case and Process Upset Project Case scenarios. Where appropriate, the previously discussed Baseline Case results have been included for comparison. Inhalation risk estimates for CACs are presented in Sections 7.11.1.1 and 7.11.1.2. Additional COPC are discussed in Section 7.11.1.3, while chemical mixtures are discussed in Section 7.11.1.4.

The exposure point concentration evaluated for each grouping is based upon the maximum air concentration predicted for a discrete receptor point within each receptor group. This is a conservative measure meant to ensure that inhalation risks to individuals present within these locations were not underestimated. Refer to Section 3.3 for a complete list of HHRA receptor locations evaluated.

In addition to the individual receptor groupings, the maximum ground level concentration within the LRASA was determined and evaluated for inhalation risks. These concentrations were determined based on the protocol outlined by the Ontario Ministry of the Environment in which a specified number of 1-hour and 24-hour concentrations have been removed from the modeling analysis of each chemical to account for meteorological anomalies; therefore it is possible that results at individual groupings exhibit higher concentrations than the maximum ground level concentration, as this protocol was not applied to the individual receptor analysis. Nevertheless, the analysis of ground level maximum concentrations is expected to provide a conservative and representative estimate of risk in the LRASA. Full details on the selection of maximum ground level concentrations are available in the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e). The following sections present acute and chronic concentration ratio (CR) values, and cancer risk estimates (LCR and ILCR), at the maximum ground level concentration, as well as at individual receptor groupings surrounding the Site, where appropriate.

For the purposes of the acute Process Upset assessment, it is assumed that the Facility operates under upset conditions for the entire duration of the assessment period (1- or 24-hours). For the chronic Process Upset assessment, it was assumed that operation under upset conditions occurs 5% of the year for CACs and metals, and 20% of the year for all other COPC. Further discussion of assumptions used to characterize upset scenarios can be found the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e). Additionally, CR estimates at each of the 15 individual receptor groupings are presented in **Appendix I**.

In general, CR values are interpreted as follows:

- A CR less than or equal to 1 signifies that the estimated exposure is less than or equal to the exposure limit (i.e*.,* the assumed safe level of exposure); therefore, no adverse health risk is expected.
- A CR greater than 1 signifies the exposure estimate exceeds the exposure limit; consequently, the potential for adverse health effects may exist.

With regards to chronic inhalation risks, separate assessments were conducted for non-carcinogenic COPC and carcinogenic COPC. Chronic, non-cancer inhalation risks (expressed as CR values) assume that an individual is continuously exposed to a predicted annual air concentration. Carcinogenic health risks, expressed as ILCRs, assume that individuals would be continuously exposed to the predicted annual air concentration over the course of a lifetime.

7.11.1.1 140,000 tpy Operational Cases – Inhalation Risk Assessment Criteria Air Contaminants (CACs)

Predicted acute CR values for Baseline Case, Project Alone Case, Project Case, Process Upset Case, and Process Upset Project Case exposures to CACs at 140,000 tpy are presented in Table 7-21.

Predicted 1-hour, 24-hour and annual air concentrations at 140,000 tpy for the CAC do not exceed their relevant exposure limit for the Baseline Case, Project Alone Case, Project Case, Process Upset Case or Process Upset Project Case; therefore, no adverse health risk is expected from potential exposure to CACs. Similarly, health risks were not predicted at any of the 15 individual receptor groupings, which include schools, daycares, farms, current/future industrial/commercial areas, park/recreational areas, hospitals, retirement homes, and eight residential areas (**Appendix I**). Further information on the receptor groupings can be found in Section 3.3.

Additionally, as discussed in Section 7.6.1.1, CACs (including NO_2, SO_2, $PM_{2.5}$, and PM_{10}) have been compared to WHO benchmarks for informational purposes. With the exception of Process Upset Project Case 24-hr $PM_{2.5}$ (CR = 1.01), none of the relevant Baseline Case, Project Alone Case, Project Case, Process Upset Case or Process Upset Project Case CACs exceed the WHO benchmarks. The exceedance of fine particulate matter is driven by baseline concentrations, and was not unexpected, as any urban area in Ontario would produce similar results. Frequency analysis of this occurrence was completed for the Courtice road ambient air monitoring station and is presented in Figure 7-13. It is apparent from the graph that 24-hour $PM_{2.5}$ concentrations exceeding the WHO benchmark of 25 µg/m^3 are very rare. Specifically, the concentration of $PM_{2.5}$ at this location is expected to be less than 25 µg/m^3, 96% of the time. As noted, WHO benchmarks are not necessarily health-based and are only intended to act as guidelines for country-regulated air quality standards. When compared to the selected Canada-Wide Standard, this exceedance did not occur.

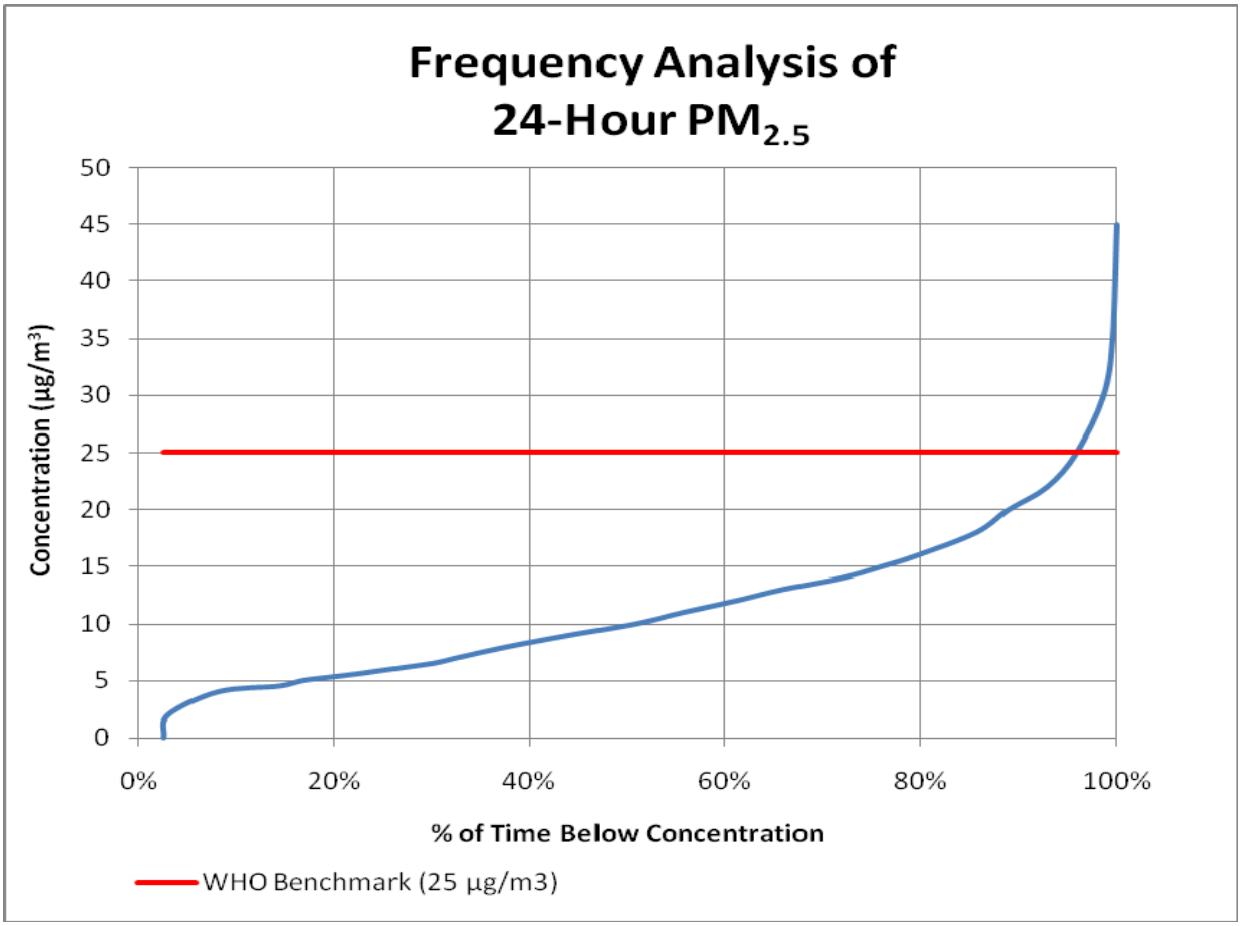


Figure 7-13 Frequency Analysis for 24-Hour $PM_{2.5}$ Concentrations

Overall, it is not expected that concentrations of CACs from the Project, at 140,000 tpy, will pose any additional undue acute or chronic risk to the health of local human receptors.

Table 7-21 Concentration Ratio (CR) Values at 140,000 tpy for Criteria Air Contaminants at the Maximum Ground Level Concentration

COPC	Concentration Ratio (CR) Values – 140,000 tpy					Concentration Ratio (CR) Values – 140,000 tpy – WHO Benchmarks[f]				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
1-Hour										
Ammonia[a]	-	6.1E-04	6.1E-04	0.0061	0.0061	-	-	-	-	-
Carbon Monoxide (CO)	0.069	0.0011	0.070	0.011	0.080	-	-	-	-	-
Hydrogen Chloride (HCl)[a]	-	0.044	0.044	0.44	0.44	-	-	-	-	-
Hydrogen Fluoride (HF)[a]	-	0.013	0.013	0.13	0.13	-	-	-	-	-
Nitrogen Dioxide (NO_2)	0.16	0.11	0.27	0.18	0.34	0.32	0.22	0.54	0.36	0.68
Particulate Matter - PM_{10} [abe]	-	-	-	-	-	-	-	-	-	-
Particulate Matter - $PM_{2.5}$ [be]	-	-	-	-	-	-	-	-	-	-
Particulate Matter - Total[be]	-	-	-	-	-	-	-	-	-	-
Sulfur Dioxide (SO_2)	0.028	0.018	0.047	0.29	0.32	-	-	-	-	-
24-Hour										

COPC	Concentration Ratio (CR) Values – 140,000 tpy					Concentration Ratio (CR) Values – 140,000 tpy – WHO Benchmarks[f]				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Ammonia[a]	-	0.0027	0.0027	0.027	0.027	-	-	-	-	-
Carbon Monoxide (CO)[c]	-	-	-	-	-	-	-	-	-	-
Hydrogen Chloride (HCl)[a]	-	0.023	0.023	0.23	0.23	-	-	-	-	-
Hydrogen Fluoride (HF)[ac]	-	-	-	-	-	-	-	-	-	-
Nitrogen Dioxide (NO_2)	0.29	0.030	0.32	0.049	0.34	-	-	-	-	-
Particulate Matter - PM_{10} [ae]	-	0.011	0.011	0.11	0.11	-	0.011	0.011	0.11	0.11
Particulate Matter - $PM_{2.5}$ [e]	0.68	0.018	0.70	0.18	0.86	0.82	0.021	0.84	0.21	**1.0**
Particulate Matter - Total[e]	0.29	0.0044	0.30	0.044	0.34	-	-	-	-	-
Sulfur Dioxide (SO_2)	0.070	0.0064	0.077	0.10	0.17	0.15	0.014	0.17	0.22	0.38
Annual										
Annual										
Ammonia[a]	-	7.8E-05	7.8E-05	1.1E-04	1.1E-04	-	-	-	-	-

COPC	Concentration Ratio (CR) Values – 140,000 tpy					Concentration Ratio (CR) Values – 140,000 tpy – WHO Benchmarks[f]				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Carbon Monoxide (CO)[d]	-	-	-	-	-	-	-	-	-	-
Hydrogen Chloride (HCl)[a]	-	6.5E-04	6.5E-04	9.5E-04	9.5E-04	-	-	-	-	-
Hydrogen Fluoride (HF)[ad]	-	-	-	-	-	-	-	-	-	-
Nitrogen Dioxide (NO_2)	0.62	0.0029	0.62	0.0030	0.62	0.93	0.0045	0.93	0.0045	0.93
Particulate Matter - PM_{10} [ade]	-	-	-	-	-	-	0.0008	0.0008	0.0011	0.0011
Particulate Matter - $PM_{2.5}$ [de]	-	-	-	-	-	0.98	0.0015	0.98	0.0022	0.98
Particulate Matter - Total[e]	0.35	2.6E-04	0.35	3.7E-04	0.35	-	-	-	-	-
Sulfur Dioxide (SO_2)	0.20	0.0018	0.21	0.0031	0.21	-	-	-	-	-

[a] Baseline Data Not Available

[b] 1-hr TRV Not Available

[c] 24-hr TRV Not Available

[d] Annual TRV Not Available

[e] Particulate Matter results include contribution of Secondary Particulate

[f] "-" indicates WHO benchmark not available

7.11.1.2 140,000 tpy Operational Cases – Inhalation Risk Assessment Criteria Air Contaminants (CACs) – Traffic Case

Predicted acute CR values for Baseline Traffic Case and Traffic Case exposures to CAC at 140,000 tpy are presented in Table 7-22.

Predicted 1-hour, 24-hour and annual air concentrations for the CAC at 140,000 tpy do not exceed their relevant exposure limit for the Baseline Traffic Case, or Traffic Case; therefore, no adverse health risk is expected from potential exposure to CACs due to the combined effect of Project emissions at 140,000 tpy and local vehicular traffic.

Additionally, as discussed in Section 7.6.1.1, CACs (including NO_2, SO_2, $PM_{2.5}$, and PM_{10}) have been compared to WHO benchmarks for informational purposes. With the exception of Traffic Case annual nitrogen dioxide (CR = 1.1), none of the relevant Baseline Traffic Case, or Traffic Case CACs exceed the WHO benchmarks. The exceedance of nitrogen dioxide is driven by baseline concentrations, and was not unexpected, as any urban area in Ontario would produce similar results. As noted, WHO benchmarks are not necessarily health-based and are only intended to act as guidelines for country-regulated air quality standards. When compared to the selected standard from Health Canada, this exceedance did not occur.

Table 7-22 Concentration Ratio (CR) Values at 140,000 tpy for Criteria Air Contaminants at the Maximum Ground Level Concentration

COPC	Operational Traffic Case Concentration Ratio (CR) Values – 140,000 tpy					
	1-hour		24-hour		Annual	
	Baseline Traffic Case	Traffic Case	Baseline Traffic Case	Traffic Case	Baseline Traffic Case	Traffic Case
Risk Assessment TRVs						
Ammonia[d]	-	-	-	-	-	-
Carbon Monoxide (CO)[bc]	0.28	0.28	-	-	-	-
Hydrogen Chloride (HCl)[d]	-	-	-	-	-	-
Hydrogen Fluoride (HF)[d]	-	-	-	-	-	-
Nitrogen Dioxide (NO_2)	0.39	0.48	0.53	0.55	0.77	0.78

COPC	Operational Traffic Case Concentration Ratio (CR) Values – 140,000 tpy					
	1-hour		24-hour		Annual	
	Baseline Traffic Case	Traffic Case	Baseline Traffic Case	Traffic Case	Baseline Traffic Case	Traffic Case
Particulate Matter - PM_{10} [ac]	-	-	0.021	0.041	-	-
Particulate Matter - $PM_{2.5}$ [ac]	-	-	0.70	0.72	-	-
Particulate Matter – Total[a]	-	-	0.31	0.37	0.36	0.37
Sulfur Dioxide (SO_2)	0.031	0.057	0.071	0.077	0.21	0.21
WHO Benchmarks[e]						
Ammonia	-	-	-	-	-	-
Carbon Monoxide (CO)	-	-	-	-	-	-
Hydrogen Chloride (HCl)	-	-	-	-	-	-
Hydrogen Fluoride (HF)	-	-	-	-	-	-
Nitrogen Dioxide (NO_2)	0.78	0.97	-	-	**1.2**	**1.2**
Particulate Matter - PM_{10}	-	-	0.021	0.041	0.010	0.012
Particulate Matter - $PM_{2.5}$	-	-	0.84	0.87	0.99	0.99
Particulate Matter – Total	-	-	-	-	-	-
Sulfur Dioxide (SO_2)	-	-	0.16	0.17	-	-

[a] 1-hr TRV Not Available

[b] 24-hr TRV Not Available

[c] Annual TRV Not Available

[d] Not Included in the Traffic Case Assessment

[e] '-' indicates that WHO benchmark not available

7.11.1.3 140,000 tpy Operational Cases – Inhalation Risk Assessment Additional COPC

Predicted acute CR values for Baseline Case, Project Alone Case, Project Case, Process Upset Case, and Process Upset Project Case exposures to other COPC at 140,000 tpy are presented in Table 7-23.

Predicted 1-hour, 24-hour or annual air concentrations for the additional COPC do not exceed their relevant exposure limit for the Baseline Case, Project Alone Case, Project Case, Process Upset Case or Process Upset Project Case at 140,000 tpy; therefore, no adverse health risk is expected from potential exposure to additional COPC. Similarly, health risks were not predicted at any of the 15 individual receptor groupings, which include schools, daycares, farms, current/future industrial/commercial areas, park/recreational areas, hospitals, retirement homes, and eight residential areas (**Appendix I**). Further information on the receptor groupings can be found in Section 3.3.1.

Overall, it is not expected that concentrations of other COPC from the Project, at 140,000 tpy, will pose any additional undue risk to the health of local human receptors.

Table 7-23 Concentration Ratio (CR) Values at 140,000 tpy for Individual COPC at the Maximum Ground Level Concentration

COPC	Concentration Ratio (CR) Values – 140,000 tpy														
	1-hour					24-hour					Annual				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Metals															
Antimony	0.0015	2.0E-04	0.0017	0.0020	0.0035	1.2E-04	5.5E-06	1.3E-04	5.5E-05	1.8E-04	0.015	2.0E-05	0.015	2.9E-05	0.015
Arsenic	0.022	7.6E-04	0.023	0.0076	0.030	0.0060	7.0E-05	0.0061	7.0E-04	0.0067	0.12	4.1E-05	0.12	5.9E-05	0.12
Barium	0.0040	1.5E-04	0.0041	0.0015	0.0055	8.2E-04	1.1E-05	8.3E-04	1.1E-04	9.2E-04	0.0049	3.1E-06	0.0050	4.5E-06	0.0050
Beryllium	0.037	0.0060	0.043	0.060	0.097	0.030	0.0017	0.032	0.017	0.047	0.043	6.9E-05	0.043	1.0E-04	0.043
Boron[c]	0.0037	0.0011	0.0048	0.011	0.015	-	-	-	-	-	0.0031	4.4E-05	0.0031	6.4E-05	0.0031
Cadmium	0.015	0.025	0.040	0.25	0.27	0.024	0.014	0.038	0.14	0.16	0.12	0.0020	0.12	0.0030	0.12
Chromium (hexavalent)[ac]	-	0.0012	0.0012	0.012	0.012	-	-	-	-	-	-	4.7E-06	4.7E-06	6.7E-06	6.7E-06
Total Chromium (and compounds)[cd]	0.0067	8.2E-04	0.0075	0.0082	0.015	-	-	-	-	-	-	-	-	-	-
Cobalt	0.0074	0.011	0.018	0.11	0.11	0.0060	0.0029	0.0089	0.029	0.035	0.0060	8.4E-05	0.0060	1.2E-04	0.0061
Lead[e]	0.0081	0.012	0.020	0.12	0.13	0.0100	0.0050	0.015	0.050	0.060	0.0066	1.5E-04	0.0067	2.1E-04	0.0068
Mercury - Inorganic[a]	-	0.0091	0.0091	0.091	0.091	-	3.8E-04	3.8E-04	0.0038	0.0038	-	7.3E-05	7.3E-05	1.1E-04	1.1E-04
Nickel[c]	0.0018	0.0053	0.0071	0.053	0.054	-	-	-	-	-	0.045	0.0025	0.047	0.0037	0.049
Phosphorus[bc]	-	-	-	-	-	-	-	-	-	-	7.3E-10	1.0E-12	7.3E-10	1.5E-12	7.3E-10
Selenium	0.0037	8.7E-05	0.0038	8.7E-04	0.0045	3.0E-04	2.4E-06	3.0E-04	2.4E-05	3.3E-04	0.015	3.5E-06	0.015	5.1E-06	0.015
Silver	0.0083	0.012	0.020	0.12	0.13	3.4E-04	1.7E-04	5.1E-04	0.0017	0.0020	0.034	4.9E-04	0.035	7.1E-04	0.035
Thallium[ac]	0.0073	0.014	0.021	0.14	0.15	-	-	-	-	-	0.029	5.7E-04	0.030	8.2E-04	0.030

COPC	Concentration Ratio (CR) Values – 140,000 tpy														
	1-hour					24-hour					Annual				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Tin	3.7E-04	3.2E-04	6.9E-04	0.0032	0.0036	3.0E-04	8.8E-05	3.9E-04	8.8E-04	0.0012	0.0015	1.3E-05	0.0015	1.9E-05	0.0015
Vanadium	0.0075	8.4E-04	0.0084	0.0084	0.016	0.0015	5.8E-05	0.0016	5.8E-04	0.0021	7.7E-04	1.7E-06	7.7E-04	2.5E-06	7.7E-04
Zinc[c]	0.0021	0.0014	0.0035	0.014	0.017	-	-	-	-	-	0.0051	5.8E-05	0.0051	8.4E-05	0.0052
Chlorinated Polycyclic Aromatics															
Dioxins and Furans (as TEQ Toxic Equivalents)[be]	-	-	-	-	-	0.0047	6.0E-04	0.0053	0.0060	0.011	0.0016	8.5E-06	0.0016	2.4E-05	0.0016
Polychlorinated Biphenyls (PCBs)	0.0010	2.6E-04	0.0013	0.0026	0.0036	2.8E-04	2.4E-05	3.0E-04	2.4E-04	5.2E-04	-	-	-	-	-
Chlorinated Monocyclic Aromatics				-	-	-	-	-	-	-				-	-
Dichlorobenzene, 1,2-[c]	8.6E-07	2.4E-08	8.9E-07	2.4E-07	1.1E-06	-	-	-	-	-	7.8E-06	5.0E-09	7.8E-06	1.4E-08	7.8E-06
Dichlorophenol, 2,4-[ac]	-	7.0E-08	7.0E-08	7.0E-07	7.0E-07	-	-	-	-	-	-	2.8E-09	2.8E-09	7.9E-09	7.9E-09
Hexachlorobenzene[cd]	6.1E-04	7.5E-05	6.8E-04	7.5E-04	0.0014	-	-	-	-	-	0.0021	3.0E-06	0.0021	8.4E-06	0.0021
Pentachlorobenzene[ac]	-	4.9E-08	4.9E-08	4.9E-07	4.9E-07	-	-	-	-	-	-	2.0E-09	2.0E-09	5.5E-09	5.5E-09
Pentachlorophenol	4.3E-04	1.5E-05	4.4E-04	1.5E-04	5.8E-04	4.4E-05	5.2E-07	4.4E-05	5.2E-06	4.9E-05	8.2E-04	6.0E-07	8.2E-04	1.7E-06	8.2E-04
Tetrachlorobenzene, 1,2,4,5-[abc]	-	-	-	-	-	-	-	-	-	-	-	8.0E-08	8.0E-08	2.2E-07	2.2E-07
Tetrachlorophenol, 2,3,4,6-[abc]	-	-	-	-	-	-	-	-	-	-	-	5.6E-09	5.6E-09	1.6E-08	1.6E-08
Trichlorobenzene, 1,2,4-	2.8E-04	4.7E-08	2.8E-04	4.7E-07	2.8E-04	1.1E-04	6.4E-09	1.1E-04	6.4E-08	1.1E-04	0.0024	1.1E-08	0.0024	3.0E-08	0.0024
Trichlorophenol, 2,4,6-[abcd]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons (PAH)															

COPC	Concentration Ratio (CR) Values – 140,000 tpy														
	1-hour					24-hour					Annual				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Acenaphthene[cd]	0.0030	6.7E-06	0.0030	6.7E-05	0.0031	-	-	-	-	-	-	-	-	-	-
Acenaphthylene[cd]	7.5E-04	5.3E-06	7.6E-04	5.3E-05	8.1E-04	-	-	-	-	-	-	-	-	-	-
Anthracene[c]	7.9E-04	3.0E-06	8.0E-04	3.0E-05	8.2E-04	-	-	-	-	-	0.0016	1.2E-07	0.0016	3.3E-07	0.0016
Benzo(a)anthracene[cd]	3.3E-04	1.1E-06	3.3E-04	1.1E-05	3.4E-04	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene[cd]	6.9E-04	2.8E-06	6.9E-04	2.8E-05	7.2E-04	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene[cd]	3.3E-04	7.3E-07	3.3E-04	7.3E-06	3.4E-04	-	-	-	-	-	-	-	-	-	-
Benzo(a)fluorene[c]	6.6E-04	2.0E-05	6.8E-04	2.0E-04	8.6E-04	-	-	-	-	-	0.0023	8.0E-07	0.0023	2.2E-06	0.0023
Benzo(b)fluorene[c]	6.6E-04	1.4E-05	6.7E-04	1.4E-04	8.0E-04	-	-	-	-	-	0.0023	5.5E-07	0.0023	1.5E-06	0.0023
Benzo(ghi)perylene[cd]	3.4E-04	3.0E-05	3.7E-04	3.0E-04	6.4E-04	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene[bd]	-	-	-	-	-	0.068	1.7E-04	0.068	0.0017	0.069	-	-	-	-	-
Benzo(e)pyrene[cd]	6.6E-04	6.3E-06	6.7E-04	6.3E-05	7.2E-04	-	-	-	-	-	-	-	-	-	-
Chrysene[cd]	4.7E-04	2.7E-06	4.7E-04	2.7E-05	5.0E-04	-	-	-	-	-	-	-	-	-	-
Dibenzo(a,c)anthracene[abcd]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzo(a,h)anthracene[cd]	3.3E-04	8.8E-07	3.3E-04	8.8E-06	3.4E-04	-	-	-	-	-	-	-	-	-	-
Fluoranthene[cd]	0.0029	3.0E-05	0.0030	3.0E-04	0.0032	-	-	-	-	-	-	-	-	-	-
Fluorene[ac]	-	1.1E-06	1.1E-06	1.1E-05	1.1E-05	-	-	-	-	-	-	4.5E-08	4.5E-08	1.3E-07	1.3E-07
Indeno(1,2,3 – cd)pyrene[cd]	3.3E-04	5.5E-06	3.4E-04	5.5E-05	3.8E-04	-	-	-	-	-	-	-	-	-	-
1-Methylnaphthalene[bc]	-	-	-	-	-	-	-	-	-	-	1.5E-04	4.8E-08	1.5E-04	1.3E-07	1.5E-04

COPC	Concentration Ratio (CR) Values – 140,000 tpy														
	1-hour					24-hour					Annual				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
2-Methylnaphthalene[bc]	-	-	-	-	-	-	-	-	-	-	2.5E-04	2.6E-07	2.5E-04	7.4E-07	2.5E-04
Naphthalene[b]	-	-	-	-	-	1.1E-04	9.4E-07	1.1E-04	9.4E-06	1.2E-04	2.9E-04	2.0E-07	2.9E-04	5.7E-07	2.9E-04
Perylene[cd]	6.6E-04	1.1E-06	6.6E-04	1.1E-05	6.7E-04	-	-	-	-	-	-	-	-	-	-
Phenanthrene[cd]	0.013	6.9E-05	0.013	6.9E-04	0.013	-	-	-	-	-	-	-	-	-	-
Pyrene[cd]	0.0014	3.6E-05	0.0014	3.6E-04	0.0017	-	-	-	-	-	-	-	-	-	-
Volatile Organic Chemicals (VOC)															
Acetaldehyde[b]	-	-	-	-	-	0.0035	7.2E-11	0.0035	7.2E-10	0.0035	0.12	1.2E-10	0.12	3.3E-10	0.12
Benzene	0.17	6.6E-05	0.17	6.6E-04	0.17	0.41	5.4E-05	0.41	5.4E-04	0.41	0.13	1.5E-06	0.13	4.2E-06	0.13
Biphenyl[bc]	-	-	-	-	-	-	-	-	-	-	2.3E-06	1.9E-08	2.3E-06	5.4E-08	2.4E-06
Bromodichloromethane[c]	0.0021	0.0046	0.0067	0.046	0.048	-	-	-	-	-	0.0053	1.8E-04	0.0055	5.1E-04	0.0058
Bromoform	0.0014	5.0E-04	0.0019	0.0050	0.0064	5.4E-04	6.3E-05	6.0E-04	6.3E-04	0.0012	0.0046	2.0E-05	0.0046	5.6E-05	0.0046
Bromomethane	0.0018	1.1E-04	0.0019	0.0011	0.0029	-	-	-	-	-	0.020	1.0E-05	0.020	2.9E-05	0.020
Carbon tetrachloride	0.014	1.2E-06	0.014	1.2E-05	0.014	0.31	9.0E-06	0.31	9.0E-05	0.31	0.0032	3.3E-09	0.0032	9.2E-09	0.0032
Chloroform	0.0055	1.8E-06	0.0055	1.8E-05	0.0055	0.23	2.6E-05	0.23	2.6E-04	0.23	0.0016	7.4E-09	0.0016	2.1E-08	0.0016
Dichlorodifluoromethane[c]	1.6E-04	6.3E-07	1.6E-04	6.3E-06	1.6E-04	-	-	-	-	-	5.6E-04	2.5E-08	5.6E-04	7.1E-08	5.6E-04
Dichloroethene, 1,1- [c]	2.9E-05	9.8E-07	3.0E-05	9.8E-06	3.9E-05	-	-	-	-	-	2.9E-06	4.1E-09	2.9E-06	1.2E-08	2.9E-06
Dichloromethane	2.2E-04	4.6E-06	2.2E-04	4.6E-05	2.7E-04	0.0058	4.0E-05	0.0058	4.0E-04	0.0062	0.0019	6.4E-07	0.0019	1.8E-06	0.0019
Ethylbenzene[b]	-	-	-	-	-	0.0012	5.2E-08	0.0012	5.2E-07	0.0012	6.9E-04	1.5E-09	6.9E-04	4.2E-09	6.9E-04

COPC	Concentration Ratio (CR) Values – 140,000 tpy														
	1-hour					24-hour					Annual				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Ethylene Dibromide	0.0032	3.7E-05	0.0032	3.7E-04	0.0035	0.0017	6.8E-06	0.0017	6.8E-05	0.0018	2.0E-04	6.5E-08	2.0E-04	1.8E-07	2.0E-04
Formaldehyde	0.55	0.0011	0.55	0.011	0.56	0.052	3.7E-05	0.052	3.7E-04	0.052	0.18	7.7E-06	0.18	2.1E-05	0.18
O-terphenyl[c]	6.6E-06	5.9E-07	7.2E-06	5.9E-06	1.3E-05	-	-	-	-	-	2.3E-05	2.4E-08	2.3E-05	6.7E-08	2.3E-05
Tetrachloroethene	6.0E-05	1.0E-07	6.0E-05	1.0E-06	6.1E-05	0.0014	7.9E-07	0.0014	7.9E-06	0.0014	7.3E-04	2.3E-08	7.3E-04	6.4E-08	7.3E-04
Tetralin[bcd]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene[c]	6.2E-04	4.9E-07	6.2E-04	4.9E-06	6.3E-04	-	-	-	-	-	8.8E-04	1.5E-08	8.8E-04	4.1E-08	8.8E-04
Trichloroethane, 1,1,1 -	3.1E-05	5.8E-08	3.1E-05	5.8E-07	3.1E-05	1.9E-05	1.2E-08	1.9E-05	1.2E-07	1.9E-05	2.0E-05	4.1E-10	2.0E-05	1.2E-09	2.0E-05
Trichloroethylene, 1,1,2 -[d]	0.0024	3.3E-07	0.0024	3.3E-06	0.0024	0.045	2.1E-06	0.045	2.1E-05	0.045	0.0050	1.3E-08	0.0050	3.7E-08	0.0050
Trichlorofluoromethane[bd]	-	-	-	-	-	3.6E-04	1.4E-06	3.6E-04	1.4E-05	3.7E-04	-	-	-	-	-
Vinyl chloride	7.2E-07	7.9E-07	1.5E-06	7.9E-06	8.6E-06	0.0059	0.0022	0.0081	0.022	0.028	3.6E-05	6.3E-07	3.7E-05	1.8E-06	3.8E-05
Xylenes, m-, p- and o-	5.3E-04	1.0E-05	5.4E-04	1.0E-04	6.3E-04	0.0066	4.1E-05	0.0067	4.1E-04	0.0070	0.028	8.8E-06	0.028	2.5E-05	0.028

[a] Baseline Data Not Available

[b] 1-hr TRV Not Available

[c] 24-hr TRV Not Available

[d] Annual TRV Not Available

[e] Measured against a benchmark CR of 0.2

7.11.1.4 140,000 tpy Operational Cases – Inhalation Risk Assessment Chemical Mixtures

Predicted additive acute CR values for Baseline Case, Project Alone Case, Project Case, Process Upset Case, and Process Upset Project Case exposures to mixtures of COPC at 140,000 tpy are provided in Table 7-24.

Interpretation of chemical mixtures is difficult as regulators have not established standards or benchmarks for the assessment of mixtures. By adding chemical CR values together, it assumes that not only is the target organ the same, but that the exposure to these chemicals actually results in a toxicological mode of direction that is directly additive. To date there have been limited or no mixture additive toxicology studies to support using this approach in human health risk assessment. This is a considerable source of uncertainty in any risk assessment being conducted in Ontario.

In addition, the maximum CR values presented for mixtures may not represent an actual location in the LRASA, because risk estimates for each individual chemical often do not occur simultaneously at the same location.

Table 7-24 Concentration Ratio (CR) Values at 140,000 tpy for Chemical Mixtures at the Maximum Ground Level Concentration

COPC	Concentration Ratio (CR) Values – 140,000 tpy				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
1-Hour					
Eye Irritants	0.0048	7.1E-04	0.0055	0.0071	0.012
Nasal Irritants	0.0079	8.3E-04	0.0087	0.0083	0.016
Respiratory Irritants	0.33	0.23	0.56	1.5	1.9
Neurological Effects (Neurotoxicants)	0.026	2.1E-04	0.026	0.0021	0.028
24-Hour					
Eye Irritants	0.0083	4.5E-05	0.0083	4.5E-04	0.0087

COPC	Concentration Ratio (CR) Values – 140,000 tpy				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Nasal Irritants	0.0079	4.1E-05	0.0079	4.1E-04	0.0083
Respiratory Irritants	1.1	0.098	1.2	0.77	1.9
Neurological Effects (Neurotoxicants)	0.55	1.2E-04	0.55	0.0012	0.55
Annual					
Nasal Irritants	0.035	1.4E-05	0.035	3.5E-05	0.035
Respiratory Irritants	0.94	0.0082	0.95	0.011	0.95
Neurological Effects (Neurotoxicants)	0.050	2.3E-04	0.050	3.5E-04	0.050
Reproductive/Developmental Effects	0.0073	1.5E-04	0.0074	2.1E-04	0.0075

7.11.1.5 140,000 tpy Operational Cases – Inhalation Risk Assessment Carcinogens

Predicted chronic ILCR values at 140,000 tpy for carcinogenic COPC from the Project Alone Case and Process Upset Case at the maximum ground level concentration are presented in

Table 7-25. Baseline Case LCR results for each COPC are also provided for comparison. Discussion of these Baseline Case LCR results can be found in Section 0.

In general, ILCR values are interpreted as follows:

- An ILCR less than or equal to 1-in-1,000,000 (i.e. 1E-06) signifies that the incremental lifetime cancer risk associated with the Project is less than the regulatory benchmark (*i.e.,* the assumed safe level of exposure); therefore, no adverse risk is expected.
- An ILCR greater than 1-in-1,000,000 (i.e. 1E-06) signifies that the incremental lifetime cancer risk exceeds the regulatory benchmark. This suggests that the potential for an elevated level of risk may be present for the COPC in question; further investigation may be needed to confirm the identified risk.

With respect to the presented LCR values, there is no regulatory benchmark for comparison. LCR values represent an individual's lifetime cancer risks associated with all potential exposures to a given COPC, including all potential background sources.

None of the predicted annual average Project Alone Case or Process Upset Case minimum ground level concentrations of carcinogenic COPC at 140,000 tpy result in an ILCR exceeding the regulatory benchmark. Similarly, health risks were not predicted at any of the 15 individual receptor groupings which include schools, daycares, farms, current/future industrial/commercial areas, park/recreational areas, hospitals, retirement homes, and eight residential areas (**Appendix I**).

Further information on the receptor groupings can be found in Section 3.2.

Overall, it is not expected that concentrations of carcinogenic COPC from the Project at 140,000 tpy will pose any individual adverse carcinogenic risk to the health of human receptors.

Table 7-25 Chronic LCR and ILCR Values at 140,000 tpy for Carcinogens at the Maximum Ground Level Concentration

COPC	Lifetime Cancer Risk (LCR) Values	Incremental Lifetime Cancer Risk (ILCR) Values – 140,000 tpy	
	Baseline Case	Project Alone Case	Process Upset Case
Metals			
Arsenic	7.7E-06	2.6E-09	3.8E-09
Beryllium	7.1E-07	1.2E-09	1.7E-09
Cadmium	5.9E-06	1.0E-07	1.4E-07
Chromium (hexavalent)[a]	-	3.5E-08	5.1E-08
Total Chromium (and compounds)	1.9E-05	3.6E-08	5.2E-08
Chlorinated Monocyclic Aromatics			
Hexachlorobenzene	2.4E-08	3.4E-11	9.6E-11
Trichlorophenol, 2,4,6-[a]	-	2.4E-13	6.6E-13
Polycyclic Aromatic Hydrocarbons (PAH)			
Benzo(a)pyrene TEQ	1.4E-05	1.4E-09	3.9E-09
Volatile Organic Chemicals (VOC)			
Acetaldehyde	6.1E-07	6.1E-16	1.7E-15
Benzene	3.1E-05	3.5E-10	9.8E-10
Carbon tetrachloride	9.2E-06	9.4E-12	2.6E-11
Chloroform	3.7E-06	1.7E-11	4.8E-11
Dichloromethane	3.6E-07	1.2E-10	3.4E-10

COPC	Lifetime Cancer Risk (LCR) Values	Incremental Lifetime Cancer Risk (ILCR) Values – 140,000 tpy	
	Baseline Case	Project Alone Case	Process Upset Case
Ethylene Dibromide	1.1E-06	3.5E-10	9.9E-10
Formaldehyde	8.8E-06	3.7E-10	1.0E-09
Tetrachloroethene	1.4E-06	4.3E-11	1.2E-10
Trichloroethylene, 1,1,2 -	1.7E-07	4.4E-13	1.2E-12
Vinyl chloride	3.2E-08	5.6E-10	1.6E-09
Chemical Mixtures			
Liver Carcinogens	5.5E-06	7.7E-10	2.2E-09
Lung Carcinogens	4.7E-05	1.8E-07	2.6E-07
Skin Carcinogens	2.1E-05	4.0E-09	7.7E-09

[a] Baseline Data Not Available

7.11.2 140,000 tpy Operational Assessment Scenarios - Multi-Pathway Risk Assessment

7.11.2.1 140,000 tpy Operational Cases – Multi-Pathway Risk Assessment Non-Carcinogens

Assuming an initial operating design capacity of 140,000 tpy, a subset of 133 unique receptor locations in 14 receptor groupings within the LRASA were selected to undergo a multi-pathway exposure assessment to evaluate chronic exposure to COPC through exposure to different local environmental media including soil, air, local produce, agricultural products, wild game and fish. As discussed in Section 7.3.4, the Facility will not impact local drinking water; therefore, aside from recreational swimmers, the multi-pathway assessment has not evaluated exposures related to potable water consumption.

The following receptor types were evaluated as part of the multi-pathway exposure assessment:

- Local Residents (Infant, Toddler, Composite)
- Local Farmers (Infant, Toddler, Composite)
- Daycare (Toddler, Adult)
- Recreation User – Sport (Toddler, Composite)
- Recreation User – Camping (Toddler, Composite)

As well, the additional risk incurred by local resident receptors while performing specific activities such as swimming, hunting or angling was evaluated. Refer to Table 3-2 for a complete list of receptor groupings evaluated. The results of the evaluation of each assessment case (i.e., Baseline Case, Project Alone Case, Project Case, Process Upset Case and Process Upset Project Case) are presented in the following sections.

Chronic risk estimates (*via* multiple exposure pathways) were expressed as HQ values for all non-carcinogenic COPC. HQ values were calculated for the Baseline Case, Project Alone Case, Project Case, Process Upset Case and Process Upset Project Case. A toddler (7 months to 4 years) was considered to represent the most sensitive receptor age class. As a result, health risks associated with exposures to non-carcinogenic COPC are presented for the toddler. HQ values for each exposure pathway and each receptor are provided in **Appendix I**.

Additionally, HQ values were also derived for resident and farmer infants (0 to 6 months) in order to evaluate the potential additional health risks associated with exposure to these COPC *via* the consumption of breast milk**.** Similar to the chronic inhalation assessment, the Process Upset scenarios assessment assumes that the Facility operates under upset conditions during

5% of the year (for metals) and during 20% of the year (for all other COPC). Further discussion of the assumptions used to characterize the Process Upset scenario can found in the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e).

Local Residents

Chronic HQ values for local resident infant and toddler receptors are presented in Table 7-26 through Table 7-33. With the exception of PCBs in infant and toddler resident receptors, and arsenic and thallium in only toddlers, all HQ values for the Baseline Case, Project Alone Case, Project Case, Process Upset Case or Process Upset Project Case at 140,000 tpy are below the regulatory benchmark; therefore it is not expected that the Project, at 140,000 tpy, will pose any additional undue risk to the health of local residents. HQ values for Project Case/Process Upset Project Case HQs for Total PCBs in infant and toddler resident receptors were 10.8 and 0.49, respectively. HQ values for arsenic and thallium were 0.32 and 0.25 for the toddler, respectively. These values are entirely driven by the Baseline Case – the Project Alone Case/Process Upset Case never represents more than approximately 0.5% of the Project Case/Process Upset Project Case risk.

The overall multi-pathway HQ values for lead and dioxin/furans (2,3,7,8-TCDD TEQ), for both residential infants and toddlers, for all assessment scenarios at 140,000 tpy, are presented in Table 7-34. These COPC are treated separately as the exposure endpoint for these chemicals are consistent regardless of the exposure pathway; therefore, inhalation CR results were added to the predicted multi-pathway HQ values and compared to a benchmark of 0.2. The results indicate that all lead HQ values for the Baseline Case, Project Alone Case, Project Case Process Upset Case or Process Upset Project Case are below the regulatory benchmark. Therefore, it is not expected that the Project will pose any additional undue risk to the health of local residents due to exposure to lead.

With regards to dioxins/furans, HQ values for Project Case/Process Upset Project Case HQs in resident infant receptors were 3.8. This value is entirely driven by the Baseline Case – the Project Alone Case/Process Upset Case never represents more than approximately 0.4% of the Project Case/Process Upset Project Case risk; therefore it is not expected that the Project, at 140,000 tpy, will pose any additional undue risk to the health of local residents.

Table 7-26 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Bowmanville Subdivision Infant and Toddler Receptor Groupings at 140,000 tpy

COPC	Hazard Quotient – Bowmanville Subdivision – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.1E-06	6.6E-12	4.1E-06	1.8E-11	4.1E-06	1.3E-05	1.6E-10	1.3E-05	4.4E-10	1.3E-05
Anthracene	9.5E-07	1.5E-12	9.5E-07	4.1E-12	9.5E-07	2.7E-06	1.3E-11	2.7E-06	3.6E-11	2.7E-06
Fluorene	6.3E-06	9.5E-12	6.3E-06	2.7E-11	6.3E-06	2.0E-05	1.3E-10	2.0E-05	3.7E-10	2.0E-05
PCBs										
Aroclor 1254 (Total PCBs)	**10.8**	7.6E-05	**10.8**	2.1E-04	**10.8**	**0.49**	9.7E-06	**0.49**	2.7E-05	**0.49**
VOCs										
1,1,1-Trichloroethane	2.1E-08	1.1E-16	2.1E-08	3.1E-16	2.1E-08	4.7E-06	5.6E-14	4.7E-06	1.6E-13	4.7E-06
Bromoform	4.7E-06	3.4E-14	4.7E-06	9.5E-14	4.7E-06	0.0023	7.9E-12	0.0023	2.2E-11	0.0023
Carbon Tetrachloride	1.6E-04	1.8E-13	1.6E-04	5.0E-13	1.6E-04	0.033	4.3E-11	0.033	1.2E-10	0.033
Chloroform	4.5E-06	8.0E-15	4.5E-06	2.3E-14	4.5E-06	0.0026	6.6E-12	0.0026	1.8E-11	0.0026

COPC	Hazard Quotient – Bowmanville Subdivision – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Dichloromethane	1.7E-05	2.8E-13	1.7E-05	7.9E-13	1.7E-05	0.0047	7.6E-10	0.0047	2.1E-09	0.0047
Trichlorofluoromethane (FREON 11)	3.7E-07	1.5E-14	3.7E-07	4.2E-14	3.7E-07	1.5E-04	7.2E-12	1.5E-04	2.0E-11	1.5E-04
Chlorinated Monocyclic Aromatics										
1,2,4,5-Tetrachlorobenzene	0.0020	9.7E-10	0.0020	2.7E-09	0.0020	0.045	9.9E-09	0.045	2.8E-08	0.045
1,2,4-Trichlorobenzene	6.3E-04	2.2E-12	6.3E-04	6.3E-12	6.3E-04	0.057	5.3E-11	0.057	1.5E-10	0.057
1,2-Dichlorobenzene	3.9E-07	1.3E-13	3.9E-07	3.6E-13	3.9E-07	1.1E-04	1.9E-11	1.1E-04	5.2E-11	1.1E-04
Hexachlorobenzene	0.0025	1.9E-10	0.0025	5.4E-10	0.0025	0.019	8.8E-10	0.019	2.5E-09	0.019
Pentachlorobenzene	9.3E-04	2.5E-09	9.3E-04	7.1E-09	9.3E-04	0.0094	1.4E-08	0.0094	4.0E-08	0.0094
Pentachlorophenol	8.9E-07	5.3E-09	9.0E-07	1.5E-08	9.1E-07	2.3E-06	5.4E-08	2.3E-06	1.5E-07	2.4E-06
Inorganics										
Antimony	0.011	1.9E-06	0.011	2.7E-06	0.011	0.052	1.5E-05	0.052	2.2E-05	0.052
Arsenic	0.10	2.2E-07	0.10	3.2E-07	0.10	**0.32**	1.6E-06	**0.32**	2.3E-06	**0.32**

COPC	Hazard Quotient – Bowmanville Subdivision – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Barium	0.0019	2.6E-09	0.0019	3.8E-09	0.0019	0.0079	2.2E-08	0.0079	3.2E-08	0.0079
Beryllium	0.0013	2.1E-07	0.0013	3.1E-07	0.0013	0.050	7.7E-07	0.050	1.1E-06	0.050
Boron	2.8E-04	1.5E-08	2.8E-04	2.1E-08	2.8E-04	0.022	4.1E-06	0.022	5.9E-06	0.022
Cadmium	0.0045	6.6E-06	0.0045	9.6E-06	0.0045	0.027	1.1E-04	0.027	1.6E-04	0.027
Chromium (Total)	5.7E-05	1.6E-10	5.7E-05	2.3E-10	5.7E-05	2.3E-04	1.3E-09	2.3E-04	1.9E-09	2.3E-04
Chromium VI	-	3.7E-08	3.7E-08	5.3E-08	5.3E-08	-	2.9E-07	2.9E-07	4.2E-07	4.2E-07
Cobalt	0.021	1.1E-06	0.021	1.6E-06	0.021	0.070	6.3E-06	0.070	9.1E-06	0.070
Mercury - Inorganic	9.1E-04	1.6E-05	9.3E-04	2.3E-05	9.4E-04	0.0061	8.1E-05	0.0061	1.2E-04	0.0062
Methylmercury	-	1.1E-06	1.1E-06	1.6E-06	1.6E-06	-	8.7E-06	8.7E-06	1.3E-05	1.3E-05
Nickel	0.0036	2.4E-06	0.0037	3.5E-06	0.0037	0.013	9.1E-06	0.013	1.3E-05	0.013
Phosphorus	2.2E-07	7.1E-14	2.2E-07	1.0E-13	2.2E-07	5.1E-05	3.0E-11	5.1E-05	4.3E-11	5.1E-05
Selenium	7.2E-04	2.5E-09	7.2E-04	3.7E-09	7.2E-04	0.011	6.5E-08	0.011	9.4E-08	0.011

COPC	Hazard Quotient – Bowmanville Subdivision – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Silver	2.1E-04	4.3E-08	2.1E-04	6.2E-08	2.1E-04	0.0024	9.7E-07	0.0024	1.4E-06	0.0024
Thallium	0.046	1.8E-04	0.046	2.6E-04	0.046	**0.25**	8.1E-04	**0.25**	0.0012	**0.25**
Tin	1.4E-04	6.0E-08	1.4E-04	8.7E-08	1.4E-04	9.2E-04	2.5E-07	9.2E-04	3.6E-07	9.2E-04
Vanadium	0.013	1.9E-07	0.013	2.8E-07	0.013	0.046	6.5E-07	0.046	9.4E-07	0.046
Zinc	9.8E-04	2.2E-07	9.8E-04	3.1E-07	9.8E-04	0.020	4.8E-06	0.020	7.0E-06	0.020

Notes:

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-27 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Courtice Subdivision Infant and Toddler Receptor Groupings at 140,000 tpy

COPC	Hazard Quotient – Courtice Subdivision – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.1E-06	4.9E-12	4.1E-06	1.4E-11	4.1E-06	1.3E-05	1.2E-10	1.3E-05	3.3E-10	1.3E-05
Anthracene	9.5E-07	1.1E-12	9.5E-07	3.0E-12	9.5E-07	2.7E-06	9.6E-12	2.7E-06	2.7E-11	2.7E-06
Fluorene	6.3E-06	7.1E-12	6.3E-06	2.0E-11	6.3E-06	2.0E-05	1.0E-10	2.0E-05	2.8E-10	2.0E-05
PCBs										
Aroclor 1254 (Total PCBs)	**10.8**	5.6E-05	**10.8**	1.6E-04	**10.8**	**0.49**	7.2E-06	**0.49**	2.0E-05	**0.49**
VOCs										
1,1,1-Trichloroethane	2.1E-08	8.3E-17	2.1E-08	2.3E-16	2.1E-08	4.7E-06	4.2E-14	4.7E-06	1.2E-13	4.7E-06
Bromoform	4.7E-06	2.5E-14	4.7E-06	7.1E-14	4.7E-06	0.0023	6.0E-12	0.0023	1.7E-11	0.0023
Carbon Tetrachloride	1.6E-04	1.3E-13	1.6E-04	3.8E-13	1.6E-04	0.033	3.2E-11	0.033	9.0E-11	0.033
Chloroform	4.5E-06	6.0E-15	4.5E-06	1.7E-14	4.5E-06	0.0026	4.9E-12	0.0026	1.4E-11	0.0026

COPC	Hazard Quotient – Courtice Subdivision – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Dichloromethane	1.7E-05	2.1E-13	1.7E-05	5.9E-13	1.7E-05	0.0047	5.7E-10	0.0047	1.6E-09	0.0047
Trichlorofluoromethane (FREON 11)	3.7E-07	1.1E-14	3.7E-07	3.2E-14	3.7E-07	1.5E-04	5.4E-12	1.5E-04	1.5E-11	1.5E-04
Chlorinated Monocyclic Aromatics										
1,2,4,5-Tetrachlorobenzene	0.0020	7.2E-10	0.0020	2.0E-09	0.0020	0.045	7.4E-09	0.045	2.1E-08	0.045
1,2,4-Trichlorobenzene	6.3E-04	1.7E-12	6.3E-04	4.7E-12	6.3E-04	0.057	4.0E-11	0.057	1.1E-10	0.057
1,2-Dichlorobenzene	3.9E-07	9.6E-14	3.9E-07	2.7E-13	3.9E-07	1.1E-04	1.4E-11	1.1E-04	3.9E-11	1.1E-04
Hexachlorobenzene	0.0025	1.5E-10	0.0025	4.1E-10	0.0025	0.019	6.6E-10	0.019	1.9E-09	0.019
Pentachlorobenzene	9.3E-04	1.9E-09	9.3E-04	5.3E-09	9.3E-04	0.0094	1.1E-08	0.0094	3.0E-08	0.0094
Pentachlorophenol	8.9E-07	3.6E-09	9.0E-07	1.0E-08	9.0E-07	2.3E-06	3.7E-08	2.3E-06	1.0E-07	2.4E-06
Inorganics										
Antimony	0.011	1.4E-06	0.011	2.0E-06	0.011	0.052	1.1E-05	0.052	1.6E-05	0.052
Arsenic	0.10	1.6E-07	0.10	2.3E-07	0.10	**0.32**	1.1E-06	**0.32**	1.6E-06	**0.32**

COPC	Hazard Quotient – Courtice Subdivision – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Barium	0.0019	1.9E-09	0.0019	2.8E-09	0.0019	0.0079	1.6E-08	0.0079	2.3E-08	0.0079
Beryllium	0.0013	1.5E-07	0.0013	2.2E-07	0.0013	0.050	5.5E-07	0.050	8.0E-07	0.050
Boron	2.8E-04	1.1E-08	2.8E-04	1.5E-08	2.8E-04	0.022	2.9E-06	0.022	4.3E-06	0.022
Cadmium	0.0045	4.8E-06	0.0045	7.0E-06	0.0045	0.027	7.8E-05	0.027	1.1E-04	0.027
Chromium (Total)	5.7E-05	1.1E-10	5.7E-05	1.7E-10	5.7E-05	2.3E-04	9.5E-10	2.3E-04	1.4E-09	2.3E-04
Chromium VI	-	2.7E-08	2.7E-08	3.9E-08	3.9E-08	-	2.0E-07	2.0E-07	3.0E-07	3.0E-07
Cobalt	0.021	8.2E-07	0.021	1.2E-06	0.021	0.070	4.5E-06	0.070	6.5E-06	0.070
Mercury - Inorganic	9.1E-04	1.0E-05	9.2E-04	1.5E-05	9.3E-04	0.0061	5.3E-05	0.0061	7.7E-05	0.0061
Methylmercury	-	8.0E-07	8.0E-07	1.2E-06	1.2E-06	-	6.1E-06	6.1E-06	8.9E-06	8.9E-06
Nickel	0.0036	1.7E-06	0.0037	2.5E-06	0.0037	0.013	6.5E-06	0.013	9.4E-06	0.013
Phosphorus	2.2E-07	5.2E-14	2.2E-07	7.5E-14	2.2E-07	5.1E-05	2.1E-11	5.1E-05	3.1E-11	5.1E-05
Selenium	7.2E-04	1.8E-09	7.2E-04	2.7E-09	7.2E-04	0.011	4.6E-08	0.011	6.6E-08	0.011

COPC	Hazard Quotient – Courtice Subdivision – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Silver	2.1E-04	3.1E-08	2.1E-04	4.5E-08	2.1E-04	0.0024	6.9E-07	0.0024	1.0E-06	0.0024
Thallium	0.046	1.3E-04	0.046	1.9E-04	0.046	**0.25**	5.8E-04	**0.25**	8.4E-04	**0.25**
Tin	1.4E-04	4.3E-08	1.4E-04	6.3E-08	1.4E-04	9.2E-04	1.8E-07	9.2E-04	2.6E-07	9.2E-04
Vanadium	0.013	1.4E-07	0.013	2.0E-07	0.013	0.046	4.6E-07	0.046	6.7E-07	0.046
Zinc	9.8E-04	1.6E-07	9.8E-04	2.3E-07	9.8E-04	0.020	3.5E-06	0.020	5.0E-06	0.020

Notes:

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-28 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Courtice Road Infant and Toddler Receptor Groupings at 140,000 tpy

COPC	Hazard Quotient – Courtice Road – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.1E-06	2.1E-11	4.1E-06	5.9E-11	4.1E-06	1.3E-05	5.1E-10	1.3E-05	1.4E-09	1.3E-05
Anthracene	9.5E-07	4.7E-12	9.5E-07	1.3E-11	9.5E-07	2.7E-06	4.1E-11	2.7E-06	1.1E-10	2.7E-06
Fluorene	6.3E-06	3.1E-11	6.3E-06	8.6E-11	6.3E-06	2.0E-05	4.3E-10	2.0E-05	1.2E-09	2.0E-05
PCBs										
Aroclor 1254 (Total PCBs)	**10.8**	2.4E-04	**10.8**	6.8E-04	**10.8**	**0.49**	3.1E-05	**0.49**	8.7E-05	**0.49**
VOCs										
1,1,1-Trichloroethane	2.1E-08	3.5E-16	2.1E-08	9.9E-16	2.1E-08	4.7E-06	1.8E-13	4.7E-06	5.0E-13	4.7E-06
Bromoform	4.7E-06	1.1E-13	4.7E-06	3.0E-13	4.7E-06	0.0023	2.5E-11	0.0023	7.1E-11	0.0023
Carbon Tetrachloride	1.6E-04	5.8E-13	1.6E-04	1.6E-12	1.6E-04	0.033	1.4E-10	0.033	3.8E-10	0.033
Chloroform	4.5E-06	2.6E-14	4.5E-06	7.2E-14	4.5E-06	0.0026	2.1E-11	0.0026	5.9E-11	0.0026

COPC	Hazard Quotient – Courtice Road – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Dichloromethane	1.7E-05	9.1E-13	1.7E-05	2.5E-12	1.7E-05	0.0047	2.4E-09	0.0047	6.8E-09	0.0047
Trichlorofluoromethane (FREON 11)	3.7E-07	4.9E-14	3.7E-07	1.4E-13	3.7E-07	1.5E-04	2.3E-11	1.5E-04	6.5E-11	1.5E-04
Chlorinated Monocyclic Aromatics										
1,2,4,5-Tetrachlorobenzene	0.0020	3.1E-09	0.0020	8.7E-09	0.0020	0.045	3.2E-08	0.045	8.9E-08	0.045
1,2,4-Trichlorobenzene	6.3E-04	7.2E-12	6.3E-04	2.0E-11	6.3E-04	0.057	1.7E-10	0.057	4.8E-10	0.057
1,2-Dichlorobenzene	3.9E-07	4.1E-13	3.9E-07	1.2E-12	3.9E-07	1.1E-04	6.0E-11	1.1E-04	1.7E-10	1.1E-04
Hexachlorobenzene	0.0025	6.2E-10	0.0025	1.7E-09	0.0025	0.019	2.8E-09	0.019	7.9E-09	0.019
Pentachlorobenzene	9.3E-04	8.1E-09	9.3E-04	2.3E-08	9.3E-04	0.0094	4.6E-08	0.0094	1.3E-07	0.0094
Pentachlorophenol	8.9E-07	1.2E-08	9.1E-07	3.4E-08	9.3E-07	2.3E-06	1.2E-07	2.4E-06	3.5E-07	2.6E-06
Inorganics	0.0E+00	0.0E+00	0.0E+00							
Antimony	0.011	4.1E-06	0.011	6.0E-06	0.011	0.052	3.2E-05	0.052	4.7E-05	0.052
Arsenic	0.10	4.9E-07	0.10	7.1E-07	0.10	**0.32**	3.1E-06	**0.32**	4.5E-06	**0.32**

COPC	Hazard Quotient – Courtice Road – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Barium	0.0019	5.8E-09	0.0019	8.5E-09	0.0019	0.0079	4.6E-08	0.0079	6.6E-08	0.0079
Beryllium	0.0013	4.6E-07	0.0013	6.7E-07	0.0013	0.050	1.7E-06	0.050	2.4E-06	0.050
Boron	2.8E-04	3.2E-08	2.8E-04	4.7E-08	2.8E-04	0.022	8.8E-06	0.022	1.3E-05	0.022
Cadmium	0.0045	1.5E-05	0.0045	2.1E-05	0.0045	0.027	2.4E-04	0.027	3.4E-04	0.027
Chromium (Total)	5.7E-05	3.5E-10	5.7E-05	5.1E-10	5.7E-05	2.3E-04	2.6E-09	2.3E-04	3.8E-09	2.3E-04
Chromium VI	-	8.1E-08	8.1E-08	1.2E-07	1.2E-07	-	5.7E-07	5.7E-07	8.2E-07	8.2E-07
Cobalt	0.021	2.5E-06	0.021	3.6E-06	0.021	0.070	1.3E-05	0.070	1.9E-05	0.070
Mercury - Inorganic	9.1E-04	3.8E-05	9.5E-04	5.5E-05	9.7E-04	0.0061	1.9E-04	0.0062	2.8E-04	0.0063
Methylmercury	-	2.4E-06	2.4E-06	3.5E-06	3.5E-06	-	1.8E-05	1.8E-05	2.7E-05	2.7E-05
Nickel	0.0036	5.3E-06	0.0037	7.6E-06	0.0037	0.013	1.9E-05	0.013	2.8E-05	0.013
Phosphorus	2.2E-07	1.6E-13	2.2E-07	2.3E-13	2.2E-07	5.1E-05	6.4E-11	5.1E-05	9.3E-11	5.1E-05
Selenium	7.2E-04	5.6E-09	7.2E-04	8.1E-09	7.2E-04	0.011	1.2E-07	0.011	1.8E-07	0.011

COPC	Hazard Quotient – Courtice Road – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Silver	2.1E-04	9.4E-08	2.1E-04	1.4E-07	2.1E-04	0.0024	2.0E-06	0.0024	2.9E-06	0.0024
Thallium	0.046	3.9E-04	0.046	5.7E-04	0.046	**0.25**	0.0017	**0.25**	0.0024	**0.26**
Tin	1.4E-04	1.3E-07	1.4E-04	1.9E-07	1.4E-04	9.2E-04	5.4E-07	9.2E-04	7.8E-07	9.2E-04
Vanadium	0.013	4.2E-07	0.013	6.1E-07	0.013	0.046	1.4E-06	0.046	2.0E-06	0.046
Zinc	9.8E-04	4.8E-07	9.8E-04	6.9E-07	9.8E-04	0.020	1.0E-05	0.020	1.5E-05	0.020

Notes:

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-29 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Maple Grove Infant and Toddler Receptor Groupings at 140,000 tpy

COPC	Hazard Quotient – Maple Grove – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.1E-06	5.9E-12	4.1E-06	1.7E-11	4.1E-06	1.3E-05	1.4E-10	1.3E-05	4.0E-10	1.3E-05
Anthracene	9.5E-07	1.3E-12	9.5E-07	3.6E-12	9.5E-07	2.7E-06	1.1E-11	2.7E-06	3.2E-11	2.7E-06
Fluorene	6.3E-06	8.5E-12	6.3E-06	2.4E-11	6.3E-06	2.0E-05	1.2E-10	2.0E-05	3.3E-10	2.0E-05
PCBs										
Aroclor 1254 (Total PCBs)	**10.8**	6.8E-05	**10.8**	1.9E-04	**10.8**	**0.49**	8.6E-06	**0.49**	2.4E-05	**0.49**
VOCs										
1,1,1-Trichloroethane	2.1E-08	9.9E-17	2.1E-08	2.8E-16	2.1E-08	4.7E-06	5.0E-14	4.7E-06	1.4E-13	4.7E-06
Bromoform	4.7E-06	3.0E-14	4.7E-06	8.5E-14	4.7E-06	0.0023	7.1E-12	0.0023	2.0E-11	0.0023
Carbon Tetrachloride	1.6E-04	1.6E-13	1.6E-04	4.5E-13	1.6E-04	0.033	3.8E-11	0.033	1.1E-10	0.033
Chloroform	4.5E-06	7.2E-15	4.5E-06	2.0E-14	4.5E-06	0.0026	5.9E-12	0.0026	1.6E-11	0.0026

COPC	Hazard Quotient – Maple Grove – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Dichloromethane	1.7E-05	2.5E-13	1.7E-05	7.1E-13	1.7E-05	0.0047	6.8E-10	0.0047	1.9E-09	0.0047
Trichlorofluoromethane (FREON 11)	3.7E-07	1.4E-14	3.7E-07	3.8E-14	3.7E-07	1.5E-04	6.5E-12	1.5E-04	1.8E-11	1.5E-04
Chlorinated Monocyclic Aromatics										
1,2,4,5-Tetrachlorobenzene	0.0020	8.7E-10	0.0020	2.4E-09	0.0020	0.045	8.8E-09	0.045	2.5E-08	0.045
1,2,4-Trichlorobenzene	6.3E-04	2.0E-12	6.3E-04	5.6E-12	6.3E-04	0.057	4.7E-11	0.057	1.3E-10	0.057
1,2-Dichlorobenzene	3.9E-07	1.2E-13	3.9E-07	3.2E-13	3.9E-07	1.1E-04	1.7E-11	1.1E-04	4.7E-11	1.1E-04
Hexachlorobenzene	0.0025	1.7E-10	0.0025	4.9E-10	0.0025	0.019	7.9E-10	0.019	2.2E-09	0.019
Pentachlorobenzene	9.3E-04	2.3E-09	9.3E-04	6.4E-09	9.3E-04	0.0094	1.3E-08	0.0094	3.6E-08	0.0094
Pentachlorophenol	8.9E-07	4.6E-09	9.0E-07	1.3E-08	9.1E-07	2.3E-06	4.7E-08	2.3E-06	1.3E-07	2.4E-06
Inorganics										
Antimony	0.011	1.0E-06	0.011	1.5E-06	0.011	0.052	7.8E-06	0.052	1.1E-05	0.052
Arsenic	0.10	1.2E-07	0.10	1.7E-07	0.10	**0.32**	7.7E-07	**0.32**	1.1E-06	**0.32**

COPC	Hazard Quotient – Maple Grove – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Barium	0.0019	1.4E-09	0.0019	2.1E-09	0.0019	0.0079	1.1E-08	0.0079	1.6E-08	0.0079
Beryllium	0.0013	1.1E-07	0.0013	1.6E-07	0.0013	0.050	4.0E-07	0.050	5.9E-07	0.050
Boron	2.8E-04	7.9E-09	2.8E-04	1.1E-08	2.8E-04	0.022	2.1E-06	0.022	3.1E-06	0.022
Cadmium	0.0045	3.6E-06	0.0045	5.2E-06	0.0045	0.027	5.8E-05	0.027	8.4E-05	0.027
Chromium (Total)	5.7E-05	8.5E-11	5.7E-05	1.2E-10	5.7E-05	2.3E-04	6.4E-10	2.3E-04	9.3E-10	2.3E-04
Chromium VI	-	2.0E-08	2.0E-08	2.9E-08	2.9E-08	-	1.4E-07	1.4E-07	2.0E-07	2.0E-07
Cobalt	0.021	6.1E-07	0.021	8.8E-07	0.021	0.070	3.2E-06	0.070	4.6E-06	0.070
Mercury - Inorganic	9.1E-04	1.2E-05	9.2E-04	1.7E-05	9.3E-04	0.0061	6.1E-05	0.0061	8.9E-05	0.0061
Methylmercury	-	5.9E-07	5.9E-07	8.6E-07	8.6E-07	-	5.3E-06	5.3E-06	7.7E-06	7.7E-06
Nickel	0.0036	1.3E-06	0.0036	1.9E-06	0.0037	0.013	4.6E-06	0.013	6.7E-06	0.013
Phosphorus	2.2E-07	3.8E-14	2.2E-07	5.6E-14	2.2E-07	5.1E-05	1.6E-11	5.1E-05	2.3E-11	5.1E-05
Selenium	7.2E-04	1.4E-09	7.2E-04	2.0E-09	7.2E-04	0.011	3.0E-08	0.011	4.3E-08	0.011

COPC	Hazard Quotient – Maple Grove – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Silver	2.1E-04	2.3E-08	2.1E-04	3.3E-08	2.1E-04	0.0024	4.9E-07	0.0024	7.1E-07	0.0024
Thallium	0.046	9.5E-05	0.046	1.4E-04	0.046	**0.25**	4.1E-04	**0.25**	5.9E-04	**0.25**
Tin	1.4E-04	3.2E-08	1.4E-04	4.7E-08	1.4E-04	9.2E-04	1.3E-07	9.2E-04	1.9E-07	9.2E-04
Vanadium	0.013	1.0E-07	0.013	1.5E-07	0.013	0.046	3.4E-07	0.046	4.9E-07	0.046
Zinc	9.8E-04	1.2E-07	9.8E-04	1.7E-07	9.8E-04	0.020	2.5E-06	0.020	3.7E-06	0.020

Notes:

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-30 Multi-Pathway Risk Assessment – Operational Cases Hazard Quotient Results for the Oshawa Subdivision Infant and Toddler Receptor Groupings at 140,000 tpy

COPC	Hazard Quotient – Oshawa Subdivision – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.1E-06	9.0E-12	4.1E-06	2.5E-11	4.1E-06	1.3E-05	2.1E-10	1.3E-05	6.0E-10	1.3E-05
Anthracene	9.5E-07	2.0E-12	9.5E-07	5.5E-12	9.5E-07	2.7E-06	1.7E-11	2.7E-06	4.9E-11	2.7E-06
Fluorene	6.3E-06	1.3E-11	6.3E-06	3.6E-11	6.3E-06	2.0E-05	1.8E-10	2.0E-05	5.1E-10	2.0E-05
PCBs										
Aroclor 1254 (Total PCBs)	**10.8**	1.0E-04	**10.8**	2.9E-04	**10.8**	**0.49**	1.3E-05	**0.49**	3.7E-05	**0.49**
VOCs										
1,1,1-Trichloroethane	2.1E-08	1.5E-16	2.1E-08	4.2E-16	2.1E-08	4.7E-06	7.6E-14	4.7E-06	2.1E-13	4.7E-06
Bromoform	4.7E-06	4.6E-14	4.7E-06	1.3E-13	4.7E-06	0.0023	1.1E-11	0.0023	3.0E-11	0.0023
Carbon Tetrachloride	1.6E-04	2.4E-13	1.6E-04	6.9E-13	1.6E-04	0.033	5.8E-11	0.033	1.6E-10	0.033
Chloroform	4.5E-06	1.1E-14	4.5E-06	3.1E-14	4.5E-06	0.0026	8.9E-12	0.0026	2.5E-11	0.0026

COPC	Hazard Quotient – Oshawa Subdivision – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Dichloromethane	1.7E-05	3.8E-13	1.7E-05	1.1E-12	1.7E-05	0.0047	1.0E-09	0.0047	2.9E-09	0.0047
Trichlorofluoromethane (FREON 11)	3.7E-07	2.1E-14	3.7E-07	5.8E-14	3.7E-07	1.5E-04	9.8E-12	1.5E-04	2.7E-11	1.5E-04
Chlorinated Monocyclic Aromatics										
1,2,4,5-Tetrachlorobenzene	0.0020	1.3E-09	0.0020	3.7E-09	0.0020	0.045	1.3E-08	0.045	3.8E-08	0.045
1,2,4-Trichlorobenzene	6.3E-04	3.1E-12	6.3E-04	8.6E-12	6.3E-04	0.057	7.2E-11	0.057	2.0E-10	0.057
1,2-Dichlorobenzene	3.9E-07	1.7E-13	3.9E-07	4.9E-13	3.9E-07	1.1E-04	2.5E-11	1.1E-04	7.1E-11	1.1E-04
Hexachlorobenzene	0.0025	2.6E-10	0.0025	7.4E-10	0.0025	0.019	1.2E-09	0.019	3.4E-09	0.019
Pentachlorobenzene	9.3E-04	3.5E-09	9.3E-04	9.7E-09	9.3E-04	0.0094	1.9E-08	0.0094	5.4E-08	0.0094
Pentachlorophenol	8.9E-07	7.0E-09	9.0E-07	2.0E-08	9.1E-07	2.3E-06	7.2E-08	2.3E-06	2.0E-07	2.5E-06
Inorganics										
Antimony	0.011	1.9E-06	0.011	2.8E-06	0.011	0.052	1.5E-05	0.052	2.2E-05	0.052
Arsenic	0.10	2.2E-07	0.10	3.2E-07	0.10	**0.32**	1.5E-06	**0.32**	2.2E-06	**0.32**

COPC	Hazard Quotient – Oshawa Subdivision – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Barium	0.0019	2.7E-09	0.0019	3.9E-09	0.0019	0.0079	2.1E-08	0.0079	3.1E-08	0.0079
Beryllium	0.0013	2.1E-07	0.0013	3.1E-07	0.0013	0.050	7.6E-07	0.050	1.1E-06	0.050
Boron	2.8E-04	1.5E-08	2.8E-04	2.1E-08	2.8E-04	0.022	4.1E-06	0.022	5.9E-06	0.022
Cadmium	0.0045	6.7E-06	0.0045	9.7E-06	0.0045	0.027	1.1E-04	0.027	1.6E-04	0.027
Chromium (Total)	5.7E-05	1.6E-10	5.7E-05	2.3E-10	5.7E-05	2.3E-04	1.3E-09	2.3E-04	1.8E-09	2.3E-04
Chromium VI	-	3.7E-08	3.7E-08	5.4E-08	5.4E-08	-	2.7E-07	2.7E-07	3.9E-07	3.9E-07
Cobalt	0.021	1.1E-06	0.021	1.7E-06	0.021	0.070	6.1E-06	0.070	8.8E-06	0.070
Mercury - Inorganic	9.1E-04	1.8E-05	9.3E-04	2.6E-05	9.4E-04	0.0061	9.4E-05	0.0061	1.4E-04	0.0062
Methylmercury	-	1.1E-06	1.1E-06	1.6E-06	1.6E-06	-	9.4E-06	9.4E-06	1.4E-05	1.4E-05
Nickel	0.0036	2.4E-06	0.0037	3.5E-06	0.0037	0.013	8.9E-06	0.013	1.3E-05	0.013
Phosphorus	2.2E-07	7.2E-14	2.2E-07	1.0E-13	2.2E-07	5.1E-05	3.0E-11	5.1E-05	4.3E-11	5.1E-05
Selenium	7.2E-04	2.6E-09	7.2E-04	3.7E-09	7.2E-04	0.011	6.0E-08	0.011	8.6E-08	0.011

COPC	Hazard Quotient – Oshawa Subdivision – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Silver	2.1E-04	4.3E-08	2.1E-04	6.3E-08	2.1E-04	0.0024	9.4E-07	0.0024	1.4E-06	0.0024
Thallium	0.046	1.8E-04	0.046	2.6E-04	0.046	**0.25**	7.8E-04	**0.25**	0.0011	**0.25**
Tin	1.4E-04	6.0E-08	1.4E-04	8.8E-08	1.4E-04	9.2E-04	2.5E-07	9.2E-04	3.6E-07	9.2E-04
Vanadium	0.013	1.9E-07	0.013	2.8E-07	0.013	0.046	6.4E-07	0.046	9.3E-07	0.046
Zinc	9.8E-04	2.2E-07	9.8E-04	3.2E-07	9.8E-04	0.020	4.8E-06	0.020	7.0E-06	0.020

Notes:

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-31 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Port Darlington Infant and Toddler Receptor Groupings at 140,000 tpy

COPC	Hazard Quotient – Port Darlington – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.1E-06	4.1E-12	4.1E-06	1.1E-11	4.1E-06	1.3E-05	9.8E-11	1.3E-05	2.7E-10	1.3E-05
Anthracene	9.5E-07	9.0E-13	9.5E-07	2.5E-12	9.5E-07	2.7E-06	7.9E-12	2.7E-06	2.2E-11	2.7E-06
Fluorene	6.3E-06	5.9E-12	6.3E-06	1.7E-11	6.3E-06	2.0E-05	8.2E-11	2.0E-05	2.3E-10	2.0E-05
PCBs										
Aroclor 1254 (Total PCBs)	**10.8**	4.7E-05	**10.8**	1.3E-04	**10.8**	**0.49**	6.0E-06	**0.49**	1.7E-05	**0.49**
VOCs										
1,1,1-Trichloroethane	2.1E-08	6.9E-17	2.1E-08	1.9E-16	2.1E-08	4.7E-06	3.5E-14	4.7E-06	9.7E-14	4.7E-06
Bromoform	4.7E-06	2.1E-14	4.7E-06	5.9E-14	4.7E-06	0.0023	4.9E-12	0.0023	1.4E-11	0.0023
Carbon Tetrachloride	1.6E-04	1.1E-13	1.6E-04	3.1E-13	1.6E-04	0.033	2.7E-11	0.033	7.5E-11	0.033
Chloroform	4.5E-06	5.0E-15	4.5E-06	1.4E-14	4.5E-06	0.0026	4.1E-12	0.0026	1.1E-11	0.0026

COPC	Hazard Quotient – Port Darlington – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Dichloromethane	1.7E-05	1.8E-13	1.7E-05	4.9E-13	1.7E-05	0.0047	4.7E-10	0.0047	1.3E-09	0.0047
Trichlorofluoromethane (FREON 11)	3.7E-07	9.4E-15	3.7E-07	2.6E-14	3.7E-07	1.5E-04	4.5E-12	1.5E-04	1.3E-11	1.5E-04
Chlorinated Monocyclic Aromatics										
1,2,4,5-Tetrachlorobenzene	0.0020	6.0E-10	0.0020	1.7E-09	0.0020	0.045	6.1E-09	0.045	1.7E-08	0.045
1,2,4-Trichlorobenzene	6.3E-04	1.4E-12	6.3E-04	3.9E-12	6.3E-04	0.057	3.3E-11	0.057	9.2E-11	0.057
1,2-Dichlorobenzene	3.9E-07	8.0E-14	3.9E-07	2.2E-13	3.9E-07	1.1E-04	1.2E-11	1.1E-04	3.2E-11	1.1E-04
Hexachlorobenzene	0.0025	1.2E-10	0.0025	3.4E-10	0.0025	0.019	5.5E-10	0.019	1.5E-09	0.019
Pentachlorobenzene	9.3E-04	1.6E-09	9.3E-04	4.4E-09	9.3E-04	0.0094	8.8E-09	0.0094	2.5E-08	0.0094
Pentachlorophenol	8.9E-07	4.4E-09	9.0E-07	1.2E-08	9.1E-07	2.3E-06	4.5E-08	2.3E-06	1.3E-07	2.4E-06
Inorganics										
Antimony	0.011	6.6E-07	0.011	9.5E-07	0.011	0.052	5.3E-06	0.052	7.6E-06	0.052

COPC	Hazard Quotient – Port Darlington – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Arsenic	0.10	7.7E-08	0.10	1.1E-07	0.10	**0.32**	5.3E-07	**0.32**	7.7E-07	**0.32**
Barium	0.0019	9.2E-10	0.0019	1.3E-09	0.0019	0.0079	7.5E-09	0.0079	1.1E-08	0.0079
Beryllium	0.0013	7.3E-08	0.0013	1.1E-07	0.0013	0.050	2.7E-07	0.050	3.9E-07	0.050
Boron	2.8E-04	5.1E-09	2.8E-04	7.4E-09	2.8E-04	0.022	1.4E-06	0.022	2.0E-06	0.022
Cadmium	0.0045	2.3E-06	0.0045	3.4E-06	0.0045	0.027	3.8E-05	0.027	5.5E-05	0.027
Chromium (Total)	5.7E-05	5.5E-11	5.7E-05	8.0E-11	5.7E-05	2.3E-04	4.6E-10	2.3E-04	6.6E-10	2.3E-04
Chromium VI	-	1.3E-08	1.3E-08	1.9E-08	1.9E-08	-	9.8E-08	9.8E-08	1.4E-07	1.4E-07
Cobalt	0.021	4.0E-07	0.021	5.7E-07	0.021	0.070	2.2E-06	0.070	3.1E-06	0.070
Mercury - Inorganic	9.1E-04	1.1E-05	9.2E-04	1.6E-05	9.3E-04	0.0061	5.8E-05	0.0061	8.4E-05	0.0061
Methylmercury	-	3.8E-07	3.8E-07	5.6E-07	5.6E-07	-	4.2E-06	4.2E-06	6.1E-06	6.1E-06
Nickel	0.0036	8.3E-07	0.0036	1.2E-06	0.0036	0.013	3.1E-06	0.013	4.5E-06	0.013
Phosphorus	2.2E-07	2.5E-14	2.2E-07	3.6E-14	2.2E-07	5.1E-05	1.0E-11	5.1E-05	1.5E-11	5.1E-05

COPC	Hazard Quotient – Port Darlington – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Selenium	7.2E-04	8.8E-10	7.2E-04	1.3E-09	7.2E-04	0.011	2.2E-08	0.011	3.2E-08	0.011
Silver	2.1E-04	1.5E-08	2.1E-04	2.2E-08	2.1E-04	0.0024	3.3E-07	0.0024	4.8E-07	0.0024
Thallium	0.046	6.2E-05	0.046	9.0E-05	0.046	**0.25**	2.8E-04	**0.25**	4.0E-04	**0.25**
Tin	1.4E-04	2.1E-08	1.4E-04	3.0E-08	1.4E-04	9.2E-04	8.6E-08	9.2E-04	1.3E-07	9.2E-04
Vanadium	0.013	6.6E-08	0.013	9.6E-08	0.013	0.046	2.2E-07	0.046	3.2E-07	0.046
Zinc	9.8E-04	7.6E-08	9.8E-04	1.1E-07	9.8E-04	0.020	1.7E-06	0.020	2.4E-06	0.020

Notes:

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-32 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Solina Road Infant and Toddler Receptor Groupings at 140,000 tpy

COPC	Hazard Quotient – Solina Road – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.1E-06	1.3E-11	4.1E-06	3.7E-11	4.1E-06	1.3E-05	3.2E-10	1.3E-05	8.9E-10	1.3E-05
Anthracene	9.5E-07	2.9E-12	9.5E-07	8.2E-12	9.5E-07	2.7E-06	2.6E-11	2.7E-06	7.2E-11	2.7E-06
Fluorene	6.3E-06	1.9E-11	6.3E-06	5.4E-11	6.3E-06	2.0E-05	2.7E-10	2.0E-05	7.5E-10	2.0E-05
PCBs										
Aroclor 1254 (Total PCBs)	**10.8**	1.5E-04	**10.8**	4.3E-04	**10.8**	**0.49**	1.9E-05	**0.49**	5.4E-05	**0.49**
VOCs										
1,1,1-Trichloroethane	2.1E-08	2.2E-16	2.1E-08	6.2E-16	2.1E-08	4.7E-06	1.1E-13	4.7E-06	3.2E-13	4.7E-06
Bromoform	4.7E-06	6.8E-14	4.7E-06	1.9E-13	4.7E-06	0.0023	1.6E-11	0.0023	4.5E-11	0.0023
Carbon Tetrachloride	1.6E-04	3.6E-13	1.6E-04	1.0E-12	1.6E-04	0.033	8.6E-11	0.033	2.4E-10	0.033
Chloroform	4.5E-06	1.6E-14	4.5E-06	4.5E-14	4.5E-06	0.0026	1.3E-11	0.0026	3.7E-11	0.0026

COPC	Hazard Quotient – Solina Road – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Dichloromethane	1.7E-05	5.7E-13	1.7E-05	1.6E-12	1.7E-05	0.0047	1.5E-09	0.0047	4.3E-09	0.0047
Trichlorofluoromethane (FREON 11)	3.7E-07	3.1E-14	3.7E-07	8.6E-14	3.7E-07	1.5E-04	1.5E-11	1.5E-04	4.1E-11	1.5E-04
Chlorinated Monocyclic Aromatics										
1,2,4,5-Tetrachlorobenzene	0.0020	2.0E-09	0.0020	5.5E-09	0.0020	0.045	2.0E-08	0.045	5.6E-08	0.045
1,2,4-Trichlorobenzene	6.3E-04	4.5E-12	6.3E-04	1.3E-11	6.3E-04	0.057	1.1E-10	0.057	3.0E-10	0.057
1,2-Dichlorobenzene	3.9E-07	2.6E-13	3.9E-07	7.3E-13	3.9E-07	1.1E-04	3.8E-11	1.1E-04	1.1E-10	1.1E-04
Hexachlorobenzene	0.0025	3.9E-10	0.0025	1.1E-09	0.0025	0.019	1.8E-09	0.019	5.0E-09	0.019
Pentachlorobenzene	9.3E-04	5.1E-09	9.3E-04	1.4E-08	9.3E-04	0.0094	2.9E-08	0.0094	8.0E-08	0.0094
Pentachlorophenol	8.9E-07	9.1E-09	9.0E-07	2.5E-08	9.2E-07	2.3E-06	9.3E-08	2.4E-06	2.6E-07	2.5E-06
Inorganics										
Antimony	0.011	2.3E-06	0.011	3.3E-06	0.011	0.052	1.8E-05	0.052	2.6E-05	0.052

COPC	Hazard Quotient – Solina Road – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Arsenic	0.10	2.7E-07	0.10	3.9E-07	0.10	**0.32**	1.7E-06	**0.32**	2.5E-06	**0.32**
Barium	0.0019	3.2E-09	0.0019	4.7E-09	0.0019	0.0079	2.5E-08	0.0079	3.7E-08	0.0079
Beryllium	0.0013	2.6E-07	0.0013	3.7E-07	0.0013	0.050	9.1E-07	0.050	1.3E-06	0.050
Boron	2.8E-04	1.8E-08	2.8E-04	2.6E-08	2.8E-04	0.022	4.9E-06	0.022	7.1E-06	0.022
Cadmium	0.0045	8.1E-06	0.0045	1.2E-05	0.0045	0.027	1.3E-04	0.027	1.9E-04	0.027
Chromium (Total)	5.7E-05	1.9E-10	5.7E-05	2.8E-10	5.7E-05	2.3E-04	1.4E-09	2.3E-04	2.1E-09	2.3E-04
Chromium VI	-	4.5E-08	4.5E-08	6.5E-08	6.5E-08	-	3.1E-07	3.1E-07	4.5E-07	4.5E-07
Cobalt	0.021	1.4E-06	0.021	2.0E-06	0.021	0.070	7.1E-06	0.070	1.0E-05	0.070
Mercury - Inorganic	9.1E-04	2.5E-05	9.4E-04	3.7E-05	9.5E-04	0.0061	1.3E-04	0.0062	1.9E-04	0.0062
Methylmercury	-	1.3E-06	1.3E-06	2.0E-06	2.0E-06	-	1.1E-05	1.1E-05	1.6E-05	1.6E-05
Nickel	0.0036	2.9E-06	0.0037	4.2E-06	0.0037	0.013	1.0E-05	0.013	1.5E-05	0.013
Phosphorus	2.2E-07	8.7E-14	2.2E-07	1.3E-13	2.2E-07	5.1E-05	3.6E-11	5.1E-05	5.2E-11	5.1E-05

COPC	Hazard Quotient – Solina Road – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Selenium	7.2E-04	3.1E-09	7.2E-04	4.5E-09	7.2E-04	0.011	6.6E-08	0.011	9.6E-08	0.011
Silver	2.1E-04	5.2E-08	2.1E-04	7.6E-08	2.1E-04	0.0024	1.1E-06	0.0024	1.6E-06	0.0024
Thallium	0.046	2.2E-04	0.046	3.1E-04	0.046	**0.25**	9.2E-04	**0.25**	0.0013	**0.25**
Tin	1.4E-04	7.3E-08	1.4E-04	1.1E-07	1.4E-04	9.2E-04	3.0E-07	9.2E-04	4.3E-07	9.2E-04
Vanadium	0.013	2.3E-07	0.013	3.4E-07	0.013	0.046	7.7E-07	0.046	1.1E-06	0.046
Zinc	9.8E-04	2.7E-07	9.8E-04	3.8E-07	9.8E-04	0.020	5.8E-06	0.020	8.4E-06	0.020

Notes:

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-33 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Tooley Infant and Toddler Receptor Groupings at 140,000 tpy

COPC	Hazard Quotient – Tooley – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.1E-06	2.4E-11	4.1E-06	6.6E-11	4.1E-06	1.3E-05	5.7E-10	1.3E-05	1.6E-09	1.3E-05
Anthracene	9.5E-07	5.2E-12	9.5E-07	1.5E-11	9.5E-07	2.7E-06	4.6E-11	2.7E-06	1.3E-10	2.7E-06
Fluorene	6.3E-06	3.4E-11	6.3E-06	9.6E-11	6.3E-06	2.0E-05	4.8E-10	2.0E-05	1.3E-09	2.0E-05
PCBs										
Aroclor 1254 (Total PCBs)	**10.8**	2.7E-04	**10.8**	7.5E-04	**10.8**	**0.49**	3.4E-05	**0.49**	9.6E-05	**0.49**
VOCs										
1,1,1-Trichloroethane	2.1E-08	4.0E-16	2.1E-08	1.1E-15	2.1E-08	4.7E-06	2.0E-13	4.7E-06	5.6E-13	4.7E-06
Bromoform	4.7E-06	1.2E-13	4.7E-06	3.4E-13	4.7E-06	0.0023	2.8E-11	0.0023	8.0E-11	0.0023
Carbon Tetrachloride	1.6E-04	6.5E-13	1.6E-04	1.8E-12	1.6E-04	0.033	1.5E-10	0.033	4.3E-10	0.033
Chloroform	4.5E-06	2.9E-14	4.5E-06	8.1E-14	4.5E-06	0.0026	2.4E-11	0.0026	6.6E-11	0.0026

COPC	Hazard Quotient – Tooley – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Dichloromethane	1.7E-05	1.0E-12	1.7E-05	2.8E-12	1.7E-05	0.0047	2.7E-09	0.0047	7.6E-09	0.0047
Trichlorofluoromethane (FREON 11)	3.7E-07	5.4E-14	3.7E-07	1.5E-13	3.7E-07	1.5E-04	2.6E-11	1.5E-04	7.2E-11	1.5E-04
Chlorinated Monocyclic Aromatics										
1,2,4,5-Tetrachlorobenzene	0.0020	3.5E-09	0.0020	9.7E-09	0.0020	0.045	3.5E-08	0.045	9.9E-08	0.045
1,2,4-Trichlorobenzene	6.3E-04	8.1E-12	6.3E-04	2.3E-11	6.3E-04	0.057	1.9E-10	0.057	5.3E-10	0.057
1,2-Dichlorobenzene	3.9E-07	4.6E-13	3.9E-07	1.3E-12	3.9E-07	1.1E-04	6.7E-11	1.1E-04	1.9E-10	1.1E-04
Hexachlorobenzene	0.0025	7.0E-10	0.0025	1.9E-09	0.0025	0.019	3.2E-09	0.019	8.9E-09	0.019
Pentachlorobenzene	9.3E-04	9.1E-09	9.3E-04	2.5E-08	9.3E-04	0.0094	5.1E-08	0.0094	1.4E-07	0.0094
Pentachlorophenol	8.9E-07	1.2E-08	9.1E-07	3.4E-08	9.3E-07	2.3E-06	1.2E-07	2.4E-06	3.5E-07	2.6E-06
Inorganics										
Antimony	0.011	4.3E-06	0.011	6.2E-06	0.011	0.052	3.3E-05	0.052	4.8E-05	0.052

COPC	Hazard Quotient – Tooley – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Arsenic	0.10	5.0E-07	0.10	7.3E-07	0.10	**0.32**	3.2E-06	**0.32**	4.6E-06	**0.32**
Barium	0.0019	6.0E-09	0.0019	8.7E-09	0.0019	0.0079	4.7E-08	0.0079	6.8E-08	0.0079
Beryllium	0.0013	4.8E-07	0.0013	6.9E-07	0.0013	0.050	1.7E-06	0.050	2.5E-06	0.050
Boron	2.8E-04	3.3E-08	2.8E-04	4.8E-08	2.8E-04	0.022	9.1E-06	0.022	1.3E-05	0.022
Cadmium	0.0045	1.5E-05	0.0045	2.2E-05	0.0045	0.027	2.4E-04	0.027	3.5E-04	0.027
Chromium (Total)	5.7E-05	3.6E-10	5.7E-05	5.2E-10	5.7E-05	2.3E-04	2.6E-09	2.3E-04	3.8E-09	2.3E-04
Chromium VI	-	8.4E-08	8.4E-08	1.2E-07	1.2E-07	-	5.7E-07	5.7E-07	8.2E-07	8.2E-07
Cobalt	0.021	2.6E-06	0.021	3.8E-06	0.021	0.070	1.3E-05	0.070	1.9E-05	0.070
Mercury - Inorganic	9.1E-04	4.0E-05	9.5E-04	5.9E-05	9.7E-04	0.0061	2.0E-04	0.0063	2.9E-04	0.0063
Methylmercury	-	2.5E-06	2.5E-06	3.6E-06	3.6E-06	-	1.8E-05	1.8E-05	2.7E-05	2.7E-05
Nickel	0.0036	5.4E-06	0.0037	7.9E-06	0.0037	0.013	1.9E-05	0.013	2.8E-05	0.013
Phosphorus	2.2E-07	1.6E-13	2.2E-07	2.4E-13	2.2E-07	5.1E-05	6.6E-11	5.1E-05	9.6E-11	5.1E-05

COPC	Hazard Quotient – Tooley – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Selenium	7.2E-04	5.8E-09	7.2E-04	8.4E-09	7.2E-04	0.011	1.2E-07	0.011	1.7E-07	0.011
Silver	2.1E-04	9.8E-08	2.1E-04	1.4E-07	2.1E-04	0.0024	2.0E-06	0.0024	2.9E-06	0.0024
Thallium	0.046	4.0E-04	0.046	5.9E-04	0.046	**0.25**	0.0017	**0.25**	0.0025	**0.26**
Tin	1.4E-04	1.4E-07	1.4E-04	2.0E-07	1.4E-04	9.2E-04	5.5E-07	9.2E-04	8.0E-07	9.2E-04
Vanadium	0.013	4.3E-07	0.013	6.3E-07	0.013	0.046	1.4E-06	0.046	2.1E-06	0.046
Zinc	9.8E-04	4.9E-07	9.8E-04	7.2E-07	9.8E-04	0.020	1.1E-05	0.020	1.6E-05	0.020

Notes:

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-34 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for Dioxins and Lead for the Local Resident Infant and Toddler Receptor Groupings at 140,000 tpy

COPC	Hazard Quotient – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Bowmanville Subdivision										
2,3,7,8-TCDD Equivalent	**3.8**	6.9E-04	**3.8**	0.0019	**3.8**	0.17	9.4E-05	0.17	2.6E-04	0.17
Lead	0.040	8.8E-05	0.040	1.0E-04	0.040	0.12	2.3E-04	0.12	3.0E-04	0.12
Courtice Subdivision										
2,3,7,8-TCDD Equivalent	**3.8**	4.9E-04	**3.8**	0.0014	**3.8**	0.17	6.7E-05	0.17	1.8E-04	0.17
Lead	0.040	5.9E-05	0.040	7.0E-05	0.040	0.12	1.6E-04	0.12	2.2E-04	0.12
Courtice Road										
2,3,7,8-TCDD Equivalent	**3.8**	0.0015	**3.8**	0.0041	**3.8**	0.17	2.0E-04	0.17	5.6E-04	0.17
Lead	0.040	1.8E-04	0.040	2.1E-04	0.040	0.12	4.8E-04	0.12	6.5E-04	0.12
Maple Grove										
2,3,7,8-TCDD Equivalent	**3.8**	3.8E-04	**3.8**	0.0011	**3.8**	0.17	5.2E-05	0.17	1.4E-04	0.17
Lead	0.040	6.4E-05	0.040	7.2E-05	0.040	0.12	1.4E-04	0.12	1.8E-04	0.12
Oshawa Subdivision										
2,3,7,8-TCDD Equivalent	**3.83**	7.1E-04	**3.83**	0.0020	**3.83**	0.17	9.6E-05	0.17	2.6E-04	0.17

COPC	Hazard Quotient – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Lead	0.040	1.0E-04	0.040	1.2E-04	0.040	0.12	2.4E-04	0.12	3.2E-04	0.12
Port Darlington										
2,3,7,8-TCDD Equivalent	**3.83**	2.8E-04	**3.83**	7.7E-04	**3.83**	0.17	3.6E-05	0.17	9.5E-05	0.17
Lead	0.040	6.1E-05	0.040	6.6E-05	0.040	0.12	1.1E-04	0.12	1.4E-04	0.12
Solina Road										
2,3,7,8-TCDD Equivalent	**3.83**	8.5E-04	**3.83**	0.0024	**3.83**	0.17	1.2E-04	0.17	3.1E-04	0.17
Lead	0.040	1.3E-04	0.040	1.5E-04	0.040	0.12	2.9E-04	0.12	3.9E-04	0.12
Tooley										
2,3,7,8-TCDD Equivalent	**3.83**	0.0015	**3.83**	0.0042	**3.83**	0.17	2.1E-04	0.17	5.7E-04	0.17
Lead	0.040	1.7E-04	0.040	2.0E-04	0.040	0.12	4.8E-04	0.12	6.5E-04	0.12

Notes:

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Local Farmers

Chronic HQ values at 140,000 tpy, predicted for local farmer receptor locations, are presented in Table 7-35 and Table 7-36. Results of the assessment indicate that none of the predicted Project Alone Case or Process Upset Case hazard quotients exceeds the regulatory benchmark at 140,000 tpy; however, for a number of COPC, for both the infant and toddler receptors, HQ values were above 0.2 for the Baseline Case, Project Case and Process Upset Project Case. Specifically, this includes Total PCBs (HQ = 117), 2,3,7,8-TCDD Equivalent (HQ = 20.3) and 1,2,4-trichlorobenzene (HQ=0.21) for the farmer infant receptor, as well as Total PCBs (HQ = 4.2), Bromoform (HQ = 0.32), Carbon Tetrachloride (HQ = 4.6), Chloroform (HQ = 0.32), Dichloromethane (HQ = 0.65), 1,2,4,5-Tetrachlorobenzene (HQ = 0.40), 1,2,4-Trichlorobenzene (HQ = 20.1), Antimony (HQ = 0.24), Arsenic (HQ = 0.57), Beryllium (HQ = 0.42), and Thallium (HQ = 1.2) for the toddler farmer receptor.

In these situations, risk from the Project Case/Process Upset Project Case is almost entirely driven by baseline concentrations. The Project Alone Case/Process Upset Case never represents more than approximately 2% of the Project Case/Process Upset Project Case risk for any of the abovementioned COPC. A more thorough discussion of this baseline risk can be found in Section 7.9.2.1. Based on this contribution, it is not expected that the Project, at 140,000 tpy, will pose any additional undue risk to the health of local farmers.

Additionally, an overall assessment was conducted for lead and dioxins/furans, accounting for both the multi-pathway HQ as well as the chronic inhalation CR. The results (Table 7-36) show that lead is not present at levels that are in exceedance of the benchmark HQ of 0.2 at 140,000 tpy; however, Baseline Case, Project Case and Process Upset Project Case HQ values for dioxins/furans for both the toddler and infant were above the benchmark HQ of 0.2. In both operational cases, the HQ values are driven by baseline conditions. The Project contribution to the observed risk never amounts to more than 1% for the infant and toddler farmer receptors. A more thorough discussion of this baseline risk can be found in Section 7.9.2.1. Based on this contribution, it is not expected that the Project, at 140,000 tpy, will pose any additional undue risk to the health of local farmers.

Table 7-35 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Farmer Infant and Toddler Receptor Groupings at 140,000 tpy

COPC	Hazard Quotient – Farmer – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.3E-06	3.4E-11	4.3E-06	9.6E-11	4.3E-06	3.8E-05	1.5E-09	3.8E-05	4.1E-09	3.8E-05
Anthracene	1.1E-06	7.3E-12	1.1E-06	2.0E-11	1.1E-06	7.6E-06	1.1E-10	7.6E-06	2.9E-10	7.6E-06
Fluorene	6.8E-06	4.7E-11	6.8E-06	1.3E-10	6.8E-06	5.8E-05	1.1E-09	5.8E-05	3.2E-09	5.8E-05
PCBs										
Aroclor 1254 (Total PCBs)	**117.5**	0.0036	**117.5**	0.010	**117.5**	**4.2**	1.4E-04	**4.2**	3.8E-04	**4.2**
VOCs										
1,1,1-Trichloroethane	1.8E-07	1.6E-14	1.8E-07	4.6E-14	1.8E-07	6.4E-04	5.1E-11	6.4E-04	1.4E-10	6.4E-04
Bromoform	6.6E-05	4.4E-11	6.6E-05	1.2E-10	6.6E-05	**0.32**	1.9E-07	**0.32**	5.3E-07	**0.32**
Carbon Tetrachloride	0.0025	4.0E-11	0.0025	1.1E-10	0.0025	**4.6**	6.3E-08	**4.6**	1.8E-07	**4.6**
Chloroform	3.1E-05	2.3E-13	3.1E-05	6.4E-13	3.1E-05	**0.32**	2.0E-09	**0.32**	5.6E-09	**0.32**
Dichloromethane	2.8E-05	2.1E-12	2.8E-05	6.0E-12	2.8E-05	**0.65**	4.9E-08	**0.65**	1.4E-07	**0.65**

COPC	Hazard Quotient – Farmer – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Trichlorofluoromethane (FREON 11)	5.9E-06	1.2E-11	5.9E-06	3.4E-11	5.9E-06	0.022	3.8E-08	0.022	1.1E-07	0.022
Chlorinated Monocyclic Aromatics										
1,2,4,5-Tetrachlorobenzene	0.020	1.6E-08	0.020	4.4E-08	0.020	**0.40**	2.4E-07	**0.40**	6.8E-07	**0.40**
1,2,4-Trichlorobenzene	**0.21**	1.7E-10	**0.21**	4.8E-10	**0.21**	**20.1**	1.3E-08	**20.1**	3.7E-08	**20.1**
1,2-Dichlorobenzene	3.0E-05	3.3E-12	3.0E-05	9.3E-12	3.0E-05	0.015	1.3E-09	0.015	3.5E-09	0.015
Hexachlorobenzene	0.026	1.4E-08	0.026	4.0E-08	0.026	0.17	7.4E-08	0.17	2.1E-07	0.17
Pentachlorobenzene	0.0098	4.0E-08	0.0098	1.1E-07	0.0098	0.083	2.8E-07	0.083	7.8E-07	0.083
Pentachlorophenol	8.9E-07	3.3E-08	9.3E-07	9.2E-08	9.9E-07	2.3E-06	3.2E-07	2.6E-06	9.0E-07	3.2E-06
Inorganics										
Antimony	0.011	5.9E-06	0.011	8.6E-06	0.011	**0.24**	8.3E-05	**0.24**	1.2E-04	**0.24**
Arsenic	0.10	7.0E-07	0.10	1.0E-06	0.10	**0.57**	7.6E-06	**0.57**	1.1E-05	**0.57**
Barium	0.0019	8.4E-09	0.0019	1.2E-08	0.0019	0.013	1.4E-07	0.013	2.0E-07	0.013

COPC	Hazard Quotient – Farmer – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Beryllium	0.0013	6.6E-07	0.0013	9.6E-07	0.0013	**0.42**	2.8E-06	**0.42**	4.1E-06	**0.42**
Boron	2.8E-04	4.6E-08	2.8E-04	6.7E-08	2.8E-04	0.12	2.7E-05	0.12	3.9E-05	0.12
Cadmium	0.0045	2.1E-05	0.0045	3.0E-05	0.0046	0.10	6.3E-04	0.11	9.2E-04	0.11
Chromium (Total)	5.7E-05	5.0E-10	5.7E-05	7.2E-10	5.7E-05	8.3E-04	1.9E-08	8.3E-04	2.8E-08	8.3E-04
Chromium VI	-	1.2E-07	1.2E-07	1.7E-07	1.7E-07	-	4.1E-06	4.1E-06	6.0E-06	6.0E-06
Cobalt	0.021	3.6E-06	0.021	5.2E-06	0.021	0.18	1.5E-04	0.18	2.2E-04	0.18
Mercury - Inorganic	9.1E-04	4.2E-05	9.6E-04	6.1E-05	9.7E-04	0.031	4.1E-04	0.031	5.9E-04	0.031
Methylmercury	-	3.5E-06	3.5E-06	5.0E-06	5.0E-06	-	4.4E-05	4.4E-05	6.4E-05	6.4E-05
Nickel	0.0036	7.5E-06	0.0037	1.1E-05	0.0037	0.051	7.4E-05	0.051	1.1E-04	0.051
Phosphorus	2.2E-07	2.3E-13	2.2E-07	3.3E-13	2.2E-07	5.0E-04	7.1E-10	5.0E-04	1.0E-09	5.0E-04
Selenium	7.2E-04	8.0E-09	7.2E-04	1.2E-08	7.2E-04	0.093	3.3E-06	0.093	4.8E-06	0.093
Silver	2.1E-04	1.4E-07	2.1E-04	2.0E-07	2.1E-04	0.017	9.6E-05	0.017	1.4E-04	0.017
Thallium	0.046	5.6E-04	0.046	8.1E-04	0.046	**1.2**	0.014	**1.2**	0.021	**1.2**

COPC	Hazard Quotient – Farmer – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Tin	1.4E-04	1.9E-07	1.4E-04	2.7E-07	1.4E-04	0.0026	1.2E-05	0.0026	1.8E-05	0.0026
Vanadium	0.013	6.0E-07	0.013	8.7E-07	0.013	0.13	3.1E-06	0.13	4.4E-06	0.13
Zinc	9.8E-04	6.9E-07	9.8E-04	9.9E-07	9.8E-04	0.14	2.7E-05	0.14	3.9E-05	0.14

Notes:

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

'-' - No baseline concentration was available for this COPC.

Table 7-36 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for Dioxins and Lead for the Farmer Infant and Toddler Receptor Groupings at 140,000 tpy

COPC	Hazard Quotient – Farmer – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
2,3,7,8-TCDD Equivalent	**20.3**	0.045	**20.3**	0.13	**20.4**	**0.72**	0.0016	**0.72**	0.0044	**0.73**
Lead	0.040	2.1E-04	0.040	2.6E-04	0.040	0.20	9.5E-04	0.20	0.0013	0.20

Notes:

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Daycare, Recreation User – Sport, Recreation User - Camping

Table 7-37 through Table 7-39 shows calculated chronic HQ values at 140,000 tpy for the daycare, recreation user – sport and recreation user – camping receptors in the LRASA. Results of the assessment indicate that none of the predicted hazard quotients exceed the regulatory benchmark for the Baseline Case, Project Alone Case, Project Case, Process Upset Case, or Process Upset Project Case; therefore, it is not expected that, at 140,000 tpy, the Project will pose any additional undue risk to the health of local daycare, recreation user – sport or recreation user - camping receptors.

Table 7-37 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Daycare Toddler Receptor Grouping at 140,000 tpy

COPC	Hazard Quotient – Daycare – 140,000 tpy				
	Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs					
Acenaphthene	3.7E-06	4.3E-12	3.7E-06	1.2E-11	3.7E-06
Anthracene	7.6E-07	8.8E-13	7.6E-07	2.5E-12	7.6E-07
Fluorene	5.5E-06	6.5E-12	5.5E-06	1.8E-11	5.5E-06
PCBs					
Aroclor 1254 (Total PCBs)	0.011	2.4E-06	0.011	6.6E-06	0.011
VOCs					
1,1,1-Trichloroethane	1.8E-08	7.4E-17	1.8E-08	2.1E-16	1.8E-08
Bromoform	4.3E-06	2.7E-14	4.3E-06	7.6E-14	4.3E-06
Carbon Tetrachloride	8.1E-05	7.4E-14	8.1E-05	2.1E-13	8.1E-05
Chloroform	4.2E-06	6.4E-15	4.2E-06	1.8E-14	4.2E-06
Dichloromethane	1.7E-05	2.3E-13	1.7E-05	6.4E-13	1.7E-05
Trichlorofluoromethane (FREON 11)	2.9E-07	1.0E-14	2.9E-07	2.9E-14	2.9E-07
Chlorinated Monocyclic Aromatics					

COPC	Hazard Quotient – Daycare – 140,000 tpy				
	Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
1,2,4,5-Tetrachlorobenzene	2.0E-04	5.4E-10	2.0E-04	1.5E-09	2.0E-04
1,2,4-Trichlorobenzene	2.6E-04	1.6E-12	2.6E-04	4.6E-12	2.6E-04
1,2-Dichlorobenzene	2.0E-07	8.3E-14	2.0E-07	2.3E-13	2.0E-07
Hexachlorobenzene	8.6E-05	9.8E-11	8.6E-05	2.7E-10	8.6E-05
Pentachlorobenzene	4.1E-05	1.7E-09	4.1E-05	4.7E-09	4.1E-05
Pentachlorophenol	8.5E-07	1.4E-10	8.5E-07	3.8E-10	8.5E-07
Inorganics					
Antimony	0.011	1.7E-06	0.011	2.5E-06	0.011
Arsenic	0.11	2.2E-07	0.11	3.2E-07	0.11
Barium	0.0019	2.4E-09	0.0019	3.5E-09	0.0019
Beryllium	0.0014	2.1E-07	0.0014	3.0E-07	0.0014
Boron	2.8E-04	1.3E-08	2.8E-04	1.9E-08	2.8E-04
Cadmium	0.0043	5.7E-06	0.0043	8.3E-06	0.0043
Chromium (Total)	6.1E-05	1.5E-10	6.1E-05	2.2E-10	6.1E-05
Chromium VI	-	3.4E-08	3.4E-08	4.9E-08	4.9E-08
Cobalt	0.021	1.0E-06	0.021	1.5E-06	0.021
Mercury - Inorganic	9.7E-04	1.5E-05	9.9E-04	2.2E-05	9.9E-04
Methylmercury	-	8.9E-07	8.9E-07	1.3E-06	1.3E-06
Nickel	0.0028	1.7E-06	0.0028	2.4E-06	0.0028
Phosphorus	2.2E-07	6.4E-14	2.2E-07	9.3E-14	2.2E-07
Selenium	8.2E-04	2.6E-09	8.2E-04	3.8E-09	8.2E-04

COPC	Hazard Quotient – Daycare – 140,000 tpy				
	Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Silver	1.8E-04	3.3E-08	1.8E-04	4.8E-08	1.8E-04
Thallium	0.051	1.8E-04	0.051	2.6E-04	0.052
Tin	1.4E-04	5.4E-08	1.4E-04	7.8E-08	1.4E-04
Vanadium	0.013	1.7E-07	0.013	2.5E-07	0.013
Zinc	0.0011	2.2E-07	0.0011	3.2E-07	0.0011

'-' - No baseline concentration was available for this COPC.

Table 7-38 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Recreation User - Sport Toddler Receptor Grouping at 140,000 tpy

COPC	Hazard Quotient – Recreation User Sport – 140,000 tpy				
	Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs					
Acenaphthene	1.6E-07	4.7E-13	1.6E-07	1.3E-12	1.6E-07
Anthracene	3.3E-08	9.5E-14	3.3E-08	2.7E-13	3.3E-08
Fluorene	2.4E-07	6.9E-13	2.4E-07	1.9E-12	2.4E-07
PCBs					
Aroclor 1254 (Total PCBs)	4.7E-04	2.6E-07	4.7E-04	7.1E-07	4.7E-04
VOCs					
1,1,1-Trichloroethane	7.6E-10	8.0E-18	7.6E-10	2.2E-17	7.6E-10

COPC	Hazard Quotient – Recreation User Sport – 140,000 tpy				
	Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Bromoform	1.8E-07	2.9E-15	1.8E-07	8.2E-15	1.8E-07
Carbon Tetrachloride	3.5E-06	8.0E-15	3.5E-06	2.2E-14	3.5E-06
Chloroform	1.8E-07	6.9E-16	1.8E-07	1.9E-15	1.8E-07
Dichloromethane	7.4E-07	2.5E-14	7.4E-07	6.9E-14	7.4E-07
Trichlorofluoromethane (FREON 11)	1.3E-08	1.1E-15	1.3E-08	3.1E-15	1.3E-08
Chlorinated Monocyclic Aromatics					
1,2,4,5-Tetrachlorobenzene	8.8E-06	5.8E-11	8.8E-06	1.6E-10	8.8E-06
1,2,4-Trichlorobenzene	1.1E-05	1.8E-13	1.1E-05	5.0E-13	1.1E-05
1,2-Dichlorobenzene	8.6E-09	8.9E-15	8.6E-09	2.5E-14	8.6E-09
Hexachlorobenzene	3.7E-06	1.1E-11	3.7E-06	2.9E-11	3.7E-06
Pentachlorobenzene	1.8E-06	1.8E-10	1.8E-06	5.1E-10	1.8E-06
Pentachlorophenol	3.7E-08	1.5E-11	3.7E-08	4.1E-11	3.7E-08
Inorganics					
Antimony	4.6E-04	9.9E-08	4.6E-04	1.4E-07	4.6E-04
Arsenic	0.0048	1.3E-08	0.0048	1.9E-08	0.0048
Barium	8.2E-05	1.4E-10	8.2E-05	2.0E-10	8.2E-05
Beryllium	6.3E-05	1.2E-08	6.3E-05	1.8E-08	6.3E-05
Boron	1.2E-05	7.7E-10	1.2E-05	1.1E-09	1.2E-05
Cadmium	1.9E-04	3.3E-07	1.9E-04	4.9E-07	1.9E-04
Chromium (Total)	2.7E-06	9.0E-12	2.7E-06	1.3E-11	2.7E-06
Chromium VI	-	2.0E-09	2.0E-09	2.8E-09	2.8E-09

COPC	Hazard Quotient – Recreation User Sport – 140,000 tpy				
	Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Cobalt	9.2E-04	6.0E-08	9.2E-04	8.7E-08	9.2E-04
Mercury - Inorganic	4.2E-05	1.2E-06	4.3E-05	1.8E-06	4.4E-05
Methylmercury	-	5.2E-08	5.2E-08	7.5E-08	7.5E-08
Nickel	1.2E-04	9.8E-08	1.2E-04	1.4E-07	1.2E-04
Phosphorus	9.7E-09	3.8E-15	9.7E-09	5.5E-15	9.7E-09
Selenium	3.5E-05	1.5E-10	3.5E-05	2.2E-10	3.5E-05
Silver	7.8E-06	1.9E-09	7.8E-06	2.8E-09	7.8E-06
Thallium	0.0022	1.1E-05	0.0022	1.5E-05	0.0022
Tin	6.1E-06	3.2E-09	6.1E-06	4.6E-09	6.1E-06
Vanadium	5.7E-04	1.0E-08	5.7E-04	1.5E-08	5.7E-04
Zinc	4.7E-05	1.3E-08	4.7E-05	1.8E-08	4.7E-05

‘-‘ - No baseline concentration was available for this COPC.

Table 7-39 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Recreation User - Camping Toddler Receptor Grouping at 140,000 tpy

COPC	Hazard Quotient – Recreation User – Camping – 140,000 tpy				
	Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs					
Acenaphthene	4.2E-07	9.8E-13	4.2E-07	2.7E-12	4.2E-07
Anthracene	8.6E-08	2.0E-13	8.6E-08	5.6E-13	8.6E-08
Fluorene	6.3E-07	1.5E-12	6.3E-07	4.1E-12	6.3E-07
PCBs					
Aroclor 1254 (Total PCBs)	0.0012	5.3E-07	0.0012	1.5E-06	0.0012
VOCs					
1,1,1-Trichloroethane	2.0E-09	1.7E-17	2.0E-09	4.7E-17	2.0E-09
Bromoform	4.8E-07	6.2E-15	4.8E-07	1.7E-14	4.8E-07
Carbon Tetrachloride	9.2E-06	1.7E-14	9.2E-06	4.7E-14	9.2E-06
Chloroform	4.8E-07	1.4E-15	4.8E-07	4.1E-15	4.8E-07
Dichloromethane	1.9E-06	5.2E-14	1.9E-06	1.5E-13	1.9E-06
Trichlorofluoromethane (FREON 11)	3.3E-08	2.3E-15	3.3E-08	6.5E-15	3.3E-08
Chlorinated Monocyclic Aromatics					
1,2,4,5-Tetrachlorobenzene	2.3E-05	1.2E-10	2.3E-05	3.4E-10	2.3E-05
1,2,4-Trichlorobenzene	3.0E-05	3.7E-13	3.0E-05	1.0E-12	3.0E-05
1,2-Dichlorobenzene	2.2E-08	1.9E-14	2.2E-08	5.3E-14	2.2E-08
Hexachlorobenzene	9.8E-06	2.2E-11	9.8E-06	6.2E-11	9.8E-06
Pentachlorobenzene	4.7E-06	3.8E-10	4.7E-06	1.1E-09	4.7E-06
Pentachlorophenol	9.7E-08	3.1E-11	9.7E-08	8.7E-11	9.7E-08
Inorganics					
Antimony	0.0012	2.8E-07	0.0012	4.1E-07	0.0012
Arsenic	0.013	3.6E-08	0.013	5.3E-08	0.013
Barium	2.2E-04	4.0E-10	2.2E-04	5.8E-10	2.2E-04

COPC	Hazard Quotient – Recreation User – Camping – 140,000 tpy				
	Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Beryllium	1.6E-04	3.5E-08	1.6E-04	5.0E-08	1.6E-04
Boron	3.2E-05	2.2E-09	3.2E-05	3.2E-09	3.2E-05
Cadmium	4.9E-04	9.5E-07	4.9E-04	1.4E-06	4.9E-04
Chromium (Total)	7.0E-06	2.6E-11	7.0E-06	3.7E-11	7.0E-06
Chromium VI	-	5.6E-09	5.6E-09	8.1E-09	8.1E-09
Cobalt	0.0024	1.7E-07	0.0024	2.5E-07	0.0024
Mercury - Inorganic	1.1E-04	2.8E-06	1.1E-04	4.1E-06	1.1E-04
Methylmercury	-	1.5E-07	1.5E-07	2.1E-07	2.1E-07
Nickel	3.2E-04	2.8E-07	3.2E-04	4.1E-07	3.2E-04
Phosphorus	2.5E-08	1.1E-14	2.5E-08	1.6E-14	2.5E-08
Selenium	9.3E-05	4.4E-10	9.3E-05	6.3E-10	9.3E-05
Silver	2.0E-05	5.5E-09	2.0E-05	8.0E-09	2.0E-05
Thallium	0.0058	3.0E-05	0.0059	4.4E-05	0.0059
Tin	1.6E-05	9.0E-09	1.6E-05	1.3E-08	1.6E-05
Vanadium	0.0015	2.9E-08	0.0015	4.2E-08	0.0015
Zinc	1.2E-04	3.6E-08	1.2E-04	5.3E-08	1.2E-04

‘-‘ - No baseline concentration was available for this COPC.

Additionally, an overall assessment was conducted for dioxins/furans and lead, accounting for both the multi-pathway HQ as well as the chronic inhalation CR. The results (Table 7-40) indicate that, at 140,000 tpy, neither COPC is present at levels that are in exceedance of the regulatory benchmark.

Table 7-40 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for Dioxins and Lead for the Daycare, Recreation User – Sport and Recreation User - Camping Toddler Receptor Groupings at 140,000 tpy

COPC	Hazard Quotient – 140,000 tpy				
	Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Daycare					
2,3,7,8-TCDD Equivalent	0.0048	2.6E-05	0.0048	6.9E-05	0.0049
Lead	0.044	8.0E-05	0.044	9.5E-05	0.044
Recreation User – Sport					
2,3,7,8-TCDD Equivalent	0.0017	7.6E-06	0.0018	1.0E-05	0.0018
Lead	0.0082	1.1E-04	0.0083	1.1E-04	0.0083
Recreation User - Camping					
2,3,7,8-TCDD Equivalent	0.0020	1.0E-05	0.0020	1.7E-05	0.0020
Lead	0.011	1.1E-04	0.011	1.1E-04	0.011

Additional Risk Related to Specific Activities

It is expected that local residential receptors may participate in activities such as swimming, hunting or angling in the LRASA. Participation in these activities may, through unique exposure pathways, increase the body burden of a receptor beyond that of a residential receptor not participating in the activity. Details on these exposure situations (swimming, hunting and angling) have been provided in Section 7.4.1. In order to provide a more complete assessment of the impact of these activities, the activity specific HQ results have been added to the worst case resident receptor results (i.e. the Tooley residential receptor grouping). This assessment allows for potential risks to be placed in context such that the results represent the risk of a local resident swimming, hunting or angling in addition to his/her normal daily activities.

Recreation User - Swimmer

Chronic HQ values for both the recreation user – swimmer receptor, as well as the recreation user – swimmer receptor combined with the Tooley resident receptor are presented in Table

7-41. Results of the assessment indicate that, with the exception of Total PCBs, arsenic and thallium, none of the predicted hazard quotients exceed the regulatory benchmark for the Baseline Case, Project Alone Case, Project Case, Process Upset Case or Process Upset Project Case at 140,000 tpy. Total PCBs, arsenic and thallium for the recreation user – swimmer receptor combined with the Tooley resident receptor exceed the regulatory benchmark (HQ = 0.52, HQ = 0.33, HQ = 0.26, respectively) for the Baseline Case, Project Case and Process Upset Project Case. This exceedance is entirely driven by Baseline Case concentrations for the toddler resident; the Project Alone Case/Process Upset Case contribution to the observed risk level is 0.01%. Furthermore, the contribution of the swimming activity to the total risk is approximately 6%. A discussion of the Baseline Case risk to the toddler resident is further discussed in Section 7.9.2.1. It is not expected that the Project, at 140,000 tpy, will pose any additional undue risk to the health of local recreational swimming receptors.

As was previously completed for other receptor categories, a separate assessment of dioxins/furans and lead, has also been conducted. This assessment provides an overall, all pathway assessment for these COPC, including exposure via inhalation. The results of this assessment, which indicates that neither COPC would be present at levels that would be in exceedance of the regulatory benchmark at 140,000 tpy, are presented in Table 7-43.

Hunting and Angling

Chronic HQ values for both the hunter/angler toddler receptor, as well as the hunter/angler receptor combined with the Tooley resident receptor are presented in Table 7-42 and Table 7-43. Results of the assessment indicate that, with the exception of total PCBs, arsenic, cadmium and thallium, none of the predicted hazard quotients exceed the regulatory benchmark for the Baseline Case, Project Alone Case, Project Case, Process Upset Case, or Process Upset Project Case at 140,000 tpy.

Exceedances of total PCBs, arsenic, cadmium and thallium stem almost entirely from the assessment of baseline concentrations – the contribution of the Project Alone Case/Process Upset Case to the total risk is never more than 2.5%. Refer to Section 7.9.2.1 for a thorough discussion of baseline hunting and angling risk. The exceedances are the result of baseline fish and wild game concentrations, which were evaluated at the method detection limit (MDL). Although these results indicate that, based on current conditions, residents who pursue activities such as hunting and angling could face slightly elevated risk levels, much like previously discussed baseline results, it is expected that these exceedances are the result of conservative estimations, such as the evaluation of the MDL. Overall, it is not expected that the Project will pose any additional undue risk to the health of local hunting/angling receptors at 140,000 tpy.

As previously completed, a separate assessment of dioxins/furans and lead has been conducted. The results of this assessment indicate a Baseline Case, Project Case and Process

Upset Project Case exceedance for dioxins/furans for the hunter/angler receptor. Much like the previously discussed risk from PCBs and certain inorganics, this risk is entirely driven by baseline concentrations of wild game and fish, which were evaluated at the method detection limit (MDL), which is a conservative estimation. Overall, it is not expected that emissions of dioxins/furans from the Project will pose any additional undue risk to the health of local hunting/angling receptors at 140,000 tpy.

Table 7-41 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Swimmer Toddler Receptor and Tooley Resident Swimmer Toddler Receptor at 140,000 tpy

COPC	Hazard Quotient – Swimmer – 140,000 tpy									
	Toddler - Swimmer					Toddler - Tooley Resident Swimmer				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.0E-07	6.3E-12	4.0E-07	1.8E-11	4.0E-07	1.3E-05	5.7E-10	1.3E-05	1.6E-09	1.3E-05
Anthracene	1.0E-07	6.0E-13	1.0E-07	1.7E-12	1.0E-07	2.8E-06	4.6E-11	2.8E-06	1.3E-10	2.8E-06
Fluorene	1.2E-06	2.8E-11	1.2E-06	7.8E-11	1.2E-06	2.1E-05	5.0E-10	2.1E-05	1.4E-09	2.1E-05
PCBs										
Aroclor 1254 (Total PCBs)	0.028	6.8E-07	0.028	1.9E-06	0.028	**0.52**	3.5E-05	**0.52**	9.8E-05	**0.52**
VOCs										
1,1,1-Trichloroethane	3.5E-07	4.6E-12	3.5E-07	1.3E-11	3.5E-07	5.0E-06	4.8E-12	5.0E-06	1.4E-11	5.0E-06
Bromoform	3.6E-05	2.1E-08	3.6E-05	5.8E-08	3.6E-05	0.0024	2.1E-08	0.0024	5.8E-08	0.0024
Carbon Tetrachloride	1.0E-03	4.0E-09	1.0E-03	1.1E-08	1.0E-03	0.034	4.1E-09	0.034	1.2E-08	0.034
Chloroform	7.0E-05	3.1E-10	7.0E-05	8.5E-10	7.0E-05	0.0027	3.3E-10	0.0027	9.2E-10	0.0027
Dichloromethane	5.2E-05	2.4E-08	5.2E-05	6.6E-08	5.2E-05	0.0047	2.6E-08	0.0047	7.3E-08	0.0047

COPC	Hazard Quotient – Swimmer – 140,000 tpy									
	Toddler - Swimmer					Toddler - Tooley Resident Swimmer				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Trichlorofluoromethane (FREON 11)	4.6E-06	3.5E-09	4.7E-06	9.8E-09	4.7E-06	1.6E-04	3.5E-09	1.6E-04	9.9E-09	1.6E-04
Chlorinated Monocyclic Aromatics										
1,2,4,5-Tetrachlorobenzene	6.2E-04	3.3E-09	6.2E-04	9.2E-09	6.2E-04	0.046	3.9E-08	0.046	1.1E-07	0.046
1,2,4-Trichlorobenzene	5.9E-04	3.0E-10	5.9E-04	8.5E-10	5.9E-04	0.057	4.9E-10	0.057	1.4E-09	0.057
1,2-Dichlorobenzene	2.2E-06	4.5E-11	2.2E-06	1.3E-10	2.2E-06	1.1E-04	1.1E-10	1.1E-04	3.1E-10	1.1E-04
Hexachlorobenzene	7.4E-04	4.7E-09	7.4E-04	1.3E-08	7.4E-04	0.020	7.8E-09	0.020	2.2E-08	0.020
Pentachlorobenzene	7.4E-05	1.2E-09	7.4E-05	3.3E-09	7.4E-05	0.0095	5.2E-08	0.0095	1.5E-07	0.0095
Pentachlorophenol	4.2E-06	1.1E-07	4.3E-06	3.0E-07	4.5E-06	6.4E-06	2.3E-07	6.7E-06	6.5E-07	7.1E-06
Inorganics										
Antimony	0.018	1.3E-05	0.018	1.9E-05	0.018	0.069	4.6E-05	0.069	6.7E-05	0.070
Arsenic	0.0095	2.7E-06	0.0095	3.9E-06	0.0095	**0.33**	5.8E-06	**0.33**	8.5E-06	**0.33**
Barium	6.4E-04	2.0E-08	6.4E-04	2.9E-08	6.4E-04	0.0085	6.7E-08	0.0085	9.7E-08	0.0085

COPC	Hazard Quotient – Swimmer – 140,000 tpy									
	Toddler - Swimmer					Toddler - Tooley Resident Swimmer				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Beryllium	7.1E-04	1.5E-07	7.1E-04	2.2E-07	7.1E-04	0.051	1.9E-06	0.051	2.7E-06	0.051
Boron	4.3E-04	1.5E-06	4.3E-04	2.1E-06	4.3E-04	0.022	1.1E-05	0.022	1.5E-05	0.022
Cadmium	2.8E-04	2.6E-05	3.1E-04	3.8E-05	3.2E-04	0.027	2.7E-04	0.027	3.9E-04	0.027
Chromium (Total)	5.7E-06	2.9E-09	5.7E-06	4.2E-09	5.7E-06	2.3E-04	5.5E-09	2.3E-04	8.0E-09	2.3E-04
Chromium VI	0.015	6.3E-07	0.015	9.1E-07	0.015	0.015	1.2E-06	0.015	1.7E-06	0.015
Cobalt	5.0E-04	7.8E-06	5.1E-04	1.1E-05	5.1E-04	0.071	2.1E-05	0.071	3.0E-05	0.071
Mercury - Inorganic	4.7E-04	1.4E-06	4.8E-04	2.1E-06	4.8E-04	0.0065	2.0E-04	0.0067	2.9E-04	0.0068
Methylmercury	-	9.1E-09	9.1E-09	1.3E-08	1.3E-08	-	1.8E-05	1.8E-05	2.7E-05	2.7E-05
Nickel	4.2E-04	8.1E-06	4.3E-04	1.2E-05	4.3E-04	0.014	2.8E-05	0.014	4.0E-05	0.014
Phosphorus	1.6E-08	6.1E-12	1.6E-08	8.8E-12	1.6E-08	5.1E-05	7.3E-11	5.1E-05	1.1E-10	5.1E-05
Selenium	0.0014	1.8E-07	0.0014	2.7E-07	0.0014	0.012	3.1E-07	0.012	4.4E-07	0.012
Silver	2.8E-05	1.3E-06	3.0E-05	1.9E-06	3.0E-05	0.0025	3.3E-06	0.0025	4.8E-06	0.0025
Thallium	0.0053	9.2E-04	0.0063	0.0013	0.0067	**0.26**	0.0026	**0.26**	0.0038	**0.26**

COPC	Hazard Quotient – Swimmer – 140,000 tpy									
	Toddler - Swimmer					Toddler - Tooley Resident Swimmer				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Tin	4.7E-06	8.6E-08	4.8E-06	1.2E-07	4.9E-06	9.3E-04	6.4E-07	9.3E-04	9.2E-07	9.3E-04
Vanadium	0.0013	1.1E-07	0.0013	1.6E-07	0.0013	0.047	1.5E-06	0.047	2.2E-06	0.047
Zinc	2.1E-04	1.3E-06	2.1E-04	1.8E-06	2.1E-04	0.021	1.2E-05	0.021	1.7E-05	0.021

Notes:

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-42 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Hunter/Angler Receptor and Tooley Resident Hunter/Angler Toddler Receptor at 140,000 tpy

COPC	Hazard Quotient - Hunter/Angler – 140,000 tpy									
	Toddler - Hunter/Angler					Toddler - Tooley Resident Hunter/Angler				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	1.3E-05	6.2E-13	1.3E-05	1.7E-12	1.3E-05	2.6E-05	5.7E-10	2.6E-05	1.6E-09	2.6E-05
Anthracene	1.7E-06	1.4E-13	1.7E-06	4.0E-13	1.7E-06	4.3E-06	4.6E-11	4.3E-06	1.3E-10	4.3E-06
Fluorene	2.1E-05	3.4E-12	2.1E-05	9.6E-12	2.1E-05	4.1E-05	4.8E-10	4.1E-05	1.3E-09	4.1E-05
PCBs										
Aroclor 1254 (Total PCBs)	**0.67**	0.0021	**0.67**	0.0059	**0.68**	**1.2**	0.0022	**1.2**	0.0060	**1.2**
VOCs										
1,1,1-Trichloroethane	-	1.9E-12	1.9E-12	5.3E-12	5.3E-12	4.7E-06	2.1E-12	4.7E-06	5.9E-12	4.7E-06
Bromoform	-	6.2E-09	6.2E-09	1.7E-08	1.7E-08	0.0023	6.2E-09	0.0023	1.7E-08	0.0023
Carbon Tetrachloride	-	3.2E-09	3.2E-09	9.0E-09	9.0E-09	0.033	3.4E-09	0.033	9.4E-09	0.033
Chloroform	-	4.1E-11	4.1E-11	1.1E-10	1.1E-10	0.0026	6.5E-11	0.0026	1.8E-10	0.0026
Dichloromethane	-	5.4E-10	5.4E-10	1.5E-09	1.5E-09	0.0047	3.3E-09	0.0047	9.1E-09	0.0047

COPC	Hazard Quotient - Hunter/Angler – 140,000 tpy									
	Toddler - Hunter/Angler					Toddler - Tooley Resident Hunter/Angler				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Trichlorofluoromethane (FREON 11)	-	1.4E-09	1.4E-09	4.0E-09	4.0E-09	1.5E-04	1.5E-09	1.5E-04	4.1E-09	1.5E-04
Chlorinated Monocyclic Aromatics										
1,2,4,5-Tetrachlorobenzene	0.064	1.4E-07	0.064	3.9E-07	0.064	0.11	1.7E-07	0.11	4.8E-07	0.11
1,2,4-Trichlorobenzene	-	3.5E-09	3.5E-09	9.7E-09	9.7E-09	0.057	3.7E-09	0.057	1.0E-08	0.057
1,2-Dichlorobenzene	-	1.0E-10	1.0E-10	2.8E-10	2.8E-10	1.1E-04	1.7E-10	1.1E-04	4.7E-10	1.1E-04
Hexachlorobenzene	0.027	2.2E-07	0.027	6.0E-07	0.027	0.046	2.2E-07	0.046	6.1E-07	0.046
Pentachlorobenzene	0.013	2.1E-07	0.013	5.8E-07	0.013	0.023	2.6E-07	0.023	7.2E-07	0.023
Pentachlorophenol	-	8.3E-06	8.3E-06	2.3E-05	2.3E-05	2.3E-06	8.4E-06	1.1E-05	2.4E-05	2.6E-05
Inorganics										
Antimony	0.034	6.3E-04	0.034	9.2E-04	0.034	0.085	6.6E-04	0.086	9.6E-04	0.086
Arsenic	**0.43**	3.3E-05	**0.43**	4.7E-05	**0.43**	**0.75**	3.6E-05	**0.75**	5.2E-05	**0.75**
Barium	0.030	4.9E-08	0.030	7.1E-08	0.030	0.038	9.6E-08	0.038	1.4E-07	0.038

COPC	Hazard Quotient - Hunter/Angler – 140,000 tpy									
	Toddler - Hunter/Angler					Toddler - Tooley Resident Hunter/Angler				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Beryllium	0.067	3.7E-06	0.067	5.4E-06	0.067	0.12	5.4E-06	0.12	7.9E-06	0.12
Boron	0.040	9.5E-08	0.040	1.4E-07	0.040	0.062	9.2E-06	0.062	1.3E-05	0.062
Cadmium	**0.46**	0.0076	**0.47**	0.011	**0.48**	**0.49**	0.0078	**0.50**	0.011	**0.50**
Chromium (Total)	1.9E-04	1.4E-07	1.9E-04	2.0E-07	1.9E-04	4.2E-04	1.4E-07	4.2E-04	2.1E-07	4.2E-04
Chromium VI	-	5.6E-06	5.6E-06	8.2E-06	8.2E-06	-	6.2E-06	6.2E-06	9.0E-06	9.0E-06
Cobalt	0.043	2.0E-04	0.043	2.9E-04	0.043	0.11	2.1E-04	0.11	3.1E-04	0.11
Mercury - Inorganic	0.11	2.5E-06	0.11	3.6E-06	0.11	0.12	2.0E-04	0.12	3.0E-04	0.12
Methylmercury	-	0.0014	0.0014	0.0020	0.0020	-	0.0014	0.0014	0.0020	0.0020
Nickel	0.024	3.1E-04	0.024	4.5E-04	0.024	0.037	3.3E-04	0.037	4.8E-04	0.038
Phosphorus	7.6E-04	2.8E-11	7.6E-04	4.0E-11	7.6E-04	8.1E-04	9.4E-11	8.1E-04	1.4E-10	8.1E-04
Selenium	0.16	7.6E-06	0.16	1.1E-05	0.16	0.17	7.7E-06	0.17	1.1E-05	0.17
Silver	0.0027	2.8E-05	0.0027	4.0E-05	0.0027	0.0051	3.0E-05	0.0051	4.3E-05	0.0052
Thallium	0.17	0.0022	0.17	0.0032	0.17	**0.42**	0.0039	**0.42**	0.0057	**0.43**

COPC	Hazard Quotient - Hunter/Angler – 140,000 tpy									
	Toddler - Hunter/Angler					Toddler - Tooley Resident Hunter/Angler				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Tin	3.8E-04	6.2E-05	4.4E-04	9.0E-05	4.7E-04	0.0013	6.3E-05	0.0014	9.1E-05	0.0014
Vanadium	0.020	4.2E-06	0.020	6.1E-06	0.020	0.066	5.6E-06	0.066	8.2E-06	0.066
Zinc	0.14	2.8E-04	0.14	4.1E-04	0.14	0.16	2.9E-04	0.16	4.3E-04	0.16

Notes:

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-43 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for Dioxins and Lead for the Swimmer and Hunter/Angler Toddler Receptors and Tooley Resident Swimmer and Hunter/Angler Toddler Receptors at 140,000 tpy

COPC	Hazard Quotient – 140,000 tpy									
	Toddler					Toddler - Tooley Resident				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Swimmer										
2,3,7,8-TCDD Equivalent	0.0026	2.8E-07	0.0026	8.0E-07	0.0026	0.17	2.1E-04	0.17	5.7E-04	0.17
Lead	7.6E-04	2.3E-05	7.8E-04	3.4E-05	7.9E-04	0.12	5.0E-04	0.12	6.9E-04	0.12
Hunting/Angling										
2,3,7,8-TCDD Equivalent	**0.38**	0.0017	**0.38**	0.0048	**0.38**	**0.54**	0.0019	**0.54**	0.0054	**0.55**
Lead	0.037	6.0E-04	0.037	8.7E-04	0.038	0.15	0.0011	0.15	0.0015	0.15

Notes:

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

7.11.2.2 140,000 tpy Operational Cases – Multi-Pathway Risk Assessment Chemical Mixtures

The results of the chronic, multi-pathway chemical mixtures assessment, at 140,000 tpy, are shown in Table 7-44 through Table 7-46. Interpretation of chemical mixtures results is difficult as regulators have not established standards or benchmarks for the assessment of mixtures. By adding chemical HQ values together, it assumes that not only is the target organ the same, but that exposure to these chemicals actually results in a toxicological mode of action that is directly additive. To date, there have been limited or no mixture additive toxicology studies to support using this approach in human health risk assessment. This is a considerable source of uncertainty in any risk assessment being conducted in Ontario.

Table 7-44 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for Local Resident Receptors from Chemical Mixtures at 140,000 tpy

COPC	Hazard Quotient – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Bowmanville Subdivision										
Haematological Effects	0.022	1.4E-06	0.022	2.0E-06	0.022	0.091	1.1E-05	0.091	1.6E-05	0.091
Kidney Effects	0.0028	1.6E-05	0.0028	2.3E-05	0.0028	0.014	8.1E-05	0.014	1.2E-04	0.014
Liver Effects	10.8	7.6E-05	10.8	2.1E-04	10.8	0.50	9.7E-06	0.50	2.7E-05	0.50
Neurological Effects	0.040	8.9E-05	0.040	1.0E-04	0.040	0.13	2.4E-04	0.13	3.2E-04	0.13
Reproductive/ Developmental Effects	3.9	7.8E-04	3.9	0.0020	3.9	0.32	3.4E-04	0.32	5.9E-04	0.32
Courtice Subdivision										
Haematological Effects	0.022	1.0E-06	0.022	1.5E-06	0.022	0.091	8.1E-06	0.091	1.2E-05	0.091
Kidney Effects	0.0028	1.0E-05	0.0028	1.5E-05	0.0028	0.014	5.3E-05	0.014	7.7E-05	0.014
Liver Effects	10.8	5.6E-05	10.8	1.6E-04	10.8	0.50	7.2E-06	0.50	2.0E-05	0.50
Neurological Effects	0.040	6.0E-05	0.040	7.1E-05	0.040	0.13	1.7E-04	0.13	2.2E-04	0.13
Reproductive/ Developmental Effects	3.9	5.5E-04	3.9	0.0014	3.9	0.32	2.4E-04	0.32	4.2E-04	0.32
Courtice Road										
Haematological Effects	0.022	3.1E-06	0.022	4.5E-06	0.022	0.091	2.4E-05	0.091	3.5E-05	0.091

COPC	Hazard Quotient – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Kidney Effects	0.0028	3.8E-05	0.0028	5.6E-05	0.0029	0.014	1.9E-04	0.014	2.8E-04	0.014
Liver Effects	10.8	2.4E-04	10.8	6.8E-04	10.8	0.50	3.1E-05	0.50	8.7E-05	0.50
Neurological Effects	0.040	1.8E-04	0.040	2.1E-04	0.041	0.13	5.0E-04	0.13	6.7E-04	0.13
Reproductive/ Developmental Effects	3.9	0.0017	3.9	0.0043	3.9	0.32	7.3E-04	0.32	0.0013	0.32
Maple Grove										
Haematological Effects	0.022	7.6E-07	0.022	1.1E-06	0.022	0.091	5.8E-06	0.091	8.5E-06	0.091
Kidney Effects	0.0028	1.2E-05	0.0028	1.7E-05	0.0028	0.014	6.1E-05	0.014	8.9E-05	0.014
Liver Effects	10.8	6.8E-05	10.8	1.9E-04	10.8	0.50	8.6E-06	0.50	2.4E-05	0.50
Neurological Effects	0.040	6.5E-05	0.040	7.3E-05	0.040	0.13	1.4E-04	0.13	1.9E-04	0.13
Reproductive/ Developmental Effects	3.9	4.5E-04	3.9	0.0011	3.9	0.32	2.0E-04	0.32	3.4E-04	0.32
Oshawa Subdivision										
Haematological Effects	0.022	1.4E-06	0.022	2.1E-06	0.022	0.091	1.1E-05	0.091	1.6E-05	0.091
Kidney Effects	0.0028	1.8E-05	0.0028	2.6E-05	0.0028	0.014	9.4E-05	0.014	1.4E-04	0.014
Liver Effects	10.8	1.0E-04	10.8	2.9E-04	10.8	0.50	1.3E-05	0.50	3.7E-05	0.50
Neurological Effects	0.040	1.1E-04	0.040	1.2E-04	0.040	0.13	2.5E-04	0.13	3.3E-04	0.13

COPC	Hazard Quotient – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Reproductive/ Developmental Effects	3.87	8.2E-04	3.9	0.0021	3.9	0.32	3.6E-04	0.32	6.1E-04	0.32
Port Darlington										
Haematological Effects	0.022	4.9E-07	0.022	7.1E-07	0.022	0.091	3.9E-06	0.091	5.7E-06	0.091
Kidney Effects	0.0028	1.1E-05	0.0028	1.6E-05	0.0028	0.014	5.8E-05	0.014	8.4E-05	0.014
Liver Effects	10.8	4.7E-05	10.8	1.3E-04	10.8	0.50	6.0E-06	0.50	1.7E-05	0.50
Neurological Effects	0.040	6.1E-05	0.040	6.7E-05	0.040	0.13	1.1E-04	0.13	1.4E-04	0.13
Reproductive/ Developmental Effects	3.87	3.4E-04	3.9	8.4E-04	3.9	0.32	1.5E-04	0.32	2.4E-04	0.32
Solina Road										
Haematological Effects	0.022	1.7E-06	0.022	2.5E-06	0.022	0.091	1.3E-05	0.091	1.9E-05	0.091
Kidney Effects	0.0028	2.5E-05	0.0028	3.7E-05	0.0028	0.014	1.3E-04	0.014	1.9E-04	0.014
Liver Effects	10.8	1.5E-04	10.8	4.3E-04	10.8	0.50	1.9E-05	0.50	5.4E-05	0.50
Neurological Effects	0.040	1.3E-04	0.040	1.5E-04	0.040	0.13	3.0E-04	0.13	4.0E-04	0.13
Reproductive/ Developmental Effects	3.87	9.8E-04	3.9	0.0025	3.9	0.32	4.4E-04	0.32	7.4E-04	0.32
Tooley										
Haematological Effects	0.022	3.2E-06	0.022	4.7E-06	0.022	0.091	2.4E-05	0.091	3.5E-05	0.091

COPC	Hazard Quotient – 140,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Kidney Effects	0.0028	4.0E-05	0.0028	5.9E-05	0.0029	0.014	2.0E-04	0.014	2.9E-04	0.014
Liver Effects	10.8	2.7E-04	10.8	7.5E-04	10.8	0.50	3.4E-05	0.50	9.6E-05	0.50
Neurological Effects	0.040	1.7E-04	0.040	2.1E-04	0.041	0.13	5.0E-04	0.13	6.8E-04	0.13
Reproductive/ Developmental Effects	3.87	0.0017	3.9	0.0044	3.9	0.32	7.4E-04	0.32	0.0013	0.32

Table 7-45 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for Farmer, Daycare, Recreation User – Sport and Recreation User – Camping Receptors from Chemical Mixtures at 140,000 tpy

COPC	Hazard Quotient – 140,000 tpy				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Local Farmer - Infant					
Haematological Effects	0.022	4.5E-06	0.022	6.5E-06	0.022
Kidney Effects	0.0028	4.2E-05	0.0028	6.1E-05	0.0029
Liver Effects	117.5	0.0036	117.5	0.010	117.5
Neurological Effects	0.040	2.2E-04	0.041	2.6E-04	0.041
Reproductive/ Developmental Effects	20.3	0.045	20.3	0.13	20.4
Local Farmer – Toddler					
Haematological Effects	0.32	1.9E-04	0.32	2.8E-04	0.32
Kidney Effects	0.044	4.1E-04	0.044	5.9E-04	0.044
Liver Effects	4.8	1.4E-04	4.8	3.9E-04	4.8
Neurological Effects	0.29	9.9E-04	0.29	0.0014	0.29
Reproductive/ Developmental Effects	1.1	0.0027	1.1	0.0059	1.1
Daycare – Toddler					
Haematological Effects	0.022	1.3E-06	0.022	1.9E-06	0.022
Kidney Effects	0.0029	1.5E-05	0.0029	2.2E-05	0.0029
Liver Effects	0.011	2.4E-06	0.011	6.6E-06	0.011
Neurological Effects	0.045	8.1E-05	0.045	9.6E-05	0.045
Reproductive/ Developmental Effects	0.052	1.1E-04	0.052	1.7E-04	0.052
Recreation User – Sport - Toddler					

COPC	Hazard Quotient – 140,000 tpy				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Haematological Effects	9.7E-04	7.6E-08	9.7E-04	1.1E-07	9.7E-04
Kidney Effects	1.2E-04	1.2E-06	1.3E-04	1.8E-06	1.3E-04
Liver Effects	4.7E-04	2.6E-07	4.7E-04	7.1E-07	4.7E-04
Neurological Effects	0.0082	1.1E-04	0.0083	1.1E-04	0.0083
Reproductive/ Developmental Effects	0.010	1.2E-04	0.010	1.2E-04	0.010
Recreation User – Camping – Toddler					
Haematological Effects	0.0026	2.2E-07	0.0026	3.1E-07	0.0026
Kidney Effects	3.3E-04	2.8E-06	3.3E-04	4.1E-06	3.3E-04
Liver Effects	0.0012	5.3E-07	0.0012	1.5E-06	0.0012
Neurological Effects	0.011	1.1E-04	0.011	1.2E-04	0.011
Reproductive/ Developmental Effects	0.013	1.2E-04	0.013	1.3E-04	0.013

Table 7-46 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Swimmer and Hunter/Angler Toddler Receptors and Tooley Resident Swimmer and Hunter/Angler Toddler Receptors from Chemical Mixtures at 140,000 tpy

COPC	Hazard Quotient – 140,000 tpy									
	Toddler					Toddler – Tooley Resident				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Swimmer										
Haematological Effects	7.2E-04	9.2E-06	7.3E-04	1.3E-05	7.3E-04	0.092	3.4E-05	0.092	4.9E-05	0.092
Kidney Effects	0.0011	1.5E-06	0.0011	2.1E-06	0.0011	0.015	2.0E-04	0.015	2.9E-04	0.015
Liver Effects	0.028	7.0E-07	0.028	2.0E-06	0.028	0.53	3.5E-05	0.53	9.8E-05	0.53
Neurological Effects	0.0022	2.4E-05	0.0022	3.4E-05	0.0022	0.13	5.2E-04	0.13	7.1E-04	0.13
Reproductive/ Developmental Effects	0.0042	3.3E-05	0.0042	4.9E-05	0.0042	0.32	7.7E-04	0.32	0.0013	0.32
Hunter/Angler										
Haematological Effects	0.19	5.4E-04	0.19	7.9E-04	0.19	0.28	5.7E-04	0.28	8.3E-04	0.28
Kidney Effects	0.14	2.5E-06	0.14	3.6E-06	0.14	0.16	2.0E-04	0.16	3.0E-04	0.16
Liver Effects	0.67	0.0021	0.67	0.0059	0.68	1.17	0.0022	1.17	0.0060	1.18
Neurological Effects	0.19	0.0020	0.19	0.0029	0.19	0.32	0.0025	0.32	0.0036	0.32
Reproductive/ Developmental Effects	0.48	0.0040	0.48	0.0082	0.49	0.79	0.0048	0.80	0.0094	0.80

7.11.2.3 140,000 tpy Operational Cases – Multi-Pathway Risk Assessment Carcinogens

The multi-pathway assessment derived oral/dermal LCR and ILCR estimates for the carcinogenic COPC under the Baseline Case (i.e., lifetime cancer risks), and the Project Alone and Process Upset Cases (i.e., incremental lifetime cancer risks), at 140,000 tpy. Lifetime exposures to carcinogens considered all life stages (i.e., infant through to adult), termed a "composite lifetime receptor", when predicting LCRs and ILCRs.

As discussed previously, predicted ILCR values for the Project Alone Case and Process Upset Case were evaluated against a 1-in-1,000,000 acceptable cancer risk benchmark; conversely, there is no benchmark for comparison of LCR values, as they represent an individual's lifetime cancer risks associated with all potential exposures to a given carcinogenic COPC within the environment. For the Baseline Case, this represents the lifetime cancer risk associated with all background sources of the COPC and does not include Project-related emissions.

Table 7-47 through Table 7-50 shows LCR and ILCR estimates for all receptors under the Baseline Case, Project Alone Case and Process Upset Case assessment scenarios. Baseline Case LCR results are provided for comparison – discussion of these results can be found in Section 7.9.2.3. Results of the assessment indicate that none of the predicted ILCR values exceed the accepted regulatory benchmark for the Project Alone Case or Process Upset Case; therefore, it is not expected that the Project will pose any additional adverse cancer risk to the health of local receptors at 140,000 tpy.

Additionally, the additive LCR and ILCR of stomach carcinogens was assessed. Interpretation of the results is difficult as there is no regulatory benchmark against which to measure the results of the analysis of chemical mixtures.

Table 7-47 Multi-Pathway Risk Assessment –Operational Cases Cancer Risk Results for the Bowmanville Subdivision, Courtice Subdivision and Courtice Road Composite Receptor Groupings at 140,000 tpy

COPC	LCR/ILCR – Bowmanville Subdivision			LCR/ILCR – Courtice Subdivision			LCR/ILCR – Courtice Road		
	Composite Receptor								
	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR
PAHs									
Benzo(a)pyrene TEQ	4.0E-06	1.8E-11	5.1E-11	4.0E-06	1.2E-11	3.4E-11	4.0E-06	3.9E-11	1.1E-10
VOCs									
Bromoform	2.4E-07	6.2E-16	1.7E-15	2.4E-07	4.7E-16	1.3E-15	2.4E-07	2.0E-15	5.6E-15
Carbon Tetrachloride	2.0E-06	2.4E-15	6.6E-15	2.0E-06	1.8E-15	4.9E-15	2.0E-06	7.5E-15	2.1E-14
Dichloromethane	1.1E-06	1.7E-13	4.7E-13	1.1E-06	1.2E-13	3.5E-13	1.1E-06	5.3E-13	1.5E-12
Chlorinated Monocyclic Aromatics									
Hexachlorobenzene	4.3E-06	1.3E-13	3.7E-13	4.3E-06	1.0E-13	2.8E-13	4.3E-06	4.3E-13	1.2E-12
Pentachlorophenol	1.6E-10	2.9E-11	8.0E-11	1.6E-10	1.9E-11	5.4E-11	1.6E-10	6.3E-11	1.8E-10
Inorganics									
Arsenic	1.9E-05	2.1E-10	3.1E-10	1.9E-05	1.5E-10	2.1E-10	1.9E-05	4.0E-10	5.8E-10
Chemical Mixtures									
Stomach Carcinogens	4.3E-06	1.8E-11	5.1E-11	4.3E-06	1.2E-11	3.4E-11	4.3E-06	3.9E-11	1.1E-10

Table 7-48 Multi-Pathway Risk Assessment –Operational Cases Cancer Risk Results for the Maple Grove, Oshawa Subdivision and Port Darlington Composite Receptor Groupings at 140,000 tpy

COPC	LCR/ILCR – Maple Grove			LCR/ILCR – Oshawa Subdivision			LCR/ILCR – Port Darlington		
	Composite Receptor								
	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR
PAHs									
Benzo(a)pyrene TEQ	4.0E-06	1.6E-11	4.4E-11	4.0E-06	2.4E-11	6.7E-11	4.0E-06	1.6E-11	4.4E-11
VOCs									
Bromoform	2.4E-07	5.6E-16	1.6E-15	2.4E-07	8.5E-16	2.4E-15	2.4E-07	3.9E-16	1.1E-15
Carbon Tetrachloride	2.0E-06	2.1E-15	5.9E-15	2.0E-06	3.2E-15	9.0E-15	2.0E-06	1.5E-15	4.1E-15
Dichloromethane	1.1E-06	1.5E-13	4.2E-13	1.1E-06	2.3E-13	6.3E-13	1.1E-06	1.0E-13	2.9E-13
Chlorinated Monocyclic Aromatics									
Hexachlorobenzene	4.3E-06	1.2E-13	3.3E-13	4.3E-06	1.8E-13	5.1E-13	4.3E-06	8.3E-14	2.3E-13
Pentachlorophenol	1.6E-10	2.5E-11	6.9E-11	1.6E-10	3.8E-11	1.1E-10	1.6E-10	2.4E-11	6.7E-11
Inorganics									
Arsenic	1.9E-05	9.9E-11	1.4E-10	1.9E-05	2.0E-10	2.8E-10	1.9E-05	7.1E-11	1.0E-10
Chemical Mixtures									
Stomach Carcinogens	4.3E-06	1.6E-11	4.4E-11	4.3E-06	2.4E-11	6.7E-11	4.3E-06	1.6E-11	4.4E-11

Table 7-49 Multi-Pathway Risk Assessment –Operational Cases Cancer Risk Results for the Solina Road, Tooley and Farmer Composite Receptor Groupings at 140,000 tpy

COPC	LCR/ILCR – Solina Road			LCR/ILCR – Tooley			LCR/ILCR – Farmer		
	Composite Receptor								
	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR
PAHs									
Benzo(a)pyrene TEQ	4.0E-06	1.6E-11	8.5E-11	4.0E-06	3.9E-11	1.1E-10	1.6E-05	1.7E-10	4.7E-10
VOCs									
Bromoform	2.4E-07	3.9E-16	3.5E-15	2.4E-07	2.2E-15	6.3E-15	3.6E-05	2.6E-11	7.1E-11
Carbon Tetrachloride	2.0E-06	1.5E-15	1.3E-14	2.0E-06	8.4E-15	2.4E-14	3.0E-04	4.8E-12	1.4E-11
Dichloromethane	1.1E-06	1.0E-13	9.4E-13	1.1E-06	6.0E-13	1.7E-12	1.7E-04	1.5E-11	4.2E-11
Chlorinated Monocyclic Aromatics									
Hexachlorobenzene	4.3E-06	8.3E-14	7.5E-13	4.3E-06	4.7E-13	1.3E-12	4.7E-05	2.5E-11	7.0E-11
Pentachlorophenol	1.6E-10	2.4E-11	1.4E-10	1.6E-10	6.3E-11	1.8E-10	1.6E-10	1.8E-10	5.0E-10
Inorganics									
Arsenic	1.9E-05	7.1E-11	3.2E-10	1.9E-05	4.0E-10	5.8E-10	9.6E-05	1.6E-09	2.3E-09
Chemical Mixtures									
Stomach Carcinogens	4.3E-06	1.6E-11	8.5E-11	4.3E-06	3.9E-11	1.1E-10	5.2E-05	2.0E-10	5.5E-10

Table 7-50 Multi-Pathway Risk Assessment –Operational Cases Cancer Risk Results for the Daycare Adult Receptor and the Recreation User – Sport and Recreation User - Camping Composite Receptor Groupings at 140,000 tpy

COPC	LCR/ILCR – Daycare			LCR/ILCR – Recreation User - Sport			LCR/ILCR – Recreation User - Camping		
	Adult Receptor			Composite Receptor					
	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR
PAHs									
Benzo(a)pyrene TEQ	8.7E-08	1.0E-13	2.8E-13	7.1E-09	2.0E-14	2.8E-13	1.9E-08	4.3E-14	1.2E-13
VOCs									
Bromoform	3.4E-11	2.2E-19	6.0E-19	2.9E-12	4.5E-20	6.0E-19	7.5E-12	9.6E-20	2.7E-19
Carbon Tetrachloride	3.5E-10	3.2E-19	8.9E-19	2.8E-11	6.4E-20	8.9E-19	7.4E-11	1.3E-19	3.8E-19
Dichloromethane	3.1E-10	4.2E-18	1.2E-17	2.7E-11	8.9E-19	1.2E-17	7.0E-11	1.9E-18	5.3E-18
Chlorinated Monocyclic Aromatics									
Hexachlorobenzene	1.9E-09	2.1E-15	6.0E-15	1.6E-10	4.4E-16	6.0E-15	4.1E-10	9.3E-16	2.6E-15
Pentachlorophenol	3.1E-11	4.9E-15	1.4E-14	2.6E-12	1.0E-15	1.4E-14	6.8E-12	2.2E-15	6.1E-15
Inorganics									
Arsenic	2.0E-06	3.9E-12	5.6E-12	1.8E-07	4.8E-13	5.6E-12	4.7E-07	1.4E-12	2.0E-12
Chemical Mixtures									
Stomach Carcinogens	8.7E-08	1.0E-13	2.8E-13	7.1E-09	2.0E-14	2.8E-13	1.9E-08	4.3E-14	1.2E-13

Additional Risk Related to Specific Activities

As was conducted for the chronic non-carcinogenic results, in order to provide a more complete assessment of the impact of swimming, hunting and angling activities, the activity specific LCR and ILCR results have been added to the worst case resident receptor results (i.e. the Tooley residential receptor grouping). This assessment allows for potential risks to be placed in context such that the results represent the risk of a local resident swimming, hunting or angling in addition to his/her normal daily activities.

Table 7-51 and Table 7-52 shows LCR and ILCR estimates for both recreation user – swimming and hunting/angling receptors, as well as the combined results for the recreation user – swimming/hunting/angling receptors and Tooley residents, under the Baseline Case, Project Alone Case and Process Upset Case assessment scenarios, at 140,000 tpy. Baseline Case LCR results are provided for comparison – discussion of these results can be found in Section 7.9.2.3. Results of the assessment indicate that none of the predicted ILCR values exceed the regulatory benchmark for the Project Alone Case or Process Upset Case; therefore, it is not expected that the Project will pose any additional adverse cancer risk to the health of local recreational swimmer and hunting/angling receptors at 140,000 tpy.

Additionally, the additive LCR and ILCR of stomach carcinogens was assessed. Interpretation of the results is difficult as there is no regulatory benchmark against which to measure the results of the analysis of chemical mixtures.

Table 7-51 Multi-Pathway Risk Assessment –Operational Cases Cancer Risk Results for the Composite Swimmer Receptor and Tooley Resident Recreational Swimmer Composite Receptor at 140,000 tpy

COPC	LCR/ILCR - Recreational Swimmer			LCR/ILCR - Recreational Swimmer		
	Composite Receptor - Swimmer			Composite Receptor - Tooley Resident Swimmer		
	Baseline Case - LCR	Project Alone - ILCR	Process Upset Case – ILCR	Baseline Case - LCR	Project Alone - ILCR	Process Upset Case - ILCR
PAHs						
Benzo(a)pyrene TEQ	1.6E-07	1.3E-12	3.5E-12	4.2E-06	4.0E-11	1.1E-10
VOCs						
Bromoform	3.2E-09	1.9E-12	5.2E-12	2.4E-07	1.9E-12	5.2E-12
Carbon Tetrachloride	1.0E-07	4.1E-13	1.2E-12	2.1E-06	4.2E-13	1.2E-12
Dichloromethane	1.2E-08	4.2E-12	1.2E-11	1.1E-06	4.8E-12	1.3E-11
Chlorinated Monocyclic Aromatics						
Hexachlorobenzene	3.4E-08	2.1E-13	5.9E-13	4.3E-06	6.9E-13	1.9E-12
Pentachlorophenol	1.3E-09	2.5E-11	7.1E-11	1.5E-09	8.8E-11	2.5E-10
Inorganics						
Arsenic	2.5E-06	7.1E-10	1.0E-09	2.1E-05	1.1E-09	1.6E-09
Chemical Mixtures						
Stomach Carcinogens	1.7E-07	3.1E-12	8.7E-12	4.5E-06	4.2E-11	1.2E-10

Table 7-52 Multi-Pathway Risk Assessment –Operational Cases Cancer Risk Results for the Composite Hunter/Angler Receptor and Tooley Resident Hunter/Angler Composite Receptor at 140,000 tpy

COPC	LCR/ILCR – Hunter/Angler			LCR/ILCR – Hunter/Angler		
	Composite Receptor – Hunter/Angler			Composite Receptor - Tooley Resident Hunter/Angler		
	Baseline Case - LCR	Project Alone - ILCR	Process Upset Case – ILCR	Baseline Case - LCR	Project Alone - ILCR	Process Upset Case - ILCR
PAHs						
Benzo(a)pyrene TEQ	3.6E-06	3.1E-11	8.7E-11	7.6E-06	7.0E-11	2.0E-10
VOCs						
Bromoform	-	5.5E-13	1.5E-12	2.4E-07	5.5E-13	1.5E-12
Carbon Tetrachloride	-	1.6E-13	4.5E-13	2.0E-06	1.7E-13	4.7E-13
Dichloromethane	-	1.2E-13	3.4E-13	1.1E-06	7.2E-13	2.0E-12
Chlorinated Monocyclic Aromatics						
Hexachlorobenzene	9.8E-06	4.8E-11	1.3E-10	1.4E-05	4.8E-11	1.3E-10
Pentachlorophenol	0.0E+00	3.2E-09	8.9E-09	1.6E-10	3.3E-09	9.1E-09
Inorganics						
Arsenic	1.5E-04	7.9E-09	1.1E-08	1.7E-04	8.3E-09	1.2E-08
Chemical Mixtures						
Stomach Carcinogens	3.6E-06	3.2E-11	8.9E-11	7.9E-06	7.0E-11	2.0E-10

400,000 TONNES/YEAR

7.12 Risk Characterization – 400,000 tpy

7.12.1 400,000 tpy Operational Assessment Scenarios – Inhalation Risk Assessment

Assuming a maximum design capacity of 400,000 tpy, the HHRA evaluated acute and chronic inhalation risks at 309 receptor locations, assessed as 15 receptor groupings, within the LRASA for Traffic Case, Project Alone Case, Project Case, Process Upset Case and Process Upset Project Case scenarios. Where appropriate, the previously discussed Baseline Case results have been included for comparison. Inhalation risk estimates for CACs are presented in Sections 7.12.1.1 and 7.11.1.2. Additional COPC are discussed in Section 7.12.1.3, while chemical mixtures are discussed in Section 7.12.1.4.

The exposure point concentration evaluated for each grouping is based upon the maximum air concentration predicted for a discrete receptor point within each receptor group. This is a conservative measure meant to ensure that inhalation risks to individuals present within these locations were not underestimated. Refer to Section 3.3 for a complete list of HHRA receptor locations evaluated.

In addition to the individual receptor groupings, the maximum ground level concentration within the LRASA was determined and evaluated for inhalation risks. These concentrations were determined based on the protocol outlined by the Ontario Ministry of the Environment in which a specified number of 1-hour and 24-hour concentrations have been removed from the modeling analysis of each chemical to account for meteorological anomalies; therefore it is possible that results at individual groupings exhibit higher concentrations than the maximum ground level concentration, as this protocol was not applied to the individual receptor analysis. Nevertheless, the analysis of ground level maximum concentrations is expected to provide a conservative and representative estimate of risk in the LRASA. Full details on the selection of maximum ground level concentrations are available in the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e). The following sections present acute and chronic concentration ratio (CR) values, and cancer risk estimates (LCR and ILCR), at the maximum ground level concentration, as well as at individual receptor groupings surrounding the Site, where appropriate.

For the purposes of the acute Process Upset assessment, it is assumed that the Facility operates under upset conditions for the entire duration of the assessment period (1- or 24-hours). For the chronic Process Upset assessment, it was assumed that operation under upset conditions occurs 5% of the year for CACs and metals, and 20% of the year for all other COPC. Further discussion of assumptions used to characterize upset scenarios can be found the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e). Additionally, CR estimates at each of the 15 individual receptor groupings are presented in **Appendix I**.

In general, CR values are interpreted as follows:

- A CR less than or equal to 1 signifies that the estimated exposure is less than or equal to the exposure limit (i.e*.,* the assumed safe level of exposure); therefore, no adverse health risk is expected.
- A CR greater than 1 signifies the exposure estimate exceeds the exposure limit; consequently, the potential for adverse health effects may exist.

With regards to chronic inhalation risks, separate assessments were conducted for non-carcinogenic COPC and carcinogenic COPC. Chronic, non-cancer inhalation risks (expressed as CR values) assume that an individual is continuously exposed to a predicted annual air concentration. Carcinogenic health risks, expressed as ILCRs, assume that individuals would be continuously exposed to the predicted annual air concentration over the course of a lifetime.

7.12.1.1 400,000 tpy Operational Cases – Inhalation Risk Assessment Criteria Air Contaminants (CACs)

Predicted acute CR values for Baseline Case, Project Alone Case, Project Case, Process Upset Case, and Process Upset Project Case exposures to CAC at 400,000 tpy are presented in Table 7-53.

Predicted 1-hour, 24-hour and annual air concentrations for the CAC at 400,000 tpy do not exceed their relevant exposure limit for the Baseline Case, Project Alone Case, Project Case, Process Upset Case or Process Upset Project Case; therefore, no adverse health risk is expected from potential exposure to CACs. Similarly, with the exception of the current/future commercial/industrial receptor grouping, health risks were not predicted at any of the 15 individual receptor groupings, which include schools, daycares, farms, park/recreational areas, hospitals, retirement homes, and eight residential areas (**Appendix I**).

However, there was one exception for the Process Upset Case, as the maximum 1-hr concentration of hydrogen chloride modelled at the Commercial/Industrial receptor group resulted in a CR value of 1.0. This slight exceedance of the government benchmark of 1.0 occurred when the facility was operating under upset conditions where two of the three exhaust streams being affected, for the entire one hour period, and at the time of the worst meteorological conditions. The probability of this hypothetical situation actually occurring is expected to be very low. Frequency analysis of this occurrence was completed at the receptor for which the exceedance occurred within the Commercial/Industrial grouping and is presented in Figure 7-14. It is apparent from the graph that 1-hour HCl concentrations exceeding the benchmark of 75 $\mu g/m^3$ are extremely rare. The concentration of HCl at this receptor is expected to be less than 20 $\mu g/m^3$, 99.9% of the time. Specifically, a concentration above the specified threshold of 75 µg/m³ was predicted to occur in only one 1-hour period over the course of 5 years.

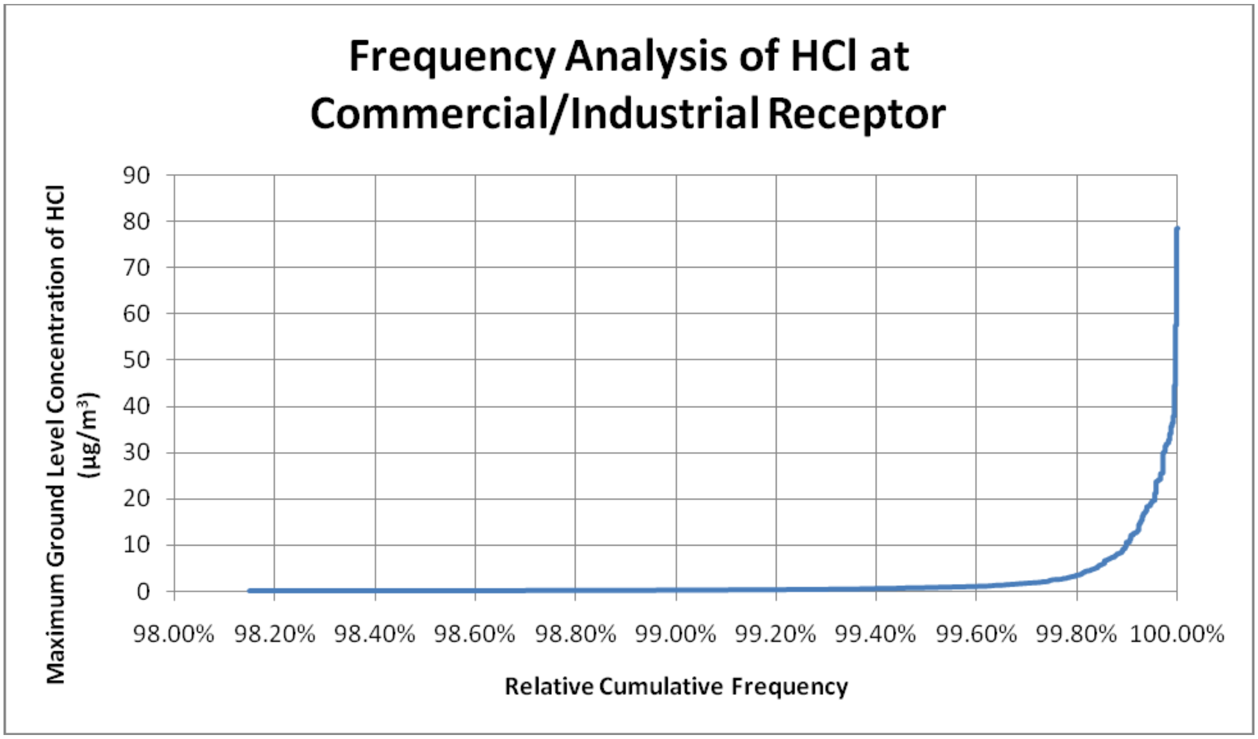


Figure 7-14 Frequency Analysis for 1-Hour Hydrogen Chloride (HCl) Concentrations

Additionally, as discussed in Section 7.6.1.1, CACs (including NO_2, SO_2, $PM_{2.5}$, and PM_{10}) have been compared to WHO benchmarks for informational purposes. With the exception of Process Upset Project Case 1-hr NO_2 (CR = 1.03) and 24-hr $PM_{2.5}$ (CR = 1.1), none of the relevant Baseline Case, Project Alone Case, Project Case, Process Upset Case or Process Upset Project Case CACs exceed the WHO benchmarks. The exceedances of fine particulate matter is driven by baseline concentrations, and was not unexpected, as any urban area in Ontario would produce similar results. For a frequency analysis of 24-hour $PM_{2.5}$ concentrations, please refer to Figure 7-13. The exceedance of nitrogen dioxide is driven by upset conditions, which conservatively assume that the Facility operates at maximum capacity while two of the three air pollution control units are not operational for the entire 1-hr exposure duration. Frequency analysis of this occurrence was completed at the Courtice Road Ambient Air Monitoring Station, Figure 7-15. It is apparent from the graph that 1-hour NO_2 concentrations exceeding the WHO benchmark of 200 µg/m³ are extremely rare. The concentration of NO_2 at this location is expected to be less than 200 µg/m³, 99.9% of the time. Specifically, a concentration above the specified threshold of 200 µg/m³ was predicted to occur in only 1 1-hour period over the course of 5 years.

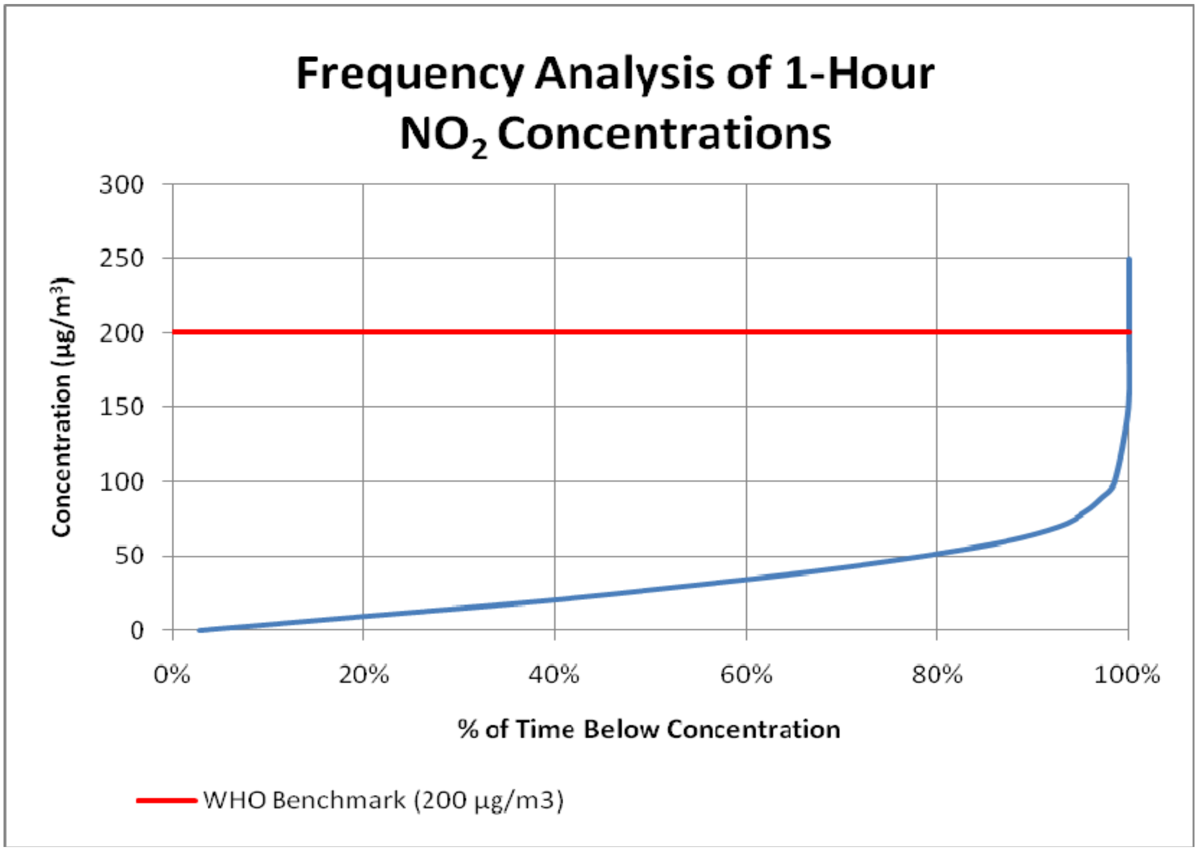


Figure 7-15 Frequency Analysis of 1-Hour NO_2 Concentrations

As noted, WHO benchmarks are not necessarily health-based and are only intended to act as guidelines for country-regulated air quality standards. When compared to the selected Canada-Wide Standard, this exceedance did not occur.

Overall, it is not expected that concentrations of CACs from the Project at 400,000 tpy will pose any additional undue acute or chronic risk to the health of local human receptors.

Table 7-53 Concentration Ratio (CR) Values for Criteria Air Contaminants at the Maximum Ground Level Concentration at 400,000 tpy

COPC	Concentration Ratio (CR) Values – 400,000 tpy					Concentration Ratio (CR) Values – 400,000 tpy - WHO Benchmarks[f]				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
1-Hour										
Ammonia[a]	-	0.0013	0.0013	0.010	0.010	-	-	-	-	-
Carbon Monoxide (CO)	0.069	0.0024	0.071	0.018	0.087	-	-	-	-	-
Hydrogen Chloride (HCl)[a]	-	0.094	0.094	0.74	0.74	-	-	-	-	-
Hydrogen Fluoride (HF)[a]	-	0.028	0.028	0.22	0.22	-	-	-	-	-
Nitrogen Dioxide (NO_2)	0.16	0.24	0.40	0.35	0.51	0.33	0.48	0.80	0.70	**1.0**
Particulate Matter - PM_{10} [abe]	-	-	-	-	-	-	-	-	-	-
Particulate Matter - $PM_{2.5}$ [be]	-	-	-	-	-	-	-	-	-	-
Particulate Matter - Total[be]	-	-	-	-	-	-	-	-	-	-
Sulfur Dioxide (SO_2)	0.028	0.040	0.068	0.49	0.52	-	-	-	-	-
24-Hour										

COPC	Concentration Ratio (CR) Values – 400,000 tpy					Concentration Ratio (CR) Values – 400,000 tpy - WHO Benchmarks[f]				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Ammonia[a]	-	0.0051	0.0051	0.040	0.040	-	-	-	-	-
Carbon Monoxide (CO)[c]	-	-	-	-	-	-	-	-	-	-
Hydrogen Chloride (HCl)[a]	-	0.043	0.043	0.33	0.33	-	-	-	-	-
Hydrogen Fluoride (HF)[ac]	-	-	-	-	-	-	-	-	-	-
Nitrogen Dioxide (NO_2)	0.29	0.057	0.35	0.085	0.38	-	-	-	-	-
Particulate Matter - PM_{10} [ae]	-	0.020	0.020	0.14	0.14	-	0.020	0.020	0.14	0.14
Particulate Matter - $PM_{2.5}$ [e]	0.68	0.034	0.72	0.23	0.91	0.80	0.040	0.84	0.27	**1.1**
Particulate Matter - Total[e]	0.29	0.0085	0.30	0.057	0.35	-	-	-	-	-
Sulfur Dioxide (SO_2)	0.070	0.012	0.082	0.15	0.22	0.16	0.026	0.19	0.33	0.49
Annual										
Ammonia[a]	-	1.7E-04	1.7E-04	2.5E-04	2.5E-04	-	-	-	-	-
Carbon Monoxide (CO)[d]	-	-	-	-	-	-	-	-	-	-

COPC	Concentration Ratio (CR) Values – 400,000 tpy					Concentration Ratio (CR) Values – 400,000 tpy - WHO Benchmarks[f]				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Hydrogen Chloride (HCl)[a]	-	0.0015	0.0015	0.0021	0.0021	-	-	-	-	-
Hydrogen Fluoride (HF)[ad]	-	-	-	-	-	-	-	-	-	-
Nitrogen Dioxide (NO_2)	0.62	0.0065	0.62	0.0067	0.62	0.93	0.0098	0.93	0.010	0.94
Particulate Matter - PM_{10} [ade]	-	-	-	-	-	-	0.0017	0.0017	0.0025	0.0025
Particulate Matter - $PM_{2.5}$ [de]	-	-	-	-	-	0.98	0.0034	0.98	0.0049	0.99
Particulate Matter - Total[e]	0.35	5.7E-04	0.36	8.2E-04	0.36	-	-	-	-	-
Sulfur Dioxide (SO_2)	0.20	0.0039	0.21	0.0068	0.21	-	-	-	-	-

[a] Baseline Data Not Available

[b] 1-hr TRV Not Available

[c] 24-hr TRV Not Available

[d] Annual TRV Not Available

[e] Particulate Matter results include contribution of Secondary Particulate

[f] "-" indicates WHO benchmark not available

7.12.1.2 400,000 tpy Operational Cases – Inhalation Risk Assessment Criteria Air Contaminants (CACs) – Traffic Case

Predicted acute CR values for Baseline Traffic Case and Traffic Case exposures to CAC at 400,000 tpy are presented in Table 7-54.

Predicted 1-hour, 24-hour and annual air concentrations for the CAC at 400,000 tpy do not exceed their relevant exposure limit for the Baseline Traffic Case, or Traffic Case; therefore, no adverse health risk is expected from potential exposure to CACs due to the combined effect of Project emissions at 400,000 tpy and local vehicular traffic.

Additionally, as discussed in Section 7.6.1.1, CACs (including NO_2, SO_2, $PM_{2.5}$, and PM_{10}) have been compared to WHO benchmarks for informational purposes. With the exception of Traffic Case 1-hr and annual nitrogen dioxide (CR = 1.3 and 1.1, respectively), none of the relevant Baseline Traffic Case, or Traffic Case CACs exceed the WHO benchmarks. Nitrogen dioxide exceedances are driven by baseline concentrations, and were not unexpected, as any urban area in Ontario would produce similar results. Please refer to Figure 7-15 for a frequency analysis of 1-hour NO_2 concentrations. A frequency analysis of annual NO_2 concentrations could not be conducted due to limited data. As noted previously, WHO benchmarks are not necessarily health-based and are only intended to act as guidelines for country-regulated air quality standards. When compared to the selected standards from the Ontario Ministry of the Environment and Health Canada, these exceedances did not occur.

Table 7-54 Concentration Ratio (CR) Values for Criteria Air Contaminants at the Maximum Ground Level Concentration at 400,000 tpy

COPC	Operational Traffic Case Concentration Ratio (CR) Values					
	1-hour		24-hour		Annual	
	Baseline Traffic Case	Traffic Case	Baseline Traffic Case	Traffic Case	Baseline Traffic Case	Traffic Case
Risk Assessment TRVs						
Ammonia [d]	-	-	-	-	-	-
Carbon Monoxide (CO)[bc]	0.28	0.28	-	-	-	-
Hydrogen Chloride (HCl)[d]	-	-	-	-	-	-

COPC	Operational Traffic Case Concentration Ratio (CR) Values					
	1-hour		24-hour		Annual	
	Baseline Traffic Case	Traffic Case	Baseline Traffic Case	Traffic Case	Baseline Traffic Case	Traffic Case
Hydrogen Fluoride (HF)[d]	-	-	-	-	-	-
Nitrogen Dioxide (NO_2)	0.39	0.63	0.53	0.57	0.77	0.78
Particulate Matter - PM_{10} [d]	-	-	0.021	0.050	-	-
Particulate Matter - $PM_{2.5}$[ac]	-	-	0.70	0.75	-	-
Particulate Matter - Total[d]	-	-	0.31	0.37	0.36	0.37
Sulfur Dioxide (SO_2)	0.031	0.079	0.071	0.083	0.21	0.21
WHO Benchmarks [e]						
Ammonia	-	-	-	-	-	-
Carbon Monoxide (CO)	-	-	-	-	-	-
Hydrogen Chloride (HCl)	-	-	-	-	-	-
Hydrogen Fluoride (HF)	-	-	-	-	-	-
Nitrogen Dioxide (NO_2)	0.78	**1.3**	-	-	**1.2**	**1.2**
Particulate Matter - PM_{10}	-	-	0.021	0.050	0.010	0.013
Particulate Matter - $PM_{2.5}$	-	-	0.84	0.90	0.99	0.99
Particulate Matter - Total	-	-	-	-	-	-
Sulfur Dioxide (SO_2)	-	-	0.16	0.18	-	-

[a] 1-hr TRV Not Available

[b] 24-hr TRV Not Available

[c] Annual TRV Not Available

[d] Not Included in the Traffic Case Assessment

[e] '-' indicates that WHO benchmark not available

7.12.1.3 400,000 tpy Operational Cases – Inhalation Assessment Additional COPC

Predicted acute CR values for Baseline Case, Project Alone Case, Project Case, Process Upset Case, and Process Upset Project Case exposures to other COPC at 400,000 tpy are presented in Table 7-55.

Predicted 1-hour, 24-hour or annual air concentrations for the additional COPC do not exceed their relevant exposure limit for the Baseline Case, Project Alone Case, Project Case, Process Upset Case or Process Upset Project Case at 400,000 tpy; therefore, no adverse health risk is expected from potential exposure to additional COPC. Similarly, health risks were not predicted at any of the 15 individual receptor groupings, which include schools, daycares, farms, current/future industrial/commercial areas, park/recreational areas, hospitals, retirement homes, and eight residential areas (**Appendix I**). Further information on the receptor groupings can be found in Section 3.3.

Overall, it is not expected that concentrations of other COPC from the Project, 400,000 tpy, will pose any additional undue risk to the health of local human receptors.

Table 7-55 Concentration Ratio (CR) Values at 400,000 tpy for Individual COPC at the Maximum Ground Level Concentration

COPC	Concentration Ratio (CR) Values – 400,000 tpy														
	1-hour					24-hour					Annual				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Metals															
Antimony	0.0015	4.3E-04	0.0019	0.0034	0.0048	1.2E-04	1.0E-05	1.3E-04	8.1E-05	2.0E-04	0.015	4.4E-05	0.015	6.4E-05	0.015
Arsenic	0.022	0.0017	0.024	0.013	0.035	0.0060	1.3E-04	0.0062	0.0010	0.0071	0.12	9.0E-05	0.12	1.3E-04	0.12
Barium	0.0040	3.3E-04	0.0043	0.0026	0.0066	8.2E-04	2.0E-05	8.4E-04	1.6E-04	9.8E-04	0.0049	6.8E-06	0.0050	9.9E-06	0.0050
Beryllium	0.037	0.013	0.050	0.10	0.14	0.030	0.0032	0.033	0.025	0.055	0.043	1.5E-04	0.043	2.2E-04	0.043
Boron[c]	0.0037	0.0024	0.0061	0.019	0.023	-	-	-	-	-	0.0031	9.9E-05	0.0032	1.4E-04	0.0032
Cadmium	0.015	0.055	0.070	0.43	0.44	0.024	0.027	0.051	0.21	0.23	0.12	0.0045	0.12	0.0066	0.13
Chromium (hexavalent)[a]	-	0.0025	0.0025	0.020	0.020	-	-	-	-	-	-	1.0E-05	1.0E-05	1.5E-05	1.5E-05
Total Chromium (and compounds)[cd]	0.0067	0.0018	0.0085	0.014	0.021	-	-	-	-	-	-	-	-	-	-
Cobalt	0.0074	0.023	0.030	0.18	0.19	0.0060	0.0055	0.012	0.043	0.049	0.0060	1.9E-04	0.0061	2.7E-04	0.0062
Lead[e]	0.0081	0.026	0.034	0.20	0.21	0.0100	0.0095	0.019	0.074	0.084	0.0066	3.2E-04	0.0069	4.7E-04	0.0070
Mercury - Inorganic[a]	-	0.020	0.020	0.15	0.15	-	7.1E-04	7.1E-04	0.0056	0.0056	-	1.6E-04	1.6E-04	2.3E-04	2.3E-04
Nickel[c]	0.0018	0.011	0.013	0.089	0.091	-	-	-	-	-	0.045	0.0056	0.050	0.0082	0.053
Phosphorus[bc]	-	-	-	-	-	-	-	-	-	-	7.3E-10	2.3E-12	7.3E-10	3.4E-12	7.3E-10
Selenium	0.0037	1.9E-04	0.0039	0.0015	0.0051	3.0E-04	4.6E-06	3.1E-04	3.6E-05	3.4E-04	0.015	7.7E-06	0.015	1.1E-05	0.015
Silver	0.0083	0.026	0.035	0.21	0.21	3.4E-04	3.2E-04	6.6E-04	0.0025	0.0028	0.034	0.0011	0.035	0.0016	0.036
Thallium[ac]	0.0073	0.031	0.038	0.24	0.25	-	-	-	-	-	0.029	0.0013	0.031	0.0018	0.031
Tin	3.7E-04	6.9E-04	0.0011	0.0054	0.0058	3.0E-04	1.7E-04	4.7E-04	0.0013	0.0016	0.0015	2.8E-05	0.0015	4.1E-05	0.0015

COPC	Concentration Ratio (CR) Values – 400,000 tpy														
	1-hour					24-hour					Annual				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Vanadium	0.0075	0.0018	0.0094	0.014	0.022	0.0015	1.1E-04	0.0017	8.6E-04	0.0024	7.7E-04	3.8E-06	7.7E-04	5.4E-06	7.8E-04
Zinc[c]	0.0021	0.0031	0.0052	0.025	0.027	-	-	-	-	-	0.0051	1.3E-04	0.0052	1.9E-04	0.0053
Chlorinated Polycyclic Aromatics															
Dioxins and Furans (as TEQ Toxic Equivalents)[be]	-	-	-	-	-	0.0047	0.0011	0.0059	0.0089	0.014	0.0016	1.9E-05	0.0016	5.3E-05	0.0017
Polychlorinated Biphenyls (PCBs)	0.0010	5.7E-04	0.0016	0.0044	0.0055	2.8E-04	4.6E-05	3.3E-04	3.6E-04	6.4E-04	-	-	-	-	-
Chlorinated Monocyclic Aromatics															
Dichlorobenzene, 1,2-[c]	8.6E-07	5.3E-08	9.1E-07	4.1E-07	1.3E-06	-	-	-	-	-	7.8E-06	1.1E-08	7.8E-06	3.1E-08	7.8E-06
Dichlorophenol, 2,4-[ac]	-	1.5E-07	1.5E-07	1.2E-06	1.2E-06	-	-	-	-	-	-	6.3E-09	6.3E-09	1.8E-08	1.8E-08
Hexachlorobenzene[cd]	6.1E-04	1.6E-04	7.7E-04	0.0013	0.0019	-	-	-	-	-	-	-	-	-	-
Pentachlorobenzene[ac]	-	1.1E-07	1.1E-07	8.3E-07	8.3E-07	-	-	-	-	-	-	4.4E-09	4.4E-09	1.2E-08	1.2E-08
Pentachlorophenol	4.3E-04	3.2E-05	4.6E-04	2.5E-04	6.8E-04	4.4E-05	9.8E-07	4.5E-05	7.7E-06	5.1E-05	8.2E-04	1.3E-06	8.2E-04	3.7E-06	8.2E-04
Tetrachlorobenzene, 1,2,4,5-[abc]	-	-	-	-	-	-	-	-	-	-	-	1.8E-07	1.8E-07	5.0E-07	5.0E-07
Tetrachlorophenol, 2,3,4,6-[abc]	-	-	-	-	-	-	-	-	-	-	-	1.3E-08	1.3E-08	3.5E-08	3.5E-08
Trichlorobenzene, 1,2,4-	2.8E-04	1.0E-07	2.8E-04	7.9E-07	2.8E-04	1.1E-04	1.2E-08	1.1E-04	9.6E-08	1.1E-04	0.0024	2.4E-08	0.0024	6.6E-08	0.0024
Trichlorophenol, 2,4,6-[abcd]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAHs															
Acenaphthene[cd]	0.0030	1.5E-05	0.0031	1.1E-04	0.0032	-	-	-	-	-	-	-	-	-	-
Acenaphthylene[cd]	7.5E-04	1.1E-05	7.6E-04	8.9E-05	8.4E-04	-	-	-	-	-	-	-	-	-	-

COPC	Concentration Ratio (CR) Values – 400,000 tpy														
	1-hour					24-hour					Annual				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Anthracene[c]	7.9E-04	6.4E-06	8.0E-04	5.0E-05	8.4E-04	-	-	-	-	-	0.0016	2.6E-07	0.0016	7.4E-07	0.0016
Benzo(a)anthracene[cd]	3.3E-04	2.4E-06	3.3E-04	1.8E-05	3.5E-04	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene[cd]	6.9E-04	6.0E-06	7.0E-04	4.7E-05	7.4E-04	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene[cd]	3.3E-04	1.6E-06	3.3E-04	1.2E-05	3.4E-04	-	-	-	-	-	-	-	-	-	-
Benzo(a)fluorene[c]	6.6E-04	4.3E-05	7.0E-04	3.4E-04	1.0E-03	-	-	-	-	-	0.0023	1.8E-06	0.0023	5.0E-06	0.0023
Benzo(b)fluorene[c]	6.6E-04	3.0E-05	6.9E-04	2.3E-04	8.9E-04	-	-	-	-	-	0.0023	1.2E-06	0.0023	3.4E-06	0.0023
Benzo(ghi)perylene[cd]	3.4E-04	6.5E-05	4.1E-04	5.1E-04	8.5E-04	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene[bd]	-	-	-	-	-	0.068	3.3E-04	0.068	0.0026	0.070	-	-	-	-	-
Benzo(e)pyrene[cd]	6.6E-04	1.4E-05	6.7E-04	1.1E-04	7.7E-04	-	-	-	-	-	-	-	-	-	-
Chrysene[cd]	4.7E-04	5.9E-06	4.8E-04	4.6E-05	5.2E-04	-	-	-	-	-	-	-	-	-	-
Dibenzo(a,c)anthracene[abcd]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzo(a,h)anthracene[cd]	3.3E-04	1.9E-06	3.3E-04	1.5E-05	3.4E-04	-	-	-	-	-	-	-	-	-	-
Fluoranthene[cd]	0.0029	6.5E-05	0.0030	5.1E-04	0.0034	-	-	-	-	-	-	-	-	-	-
Fluorene[ac]	-	2.5E-06	2.5E-06	1.9E-05	1.9E-05	-	-	-	-	-	-	1.0E-07	1.0E-07	2.8E-07	2.8E-07
Indeno(1,2,3 – cd)pyrene[cd]	3.3E-04	1.2E-05	3.4E-04	9.3E-05	4.2E-04	-	-	-	-	-	-	-	-	-	-
1-Methylnaphthalene[bc]	-	-	-	-	-	-	-	-	-	-	1.5E-04	1.1E-07	1.5E-04	3.0E-07	1.5E-04
2-Methylnaphthalene[bc]	-	-	-	-	-	-	-	-	-	-	2.5E-04	5.9E-07	2.5E-04	1.6E-06	2.5E-04
Naphthalene[b]	-	-	-	-	-	1.1E-04	1.8E-06	1.1E-04	1.4E-05	1.2E-04	2.9E-04	4.6E-07	2.9E-04	1.3E-06	2.9E-04
Perylene[cd]	6.6E-04	2.4E-06	6.6E-04	1.9E-05	6.8E-04	-	-	-	-	-	-	-	-	-	-

COPC	Concentration Ratio (CR) Values – 400,000 tpy														
	1-hour					24-hour					Annual				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Phenanthrene[cd]	0.013	1.5E-04	0.013	0.0012	0.014	-	-	-	-	-	-	-	-	-	-
Pyrene[cd]	0.0014	7.9E-05	0.0015	6.2E-04	0.0020	-	-	-	-	-	-	-	-	-	-
VOCs															
Acetaldehyde[b]	-	-	-	-	-	0.0035	1.0E-10	0.0035	7.9E-10	0.0035	0.12	1.9E-10	0.12	5.3E-10	0.12
Benzene	0.17	1.4E-04	0.17	0.0011	0.17	0.41	1.0E-04	0.41	7.9E-04	0.41	0.13	3.3E-06	0.13	9.3E-06	0.13
Biphenyl[bc]	-	-	-	-	-	-	-	-	-	-	2.3E-06	4.3E-08	2.4E-06	1.2E-07	2.4E-06
Bromodichloromethane[c]	0.0021	0.0073	0.0094	0.057	0.059	-	-	-	-	-	0.0053	3.0E-04	0.0056	8.4E-04	0.0062
Bromoform	0.0014	8.0E-04	0.0022	0.0062	0.0077	5.4E-04	8.7E-05	6.2E-04	6.9E-04	0.0012	0.0046	3.3E-05	0.0046	9.2E-05	0.0047
Bromomethane	0.0018	2.4E-04	0.0020	0.0018	0.0036	-	-	-	-	-	0.020	2.3E-05	0.020	6.5E-05	0.020
Carbon tetrachloride	0.014	1.9E-06	0.014	1.5E-05	0.014	0.31	1.2E-05	0.31	9.8E-05	0.31	0.0032	5.4E-09	0.0032	1.5E-08	0.0032
Chloroform	0.0055	4.0E-06	0.0055	3.1E-05	0.0055	0.23	4.8E-05	0.23	3.8E-04	0.23	0.0016	1.6E-08	0.0016	4.6E-08	0.0016
Dichlorodifluoromethane[c]	1.6E-04	1.4E-06	1.6E-04	1.1E-05	1.7E-04	-	-	-	-	-	5.6E-04	5.6E-08	5.6E-04	1.6E-07	5.6E-04
Dichloroethene, 1,1- [c]	2.9E-05	2.1E-06	3.1E-05	1.7E-05	4.6E-05	-	-	-	-	-	2.9E-06	9.1E-09	2.9E-06	2.6E-08	2.9E-06
Dichloromethane	2.2E-04	9.9E-06	2.3E-04	7.7E-05	3.0E-04	0.0058	7.6E-05	0.0058	5.9E-04	0.0063	0.0019	1.4E-06	0.0019	4.0E-06	0.0019
Ethylbenzene	-	-	-	-	-	0.0012	9.8E-08	0.0012	7.7E-07	0.0012	6.9E-04	3.3E-09	6.9E-04	9.4E-09	6.9E-04
Ethylene Dibromide	0.0032	5.9E-05	0.0032	4.6E-04	0.0036	0.0017	9.4E-06	0.0017	7.4E-05	0.0018	2.0E-04	1.1E-07	2.0E-04	3.0E-07	2.1E-04
Formaldehyde	0.55	0.0025	0.55	0.019	0.57	0.052	6.9E-05	0.052	5.4E-04	0.053	0.18	1.7E-05	0.18	4.8E-05	0.18
O-terphenyl[c]	6.6E-06	1.3E-06	7.9E-06	1.0E-05	1.7E-05	-	-	-	-	-	2.3E-05	5.3E-08	2.3E-05	1.5E-07	2.3E-05
Tetrachloroethene	6.0E-05	2.2E-07	6.0E-05	1.7E-06	6.2E-05	0.0014	1.5E-06	0.0014	1.2E-05	0.0014	7.3E-04	5.1E-08	7.3E-04	1.4E-07	7.3E-04

COPC	Concentration Ratio (CR) Values – 400,000 tpy														
	1-hour					24-hour					Annual				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Tetralin[bcd]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene[c]	6.2E-04	1.1E-06	6.2E-04	8.4E-06	6.3E-04	-	-	-	-	-	8.8E-04	3.2E-08	8.8E-04	9.1E-08	8.8E-04
Trichloroethane, 1,1,1 -	3.1E-05	1.2E-07	3.1E-05	9.7E-07	3.2E-05	1.9E-05	2.3E-08	1.9E-05	1.8E-07	1.9E-05	2.0E-05	9.2E-10	2.0E-05	2.6E-09	2.0E-05
Trichloroethylene, 1,1,2 -	0.0024	7.2E-07	0.0024	5.6E-06	0.0024	0.045	3.9E-06	0.045	3.0E-05	0.045	0.0050	2.9E-08	0.0050	8.2E-08	0.0050
Trichlorofluoromethane[bd]	-	-	-	-	-	3.6E-04	2.7E-06	3.6E-04	2.1E-05	3.8E-04	-	-	-	-	-
Vinyl chloride	7.2E-07	1.7E-06	2.4E-06	1.3E-05	1.4E-05	0.0059	0.0041	0.010	0.032	0.038	3.6E-05	1.4E-06	3.8E-05	3.9E-06	4.0E-05
Xylenes, m-, p- and o-	5.3E-04	2.2E-05	5.6E-04	1.7E-04	7.0E-04	0.0066	7.8E-05	0.0067	6.1E-04	0.0072	0.028	1.9E-05	0.028	5.5E-05	0.028

[a] Baseline Data Not Available

[b] 1-hr TRV Not Available

[c] 24-hr TRV Not Available

[d] Annual TRV Not Available

[e] Measured against a benchmark CR of 0.2

7.12.1.4 400,000 tpy Operational Cases – Inhalation Risk Assessment Chemical Mixtures

Predicted additive acute CR values for Baseline Case, Project Alone Case, Project Case, Process Upset Case, and Process Upset Project Case exposures to mixtures of COPC at 400,000 tpy are provided in Table 7-56.

Interpretation of chemical mixtures is difficult as regulators have not established standards or benchmarks for the assessment of mixtures. By adding chemical CR values together, it assumes that not only is the target organ the same, but that the exposure to these chemicals actually results in a toxicological mode of direction that is directly additive. To date there have been limited or no mixture additive toxicology studies to support using this approach in human health risk assessment. This is a considerable source of uncertainty in any risk assessment being conducted in Ontario.

In addition, the maximum CR values presented for mixtures may not represent an actual location in the LRASA, because risk estimates for each individual chemical often do not occur simultaneously at the same location.

Table 7-56 Concentration Ratio (CR) Values at 400,000 tpy for Chemical Mixtures at the Maximum Ground Level Concentration

COPC	Concentration Ratio (CR) Values – 400,000 tpy				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
1-Hour					
Eye Irritants	0.0048	0.0015	0.0064	0.012	0.017
Nasal Irritants	0.0079	0.0018	0.0097	0.014	0.022
Respiratory Irritants	0.33	0.51	0.84	2.6	3.0
Neurological Effects (Neurotoxicants)	0.026	4.5E-04	0.027	0.0035	0.030
24-Hour					
Eye Irritants	0.0083	8.3E-05	0.0083	6.6E-04	0.0089

COPC	Concentration Ratio (CR) Values – 400,000 tpy				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Nasal Irritants	0.0079	7.9E-05	0.0079	6.2E-04	0.0085
Respiratory Irritants	1.1	0.19	1.3	1.1	2.2
Neurological Effects (Neurotoxicants)	0.55	2.2E-04	0.55	0.0017	0.55
Annual					
Nasal Irritants	0.035	3.2E-05	0.035	7.8E-05	0.035
Respiratory Irritants	0.94	0.018	0.96	0.025	0.97
Neurological Effects (Neurotoxicants)	0.050	5.1E-04	0.050	7.7E-04	0.050
Reproductive/Developmental Effects	0.0073	3.2E-04	0.0076	4.7E-04	0.0077

7.12.1.5 400,000 tpy Operational Cases – Inhalation Risk Assessment Carcinogens

Predicted chronic ILCR values at 400,000 tpy for carcinogenic COPC from the Project Alone Case and Process Upset Case at the maximum ground level concentration are presented in Table 7-57. Baseline Case LCR results for each COPC are also provided for comparison. Discussion of these Baseline Case LCR results can be found in Section 0.

In general, ILCR values are interpreted as follows:

- An ILCR less than or equal to 1-in-1,000,000 (i.e. 1E-06) signifies that the incremental lifetime cancer risk associated with the Project is less than the regulatory benchmark (*i.e.,* the assumed safe level of exposure); therefore, no adverse risk is expected.
- An ILCR greater than 1-in-1,000,000 (i.e. 1E-06) signifies that the incremental lifetime cancer risk exceeds the regulatory benchmark. This suggests that the potential for an elevated level of risk may be present for the COPC in question; further investigation may be needed to confirm the identified risk.

With respect to the presented LCR values, there is no regulatory benchmark for comparison. LCR values represent an individual's lifetime cancer risks associated with all potential exposures to a given COPC, including all potential background sources.

None of the predicted annual average Project Alone Case or Process Upset Case minimum ground level concentrations of carcinogenic COPC at 400,000 tpy result in an ILCR exceeding the regulatory benchmark. Similarly, health risks were not predicted at any of the 15 individual receptor groupings which include schools, daycares, farms, current/future industrial/commercial areas, park/recreational areas, hospitals, retirement homes, and eight residential areas (**Appendix I**).

Further information on the receptor groupings can be found in Section 3.2.

Overall, it is not expected that concentrations of carcinogenic COPC from the Project at 400,000 tpy will pose any individual adverse carcinogenic risk to the health of human receptors.

Table 7-57 Chronic LCR and ILCR Values at 400,000 tpy for Carcinogens at the Maximum Ground Level Concentration

COPC	Lifetime Cancer Risk (LCR) Values	Incremental Lifetime Cancer Risk (ILCR) Values – 400,000 tpy	
	Baseline Case	Project Alone Case	Process Upset Case
Metals			
Arsenic	7.7E-06	5.8E-09	8.5E-09
Beryllium	7.1E-07	2.6E-09	3.7E-09
Cadmium	5.9E-06	2.2E-07	3.2E-07
Chromium (hexavalent)[a]	-	7.8E-08	1.1E-07
Total Chromium (and compounds)	1.9E-05	7.9E-08	1.1E-07
Chlorinated Monocyclic Aromatics			
Hexachlorobenzene	2.4E-08	7.6E-11	2.1E-10
Trichlorophenol, 2,4,6-[a]	-	5.2E-13	1.5E-12
Polycyclic Aromatic Hydrocarbons (PAH)			

COPC	Lifetime Cancer Risk (LCR) Values	:remental Lifetime Cancer Risk (ILCR) Values – 400,000 tpy	
	Baseline Case	Project Alone Case	Process Upset Case
Benzo(a)pyrene TEQ	1.4E-05	3.1E-09	8.6E-09
Volatile Organic Chemicals (VOC)			
Acetaldehyde	6.1E-07	9.9E-16	2.8E-15
Benzene	3.1E-05	7.8E-10	2.2E-09
Carbon tetrachloride	9.2E-06	1.5E-11	4.3E-11
Chloroform	3.7E-06	3.8E-11	1.1E-10
Dichloromethane	3.6E-07	2.7E-10	7.5E-10
Ethylene Dibromide	1.1E-06	5.8E-10	1.6E-09
Formaldehyde	8.8E-06	8.1E-10	2.3E-09
Tetrachloroethene	1.4E-06	9.5E-11	2.7E-10
Trichloroethylene, 1,1,2 -	1.7E-07	9.7E-13	2.7E-12
Vinyl chloride	3.2E-08	1.2E-09	3.5E-09
Chemical Mixtures			
Liver Carcinogens	5.5E-06	1.7E-09	4.8E-09
Lung Carcinogens	4.7E-05	3.9E-07	5.7E-07
Skin Carcinogens	2.1E-05	8.9E-09	1.7E-08

[a] Baseline Data Not Available

7.12.2.1 400,000 tpy Operational Cases – Multi-Pathway Risk Assessment Non-Carcinogens

Assuming a maximum design capacity of 400,000 tpy, a subset of 133 unique receptor locations in 14 receptor groupings within the LRASA were selected to undergo a multi-pathway exposure assessment to evaluate chronic exposure to COPC through exposure to different local environmental media including soil, air, local produce, agricultural products, wild game and fish. As discussed in Section 7.3.4, the Facility will not impact local drinking water; therefore, aside from recreational swimmers, the multi-pathway assessment has not evaluated exposures related to potable water consumption.

The following receptor types were evaluated as part of the multi-pathway exposure assessment:

- Local Residents (Infant, Toddler, Composite)
- Local Farmers (Infant, Toddler, Composite)
- Daycare (Toddler, Adult)
- Recreation User – Sport (Toddler, Composite)
- Recreation User – Camping (Toddler, Composite)

As well, the additional risk incurred by local resident receptors while performing specific activities such as swimming, hunting or angling was evaluated. Refer to Table 3-2 for a complete list of receptor groupings evaluated. The results of the evaluation of each assessment case (i.e., Baseline Case, Project Alone Case, Project Case, Process Upset Case and Process Upset Project Case) are presented in the following sections.

Chronic risk estimates (*via* multiple exposure pathways) were expressed as HQ values for all non-carcinogenic COPC. HQ values were calculated for the Baseline Case, Project Alone Case, Project Case, Process Upset Case and Process Upset Project Case. A toddler (7 months to 4 years) was considered to represent the most sensitive receptor age class. As a result, health risks associated with exposures to non-carcinogenic COPC are presented for the toddler. HQ values for each exposure pathway and each receptor are provided in **Appendix I**.

Additionally, HQ values were also derived for resident and farmer infants (0 to 6 months) in order to evaluate the potential additional health risks associated with exposure to these COPC *via* the consumption of breast milk**.** Similar to the chronic inhalation assessment, the Process Upset scenarios assessment assumes that the Facility operates under upset conditions during 5% of the year (for metals) and during 20% of the year (for all other COPC). Further discussion of the assumptions used to characterize the Process Upset scenario can found in the *Air Quality Assessment Technical Study Report* (Jacques Whitford, 2009e).

Local Residents

Chronic HQ values for local resident infant and toddler receptors are presented in Table 7-58 through Table 7-65. With the exception of PCBs in infant and toddler resident receptors, and arsenic and thallium in toddler receptors, all HQ values for the Baseline Case, Project Alone Case, Project Case, Process Upset Case or Process Upset Project Case at 400,000 tpy are below the regulatory benchmark; therefore it is not expected that the Project, at 400,000 tpy, will pose any additional undue risk to the health of local residents. HQ values for Project Case/Process Upset Project Case for Total PCBs in infant and toddler resident receptors were 10.8 and 0.49. HQ values for Project Case/Process Upset Project Case for arsenic and thallium in toddler resident receptors were 0.32 and 0.26 respectively. These values are entirely driven by the Baseline Case – the Project Alone Case/Process Upset Case never represents more than approximately 1.5% of the Project Case/Process Upset Project Case risk.

The overall multi-pathway HQ values for lead and dioxin/furans (2,3,7,8-TCDD TEQ), for both residential infants and toddlers, for all assessment scenarios at 400,000 tpy, are presented in Table 7-66. These COPC are treated separately as the exposure endpoint for these chemicals are consistent regardless of the exposure pathway; therefore, inhalation CR results were added to the predicted multi-pathway HQ values and compared to a benchmark of 0.2. The results indicate that all lead HQ values for the Baseline Case, Project Alone Case, Project Case Process Upset Case or Process Upset Project Case are below the regulatory benchmark. Therefore, it is not expected that the Project will pose any additional undue risk to the health of local residents due to exposure to lead.

With regards to dioxins/furans, HQ values for Project Case/Process Upset Project Case HQs in resident infant receptors were 3.83. This value is entirely driven by the Baseline Case – the Project Alone Case/Process Upset Case never represents more than approximately 0.6% of the Project Case/Process Upset Project Case risk; therefore it is not expected that the Project, at 400,000 tpy, will pose any additional undue risk to the health of local residents.

Table 7-58 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Bowmanville Subdivision Infant and Toddler Receptor Groupings at 400,000 tpy

COPC	Hazard Quotient – Bowmanville Subdivision – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.1E-06	1.9E-11	4.1E-06	5.2E-11	4.1E-06	1.3E-05	4.5E-10	1.3E-05	1.3E-09	1.3E-05
Anthracene	9.5E-07	4.1E-12	9.5E-07	1.2E-11	9.5E-07	2.7E-06	3.6E-11	2.7E-06	1.0E-10	2.7E-06
Fluorene	6.3E-06	2.7E-11	6.3E-06	7.6E-11	6.3E-06	2.0E-05	3.8E-10	2.0E-05	1.1E-09	2.0E-05
PCBs										
Aroclor 1254 (Total PCBs)	**10.8**	2.1E-04	**10.8**	6.0E-04	**10.8**	**0.49**	2.7E-05	**0.49**	7.7E-05	**0.49**
VOCs										
1,1,1-Trichloroethane	2.1E-08	3.1E-16	2.1E-08	8.8E-16	2.1E-08	4.7E-06	1.6E-13	4.7E-06	4.5E-13	4.7E-06
Bromoform	4.7E-06	7.1E-14	4.7E-06	2.0E-13	4.7E-06	0.0023	1.7E-11	0.0023	4.6E-11	0.0023
Carbon Tetrachloride	1.6E-04	3.8E-13	1.6E-04	1.1E-12	1.6E-04	0.033	9.0E-11	0.033	2.5E-10	0.033
Chloroform	4.5E-06	2.3E-14	4.5E-06	6.4E-14	4.5E-06	0.0026	1.9E-11	0.0026	5.2E-11	0.0026
Dichloromethane	1.7E-05	8.1E-13	1.7E-05	2.3E-12	1.7E-05	0.0047	2.2E-09	0.0047	6.1E-09	0.0047
Trichlorofluoromethane (FREON 11)	3.7E-07	4.3E-14	3.7E-07	1.2E-13	3.7E-07	1.5E-04	2.1E-11	1.5E-04	5.7E-11	1.5E-04
Chlorinated Monocyclic Aromatics										

COPC	Hazard Quotient – Bowmanville Subdivision – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
1,2,4,5-Tetrachlorobenzene	0.0020	2.8E-09	0.0020	7.7E-09	0.0020	0.045	2.8E-08	0.045	7.9E-08	0.045
1,2,4-Trichlorobenzene	6.3E-04	6.4E-12	6.3E-04	1.8E-11	6.3E-04	0.057	1.5E-10	0.057	4.2E-10	0.057
1,2-Dichlorobenzene	3.9E-07	3.7E-13	3.9E-07	1.0E-12	3.9E-07	1.1E-04	5.3E-11	1.1E-04	1.5E-10	1.1E-04
Hexachlorobenzene	0.0025	5.5E-10	0.0025	1.5E-09	0.0025	0.019	2.5E-09	0.019	7.0E-09	0.019
Pentachlorobenzene	9.3E-04	7.2E-09	9.3E-04	2.0E-08	9.3E-04	0.0094	4.0E-08	0.0094	1.1E-07	0.0094
Pentachlorophenol	8.9E-07	1.4E-08	9.1E-07	3.7E-08	9.3E-07	2.3E-06	1.4E-07	2.4E-06	3.8E-07	2.7E-06
Inorganics										
Antimony	0.011	5.3E-06	0.011	7.7E-06	0.011	0.052	4.3E-05	0.052	6.2E-05	0.052
Arsenic	0.10	6.2E-07	0.10	9.1E-07	0.10	**0.32**	4.4E-06	**0.32**	6.3E-06	**0.32**
Barium	0.0019	7.5E-09	0.0019	1.1E-08	0.0019	0.0079	6.1E-08	0.0079	8.9E-08	0.0079
Beryllium	0.0013	6.0E-07	0.0013	8.6E-07	0.0013	0.050	2.2E-06	0.050	3.1E-06	0.050
Boron	2.8E-04	4.1E-08	2.8E-04	6.0E-08	2.8E-04	0.022	1.2E-05	0.022	1.7E-05	0.022
Cadmium	0.0045	1.9E-05	0.0045	2.7E-05	0.0046	0.027	3.1E-04	0.027	4.4E-04	0.027
Chromium (Total)	5.7E-05	4.5E-10	5.7E-05	6.5E-10	5.7E-05	2.3E-04	3.8E-09	2.3E-04	5.4E-09	2.3E-04
Chromium VI	-	1.0E-07	1.0E-07	1.5E-07	1.5E-07	-	8.1E-07	8.1E-07	1.2E-06	1.2E-06
Cobalt	0.021	3.2E-06	0.021	4.7E-06	0.021	0.070	1.8E-05	0.070	2.6E-05	0.070

COPC	Hazard Quotient – Bowmanville Subdivision – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Mercury - Inorganic	9.1E-04	4.3E-05	9.6E-04	6.2E-05	9.7E-04	0.0061	2.2E-04	0.0063	3.1E-04	0.0064
Methylmercury	-	3.1E-06	3.1E-06	4.5E-06	4.5E-06	-	2.4E-05	2.4E-05	3.4E-05	3.4E-05
Nickel	0.0036	6.8E-06	0.0037	9.8E-06	0.0037	0.013	2.6E-05	0.013	3.7E-05	0.013
Phosphorus	2.2E-07	2.0E-13	2.2E-07	2.9E-13	2.2E-07	5.1E-05	8.4E-11	5.1E-05	1.2E-10	5.1E-05
Selenium	7.2E-04	7.2E-09	7.2E-04	1.0E-08	7.2E-04	0.011	1.8E-07	0.011	2.6E-07	0.011
Silver	2.1E-04	1.2E-07	2.1E-04	1.8E-07	2.1E-04	0.0024	2.7E-06	0.0024	4.0E-06	0.0024
Thallium	0.046	5.0E-04	0.046	7.3E-04	0.046	**0.25**	0.0023	**0.26**	0.0033	**0.26**
Tin	1.4E-04	1.7E-07	1.4E-04	2.5E-07	1.4E-04	9.2E-04	7.0E-07	9.2E-04	1.0E-06	9.2E-04
Vanadium	0.013	5.4E-07	0.013	7.8E-07	0.013	0.046	1.8E-06	0.046	2.6E-06	0.046
Zinc	9.8E-04	6.1E-07	9.8E-04	8.9E-07	9.8E-04	0.020	1.4E-05	0.020	2.0E-05	0.020

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-59 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Courtice Subdivision Infant and Toddler Receptor Groupings at 400,000 tpy

COPC	Hazard Quotient – Courtice Subdivision – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.1E-06	1.4E-11	4.1E-06	3.9E-11	4.1E-06	1.3E-05	3.4E-10	1.3E-05	9.4E-10	1.3E-05
Anthracene	9.5E-07	3.1E-12	9.5E-07	8.7E-12	9.5E-07	2.7E-06	2.7E-11	2.7E-06	7.6E-11	2.7E-06
Fluorene	6.3E-06	2.0E-11	6.3E-06	5.7E-11	6.3E-06	2.0E-05	2.8E-10	2.0E-05	7.9E-10	2.0E-05
PCBs										
Aroclor 1254 (Total PCBs)	**10.8**	1.6E-04	**10.8**	4.5E-04	**10.8**	**0.49**	2.1E-05	**0.49**	5.7E-05	**0.49**
VOCs										
1,1,1-Trichloroethane	2.1E-08	2.4E-16	2.1E-08	6.6E-16	2.1E-08	4.7E-06	1.2E-13	4.7E-06	3.3E-13	4.7E-06
Bromoform	4.7E-06	5.3E-14	4.7E-06	1.5E-13	4.7E-06	0.0023	1.2E-11	0.0023	3.5E-11	0.0023
Carbon Tetrachloride	1.6E-04	2.8E-13	1.6E-04	7.9E-13	1.6E-04	0.033	6.7E-11	0.033	1.9E-10	0.033
Chloroform	4.5E-06	1.7E-14	4.5E-06	4.8E-14	4.5E-06	0.0026	1.4E-11	0.0026	3.9E-11	0.0026
Dichloromethane	1.7E-05	6.0E-13	1.7E-05	1.7E-12	1.7E-05	0.0047	1.6E-09	0.0047	4.5E-09	0.0047
Trichlorofluoromethane (FREON 11)	3.7E-07	3.2E-14	3.7E-07	9.0E-14	3.7E-07	1.5E-04	1.5E-11	1.5E-04	4.3E-11	1.5E-04
Chlorinated Monocyclic Aromatics										

COPC	Hazard Quotient – Courtice Subdivision – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
1,2,4,5-Tetrachlorobenzene	0.0020	2.1E-09	0.0020	5.8E-09	0.0020	0.045	2.1E-08	0.045	5.9E-08	0.045
1,2,4-Trichlorobenzene	6.3E-04	4.8E-12	6.3E-04	1.3E-11	6.3E-04	0.057	1.1E-10	0.057	3.2E-10	0.057
1,2-Dichlorobenzene	3.9E-07	2.7E-13	3.9E-07	7.7E-13	3.9E-07	1.1E-04	4.0E-11	1.1E-04	1.1E-10	1.1E-04
Hexachlorobenzene	0.0025	4.1E-10	0.0025	1.2E-09	0.0025	0.019	1.9E-09	0.019	5.3E-09	0.019
Pentachlorobenzene	9.3E-04	5.4E-09	9.3E-04	1.5E-08	9.3E-04	0.0094	3.0E-08	0.0094	8.5E-08	0.0094
Pentachlorophenol	8.9E-07	9.6E-09	9.0E-07	2.6E-08	9.2E-07	2.3E-06	9.9E-08	2.4E-06	2.7E-07	2.5E-06
Inorganics										
Antimony	0.011	3.8E-06	0.011	5.5E-06	0.011	0.052	3.1E-05	0.052	4.4E-05	0.052
Arsenic	0.10	4.5E-07	0.10	6.5E-07	0.10	**0.32**	3.1E-06	**0.32**	4.5E-06	**0.32**
Barium	0.0019	5.4E-09	0.0019	7.8E-09	0.0019	0.0079	4.4E-08	0.0079	6.3E-08	0.0079
Beryllium	0.0013	4.3E-07	0.0013	6.2E-07	0.0013	0.050	1.5E-06	0.050	2.2E-06	0.050
Boron	2.8E-04	3.0E-08	2.8E-04	4.3E-08	2.8E-04	0.022	8.2E-06	0.022	1.2E-05	0.022
Cadmium	0.0045	1.4E-05	0.0045	2.0E-05	0.0045	0.027	2.2E-04	0.027	3.2E-04	0.027
Chromium (Total)	5.7E-05	3.2E-10	5.7E-05	4.7E-10	5.7E-05	2.3E-04	2.6E-09	2.3E-04	3.8E-09	2.3E-04
Chromium VI	-	7.5E-08	7.5E-08	1.1E-07	1.1E-07	-	5.7E-07	5.7E-07	8.2E-07	8.2E-07
Cobalt	0.021	2.3E-06	0.021	3.3E-06	0.021	0.070	1.3E-05	0.070	1.8E-05	0.070

COPC	Hazard Quotient – Courtice Subdivision – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Mercury - Inorganic	9.1E-04	2.9E-05	9.4E-04	4.1E-05	9.5E-04	0.0061	1.5E-04	0.0062	2.1E-04	0.0063
Methylmercury	-	2.2E-06	2.2E-06	3.2E-06	3.2E-06	-	1.7E-05	1.7E-05	2.4E-05	2.4E-05
Nickel	0.0036	4.8E-06	0.0037	7.0E-06	0.0037	0.013	1.8E-05	0.013	2.6E-05	0.013
Phosphorus	2.2E-07	1.5E-13	2.2E-07	2.1E-13	2.2E-07	5.1E-05	6.0E-11	5.1E-05	8.7E-11	5.1E-05
Selenium	7.2E-04	5.2E-09	7.2E-04	7.5E-09	7.2E-04	0.011	1.3E-07	0.011	1.8E-07	0.011
Silver	2.1E-04	8.7E-08	2.1E-04	1.3E-07	2.1E-04	0.0024	1.9E-06	0.0024	2.8E-06	0.0024
Thallium	0.046	3.6E-04	0.046	5.2E-04	0.046	**0.25**	0.0016	**0.25**	0.0023	**0.26**
Tin	1.4E-04	1.2E-07	1.4E-04	1.8E-07	1.4E-04	9.2E-04	5.0E-07	9.2E-04	7.3E-07	9.2E-04
Vanadium	0.013	3.9E-07	0.013	5.6E-07	0.013	0.046	1.3E-06	0.046	1.9E-06	0.046
Zinc	9.8E-04	4.4E-07	9.8E-04	6.4E-07	9.8E-04	0.020	9.7E-06	0.020	1.4E-05	0.020

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-60 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Courtice Road Infant and Toddler Receptor Groupings at 400,000 tpy

COPC	Hazard Quotient – Courtice Road – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.1E-06	5.9E-11	4.1E-06	1.6E-10	4.1E-06	1.3E-05	1.4E-09	1.3E-05	3.9E-09	1.3E-05
Anthracene	9.5E-07	1.3E-11	9.5E-07	3.6E-11	9.5E-07	2.7E-06	1.1E-10	2.7E-06	3.2E-10	2.7E-06
Fluorene	6.3E-06	8.5E-11	6.3E-06	2.4E-10	6.3E-06	2.0E-05	1.2E-09	2.0E-05	3.3E-09	2.0E-05
PCBs										
Aroclor 1254 (Total PCBs)	**10.8**	6.7E-04	**10.8**	0.0019	**10.8**	**0.49**	8.6E-05	**0.49**	2.4E-04	**0.50**
VOCs										
1,1,1-Trichloroethane	2.1E-08	9.8E-16	2.1E-08	2.8E-15	2.1E-08	4.7E-06	5.0E-13	4.7E-06	1.4E-12	4.7E-06
Bromoform	4.7E-06	2.2E-13	4.7E-06	6.2E-13	4.7E-06	0.0023	5.2E-11	0.0023	1.5E-10	0.0023
Carbon Tetrachloride	1.6E-04	1.2E-12	1.6E-04	3.3E-12	1.6E-04	0.033	2.8E-10	0.033	7.8E-10	0.033
Chloroform	4.5E-06	7.2E-14	4.5E-06	2.0E-13	4.5E-06	0.0026	5.8E-11	0.0026	1.6E-10	0.0026
Dichloromethane	1.7E-05	2.5E-12	1.7E-05	7.1E-12	1.7E-05	0.0047	6.8E-09	0.0047	1.9E-08	0.0047
Trichlorofluoromethane (FREON 11)	3.7E-07	1.3E-13	3.7E-07	3.8E-13	3.7E-07	1.5E-04	6.4E-11	1.5E-04	1.8E-10	1.5E-04
Chlorinated Monocyclic Aromatics										

COPC	Hazard Quotient – Courtice Road – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
1,2,4,5-Tetrachlorobenzene	0.0020	8.6E-09	0.0020	2.4E-08	0.0020	0.045	8.8E-08	0.045	2.5E-07	0.045
1,2,4-Trichlorobenzene	6.3E-04	2.0E-11	6.3E-04	5.6E-11	6.3E-04	0.057	4.7E-10	0.057	1.3E-09	0.057
1,2-Dichlorobenzene	3.9E-07	1.1E-12	3.9E-07	3.2E-12	3.9E-07	1.1E-04	1.7E-10	1.1E-04	4.6E-10	1.1E-04
Hexachlorobenzene	0.0025	1.7E-09	0.0025	4.8E-09	0.0025	0.019	7.8E-09	0.019	2.2E-08	0.019
Pentachlorobenzene	9.3E-04	2.3E-08	9.3E-04	6.3E-08	9.3E-04	0.0094	1.3E-07	0.0094	3.5E-07	0.0094
Pentachlorophenol	8.9E-07	2.9E-08	9.2E-07	7.9E-08	9.7E-07	2.3E-06	3.0E-07	2.6E-06	8.3E-07	3.1E-06
Inorganics										
Antimony	0.011	1.2E-05	0.011	1.7E-05	0.011	0.052	9.2E-05	0.052	1.3E-04	0.052
Arsenic	0.10	1.4E-06	0.10	2.0E-06	0.10	**0.32**	8.9E-06	**0.32**	1.3E-05	**0.32**
Barium	0.0019	1.7E-08	0.0019	2.4E-08	0.0019	0.0079	1.3E-07	0.0079	1.9E-07	0.0079
Beryllium	0.0013	1.3E-06	0.0013	1.9E-06	0.0013	0.050	4.7E-06	0.050	6.9E-06	0.050
Boron	2.8E-04	9.2E-08	2.8E-04	1.3E-07	2.8E-04	0.022	2.5E-05	0.022	3.7E-05	0.022
Cadmium	0.0045	4.2E-05	0.0046	6.1E-05	0.0046	0.027	6.8E-04	0.027	9.8E-04	0.028
Chromium (Total)	5.7E-05	1.0E-09	5.7E-05	1.4E-09	5.7E-05	2.3E-04	7.5E-09	2.3E-04	1.1E-08	2.3E-04
Chromium VI	-	2.3E-07	2.3E-07	3.4E-07	3.4E-07	-	1.6E-06	1.6E-06	2.3E-06	2.3E-06
Cobalt	0.021	7.2E-06	0.021	1.0E-05	0.021	0.070	3.7E-05	0.070	5.3E-05	0.070

COPC	Hazard Quotient – Courtice Road – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Mercury - Inorganic	9.1E-04	9.8E-05	0.0010	1.4E-04	0.0011	0.0061	4.9E-04	0.0065	7.1E-04	0.0068
Methylmercury	-	7.0E-06	7.0E-06	1.0E-05	1.0E-05	-	5.0E-05	5.0E-05	7.2E-05	7.2E-05
Nickel	0.0036	1.5E-05	0.0037	2.2E-05	0.0037	0.013	5.4E-05	0.013	7.9E-05	0.013
Phosphorus	2.2E-07	4.5E-13	2.2E-07	6.5E-13	2.2E-07	5.1E-05	1.8E-10	5.1E-05	2.7E-10	5.1E-05
Selenium	7.2E-04	1.6E-08	7.2E-04	2.3E-08	7.2E-04	0.011	3.4E-07	0.011	5.0E-07	0.011
Silver	2.1E-04	2.7E-07	2.1E-04	3.9E-07	2.1E-04	0.0024	5.7E-06	0.0024	8.2E-06	0.0024
Thallium	0.046	0.0011	0.047	0.0016	0.047	**0.25**	0.0048	**0.26**	0.0069	**0.26**
Tin	1.4E-04	3.8E-07	1.4E-04	5.5E-07	1.4E-04	9.2E-04	1.5E-06	9.2E-04	2.2E-06	9.2E-04
Vanadium	0.013	1.2E-06	0.013	1.7E-06	0.013	0.046	4.0E-06	0.046	5.8E-06	0.046
Zinc	9.8E-04	1.4E-06	9.8E-04	2.0E-06	9.8E-04	0.020	3.0E-05	0.020	4.3E-05	0.020

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-61 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Maple Grove Infant and Toddler Receptor Groupings – 400,000 tpy

COPC	Hazard Quotient – Maple Grove – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.1E-06	1.6E-11	4.1E-06	4.5E-11	4.1E-06	1.3E-05	3.9E-10	1.3E-05	1.1E-09	1.3E-05
Anthracene	9.5E-07	3.6E-12	9.5E-07	1.0E-11	9.5E-07	2.7E-06	3.1E-11	2.7E-06	8.8E-11	2.7E-06
Fluorene	6.3E-06	2.3E-11	6.3E-06	6.6E-11	6.3E-06	2.0E-05	3.3E-10	2.0E-05	9.1E-10	2.0E-05
PCBs										
Aroclor 1254 (Total PCBs)	**10.8**	1.9E-04	**10.8**	5.2E-04	**10.8**	**0.49**	2.4E-05	**0.49**	6.6E-05	**0.49**
VOCs										
1,1,1-Trichloroethane	2.1E-08	2.7E-16	2.1E-08	7.6E-16	2.1E-08	4.7E-06	1.4E-13	4.7E-06	3.8E-13	4.7E-06
Bromoform	4.7E-06	6.1E-14	4.7E-06	1.7E-13	4.7E-06	0.0023	1.4E-11	0.0023	4.0E-11	0.0023
Carbon Tetrachloride	1.6E-04	3.2E-13	1.6E-04	9.1E-13	1.6E-04	0.033	7.7E-11	0.033	2.2E-10	0.033
Chloroform	4.5E-06	2.0E-14	4.5E-06	5.5E-14	4.5E-06	0.0026	1.6E-11	0.0026	4.5E-11	0.0026
Dichloromethane	1.7E-05	7.0E-13	1.7E-05	1.9E-12	1.7E-05	0.0047	1.9E-09	0.0047	5.2E-09	0.0047
Trichlorofluoromethane (FREON 11)	3.7E-07	3.7E-14	3.7E-07	1.0E-13	3.7E-07	1.5E-04	1.8E-11	1.5E-04	5.0E-11	1.5E-04
Chlorinated Monocyclic Aromatics										

COPC	Hazard Quotient – Maple Grove – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
1,2,4,5-Tetrachlorobenzene	0.0020	2.4E-09	0.0020	6.7E-09	0.0020	0.045	2.4E-08	0.045	6.8E-08	0.045
1,2,4-Trichlorobenzene	6.3E-04	5.5E-12	6.3E-04	1.5E-11	6.3E-04	0.057	1.3E-10	0.057	3.6E-10	0.057
1,2-Dichlorobenzene	3.9E-07	3.2E-13	3.9E-07	8.8E-13	3.9E-07	1.1E-04	4.6E-11	1.1E-04	1.3E-10	1.1E-04
Hexachlorobenzene	0.0025	4.8E-10	0.0025	1.3E-09	0.0025	0.019	2.2E-09	0.019	6.1E-09	0.019
Pentachlorobenzene	9.3E-04	6.2E-09	9.3E-04	1.7E-08	9.3E-04	0.0094	3.5E-08	0.0094	9.8E-08	0.0094
Pentachlorophenol	8.9E-07	1.2E-08	9.0E-07	3.2E-08	9.2E-07	2.3E-06	1.2E-07	2.4E-06	3.2E-07	2.6E-06
Inorganics										
Antimony	0.011	2.9E-06	0.011	4.2E-06	0.011	0.052	2.2E-05	0.052	3.2E-05	0.052
Arsenic	0.10	3.4E-07	0.10	4.9E-07	0.10	**0.32**	2.2E-06	**0.32**	3.1E-06	**0.32**
Barium	0.0019	4.0E-09	0.0019	5.9E-09	0.0019	0.0079	3.2E-08	0.0079	4.6E-08	0.0079
Beryllium	0.0013	3.2E-07	0.0013	4.7E-07	0.0013	0.050	1.1E-06	0.050	1.7E-06	0.050
Boron	2.8E-04	2.2E-08	2.8E-04	3.2E-08	2.8E-04	0.022	6.1E-06	0.022	8.8E-06	0.022
Cadmium	0.0045	1.0E-05	0.0045	1.5E-05	0.0045	0.027	1.6E-04	0.027	2.4E-04	0.027
Chromium (Total)	5.7E-05	2.4E-10	5.7E-05	3.5E-10	5.7E-05	2.3E-04	1.8E-09	2.3E-04	2.6E-09	2.3E-04
Chromium VI	-	5.6E-08	5.6E-08	8.1E-08	8.1E-08	-	3.9E-07	3.9E-07	5.7E-07	5.7E-07
Cobalt	0.021	1.7E-06	0.021	2.5E-06	0.021	0.070	9.0E-06	0.070	1.3E-05	0.070

COPC	Hazard Quotient – Maple Grove – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Mercury - Inorganic	9.1E-04	3.1E-05	9.4E-04	4.6E-05	9.6E-04	0.0061	1.6E-04	0.0062	2.3E-04	0.0063
Methylmercury	-	1.7E-06	1.7E-06	2.4E-06	2.4E-06	-	1.4E-05	1.4E-05	2.1E-05	2.1E-05
Nickel	0.0036	3.6E-06	0.0037	5.3E-06	0.0037	0.013	1.3E-05	0.013	1.9E-05	0.013
Phosphorus	2.2E-07	1.1E-13	2.2E-07	1.6E-13	2.2E-07	5.1E-05	4.5E-11	5.1E-05	6.5E-11	5.1E-05
Selenium	7.2E-04	3.9E-09	7.2E-04	5.6E-09	7.2E-04	0.011	8.5E-08	0.011	1.2E-07	0.011
Silver	2.1E-04	6.5E-08	2.1E-04	9.5E-08	2.1E-04	0.0024	1.4E-06	0.0024	2.0E-06	0.0024
Thallium	0.046	2.7E-04	0.046	3.9E-04	0.046	**0.25**	0.0012	**0.25**	0.0017	**0.25**
Tin	1.4E-04	9.1E-08	1.4E-04	1.3E-07	1.4E-04	9.2E-04	3.7E-07	9.2E-04	5.4E-07	9.2E-04
Vanadium	0.013	2.9E-07	0.013	4.2E-07	0.013	0.046	9.7E-07	0.046	1.4E-06	0.046
Zinc	9.8E-04	3.3E-07	9.8E-04	4.8E-07	9.8E-04	0.020	7.2E-06	0.020	1.0E-05	0.020

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-62 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Oshawa Subdivision Infant and Toddler Receptor Groupings at 400,000 tpy

COPC	Hazard Quotient – Oshawa Subdivision – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.1E-06	2.3E-11	4.1E-06	6.6E-11	4.1E-06	1.3E-05	5.6E-10	1.3E-05	1.6E-09	1.3E-05
Anthracene	9.5E-07	5.2E-12	9.5E-07	1.4E-11	9.5E-07	2.7E-06	4.6E-11	2.7E-06	1.3E-10	2.7E-06
Fluorene	6.3E-06	3.4E-11	6.3E-06	9.5E-11	6.3E-06	2.0E-05	4.7E-10	2.0E-05	1.3E-09	2.0E-05
PCBs										
Aroclor 1254 (Total PCBs)	**10.8**	2.7E-04	**10.8**	7.5E-04	**10.8**	**0.49**	3.4E-05	**0.49**	9.6E-05	**0.49**
VOCs										
1,1,1-Trichloroethane	2.1E-08	3.9E-16	2.1E-08	1.1E-15	2.1E-08	4.7E-06	2.0E-13	4.7E-06	5.6E-13	4.7E-06
Bromoform	4.7E-06	8.9E-14	4.7E-06	2.5E-13	4.7E-06	0.0023	2.1E-11	0.0023	5.8E-11	0.0023
Carbon Tetrachloride	1.6E-04	4.7E-13	1.6E-04	1.3E-12	1.6E-04	0.033	1.1E-10	0.033	3.1E-10	0.033
Chloroform	4.5E-06	2.9E-14	4.5E-06	8.0E-14	4.5E-06	0.0026	2.3E-11	0.0026	6.6E-11	0.0026
Dichloromethane	1.7E-05	1.0E-12	1.7E-05	2.8E-12	1.7E-05	0.0047	2.7E-09	0.0047	7.6E-09	0.0047
Trichlorofluoromethane (FREON 11)	3.7E-07	5.4E-14	3.7E-07	1.5E-13	3.7E-07	1.5E-04	2.6E-11	1.5E-04	7.2E-11	1.5E-04
Chlorinated Monocyclic Aromatics										

COPC	Hazard Quotient – Oshawa Subdivision – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
1,2,4,5-Tetrachlorobenzene	0.0020	3.4E-09	0.0020	9.7E-09	0.0020	0.045	3.5E-08	0.045	9.8E-08	0.045
1,2,4-Trichlorobenzene	6.3E-04	8.0E-12	6.3E-04	2.2E-11	6.3E-04	0.057	1.9E-10	0.057	5.3E-10	0.057
1,2-Dichlorobenzene	3.9E-07	4.6E-13	3.9E-07	1.3E-12	3.9E-07	1.1E-04	6.7E-11	1.1E-04	1.9E-10	1.1E-04
Hexachlorobenzene	0.0025	6.9E-10	0.0025	1.9E-09	0.0025	0.019	3.1E-09	0.019	8.8E-09	0.019
Pentachlorobenzene	9.3E-04	9.0E-09	9.3E-04	2.5E-08	9.3E-04	0.0094	5.1E-08	0.0094	1.4E-07	0.0094
Pentachlorophenol	8.9E-07	1.7E-08	9.1E-07	4.7E-08	9.4E-07	2.3E-06	1.8E-07	2.5E-06	4.8E-07	2.8E-06
Inorganics										
Antimony	0.011	5.1E-06	0.011	7.3E-06	0.011	0.052	4.0E-05	0.052	5.8E-05	0.052
Arsenic	0.10	5.9E-07	0.10	8.6E-07	0.10	**0.32**	4.0E-06	**0.32**	5.7E-06	**0.32**
Barium	0.0019	7.1E-09	0.0019	1.0E-08	0.0019	0.0079	5.7E-08	0.0079	8.2E-08	0.0079
Beryllium	0.0013	5.7E-07	0.0013	8.2E-07	0.0013	0.050	2.0E-06	0.050	2.9E-06	0.050
Boron	2.8E-04	3.9E-08	2.8E-04	5.7E-08	2.8E-04	0.022	1.1E-05	0.022	1.6E-05	0.022
Cadmium	0.0045	1.8E-05	0.0045	2.6E-05	0.0046	0.027	2.9E-04	0.027	4.2E-04	0.027
Chromium (Total)	5.7E-05	4.3E-10	5.7E-05	6.2E-10	5.7E-05	2.3E-04	3.3E-09	2.3E-04	4.9E-09	2.3E-04
Chromium VI	-	9.9E-08	9.9E-08	1.4E-07	1.4E-07	-	7.2E-07	7.2E-07	1.0E-06	1.0E-06
Cobalt	0.021	3.1E-06	0.021	4.4E-06	0.021	0.070	1.6E-05	0.070	2.3E-05	0.070

COPC	Hazard Quotient – Oshawa Subdivision – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Mercury - Inorganic	9.1E-04	4.7E-05	9.6E-04	6.8E-05	9.8E-04	0.0061	2.4E-04	0.0063	3.5E-04	0.0064
Methylmercury	-	3.0E-06	3.0E-06	4.3E-06	4.3E-06	-	2.4E-05	2.4E-05	3.5E-05	3.5E-05
Nickel	0.0036	6.4E-06	0.0037	9.3E-06	0.0037	0.013	2.4E-05	0.013	3.4E-05	0.013
Phosphorus	2.2E-07	1.9E-13	2.2E-07	2.8E-13	2.2E-07	5.1E-05	7.9E-11	5.1E-05	1.1E-10	5.1E-05
Selenium	7.2E-04	6.8E-09	7.2E-04	9.9E-09	7.2E-04	0.011	1.6E-07	0.011	2.3E-07	0.011
Silver	2.1E-04	1.2E-07	2.1E-04	1.7E-07	2.1E-04	0.0024	2.5E-06	0.0024	3.6E-06	0.0024
Thallium	0.046	4.8E-04	0.046	6.9E-04	0.046	**0.25**	0.0021	**0.25**	0.0030	**0.26**
Tin	1.4E-04	1.6E-07	1.4E-04	2.3E-07	1.4E-04	9.2E-04	6.6E-07	9.2E-04	9.6E-07	9.2E-04
Vanadium	0.013	5.1E-07	0.013	7.4E-07	0.013	0.046	1.7E-06	0.046	2.5E-06	0.046
Zinc	9.8E-04	5.8E-07	9.8E-04	8.5E-07	9.8E-04	0.020	1.3E-05	0.020	1.9E-05	0.020

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-63 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Port Darlington Infant and Toddler Receptor Groupings at 400,000 tpy

COPC	Hazard Quotient – Port Darlington – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.1E-06	1.1E-11	4.1E-06	3.0E-11	4.1E-06	1.3E-05	2.5E-10	1.3E-05	7.1E-10	1.3E-05
Anthracene	9.5E-07	2.3E-12	9.5E-07	6.5E-12	9.5E-07	2.7E-06	2.1E-11	2.7E-06	5.8E-11	2.7E-06
Fluorene	6.3E-06	1.5E-11	6.3E-06	4.3E-11	6.3E-06	2.0E-05	2.1E-10	2.0E-05	6.0E-10	2.0E-05
PCBs										
Aroclor 1254 (Total PCBs)	**10.8**	1.2E-04	**10.8**	3.4E-04	**10.8**	**0.49**	1.6E-05	**0.49**	4.4E-05	**0.49**
VOCs										
1,1,1-Trichloroethane	2.1E-08	1.8E-16	2.1E-08	5.0E-16	2.1E-08	4.7E-06	9.0E-14	4.7E-06	2.5E-13	4.7E-06
Bromoform	4.7E-06	4.0E-14	4.7E-06	1.1E-13	4.7E-06	0.0023	9.4E-12	0.0023	2.6E-11	0.0023
Carbon Tetrachloride	1.6E-04	2.1E-13	1.6E-04	6.0E-13	1.6E-04	0.033	5.1E-11	0.033	1.4E-10	0.033
Chloroform	4.5E-06	1.3E-14	4.5E-06	3.6E-14	4.5E-06	0.0026	1.1E-11	0.0026	3.0E-11	0.0026
Dichloromethane	1.7E-05	4.6E-13	1.7E-05	1.3E-12	1.7E-05	0.0047	1.2E-09	0.0047	3.4E-09	0.0047
Trichlorofluoromethane (FREON 11)	3.7E-07	2.4E-14	3.7E-07	6.8E-14	3.7E-07	1.5E-04	1.2E-11	1.5E-04	3.3E-11	1.5E-04
Chlorinated Monocyclic Aromatics										

COPC	Hazard Quotient – Port Darlington – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
1,2,4,5-Tetrachlorobenzene	0.0020	1.6E-09	0.0020	4.4E-09	0.0020	0.045	1.6E-08	0.045	4.4E-08	0.045
1,2,4-Trichlorobenzene	6.3E-04	3.6E-12	6.3E-04	1.0E-11	6.3E-04	0.057	8.5E-11	0.057	2.4E-10	0.057
1,2-Dichlorobenzene	3.9E-07	2.1E-13	3.9E-07	5.8E-13	3.9E-07	1.1E-04	3.0E-11	1.1E-04	8.4E-11	1.1E-04
Hexachlorobenzene	0.0025	3.1E-10	0.0025	8.8E-10	0.0025	0.019	1.4E-09	0.019	4.0E-09	0.019
Pentachlorobenzene	9.3E-04	4.1E-09	9.3E-04	1.1E-08	9.3E-04	0.0094	2.3E-08	0.0094	6.4E-08	0.0094
Pentachlorophenol	8.9E-07	1.1E-08	9.0E-07	3.0E-08	9.2E-07	2.3E-06	1.1E-07	2.4E-06	3.0E-07	2.6E-06
Inorganics										
Antimony	0.011	1.8E-06	0.011	2.6E-06	0.011	0.052	1.4E-05	0.052	2.1E-05	0.052
Arsenic	0.10	2.1E-07	0.10	3.1E-07	0.10	**0.32**	1.5E-06	**0.32**	2.1E-06	**0.32**
Barium	0.0019	2.5E-09	0.0019	3.7E-09	0.0019	0.0079	2.1E-08	0.0079	3.0E-08	0.0079
Beryllium	0.0013	2.0E-07	0.0013	2.9E-07	0.0013	0.050	7.3E-07	0.050	1.1E-06	0.050
Boron	2.8E-04	1.4E-08	2.8E-04	2.0E-08	2.8E-04	0.022	3.9E-06	0.022	5.7E-06	0.022
Cadmium	0.0045	6.4E-06	0.0045	9.3E-06	0.0045	0.027	1.0E-04	0.027	1.5E-04	0.027
Chromium (Total)	5.7E-05	1.5E-10	5.7E-05	2.2E-10	5.7E-05	2.3E-04	1.3E-09	2.3E-04	1.8E-09	2.3E-04
Chromium VI	-	3.5E-08	3.5E-08	5.1E-08	5.1E-08	-	2.7E-07	2.7E-07	3.9E-07	3.9E-07
Cobalt	0.021	1.1E-06	0.021	1.6E-06	0.021	0.070	5.9E-06	0.070	8.6E-06	0.070

COPC	Hazard Quotient – Port Darlington – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Mercury - Inorganic	9.1E-04	2.8E-05	9.4E-04	4.1E-05	9.5E-04	0.0061	1.5E-04	0.0062	2.1E-04	0.0063
Methylmercury	-	1.1E-06	1.1E-06	1.5E-06	1.5E-06	-	1.1E-05	1.1E-05	1.6E-05	1.6E-05
Nickel	0.0036	2.3E-06	0.0037	3.3E-06	0.0037	0.013	8.6E-06	0.013	1.2E-05	0.013
Phosphorus	2.2E-07	6.9E-14	2.2E-07	1.0E-13	2.2E-07	5.1E-05	2.8E-11	5.1E-05	4.1E-11	5.1E-05
Selenium	7.2E-04	2.4E-09	7.2E-04	3.5E-09	7.2E-04	0.011	6.0E-08	0.011	8.7E-08	0.011
Silver	2.1E-04	4.1E-08	2.1E-04	6.0E-08	2.1E-04	0.0024	9.2E-07	0.0024	1.3E-06	0.0024
Thallium	0.046	1.7E-04	0.046	2.5E-04	0.046	**0.25**	7.6E-04	**0.25**	0.0011	**0.25**
Tin	1.4E-04	5.8E-08	1.4E-04	8.3E-08	1.4E-04	9.2E-04	2.4E-07	9.2E-04	3.5E-07	9.2E-04
Vanadium	0.013	1.8E-07	0.013	2.7E-07	0.013	0.046	6.2E-07	0.046	9.0E-07	0.046
Zinc	9.8E-04	2.1E-07	9.8E-04	3.0E-07	9.8E-04	0.020	4.6E-06	0.020	6.7E-06	0.020

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-64 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Solina Road Infant and Toddler Receptor Groupings at 400,000 tpy

COPC	Hazard Quotient – Solina Road – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.1E-06	3.6E-11	4.1E-06	1.0E-10	4.1E-06	1.3E-05	8.7E-10	1.3E-05	2.4E-09	1.3E-05
Anthracene	9.5E-07	8.0E-12	9.5E-07	2.2E-11	9.5E-07	2.7E-06	7.0E-11	2.7E-06	2.0E-10	2.7E-06
Fluorene	6.3E-06	5.2E-11	6.3E-06	1.5E-10	6.3E-06	2.0E-05	7.3E-10	2.0E-05	2.0E-09	2.0E-05
PCBs										
Aroclor 1254 (Total PCBs)	**10.8**	4.1E-04	**10.8**	0.0012	**10.8**	**0.49**	5.3E-05	**0.49**	1.5E-04	**0.49**
VOCs										
1,1,1-Trichloroethane	2.1E-08	6.1E-16	2.1E-08	1.7E-15	2.1E-08	4.7E-06	3.1E-13	4.7E-06	8.6E-13	4.7E-06
Bromoform	4.7E-06	1.4E-13	4.7E-06	3.8E-13	4.7E-06	0.0023	3.2E-11	0.0023	9.0E-11	0.0023
Carbon Tetrachloride	1.6E-04	7.3E-13	1.6E-04	2.0E-12	1.6E-04	0.033	1.7E-10	0.033	4.8E-10	0.033
Chloroform	4.5E-06	4.4E-14	4.5E-06	1.2E-13	4.5E-06	0.0026	3.6E-11	0.0026	1.0E-10	0.0026
Dichloromethane	1.7E-05	1.6E-12	1.7E-05	4.4E-12	1.7E-05	0.0047	4.2E-09	0.0047	1.2E-08	0.0047
Trichlorofluoromethane (FREON 11)	3.7E-07	8.3E-14	3.7E-07	2.3E-13	3.7E-07	1.5E-04	4.0E-11	1.5E-04	1.1E-10	1.5E-04
Chlorinated Monocyclic Aromatics										

COPC	Hazard Quotient – Solina Road – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
1,2,4,5-Tetrachlorobenzene	0.0020	5.3E-09	0.0020	1.5E-08	0.0020	0.045	5.4E-08	0.045	1.5E-07	0.045
1,2,4-Trichlorobenzene	6.3E-04	1.2E-11	6.3E-04	3.5E-11	6.3E-04	0.057	2.9E-10	0.057	8.2E-10	0.057
1,2-Dichlorobenzene	3.9E-07	7.1E-13	3.9E-07	2.0E-12	3.9E-07	1.1E-04	1.0E-10	1.1E-04	2.9E-10	1.1E-04
Hexachlorobenzene	0.0025	1.1E-09	0.0025	3.0E-09	0.0025	0.019	4.9E-09	0.019	1.4E-08	0.019
Pentachlorobenzene	9.3E-04	1.4E-08	9.3E-04	3.9E-08	9.3E-04	0.0094	7.8E-08	0.0094	2.2E-07	0.0094
Pentachlorophenol	8.9E-07	2.0E-08	9.1E-07	5.6E-08	9.5E-07	2.3E-06	2.1E-07	2.5E-06	5.8E-07	2.9E-06
Inorganics										
Antimony	0.011	6.8E-06	0.011	9.8E-06	0.011	0.052	5.2E-05	0.052	7.5E-05	0.052
Arsenic	0.10	8.0E-07	0.10	1.2E-06	0.10	**0.32**	5.0E-06	**0.32**	7.3E-06	**0.32**
Barium	0.0019	9.5E-09	0.0019	1.4E-08	0.0019	0.0079	7.4E-08	0.0079	1.1E-07	0.0079
Beryllium	0.0013	7.6E-07	0.0013	1.1E-06	0.0013	0.050	2.7E-06	0.050	3.9E-06	0.050
Boron	2.8E-04	5.3E-08	2.8E-04	7.6E-08	2.8E-04	0.022	1.4E-05	0.022	2.1E-05	0.022
Cadmium	0.0045	2.4E-05	0.0045	3.5E-05	0.0046	0.027	3.9E-04	0.027	5.6E-04	0.027
Chromium (Total)	5.7E-05	5.7E-10	5.7E-05	8.3E-10	5.7E-05	2.3E-04	4.2E-09	2.3E-04	6.1E-09	2.3E-04
Chromium VI	-	1.3E-07	1.3E-07	1.9E-07	1.9E-07	-	9.0E-07	9.0E-07	1.3E-06	1.3E-06
Cobalt	0.021	4.1E-06	0.021	5.9E-06	0.021	0.070	2.1E-05	0.070	3.0E-05	0.070

COPC	Hazard Quotient – Solina Road – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Mercury - Inorganic	9.1E-04	6.3E-05	9.8E-04	9.1E-05	0.0010	0.0061	3.1E-04	0.0064	4.6E-04	0.0065
Methylmercury	-	4.0E-06	4.0E-06	5.8E-06	5.8E-06	-	3.0E-05	3.0E-05	4.3E-05	4.3E-05
Nickel	0.0036	8.6E-06	0.0037	1.2E-05	0.0037	0.013	3.1E-05	0.013	4.5E-05	0.013
Phosphorus	2.2E-07	2.6E-13	2.2E-07	3.7E-13	2.2E-07	5.1E-05	1.1E-10	5.1E-05	1.5E-10	5.1E-05
Selenium	7.2E-04	9.1E-09	7.2E-04	1.3E-08	7.2E-04	0.011	1.9E-07	0.011	2.8E-07	0.011
Silver	2.1E-04	1.5E-07	2.1E-04	2.2E-07	2.1E-04	0.0024	3.2E-06	0.0024	4.7E-06	0.0024
Thallium	0.046	6.4E-04	0.046	9.3E-04	0.046	**0.25**	0.0027	**0.26**	0.0039	**0.26**
Tin	1.4E-04	2.2E-07	1.4E-04	3.1E-07	1.4E-04	9.2E-04	8.7E-07	9.2E-04	1.3E-06	9.2E-04
Vanadium	0.013	6.9E-07	0.013	9.9E-07	0.013	0.046	2.3E-06	0.046	3.3E-06	0.046
Zinc	9.8E-04	7.8E-07	9.8E-04	1.1E-06	9.8E-04	0.020	1.7E-05	0.020	2.5E-05	0.020

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-65 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Tooley Infant and Toddler Receptor Groupings at 400,000 tpy

COPC	Hazard Quotient – Tooley – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.1E-06	6.5E-11	4.1E-06	1.8E-10	4.1E-06	1.3E-05	1.6E-09	1.3E-05	4.3E-09	1.3E-05
Anthracene	9.5E-07	1.4E-11	9.5E-07	4.0E-11	9.5E-07	2.7E-06	1.3E-10	2.7E-06	3.5E-10	2.7E-06
Fluorene	6.3E-06	9.4E-11	6.3E-06	2.6E-10	6.3E-06	2.0E-05	1.3E-09	2.0E-05	3.7E-09	2.0E-05
PCBs										
Aroclor 1254 (Total PCBs)	**10.8**	7.4E-04	**10.8**	0.0021	**10.8**	**0.49**	9.4E-05	**0.49**	2.6E-04	**0.50**
VOCs										
1,1,1-Trichloroethane	2.1E-08	1.1E-15	2.1E-08	3.0E-15	2.1E-08	4.7E-06	5.5E-13	4.7E-06	1.5E-12	4.7E-06
Bromoform	4.7E-06	2.4E-13	4.7E-06	6.8E-13	4.7E-06	0.0023	5.7E-11	0.0023	1.6E-10	0.0023
Carbon Tetrachloride	1.6E-04	1.3E-12	1.6E-04	3.6E-12	1.6E-04	0.033	3.1E-10	0.033	8.6E-10	0.033
Chloroform	4.5E-06	7.9E-14	4.5E-06	2.2E-13	4.5E-06	0.0026	6.5E-11	0.0026	1.8E-10	0.0026
Dichloromethane	1.7E-05	2.8E-12	1.7E-05	7.8E-12	1.7E-05	0.0047	7.5E-09	0.0047	2.1E-08	0.0047
Trichlorofluoromethane (FREON 11)	3.7E-07	1.5E-13	3.7E-07	4.2E-13	3.7E-07	1.5E-04	7.1E-11	1.5E-04	2.0E-10	1.5E-04
Chlorinated Monocyclic Aromatics										

COPC	Hazard Quotient – Tooley – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
1,2,4,5-Tetrachlorobenzene	0.0020	9.5E-09	0.0020	2.7E-08	0.0020	0.045	9.7E-08	0.045	2.7E-07	0.045
1,2,4-Trichlorobenzene	6.3E-04	2.2E-11	6.3E-04	6.2E-11	6.3E-04	0.057	5.2E-10	0.057	1.5E-09	0.057
1,2-Dichlorobenzene	3.9E-07	1.3E-12	3.9E-07	3.5E-12	3.9E-07	1.1E-04	1.8E-10	1.1E-04	5.1E-10	1.1E-04
Hexachlorobenzene	0.0025	1.9E-09	0.0025	5.3E-09	0.0025	0.019	8.7E-09	0.019	2.4E-08	0.019
Pentachlorobenzene	9.3E-04	2.5E-08	9.3E-04	7.0E-08	9.3E-04	0.0094	1.4E-07	0.0094	3.9E-07	0.0094
Pentachlorophenol	8.9E-07	2.7E-08	9.2E-07	7.5E-08	9.7E-07	2.3E-06	2.9E-07	2.6E-06	7.9E-07	3.1E-06
Inorganics										
Antimony	0.011	1.3E-05	0.011	1.8E-05	0.011	0.052	9.6E-05	0.052	1.4E-04	0.052
Arsenic	0.10	1.5E-06	0.10	2.1E-06	0.10	**0.32**	9.2E-06	**0.32**	1.3E-05	**0.32**
Barium	0.0019	1.8E-08	0.0019	2.6E-08	0.0019	0.0079	1.4E-07	0.0079	2.0E-07	0.0079
Beryllium	0.0013	1.4E-06	0.0013	2.0E-06	0.0013	0.050	5.0E-06	0.050	7.2E-06	0.050
Boron	2.8E-04	9.8E-08	2.8E-04	1.4E-07	2.8E-04	0.022	2.6E-05	0.022	3.8E-05	0.022
Cadmium	0.0045	4.4E-05	0.0046	6.4E-05	0.0046	0.027	7.1E-04	0.027	0.0010	0.028
Chromium (Total)	5.7E-05	1.1E-09	5.7E-05	1.5E-09	5.7E-05	2.3E-04	7.7E-09	2.3E-04	1.1E-08	2.3E-04
Chromium VI	-	2.4E-07	2.4E-07	3.6E-07	3.6E-07	-	1.6E-06	1.6E-06	2.4E-06	2.4E-06
Cobalt	0.021	7.6E-06	0.021	1.1E-05	0.021	0.070	3.8E-05	0.070	5.6E-05	0.070

COPC	Hazard Quotient – Tooley – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Mercury - Inorganic	9.1E-04	1.0E-04	0.0010	1.5E-04	0.0011	0.0061	4.9E-04	0.0066	7.2E-04	0.0068
Methylmercury	-	7.3E-06	7.3E-06	1.1E-05	1.1E-05	-	5.0E-05	5.0E-05	7.2E-05	7.2E-05
Nickel	0.0036	1.6E-05	0.0037	2.3E-05	0.0037	0.013	5.7E-05	0.013	8.2E-05	0.013
Phosphorus	2.2E-07	4.8E-13	2.2E-07	6.9E-13	2.2E-07	5.1E-05	1.9E-10	5.1E-05	2.8E-10	5.1E-05
Selenium	7.2E-04	1.7E-08	7.2E-04	2.5E-08	7.2E-04	0.011	3.5E-07	0.011	5.1E-07	0.011
Silver	2.1E-04	2.9E-07	2.1E-04	4.1E-07	2.1E-04	0.0024	5.9E-06	0.0024	8.6E-06	0.0024
Thallium	0.046	0.0012	0.047	0.0017	0.047	**0.25**	0.0050	**0.26**	0.0072	**0.26**
Tin	1.4E-04	4.0E-07	1.4E-04	5.8E-07	1.4E-04	9.2E-04	1.6E-06	9.2E-04	2.3E-06	9.2E-04
Vanadium	0.013	1.3E-06	0.013	1.8E-06	0.013	0.046	4.2E-06	0.046	6.1E-06	0.046
Zinc	9.8E-04	1.4E-06	9.8E-04	2.1E-06	9.8E-04	0.020	3.1E-05	0.020	4.6E-05	0.020

'-' - No baseline concentration was available for this COPC.

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Table 7-66 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for Dioxins and Lead for the Local Resident Infant and Toddler Receptor Groupings at 400,000 tpy

COPC	Hazard Quotient – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Bowmanville Subdivision										
2,3,7,8-TCDD Equivalent	**3.8**	0.0019	**3.8**	0.0030	**3.8**	0.17	2.6E-04	0.17	3.8E-04	0.17
Lead	0.040	1.5E-04	0.040	1.9E-04	0.040	0.12	5.4E-04	0.12	7.6E-04	0.12
Courtice Subdivision										
2,3,7,8-TCDD Equivalent	**3.8**	0.0014	**3.8**	0.0021	**3.8**	0.17	1.9E-04	0.17	2.7E-04	0.17
Lead	0.040	1.0E-04	0.040	1.3E-04	0.040	0.12	3.8E-04	0.12	5.4E-04	0.12
Courtice Road										
2,3,7,8-TCDD Equivalent	**3.8**	0.0041	**3.8**	0.0063	**3.8**	0.17	5.7E-04	0.17	8.3E-04	0.17
Lead	0.040	3.1E-04	0.040	4.1E-04	0.040	0.12	0.0012	0.12	0.0017	0.12
Maple Grove										
2,3,7,8-TCDD Equivalent	**3.8**	0.0011	**3.8**	0.0017	**3.8**	0.17	1.4E-04	0.17	2.1E-04	0.17
Lead	0.040	9.7E-05	0.040	1.2E-04	0.040	0.12	3.1E-04	0.12	4.2E-04	0.12
Oshawa Subdivision										
2,3,7,8-TCDD Equivalent	**3.83**	0.0019	**3.83**	0.0029	**3.83**	0.17	2.5E-04	0.17	3.6E-04	0.17
Lead	0.040	1.6E-04	0.040	2.0E-04	0.040	0.12	5.3E-04	0.12	7.4E-04	0.12

COPC	Hazard Quotient – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Port Darlington										
2,3,7,8-TCDD Equivalent	**3.83**	7.4E-04	**3.83**	0.0013	**3.83**	0.17	9.3E-05	0.17	1.4E-04	0.17
Lead	0.040	8.2E-05	0.040	9.6E-05	0.040	0.12	2.2E-04	0.12	2.9E-04	0.12
Solina Road										
2,3,7,8-TCDD Equivalent	**3.83**	0.0024	**3.83**	0.0037	**3.83**	0.17	3.3E-04	0.17	4.8E-04	0.17
Lead	0.040	2.1E-04	0.040	2.6E-04	0.040	0.12	7.0E-04	0.12	9.7E-04	0.12
Tooley										
2,3,7,8-TCDD Equivalent	**3.83**	0.0042	**3.83**	0.0064	**3.83**	0.17	5.9E-04	0.17	8.7E-04	0.17
Lead	0.040	3.2E-04	0.040	4.2E-04	0.040	0.12	0.0012	0.12	0.0017	0.12

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Local Farmers

Chronic HQ values at 400,000 tpy, predicted for local farmer receptor locations, are presented in Table 7-67 and Table 7-68. Results of the assessment indicate that none of the predicted Project Alone Case or Process Upset Case hazard quotients exceeds the regulatory benchmark at 400,000 tpy; however, for a number of COPC, for both the infant and toddler receptors, HQ values were above 0.2 for the Baseline Case, Project Case and Process Upset Project Case. Specifically, this includes Total PCBs (HQ = 117), 2,3,7,8-TCDD Equivalent (HQ = 12) and 1,2,4-trichlorobenzene (HQ=0.21) for the farmer infant receptor, as well as Total PCBs (HQ = 4.2), Bromoform (HQ = 0.32), Carbon Tetrachloride (HQ = 4.6), Chloroform (HQ = 0.32), Dichloromethane (HQ = 0.65), 1,2,4,5-Tetrachlorobenzene (HQ = 0.40), 1,2,4-Trichlorobenzene (HQ = 20.1), Antimony (HQ = 0.24), Arsenic (HQ = 0.57), Beryllium (HQ = 0.42), and Thallium (HQ = 1.2) for the toddler farmer receptor.

In these situations, risk from the Project Case/Process Upset Project Case is almost entirely driven by baseline concentrations. The Project Alone Case/Process Upset Case never represents more than approximately 5% of the Project Case/Process Upset Project Case risk for any of the abovementioned COPC. A more thorough discussion of this baseline farmer risk can be found in Section 7.9.2.1. Based on this contribution, it is not expected that the Project will pose any additional undue risk to the health of local farmers.

Additionally, an overall assessment was conducted for lead and dioxins/furans, accounting for both the multi-pathway HQ as well as the chronic inhalation CR. The results (Table 7-68) show that lead is not present at levels that are in exceedance of the benchmark HQ of 0.2; however, Baseline Case, Project Case, Process Upset Case (farmer infant only) and Process Upset Project Case HQ values for dioxins/furans for both the toddler and infant were above the benchmark HQ of 0.2. In the case of the farmer toddler receptor, the HQ values are driven by baseline conditions. The Project contribution to the observed risk is less than 2%. A more thorough discussion of this baseline risk can be found in Section 7.9.2.1.

The lone exception was an infant farmer modelled to be exposed to breast milk of a mother living in close proximity to the EFW facility under the Process Upset Case for dioxin and furan exposure. The farmer infant dioxin and furan HQ of 0.22 was slightly in excess of the government benchmark of 0.2. Again the Process Upset Case assumes that the Facility is operating at full capacity with two of the three exhaust streams being affected for 20% of the year. This is based on the conservative US EPA default scenario for process upsets when there is a lack of empirical data. In addition, the sole source of food for an infant is breast milk, thus an acceptable benchmark for comparison of potential risk could have been selected as 1.0.

Overall, the results of the human health risk assessment indicate that, with the exception of a potential Process Upset scenario farm infant to dioxin and furan in breast milk, it is not expected the Facility will lead to any adverse health risks to local residents, farmers or other receptors in

LRASA while operating at 400,000 tonnes/year. Regardless, in the event that a 400,000 tpy expansion of the facility is eventually contemplated, special consideration should be given at that time to ensure that Process Upset Conditions do not result in an undue risk to people living and working in the area surrounding the Facility.

Table 7-67 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Farmer Infant and Toddler Receptor Groupings at 400,000 tpy

COPC	Hazard Quotient – Farmer – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.3E-06	1.0E-10	4.3E-06	2.9E-10	4.3E-06	3.8E-05	4.4E-09	3.8E-05	1.2E-08	3.8E-05
Anthracene	1.1E-06	2.2E-11	1.1E-06	6.1E-11	1.1E-06	7.6E-06	3.1E-10	7.6E-06	8.7E-10	7.6E-06
Fluorene	6.8E-06	1.4E-10	6.8E-06	3.9E-10	6.8E-06	5.8E-05	3.4E-09	5.8E-05	9.4E-09	5.8E-05
PCBs										
Aroclor 1254 (Total PCBs)	**117.5**	0.011	**117.5**	0.029	**117.5**	**4.2**	4.0E-04	**4.2**	0.0011	**4.2**
VOCs										
1,1,1-Trichloroethane	1.8E-07	4.6E-14	1.8E-07	1.3E-13	1.8E-07	6.4E-04	1.4E-10	6.4E-04	4.0E-10	6.4E-04
Bromoform	6.6E-05	9.1E-11	6.6E-05	2.5E-10	6.6E-05	**0.32**	3.9E-07	**0.32**	1.1E-06	**0.32**
Carbon Tetrachloride	0.0025	8.2E-11	0.0025	2.3E-10	0.0025	**4.6**	1.3E-07	**4.6**	3.6E-07	**4.6**
Chloroform	3.1E-05	6.5E-13	3.1E-05	1.8E-12	3.1E-05	**0.32**	5.6E-09	**0.32**	1.6E-08	**0.32**
Dichloromethane	2.8E-05	6.2E-12	2.8E-05	1.7E-11	2.8E-05	**0.65**	1.4E-07	**0.65**	3.9E-07	**0.65**
Trichlorofluoromethane (FREON 11)	5.9E-06	3.4E-11	5.9E-06	9.5E-11	5.9E-06	0.022	1.1E-07	0.022	3.0E-07	0.022
Chlorinated Monocyclic Aromatics										

COPC	Hazard Quotient – Farmer – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
1,2,4,5-Tetrachlorobenzene	0.020	4.5E-08	0.020	1.3E-07	0.020	**0.40**	6.9E-07	**0.40**	1.9E-06	**0.40**
1,2,4-Trichlorobenzene	**0.21**	4.8E-10	**0.21**	1.3E-09	**0.21**	**20.1**	3.7E-08	**20.1**	1.0E-07	**20.1**
1,2-Dichlorobenzene	3.0E-05	9.4E-12	3.0E-05	2.6E-11	3.0E-05	0.015	3.6E-09	0.015	1.0E-08	0.015
Hexachlorobenzene	0.026	4.0E-08	0.026	1.1E-07	0.026	0.17	2.1E-07	0.17	5.8E-07	0.17
Pentachlorobenzene	0.0098	1.2E-07	0.0098	3.2E-07	0.0098	0.083	8.2E-07	0.083	2.3E-06	0.083
Pentachlorophenol	8.9E-07	7.6E-08	9.7E-07	2.1E-07	1.1E-06	2.3E-06	7.6E-07	3.0E-06	2.1E-06	4.4E-06
Inorganics										
Antimony	0.011	1.8E-05	0.011	2.7E-05	0.011	**0.24**	2.6E-04	**0.24**	3.7E-04	**0.24**
Arsenic	0.10	2.2E-06	0.10	3.1E-06	0.10	**0.57**	2.3E-05	**0.57**	3.4E-05	**0.57**
Barium	0.0019	2.6E-08	0.0019	3.8E-08	0.0019	0.013	4.2E-07	0.013	6.1E-07	0.013
Beryllium	0.0013	2.1E-06	0.0013	3.0E-06	0.0013	**0.42**	8.7E-06	**0.42**	1.3E-05	**0.42**
Boron	2.8E-04	1.4E-07	2.8E-04	2.1E-07	2.8E-04	0.12	8.3E-05	0.12	1.2E-04	0.12
Cadmium	0.0045	6.5E-05	0.0046	9.4E-05	0.0046	0.10	0.0020	0.11	0.0028	0.11
Chromium (Total)	5.7E-05	1.6E-09	5.7E-05	2.2E-09	5.7E-05	8.3E-04	6.0E-08	8.3E-04	8.7E-08	8.3E-04
Chromium VI	-	3.6E-07	3.6E-07	5.2E-07	5.2E-07	-	1.3E-05	1.3E-05	1.8E-05	1.8E-05
Cobalt	0.021	1.1E-05	0.021	1.6E-05	0.021	0.18	4.7E-04	0.18	6.8E-04	0.18

COPC	Hazard Quotient – Farmer – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Mercury - Inorganic	9.1E-04	1.1E-04	0.0010	1.6E-04	0.0011	0.031	0.0011	0.032	0.0016	0.032
Methylmercury	-	1.1E-05	1.1E-05	1.6E-05	1.6E-05	-	1.3E-04	1.3E-04	1.8E-04	1.8E-04
Nickel	0.0036	2.3E-05	0.0037	3.4E-05	0.0037	0.051	2.3E-04	0.052	3.3E-04	0.052
Phosphorus	2.2E-07	7.0E-13	2.2E-07	1.0E-12	2.2E-07	5.0E-04	2.2E-09	5.0E-04	3.2E-09	5.0E-04
Selenium	7.2E-04	2.5E-08	7.2E-04	3.6E-08	7.2E-04	0.093	1.0E-05	0.093	1.5E-05	0.093
Silver	2.1E-04	4.2E-07	2.1E-04	6.1E-07	2.1E-04	0.017	3.0E-04	0.018	4.3E-04	0.018
Thallium	0.046	0.0017	0.047	0.0025	0.048	**1.2**	0.044	**1.2**	0.064	**1.2**
Tin	1.4E-04	5.9E-07	1.4E-04	8.5E-07	1.4E-04	0.0026	3.8E-05	0.0026	5.5E-05	0.0026
Vanadium	0.013	1.9E-06	0.013	2.7E-06	0.013	0.13	9.4E-06	0.13	1.4E-05	0.13
Zinc	9.8E-04	2.1E-06	9.8E-04	3.1E-06	9.8E-04	0.14	8.3E-05	0.14	1.2E-04	0.14

Notes:

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

'-' - No baseline concentration was available for this COPC.

Table 7-68 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for Dioxins and Lead for the Farmer Infant and Toddler Receptor Groupings at 400,000 tpy

COPC	Hazard Quotient – Farmer – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
2,3,7,8-TCDD Equivalent	**20.3**	0.11	**20.4**	**0.22**	**20.5**	**0.72**	0.0039	**0.72**	0.0076	**0.73**
Lead	0.040	4.3E-04	0.040	5.8E-04	0.040	0.20	0.0027	0.20	0.0039	0.20

Notes:

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

Daycare, Recreation User – Sport, Recreation User - Camping

Table 7-69 through Table 7-71 shows calculated chronic HQ values at 400,000 tpy for the daycare, recreation user – sport and recreation user – camping receptors in the LRASA. Results of the assessment indicate that none of the predicted hazard quotients exceed the regulatory benchmark for the Baseline Case, Project Alone Case, Project Case, Process Upset Case, or Process Upset Project Case; therefore, it is not expected that, at 400,000 tpy, the Project will pose any additional undue risk to the health of local daycare, recreation user – sport or recreation user - camping receptors.

Table 7-69 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Daycare Toddler Receptor Grouping at 400,000 tpy

COPC	Hazard Quotient – Daycare – 400,000 tpy				
	Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs					
Acenaphthene	3.7E-06	1.2E-11	3.7E-06	3.3E-11	3.7E-06
Anthracene	7.6E-07	2.4E-12	7.6E-07	6.7E-12	7.6E-07
Fluorene	5.5E-06	1.7E-11	5.5E-06	4.9E-11	5.5E-06
PCBs					
Aroclor 1254 (Total PCBs)	0.011	6.4E-06	0.011	1.8E-05	0.011
VOCs					
1,1,1-Trichloroethane	1.8E-08	2.0E-16	1.8E-08	5.6E-16	1.8E-08
Bromoform	4.3E-06	5.4E-14	4.3E-06	1.5E-13	4.3E-06
Carbon Tetrachloride	8.1E-05	1.5E-13	8.1E-05	4.1E-13	8.1E-05
Chloroform	4.2E-06	1.7E-14	4.2E-06	4.8E-14	4.2E-06
Dichloromethane	1.7E-05	6.2E-13	1.7E-05	1.7E-12	1.7E-05
Trichlorofluoromethane (FREON 11)	2.9E-07	2.8E-14	2.9E-07	7.7E-14	2.9E-07
Chlorinated Monocyclic Aromatics					
1,2,4,5-Tetrachlorobenzene	2.0E-04	1.4E-09	2.0E-04	4.1E-09	2.0E-04
1,2,4-Trichlorobenzene	2.6E-04	4.4E-12	2.6E-04	1.2E-11	2.6E-04
1,2-Dichlorobenzene	2.0E-07	2.2E-13	2.0E-07	6.3E-13	2.0E-07

COPC	Hazard Quotient – Daycare – 400,000 tpy				
	Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Hexachlorobenzene	8.6E-05	2.6E-10	8.6E-05	7.4E-10	8.6E-05
Pentachlorobenzene	4.1E-05	4.6E-09	4.1E-05	1.3E-08	4.1E-05
Pentachlorophenol	8.5E-07	3.7E-10	8.5E-07	1.0E-09	8.5E-07
Inorganics					
Antimony	0.011	4.5E-06	0.011	6.5E-06	0.011
Arsenic	0.11	5.8E-07	0.11	8.4E-07	0.11
Barium	0.0019	6.3E-09	0.0019	9.2E-09	0.0019
Beryllium	0.0014	5.5E-07	0.0014	8.0E-07	0.0014
Boron	2.8E-04	3.5E-08	2.8E-04	5.1E-08	2.8E-04
Cadmium	0.0043	1.5E-05	0.0043	2.2E-05	0.0043
Chromium (Total)	6.1E-05	4.1E-10	6.1E-05	5.9E-10	6.1E-05
Chromium VI	-	8.9E-08	8.9E-08	1.3E-07	1.3E-07
Cobalt	0.021	2.7E-06	0.021	3.9E-06	0.021
Mercury - Inorganic	9.7E-04	3.9E-05	0.0010	5.7E-05	0.0010
Methylmercury	-	2.4E-06	2.4E-06	3.4E-06	3.4E-06
Nickel	0.0028	4.4E-06	0.0029	6.4E-06	0.0029
Phosphorus	2.2E-07	1.7E-13	2.2E-07	2.5E-13	2.2E-07
Selenium	8.2E-04	6.9E-09	8.2E-04	1.0E-08	8.2E-04
Silver	1.8E-04	8.7E-08	1.8E-04	1.3E-07	1.8E-04
Thallium	0.051	4.8E-04	0.052	6.9E-04	0.052
Tin	1.4E-04	1.4E-07	1.4E-04	2.1E-07	1.4E-04
Vanadium	0.013	4.5E-07	0.013	6.6E-07	0.013
Zinc	0.0011	5.8E-07	0.0011	8.3E-07	0.0011

‘-‘ - No baseline concentration was available for this COPC.

Table 7-70 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Recreation User - Sport Toddler Receptor Grouping at 400,000 tpy

COPC	Hazard Quotient – Recreation User Sport – 400,000 tpy				
	Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs					
Acenaphthene	1.6E-07	1.2E-12	1.6E-07	3.4E-12	1.6E-07
Anthracene	3.3E-08	2.5E-13	3.3E-08	7.0E-13	3.3E-08
Fluorene	2.4E-07	1.8E-12	2.4E-07	5.1E-12	2.4E-07
PCBs					
Aroclor 1254 (Total PCBs)	4.7E-04	6.7E-07	4.7E-04	1.9E-06	4.7E-04
VOCs					
1,1,1-Trichloroethane	7.6E-10	2.1E-17	7.6E-10	5.9E-17	7.6E-10
Bromoform	1.8E-07	5.7E-15	1.8E-07	1.6E-14	1.8E-07
Carbon Tetrachloride	3.5E-06	1.5E-14	3.5E-06	4.3E-14	3.5E-06
Chloroform	1.8E-07	1.8E-15	1.8E-07	5.1E-15	1.8E-07
Dichloromethane	7.4E-07	6.5E-14	7.4E-07	1.8E-13	7.4E-07
Trichlorofluoromethane (FREON 11)	1.3E-08	2.9E-15	1.3E-08	8.1E-15	1.3E-08
Chlorinated Monocyclic Aromatics					
1,2,4,5-Tetrachlorobenzene	8.8E-06	1.5E-10	8.8E-06	4.2E-10	8.8E-06
1,2,4-Trichlorobenzene	1.1E-05	4.7E-13	1.1E-05	1.3E-12	1.1E-05
1,2-Dichlorobenzene	8.6E-09	2.3E-14	8.6E-09	6.6E-14	8.6E-09
Hexachlorobenzene	3.7E-06	2.8E-11	3.7E-06	7.7E-11	3.7E-06
Pentachlorobenzene	1.8E-06	4.8E-10	1.8E-06	1.3E-09	1.8E-06
Pentachlorophenol	3.7E-08	3.9E-11	3.7E-08	1.1E-10	3.7E-08

COPC	Hazard Quotient – Recreation User Sport – 400,000 tpy				
	Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Inorganics					
Antimony	4.6E-04	2.8E-07	4.6E-04	4.1E-07	4.6E-04
Arsenic	0.0048	3.6E-08	0.0048	5.3E-08	0.0048
Barium	8.2E-05	4.0E-10	8.2E-05	5.8E-10	8.2E-05
Beryllium	6.3E-05	3.5E-08	6.3E-05	5.0E-08	6.3E-05
Boron	1.2E-05	2.2E-09	1.2E-05	3.2E-09	1.2E-05
Cadmium	1.9E-04	9.5E-07	1.9E-04	1.4E-06	1.9E-04
Chromium (Total)	2.7E-06	2.6E-11	2.7E-06	3.7E-11	2.7E-06
Chromium VI	-	5.6E-09	5.6E-09	8.1E-09	8.1E-09
Cobalt	9.2E-04	1.7E-07	9.2E-04	2.5E-07	9.2E-04
Mercury - Inorganic	4.2E-05	2.9E-06	4.5E-05	4.2E-06	4.6E-05
Methylmercury	-	1.5E-07	1.5E-07	2.2E-07	2.2E-07
Nickel	1.2E-04	2.8E-07	1.2E-04	4.1E-07	1.2E-04
Phosphorus	9.7E-09	1.1E-14	9.7E-09	1.6E-14	9.7E-09
Selenium	3.5E-05	4.4E-10	3.5E-05	6.3E-10	3.5E-05
Silver	7.8E-06	5.5E-09	7.8E-06	8.0E-09	7.8E-06
Thallium	0.0022	3.0E-05	0.0023	4.4E-05	0.0023
Tin	6.1E-06	9.0E-09	6.1E-06	1.3E-08	6.1E-06
Vanadium	5.7E-04	2.9E-08	5.7E-04	4.2E-08	5.7E-04
Zinc	4.7E-05	3.6E-08	4.7E-05	5.3E-08	4.7E-05

‘-‘ - No baseline concentration was available for this COPC.

Table 7-71 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Recreation User - Camping Toddler Receptor Grouping at 400,000 tpy

COPC	Hazard Quotient – Recreation User – Camping – 400,000 tpy				
	Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
PAHs					
Acenaphthene	4.2E-07	2.7E-12	4.2E-07	7.4E-12	4.2E-07
Anthracene	8.6E-08	5.4E-13	8.6E-08	1.5E-12	8.6E-08
Fluorene	6.3E-07	4.0E-12	6.3E-07	1.1E-11	6.3E-07
PCBs					
Aroclor 1254 (Total PCBs)	0.0012	1.5E-06	0.0012	4.1E-06	0.0012
VOCs					
1,1,1-Trichloroethane	2.0E-09	4.6E-17	2.0E-09	1.3E-16	2.0E-09
Bromoform	4.8E-07	1.2E-14	4.8E-07	3.4E-14	4.8E-07
Carbon Tetrachloride	9.2E-06	3.4E-14	9.2E-06	9.4E-14	9.2E-06
Chloroform	4.8E-07	3.9E-15	4.8E-07	1.1E-14	4.8E-07
Dichloromethane	1.9E-06	1.4E-13	1.9E-06	4.0E-13	1.9E-06
Trichlorofluoromethane (FREON 11)	3.3E-08	6.3E-15	3.3E-08	1.8E-14	3.3E-08
Chlorinated Monocyclic Aromatics					
1,2,4,5-Tetrachlorobenzene	2.3E-05	3.3E-10	2.3E-05	9.2E-10	2.3E-05
1,2,4-Trichlorobenzene	3.0E-05	1.0E-12	3.0E-05	2.8E-12	3.0E-05
1,2-Dichlorobenzene	2.2E-08	5.1E-14	2.2E-08	1.4E-13	2.2E-08
Hexachlorobenzene	9.8E-06	6.0E-11	9.8E-06	1.7E-10	9.8E-06
Pentachlorobenzene	4.7E-06	1.0E-09	4.7E-06	2.9E-09	4.7E-06
Pentachlorophenol	9.7E-08	8.4E-11	9.7E-08	2.4E-10	9.7E-08

COPC	Hazard Quotient – Recreation User – Camping – 400,000 tpy				
	Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Inorganics					
Antimony	0.0012	8.1E-07	0.0012	1.2E-06	0.0012
Arsenic	0.013	1.0E-07	0.013	1.5E-07	0.013
Barium	2.2E-04	1.1E-09	2.2E-04	1.7E-09	2.2E-04
Beryllium	1.6E-04	9.9E-08	1.6E-04	1.4E-07	1.6E-04
Boron	3.2E-05	6.3E-09	3.2E-05	9.1E-09	3.2E-05
Cadmium	4.9E-04	2.7E-06	4.9E-04	4.0E-06	4.9E-04
Chromium (Total)	7.0E-06	7.4E-11	7.0E-06	1.1E-10	7.0E-06
Chromium VI	-	1.6E-08	1.6E-08	2.3E-08	2.3E-08
Cobalt	0.0024	4.9E-07	0.0024	7.1E-07	0.0024
Mercury - Inorganic	1.1E-04	7.2E-06	1.2E-04	1.0E-05	1.2E-04
Methylmercury	-	4.2E-07	4.2E-07	6.1E-07	6.1E-07
Nickel	3.2E-04	8.0E-07	3.2E-04	1.2E-06	3.2E-04
Phosphorus	2.5E-08	3.1E-14	2.5E-08	4.5E-14	2.5E-08
Selenium	9.3E-05	1.2E-09	9.3E-05	1.8E-09	9.3E-05
Silver	2.0E-05	1.6E-08	2.0E-05	2.3E-08	2.0E-05
Thallium	0.0058	8.6E-05	0.0059	1.2E-04	0.0060
Tin	1.6E-05	2.6E-08	1.6E-05	3.7E-08	1.6E-05
Vanadium	0.0015	8.2E-08	0.0015	1.2E-07	0.0015
Zinc	1.2E-04	1.0E-07	1.2E-04	1.5E-07	1.2E-04

‘-‘ - No baseline concentration was available for this COPC.

Additionally, an overall assessment was conducted for dioxins/furans and lead, accounting for both the multi-pathway HQ as well as the chronic inhalation CR. The results (Table 7-72) indicate that, at 400,000 tpy, neither COPC is present at levels that are in exceedance of the regulatory benchmark.

Table 7-72 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for Dioxins and Lead for the Daycare, Recreation User – Sport and Recreation User - Camping Toddler Receptor Groupings at 400,000 tpy

COPC	Hazard Quotient – 400,000 tpy				
	Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Daycare					
2,3,7,8-TCDD Equivalent	0.0048	6.5E-05	0.0048	9.4E-05	0.0049
Lead	0.044	1.4E-04	0.044	1.8E-04	0.044
Recreation User – Sport					
2,3,7,8-TCDD Equivalent	0.0017	1.0E-05	0.0018	1.2E-05	0.0018
Lead	0.0082	1.1E-04	0.0083	1.1E-04	0.0083
Recreation User - Camping					
2,3,7,8-TCDD Equivalent	0.0020	1.7E-05	0.0020	2.3E-05	0.0020
Lead	0.011	1.2E-04	0.011	1.3E-04	0.011

Additional Risk Related to Specific Activities

It is expected that local residential receptors may participate in activities such as swimming, hunting or angling in the LRASA. Participation in these activities may, through unique exposure pathways, increase the body burden of a receptor beyond that of a residential receptor not participating in the activity. Details on these exposure situations (swimming, hunting and angling) have been provided in Section 7.4.1. In order to provide a more complete assessment of the impact of these activities, the activity specific HQ results have been added to the worst case resident receptor results (i.e. the Tooley residential receptor grouping). This assessment allows for potential risks to be placed in context such that the results represent the risk of a local resident swimming, hunting or angling in addition to his/her normal daily activities.

Recreation User - Swimmer

Chronic HQ values for both the recreation user – swimmer receptor, as well as the recreation user – swimmer receptor combined with the Tooley resident receptor are presented in Table 7-73. Results of the assessment indicate that, with the exception of Total PCBs, arsenic and thallium none of the predicted hazard quotients exceed the regulatory benchmark for the Baseline Case, Project Alone Case, Project Case, Process Upset Case or Process Upset Project Case at 400,000 tpy. Total PCBs, arsenic and thallium for the recreation user – swimmer receptor combined with the Tooley resident receptor exceed the regulatory benchmark (HQ = 0.52; HQ=0.33; HQ=0.26, respectively) for the Baseline Case, Project Case and Process Upset Project Case. This exceedance is entirely driven by Baseline Case concentrations for the toddler resident; the Project Alone Case/Process Upset Case contribution to the observed risk level is never more than 0.04%. Furthermore, the contribution of the swimming activity to the total risk is never more than approximately 6%. A discussion of the Baseline Case risk to the toddler resident is further discussed in Section 7.9.2.1. It is not expected that the Project, at 400,000 tpy, will pose any additional undue risk to the health of local recreational swimming receptors.

As was previously completed for other receptor categories, a separate assessment of dioxins/furans and lead, has also been conducted. This assessment provides an overall, all pathway assessment for these COPC, including exposure via inhalation. The results of this assessment, which indicates that neither COPC would be present at levels that would be in exceedance of the regulatory benchmark at 400,000 tpy, are presented in Table 7-75.

Hunting and Angling

Chronic HQ values for both the hunter/angler toddler receptor, as well as the hunter/angler receptor combined with the Tooley resident receptor are presented in Table 7-74 and Table 7-75. Results of the assessment indicate that, with the exception of total PCBs, arsenic, cadmium and thallium, none of the predicted hazard quotients exceed the regulatory benchmark for the Baseline Case, Project Alone Case, Project Case, Process Upset Case, or Process Upset Project Case at 400,000 tpy.

Exceedances of total PCBs, arsenic, cadmium and thallium stem almost entirely from the assessment of baseline concentrations – the contribution of the Project Alone Case/Process Upset Case to the total risk is never more than 6.5%. Refer to Section 7.9.2.1 for a thorough discussion of baseline risk. The exceedances are the result of baseline fish and wild game concentrations, which were evaluated at the method detection limit (MDL). Although these results indicate that, based on current conditions, residents who pursue activities such as hunting and angling could face slightly elevated risk levels, much like previously discussed baseline results, it is expected that these exceedances are the result of conservative estimations, such as the evaluation of the MDL. Overall, it is not expected that the Project will pose any additional undue risk to the health of local hunting/angling receptors at 400,000 tpy.

As previously completed, a separate assessment of dioxins/furans and lead has been conducted. The results of this assessment indicate a Baseline Case, Project Case and Process Upset Project Case exceedance for dioxins/furans for the hunter/angler receptor. Much like the previously discussed risk from PCBs and certain inorganics, this risk is entirely driven by baseline concentrations of wild game and fish, which were evaluated at the method detection limit (MDL), which is a conservative estimation. Overall, it is not expected that emissions of dioxins/furans from the Project will pose any additional undue risk to the health of local hunting/angling receptors at 400,000 tpy.

Table 7-73 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Swimmer Toddler Receptor and Tooley Resident Swimmer Toddler Receptor at 400,000 tpy

COPC	Hazard Quotient – Swimmer – 400,000 tpy									
	Toddler - Swimmer					Toddler - Tooley Resident Swimmer				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	4.0E-07	1.6E-11	4.0E-07	4.6E-11	4.0E-07	1.3E-05	1.6E-09	1.3E-05	4.4E-09	1.3E-05
Anthracene	1.0E-07	1.6E-12	1.0E-07	4.4E-12	1.0E-07	2.8E-06	1.3E-10	2.8E-06	3.6E-10	2.8E-06
Fluorene	1.2E-06	7.2E-11	1.2E-06	2.0E-10	1.2E-06	2.1E-05	1.4E-09	2.1E-05	3.9E-09	2.1E-05
PCBs										
Aroclor 1254 (Total PCBs)	0.028	1.8E-06	0.028	5.0E-06	0.028	**0.52**	9.6E-05	**0.52**	2.7E-04	**0.52**
VOCs										
1,1,1-Trichloroethane	3.5E-07	1.2E-11	3.5E-07	3.4E-11	3.5E-07	5.0E-06	1.3E-11	5.0E-06	3.5E-11	5.0E-06
Bromoform	3.6E-05	3.9E-08	3.6E-05	1.1E-07	3.6E-05	0.0024	3.9E-08	0.0024	1.1E-07	0.0024
Carbon Tetrachloride	1.0E-03	7.6E-09	1.0E-03	2.1E-08	1.0E-03	0.034	7.9E-09	0.034	2.2E-08	0.034
Chloroform	7.0E-05	7.9E-10	7.0E-05	2.2E-09	7.0E-05	0.0027	8.6E-10	0.0027	2.4E-09	0.0027
Dichloromethane	5.2E-05	6.1E-08	5.2E-05	1.7E-07	5.2E-05	0.0047	6.9E-08	0.0047	1.9E-07	0.0047
Trichlorofluoromethane (FREON 11)	4.6E-06	9.1E-09	4.7E-06	2.5E-08	4.7E-06	1.6E-04	9.1E-09	1.6E-04	2.6E-08	1.6E-04
Chlorinated Monocyclic Aromatics										

COPC	Hazard Quotient – Swimmer – 400,000 tpy									
	Toddler - Swimmer					Toddler - Tooley Resident Swimmer				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
1,2,4,5-Tetrachlorobenzene	6.2E-04	8.5E-09	6.2E-04	2.4E-08	6.2E-04	0.046	1.1E-07	0.046	3.0E-07	0.046
1,2,4-Trichlorobenzene	5.9E-04	7.9E-10	5.9E-04	2.2E-09	5.9E-04	0.057	1.3E-09	0.057	3.7E-09	0.057
1,2-Dichlorobenzene	2.2E-06	1.2E-10	2.2E-06	3.3E-10	2.2E-06	1.1E-04	3.0E-10	1.1E-04	8.4E-10	1.1E-04
Hexachlorobenzene	7.4E-04	1.2E-08	7.4E-04	3.4E-08	7.4E-04	0.020	2.1E-08	0.020	5.8E-08	0.020
Pentachlorobenzene	7.4E-05	3.1E-09	7.4E-05	8.6E-09	7.4E-05	0.0095	1.4E-07	0.0095	4.0E-07	0.0095
Pentachlorophenol	4.2E-06	2.8E-07	4.4E-06	7.8E-07	4.9E-06	6.4E-06	5.7E-07	7.0E-06	1.6E-06	8.0E-06
Inorganics										
Antimony	0.018	3.5E-05	0.018	5.1E-05	0.018	0.069	1.3E-04	0.070	1.9E-04	0.070
Arsenic	0.0095	7.2E-06	0.0095	1.0E-05	0.0095	**0.33**	1.6E-05	**0.33**	2.4E-05	**0.33**
Barium	6.4E-04	5.4E-08	6.4E-04	7.9E-08	6.4E-04	0.0085	1.9E-07	0.0085	2.8E-07	0.0085
Beryllium	7.1E-04	4.1E-07	7.1E-04	6.0E-07	7.1E-04	0.051	5.4E-06	0.051	7.8E-06	0.051
Boron	4.3E-04	3.9E-06	4.3E-04	5.7E-06	4.3E-04	0.022	3.0E-05	0.022	4.4E-05	0.022
Cadmium	2.8E-04	7.0E-05	3.6E-04	1.0E-04	3.9E-04	0.027	7.8E-04	0.028	0.0011	0.028
Chromium (Total)	5.7E-06	7.7E-09	5.7E-06	1.1E-08	5.7E-06	2.3E-04	1.5E-08	2.3E-04	2.2E-08	2.3E-04
Chromium VI	0.015	1.7E-06	0.015	2.4E-06	0.015	0.015	3.3E-06	0.015	4.8E-06	0.015
Cobalt	5.0E-04	2.1E-05	5.2E-04	3.0E-05	5.3E-04	0.071	5.9E-05	0.071	8.6E-05	0.071

COPC	Hazard Quotient – Swimmer – 400,000 tpy									
	Toddler - Swimmer					Toddler - Tooley Resident Swimmer				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Mercury - Inorganic	4.7E-04	3.6E-06	4.8E-04	5.3E-06	4.8E-04	0.0065	5.0E-04	0.0070	7.2E-04	0.0073
Methylmercury	-	2.4E-08	2.4E-08	3.5E-08	3.5E-08	-	5.0E-05	5.0E-05	7.2E-05	7.2E-05
Nickel	4.2E-04	2.2E-05	4.4E-04	3.2E-05	4.5E-04	0.014	7.8E-05	0.014	1.1E-04	0.014
Phosphorus	1.6E-08	1.6E-11	1.6E-08	2.4E-11	1.6E-08	5.1E-05	2.1E-10	5.1E-05	3.1E-10	5.1E-05
Selenium	0.0014	4.9E-07	0.0014	7.2E-07	0.0014	0.012	8.4E-07	0.012	1.2E-06	0.012
Silver	2.8E-05	3.4E-06	3.2E-05	5.0E-06	3.3E-05	0.0025	9.3E-06	0.0025	1.4E-05	0.0025
Thallium	0.0053	0.0025	0.0078	0.0036	0.0089	**0.26**	0.0074	**0.27**	0.011	**0.27**
Tin	4.7E-06	2.3E-07	5.0E-06	3.3E-07	5.1E-06	9.3E-04	1.8E-06	9.3E-04	2.7E-06	9.3E-04
Vanadium	0.0013	2.9E-07	0.0013	4.2E-07	0.0013	0.047	4.5E-06	0.047	6.5E-06	0.047
Zinc	2.1E-04	3.4E-06	2.2E-04	4.9E-06	2.2E-04	0.021	3.5E-05	0.021	5.0E-05	0.021

Notes:

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

'-' - No baseline concentration was available for this COPC.

Table 7-74 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Hunter/Angler Receptor and Tooley Resident Hunter/Angler Toddler Receptor at 400,000 tpy

COPC	Hazard Quotient - Hunter/Angler – 400,000 tpy									
	Toddler - Hunter/Angler					Toddler - Tooley Resident Hunter/Angler				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
PAHs										
Acenaphthene	1.3E-05	1.7E-12	1.3E-05	4.7E-12	1.3E-05	2.6E-05	1.6E-09	2.6E-05	4.3E-09	2.6E-05
Anthracene	1.7E-06	3.8E-13	1.7E-06	1.1E-12	1.7E-06	4.3E-06	1.3E-10	4.3E-06	3.5E-10	4.3E-06
Fluorene	2.1E-05	9.0E-12	2.1E-05	2.5E-11	2.1E-05	4.1E-05	1.3E-09	4.1E-05	3.7E-09	4.1E-05
PCBs										
Aroclor 1254 (Total PCBs)	**0.67**	0.0055	**0.68**	0.015	**0.69**	**1.2**	0.0056	**1.2**	0.016	**1.2**
VOCs										
1,1,1-Trichloroethane	-	4.9E-12	4.9E-12	1.4E-11	1.4E-11	4.7E-06	5.5E-12	4.7E-06	1.5E-11	4.7E-06
Bromoform	-	1.2E-08	1.2E-08	3.3E-08	3.3E-08	0.0023	1.2E-08	0.0023	3.3E-08	0.0023
Carbon Tetrachloride	-	6.1E-09	6.1E-09	1.7E-08	1.7E-08	0.033	6.5E-09	0.033	1.8E-08	0.033
Chloroform	-	1.1E-10	1.1E-10	3.0E-10	3.0E-10	0.0026	1.7E-10	0.0026	4.8E-10	0.0026
Dichloromethane	-	1.4E-09	1.4E-09	4.0E-09	4.0E-09	0.0047	8.9E-09	0.0047	2.5E-08	0.0047
Trichlorofluoromethane (FREON 11)	-	3.7E-09	3.7E-09	1.0E-08	1.0E-08	1.5E-04	3.8E-09	1.5E-04	1.1E-08	1.5E-04
Chlorinated Monocyclic Aromatics										

COPC	Hazard Quotient - Hunter/Angler – 400,000 tpy									
	Toddler - Hunter/Angler					Toddler - Tooley Resident Hunter/Angler				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
1,2,4,5-Tetrachlorobenzene	0.064	3.6E-07	0.064	1.0E-06	0.064	0.11	4.5E-07	0.11	1.3E-06	0.11
1,2,4-Trichlorobenzene	-	9.0E-09	9.0E-09	2.5E-08	2.5E-08	0.057	9.6E-09	0.057	2.7E-08	0.057
1,2-Dichlorobenzene	-	2.6E-10	2.6E-10	7.4E-10	7.4E-10	1.1E-04	4.5E-10	1.1E-04	1.2E-09	1.1E-04
Hexachlorobenzene	0.027	5.6E-07	0.027	1.6E-06	0.027	0.046	5.7E-07	0.046	1.6E-06	0.046
Pentachlorobenzene	0.013	5.4E-07	0.013	1.5E-06	0.013	0.023	6.8E-07	0.023	1.9E-06	0.023
Pentachlorophenol	0.0E+00	2.1E-05	2.1E-05	6.0E-05	6.0E-05	2.3E-06	2.2E-05	2.4E-05	6.1E-05	6.3E-05
Inorganics										
Antimony	0.034	0.0017	0.035	0.0024	0.036	0.085	0.0018	0.087	0.0026	0.088
Arsenic	**0.43**	8.7E-05	**0.43**	1.3E-04	**0.43**	**0.75**	9.6E-05	**0.75**	1.4E-04	**0.75**
Barium	0.030	1.3E-07	0.030	1.9E-07	0.030	0.038	2.7E-07	0.038	3.9E-07	0.038
Beryllium	0.067	9.9E-06	0.067	1.4E-05	0.067	0.12	1.5E-05	0.12	2.2E-05	0.12
Boron	0.040	2.8E-07	0.040	4.0E-07	0.040	0.062	2.7E-05	0.062	3.9E-05	0.062
Cadmium	**0.46**	0.020	**0.48**	0.029	**0.49**	**0.49**	0.021	**0.51**	0.030	**0.52**
Chromium (Total)	1.9E-04	3.7E-07	1.9E-04	5.4E-07	1.9E-04	4.2E-04	3.8E-07	4.2E-04	5.5E-07	4.2E-04
Chromium VI	-	1.5E-05	1.5E-05	2.2E-05	2.2E-05	-	1.7E-05	1.7E-05	2.4E-05	2.4E-05
Cobalt	0.043	5.4E-04	0.043	7.8E-04	0.043	0.11	5.7E-04	0.11	8.3E-04	0.11

COPC	Hazard Quotient - Hunter/Angler – 400,000 tpy									
	Toddler - Hunter/Angler					Toddler - Tooley Resident Hunter/Angler				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Mercury - Inorganic	0.11	6.8E-06	0.11	9.8E-06	0.11	0.12	5.0E-04	0.12	7.3E-04	0.12
Methylmercury	-	0.0035	0.0035	0.0051	0.0051	-	0.0036	0.0036	0.0052	0.0052
Nickel	0.024	8.3E-04	0.025	0.0012	0.025	0.037	8.9E-04	0.038	0.0013	0.038
Phosphorus	7.6E-04	8.0E-11	7.6E-04	1.2E-10	7.6E-04	8.1E-04	2.7E-10	8.1E-04	4.0E-10	8.1E-04
Selenium	0.16	2.0E-05	0.16	2.9E-05	0.16	0.17	2.1E-05	0.17	3.0E-05	0.17
Silver	0.0027	7.4E-05	0.0028	1.1E-04	0.0028	0.0051	8.0E-05	0.0052	1.2E-04	0.0052
Thallium	0.17	0.0064	0.17	0.0093	0.18	**0.42**	0.011	**0.43**	0.017	**0.44**
Tin	3.8E-04	1.7E-04	5.4E-04	2.4E-04	6.2E-04	0.0013	1.7E-04	0.0015	2.4E-04	0.0015
Vanadium	0.020	1.1E-05	0.020	1.6E-05	0.020	0.066	1.5E-05	0.066	2.2E-05	0.066
Zinc	0.14	7.5E-04	0.14	0.0011	0.14	0.16	7.9E-04	0.16	0.0011	0.16

Notes:

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

'-' - No baseline concentration was available for this COPC.

Table 7-75 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for Dioxins and Lead for the Swimmer and Hunter/Angler Toddler Receptors and Tooley Resident Swimmer and Hunter/Angler Toddler Receptors at 400,000 tpy

COPC	Hazard Quotient – 400,000 tpy									
	Toddler					Toddler - Tooley Resident				
	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Swimmer										
2,3,7,8-TCDD Equivalent	0.0026	7.5E-07	0.0026	1.1E-06	0.0026	0.17	6.0E-04	0.17	8.7E-04	0.17
Lead	7.6E-04	6.2E-05	8.2E-04	9.1E-05	8.5E-04	0.12	0.0013	0.12	0.0018	0.12
Hunting/Angling										
2,3,7,8-TCDD Equivalent	**0.38**	0.0046	**0.38**	0.0070	**0.38**	**0.54**	0.0052	**0.55**	0.0078	**0.55**
Lead	0.037	0.0016	0.038	0.0023	0.039	0.15	0.0028	0.16	0.0040	0.16

Notes:

A **bolded** cell indicates exposures for that particular scenario and COPC exceeded the regulatory benchmark.

7.12.2.2 400,000 tpy Operational Cases – Multi-Pathway Risk Assessment Chemical Mixtures

The results of the chronic, multi-pathway chemical mixtures assessment, at 400,000 tpy, are shown in Table 7-76 through Table 7-78. Interpretation of chemical mixtures results is difficult as regulators have not established standards or benchmarks for the assessment of mixtures. By adding chemical HQ values together, it assumes that not only is the target organ the same, but that exposure to these chemicals actually results in a toxicological mode of action that is directly additive. To date, there have been limited or no mixture additive toxicology studies to support using this approach in human health risk assessment. This is a considerable source of uncertainty in any risk assessment being conducted in Ontario.

Table 7-76 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for Local Resident Receptors from Chemical Mixtures at 400,000 tpy

COPC	Hazard Quotient – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Bowmanville Subdivision										
Haematological Effects	0.022	4.0E-06	0.022	5.8E-06	0.022	0.091	3.2E-05	0.091	4.6E-05	0.091
Kidney Effects	0.0028	4.3E-05	0.0028	6.2E-05	0.0029	0.014	2.2E-04	0.014	3.1E-04	0.014
Liver Effects	10.8	2.1E-04	10.8	6.0E-04	10.8	0.50	2.7E-05	0.50	7.7E-05	0.50
Neurological Effects	0.040	1.5E-04	0.040	2.0E-04	0.041	0.13	5.7E-04	0.13	8.0E-04	0.13
Reproductive/ Developmental Effects	3.9	0.0021	3.9	0.0032	3.9	0.32	8.6E-04	0.32	0.0012	0.32
Courtice Subdivision										
Haematological Effects	0.022	2.9E-06	0.022	4.2E-06	0.022	0.091	2.3E-05	0.091	3.3E-05	0.091
Kidney Effects	0.0028	2.9E-05	0.0028	4.1E-05	0.0028	0.014	1.5E-04	0.014	2.1E-04	0.014
Liver Effects	10.8	1.6E-04	10.8	4.5E-04	10.8	0.50	2.1E-05	0.50	5.7E-05	0.50
Neurological Effects	0.040	1.0E-04	0.040	1.4E-04	0.040	0.13	4.0E-04	0.13	5.7E-04	0.13
Reproductive/ Developmental Effects	3.9	0.0015	3.9	0.0023	3.9	0.32	6.1E-04	0.32	8.8E-04	0.32
Courtice Road										
Haematological Effects	0.022	8.9E-06	0.022	1.3E-05	0.022	0.091	6.8E-05	0.091	9.9E-05	0.091

COPC	Hazard Quotient – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Kidney Effects	0.0028	9.8E-05	0.0029	1.4E-04	0.0029	0.014	4.9E-04	0.014	7.1E-04	0.015
Liver Effects	10.8	6.7E-04	10.8	0.0019	10.8	0.50	8.6E-05	0.50	2.4E-04	0.50
Neurological Effects	0.040	3.2E-04	0.041	4.2E-04	0.041	0.13	0.0012	0.13	0.0017	0.13
Reproductive/ Developmental Effects	3.9	0.0044	3.9	0.0067	3.9	0.32	0.0019	0.32	0.0027	0.32
Maple Grove										
Haematological Effects	0.022	2.2E-06	0.022	3.1E-06	0.022	0.091	1.7E-05	0.091	2.4E-05	0.091
Kidney Effects	0.0028	3.1E-05	0.0028	4.6E-05	0.0029	0.014	1.6E-04	0.014	2.3E-04	0.014
Liver Effects	10.8	1.9E-04	10.8	5.2E-04	10.8	0.50	2.4E-05	0.50	6.6E-05	0.50
Neurological Effects	0.040	9.9E-05	0.040	1.2E-04	0.040	0.13	3.2E-04	0.13	4.4E-04	0.13
Reproductive/ Developmental Effects	3.9	0.0012	3.9	0.0018	3.9	0.32	4.8E-04	0.32	6.8E-04	0.32
Oshawa Subdivision										
Haematological Effects	0.022	3.8E-06	0.022	5.5E-06	0.022	0.091	3.0E-05	0.091	4.3E-05	0.091
Kidney Effects	0.0028	4.7E-05	0.0029	6.8E-05	0.0029	0.014	2.4E-04	0.014	3.5E-04	0.014
Liver Effects	10.8	2.7E-04	10.8	7.5E-04	10.8	0.50	3.4E-05	0.50	9.6E-05	0.50
Neurological Effects	0.040	1.6E-04	0.040	2.0E-04	0.041	0.13	5.5E-04	0.13	7.7E-04	0.13

COPC	Hazard Quotient – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Reproductive/ Developmental Effects	3.87	0.0020	3.9	0.0031	3.9	0.32	8.4E-04	0.32	0.0012	0.32
Port Darlington										
Haematological Effects	0.022	1.4E-06	0.022	2.0E-06	0.022	0.091	1.1E-05	0.091	1.6E-05	0.091
Kidney Effects	0.0028	2.8E-05	0.0028	4.1E-05	0.0028	0.014	1.5E-04	0.014	2.1E-04	0.014
Liver Effects	10.8	1.2E-04	10.8	3.4E-04	10.8	0.50	1.6E-05	0.50	4.4E-05	0.50
Neurological Effects	0.040	8.3E-05	0.040	9.7E-05	0.040	0.13	2.3E-04	0.13	3.1E-04	0.13
Reproductive/ Developmental Effects	3.87	8.3E-04	3.9	0.0014	3.9	0.32	3.3E-04	0.32	4.6E-04	0.32
Solina Road										
Haematological Effects	0.022	5.1E-06	0.022	7.4E-06	0.022	0.091	3.9E-05	0.091	5.6E-05	0.091
Kidney Effects	0.0028	6.3E-05	0.0029	9.1E-05	0.0029	0.014	3.1E-04	0.014	4.6E-04	0.014
Liver Effects	10.8	4.1E-04	10.8	0.0012	10.8	0.50	5.3E-05	0.50	1.5E-04	0.50
Neurological Effects	0.040	2.1E-04	0.041	2.7E-04	0.041	0.13	7.3E-04	0.13	0.0010	0.13
Reproductive/ Developmental Effects	3.87	0.0026	3.9	0.0040	3.9	0.32	0.0011	0.32	0.0016	0.32
Tooley										
Haematological Effects	0.022	9.4E-06	0.022	1.4E-05	0.022	0.091	7.1E-05	0.091	5.6E-05	0.091

COPC	Hazard Quotient – 400,000 tpy									
	Infant					Toddler				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Kidney Effects	0.0028	1.0E-04	0.0029	1.5E-04	0.0030	0.014	4.9E-04	0.014	4.6E-04	0.014
Liver Effects	10.8	7.4E-04	10.8	0.0021	10.8	0.50	9.4E-05	0.50	1.5E-04	0.50
Neurological Effects	0.040	3.2E-04	0.041	4.3E-04	0.041	0.13	0.0013	0.13	0.0010	0.13
Reproductive/ Developmental Effects	3.87	0.0046	3.9	0.0068	3.9	0.32	0.0019	0.32	0.0016	0.32

Table 7-77 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for Farmer, Daycare, Recreation User – Sport and Recreation User – Camping Receptors from Chemical Mixtures at 400,000 tpy

COPC	Hazard Quotient – 400,000 tpy				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Local Farmer - Infant					
Haematological Effects	0.022	1.4E-05	0.022	2.0E-05	0.022
Kidney Effects	0.0028	1.1E-04	0.0029	1.6E-04	0.0030
Liver Effects	117.5	0.011	117.5	0.029	117.5
Neurological Effects	0.040	4.4E-04	0.041	5.9E-04	0.041
Reproductive/ Developmental Effects	20.3	0.11	20.4	0.22	20.5
Local Farmer – Toddler					
Haematological Effects	0.32	5.9E-04	0.32	8.6E-04	0.32
Kidney Effects	0.044	0.0011	0.045	0.0016	0.045
Liver Effects	4.8	4.0E-04	4.8	0.0011	4.8
Neurological Effects	0.29	0.0028	0.29	0.0041	0.29
Reproductive/ Developmental Effects	1.1	0.0071	1.1	0.012	1.1
Daycare – Toddler					
Haematological Effects	0.022	3.4E-06	0.022	5.0E-06	0.02
Kidney Effects	0.0029	3.9E-05	0.0029	0.0001	0.003
Liver Effects	0.011	6.4E-06	0.011	0.0000	0.01
Neurological Effects	0.045	1.4E-04	0.045	0.0002	0.05
Reproductive/ Developmental Effects	0.052	2.1E-04	0.052	0.000	0.05
Recreation User – Sport - Toddler					

COPC	Hazard Quotient – 400,000 tpy				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Haematological Effects	9.7E-04	2.2E-07	9.7E-04	3.1E-07	9.7E-04
Kidney Effects	1.2E-04	2.9E-06	1.3E-04	4.2E-06	1.3E-04
Liver Effects	4.7E-04	6.7E-07	4.7E-04	1.9E-06	4.7E-04
Neurological Effects	0.0082	1.1E-04	0.0083	1.2E-04	0.0083
Reproductive/ Developmental Effects	0.010	1.2E-04	0.010	1.3E-04	0.010
Recreation User – Camping – Toddler					
Haematological Effects	0.0026	6.2E-07	0.0026	9.0E-07	0.0026
Kidney Effects	3.3E-04	7.2E-06	3.3E-04	1.0E-05	3.4E-04
Liver Effects	0.0012	1.5E-06	0.0012	4.1E-06	0.0012
Neurological Effects	0.011	1.2E-04	0.011	1.3E-04	0.011
Reproductive/ Developmental Effects	0.013	1.4E-04	0.013	1.5E-04	0.013

Table 7-78 Multi-Pathway Risk Assessment –Operational Cases Hazard Quotient Results for the Swimmer and Hunter/Angler Toddler Receptors and Tooley Resident Swimmer and Hunter/Angler Toddler Receptors from Chemical Mixtures at 400,000 tpy

COPC	Hazard Quotient – 400,000 tpy									
	Toddler					Toddler – Tooley Resident				
	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Swimmer										
Haematological Effects	7.2E-04	2.5E-05	7.4E-04	3.6E-05	7.5E-04	0.092	9.6E-05	0.092	1.4E-04	0.092
Kidney Effects	0.0011	3.7E-06	0.0011	5.4E-06	0.0011	0.015	5.0E-04	0.016	7.2E-04	0.016
Liver Effects	0.028	1.8E-06	0.028	5.1E-06	0.028	0.53	9.6E-05	0.53	2.7E-04	0.53
Neurological Effects	0.0022	6.3E-05	0.0022	9.1E-05	0.0023	0.13	0.0013	0.13	0.0019	0.13
Reproductive/ Developmental Effects	0.0042	8.9E-05	0.0043	1.3E-04	0.0043	0.32	0.0020	0.32	0.0029	0.32
Hunter/Angler										
Haematological Effects	0.19	0.0015	0.19	0.0021	0.19	0.28	0.0015	0.28	0.0022	0.28
Kidney Effects	0.14	6.9E-06	0.14	1.0E-05	0.14	0.16	5.0E-04	0.16	7.3E-04	0.16
Liver Effects	0.67	0.0055	0.68	0.015	0.69	1.17	0.0056	1.18	0.016	1.19
Neurological Effects	0.19	0.0051	0.20	0.0074	0.20	0.32	0.0064	0.33	0.0092	0.33
Reproductive/ Developmental Effects	0.48	0.011	0.49	0.016	0.49	0.79	0.012	0.81	0.018	0.81

7.12.2.3 400,000 tpy Operational Cases – Multi-Pathway Risk Assessment Carcinogens

The multi-pathway assessment derived oral/dermal LCR and ILCR estimates for the carcinogenic COPC under the Baseline Case (i.e., lifetime cancer risks), and the Project Alone and Process Upset Cases (i.e., incremental lifetime cancer risks), at 400,000 tpy. Lifetime exposures to carcinogens considered all life stages (i.e., infant through to adult), termed a "composite lifetime receptor", when predicting LCRs and ILCRs.

As discussed previously, predicted ILCR values for the Project Alone Case and Process Upset Case were evaluated against a 1-in-1,000,000 acceptable cancer risk benchmark; conversely, there is no benchmark for comparison of LCR values, as they represent an individual's lifetime cancer risks associated with all potential exposures to a given carcinogenic COPC within the environment. For the Baseline Case, this represents the lifetime cancer risk associated with all background sources of the COPC and does not include Project-related emissions.

Table 7-79 through Table 7-82 shows LCR and ILCR estimates for all receptors under the Baseline Case, Project Alone Case and Process Upset Case assessment scenarios. Baseline Case LCR results are provided for comparison – discussion of these results can be found in Section 7.9.2.3. Results of the assessment indicate that none of the predicted ILCR values exceed the accepted regulatory benchmark for the Project Alone Case or Process Upset Case; therefore, it is not expected that the Project will pose any additional adverse cancer risk to the health of local receptors at 400,000 tpy.

Additionally, the additive LCR and ILCR of stomach carcinogens was assessed. Interpretation of the results is difficult as there is no regulatory benchmark against which to measure the results of the analysis of chemical mixtures.

Table 7-79 Multi-Pathway Risk Assessment –Operational Cases Cancer Risk Results for the Bowmanville Subdivision, Courtice Subdivision and Courtice Road Composite Receptor Groupings at 400,000 tpy

COPC	LCR/ILCR – Bowmanville Subdivision			LCR/ILCR – Courtice Subdivision			LCR/ILCR – Courtice Road		
	Composite Receptor								
	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR
PAHs									
Benzo(a)pyrene TEQ	4.0E-06	4.6E-11	1.3E-10	4.0E-06	3.2E-11	8.8E-11	4.0E-06	9.2E-11	2.5E-10
VOCs									
Bromoform	2.4E-07	1.3E-15	3.6E-15	2.4E-07	9.8E-16	2.7E-15	2.4E-07	4.1E-15	1.1E-14
Carbon Tetrachloride	2.0E-06	4.9E-15	1.4E-14	2.0E-06	3.7E-15	1.0E-14	2.0E-06	1.5E-14	4.3E-14
Dichloromethane	1.1E-06	4.7E-13	1.3E-12	1.1E-06	3.6E-13	1.0E-12	1.1E-06	1.5E-12	4.2E-12
Chlorinated Monocyclic Aromatics									
Hexachlorobenzene	4.3E-06	3.8E-13	1.1E-12	4.3E-06	2.8E-13	7.9E-13	4.3E-06	1.2E-12	3.3E-12
Pentachlorophenol	1.6E-10	7.3E-11	2.0E-10	1.6E-10	5.1E-11	1.4E-10	1.6E-10	1.5E-10	4.2E-10
Inorganics									
Arsenic	1.9E-05	5.9E-10	8.5E-10	1.9E-05	4.1E-10	6.0E-10	1.9E-05	1.1E-09	1.6E-09
Chemical Mixtures									
Stomach Carcinogens	4.3E-06	4.6E-11	1.3E-10	4.3E-06	3.2E-11	8.8E-11	4.3E-06	9.2E-11	2.5E-10

Table 7-80 Multi-Pathway Risk Assessment –Operational Cases Cancer Risk Results for the Maple Grove, Oshawa Subdivision and Port Darlington Composite Receptor Groupings at 400,000 tpy

COPC	LCR/ILCR – Maple Grove			LCR/ILCR – Oshawa Subdivision			LCR/ILCR – Port Darlington		
	Composite Receptor								
	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR
PAHs									
Benzo(a)pyrene TEQ	4.0E-06	3.9E-11	1.1E-10	4.0E-06	5.8E-11	1.6E-10	4.0E-06	3.8E-11	1.0E-10
VOCs									
Bromoform	2.4E-07	1.1E-15	3.1E-15	2.4E-07	1.6E-15	4.6E-15	2.4E-07	7.4E-16	2.1E-15
Carbon Tetrachloride	2.0E-06	4.2E-15	1.2E-14	2.0E-06	6.2E-15	1.7E-14	2.0E-06	2.8E-15	7.8E-15
Dichloromethane	1.1E-06	4.1E-13	1.1E-12	1.1E-06	5.9E-13	1.7E-12	1.1E-06	2.7E-13	7.5E-13
Chlorinated Monocyclic Aromatics									
Hexachlorobenzene	4.3E-06	3.3E-13	9.1E-13	4.3E-06	4.7E-13	1.3E-12	4.3E-06	2.1E-13	6.0E-13
Pentachlorophenol	1.6E-10	6.2E-11	1.7E-10	1.6E-10	9.2E-11	2.5E-10	1.6E-10	5.9E-11	1.6E-10
Inorganics									
Arsenic	1.9E-05	2.8E-10	4.0E-10	1.9E-05	5.2E-10	7.5E-10	1.9E-05	2.0E-10	2.8E-10
Chemical Mixtures									
Stomach Carcinogens	4.3E-06	3.9E-11	1.1E-10	4.3E-06	5.8E-11	1.6E-10	4.3E-06	3.8E-11	1.0E-10

Table 7-81 Multi-Pathway Risk Assessment –Operational Cases Cancer Risk Results for the Solina Road, Tooley and Farmer Composite Receptor Groupings at 400,000 tpy

COPC	LCR/ILCR – Solina Road			LCR/ILCR – Tooley			LCR/ILCR – Farmer		
	Composite Receptor								
	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR
PAHs									
Benzo(a)pyrene TEQ	4.0E-06	6.6E-11	1.8E-10	4.0E-06	8.5E-11	2.3E-10	1.6E-05	3.7E-10	1.0E-09
VOCs									
Bromoform	2.4E-07	2.5E-15	7.1E-15	2.4E-07	4.5E-15	1.3E-14	3.6E-05	5.3E-11	1.5E-10
Carbon Tetrachloride	2.0E-06	9.5E-15	2.6E-14	2.0E-06	1.7E-14	4.7E-14	3.0E-04	1.0E-11	2.8E-11
Dichloromethane	1.1E-06	9.2E-13	2.6E-12	1.1E-06	1.6E-12	4.6E-12	1.7E-04	4.2E-11	1.2E-10
Chlorinated Monocyclic Aromatics									
Hexachlorobenzene	4.3E-06	7.3E-13	2.0E-12	4.3E-06	1.3E-12	3.6E-12	4.7E-05	7.0E-11	1.9E-10
Pentachlorophenol	1.6E-10	1.1E-10	2.9E-10	1.6E-10	1.4E-10	3.9E-10	1.6E-10	4.1E-10	1.1E-09
Inorganics									
Arsenic	1.9E-05	6.4E-10	9.3E-10	1.9E-05	1.2E-09	1.7E-09	9.6E-05	5.0E-09	7.2E-09
Chemical Mixtures									
Stomach Carcinogens	4.3E-06	6.6E-11	1.8E-10	4.3E-06	8.5E-11	2.3E-10	5.2E-05	4.2E-10	1.2E-09

Table 7-82 Multi-Pathway Risk Assessment –Operational Cases Cancer Risk Results for the Daycare Adult Receptor and the Recreation User – Sport and Recreation User - Camping Composite Receptor Groupings at 400,000 tpy

COPC	LCR/ILCR – Daycare			LCR/ILCR – Recreation User - Sport			LCR/ILCR – Recreation User - Camping		
	Adult Receptor			Composite Receptor					
	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR	Baseline Case - LCR	Project Alone Case - ILCR	Process Upset Case - ILCR
PAHs									
Benzo(a)pyrene TEQ	8.7E-08	2.7E-13	7.7E-13	7.1E-09	5.4E-14	1.5E-13	1.9E-08	1.2E-13	3.3E-13
VOCs									
Bromoform	3.4E-11	4.3E-19	1.2E-18	2.9E-12	8.8E-20	2.5E-19	7.5E-12	1.9E-19	5.3E-19
Carbon Tetrachloride	3.5E-10	6.3E-19	1.8E-18	2.8E-11	1.2E-19	3.5E-19	7.4E-11	2.7E-19	7.5E-19
Dichloromethane	3.1E-10	1.1E-17	3.2E-17	2.7E-11	2.3E-18	6.6E-18	7.0E-11	5.1E-18	1.4E-17
Chlorinated Monocyclic Aromatics									
Hexachlorobenzene	1.9E-09	5.7E-15	1.6E-14	1.6E-10	1.2E-15	3.3E-15	4.1E-10	2.5E-15	7.1E-15
Pentachlorophenol	3.1E-11	1.3E-14	3.7E-14	2.6E-12	2.7E-15	7.7E-15	6.8E-12	6.0E-15	1.7E-14
Inorganics									
Arsenic	2.0E-06	1.0E-11	1.5E-11	1.8E-07	1.4E-12	2.0E-12	4.7E-07	3.9E-12	5.7E-12
Chemical Mixtures									
Stomach Carcinogens	8.7E-08	2.7E-13	7.7E-13	7.1E-09	5.4E-14	1.5E-13	1.9E-08	1.2E-13	3.3E-13

Additional Risk Related to Specific Activities

As was conducted for the chronic non-carcinogenic results, in order to provide a more complete assessment of the impact of swimming, hunting and angling activities, the activity specific LCR and ILCR results have been added to the worst case resident receptor results (i.e. the Tooley residential receptor grouping). This assessment allows for potential risks to be placed in context such that the results represent the risk of a local resident swimming, hunting or angling in addition to his/her normal daily activities.

Table 7-83 and Table 7-84 shows LCR and ILCR estimates for both recreation user – swimming and hunting/angling receptors, as well as the combined results for the recreation user – swimming/hunting/angling receptors and Tooley residents, under the Baseline Case, Project Alone Case and Process Upset Case assessment scenarios, at 400,000 tpy. Baseline Case LCR results are provided for comparison – discussion of these results can be found in Section 7.9.2.3. Results of the assessment indicate that none of the predicted ILCR values exceed the regulatory benchmark for the Project Alone Case or Process Upset Case; therefore, it is not expected that the Project will pose any additional adverse cancer risk to the health of local recreational swimmer and hunting/angling receptors at 400,000 tpy.

Additionally, the additive LCR and ILCR of stomach carcinogens was assessed. Interpretation of the results is difficult as there is no regulatory benchmark against which to measure the results of the analysis of chemical mixtures.

Table 7-83 Multi-Pathway Risk Assessment –Operational Cases Cancer Risk Results for the Composite Swimmer Receptor and Tooley Resident Recreational Swimmer Composite Receptor at 400,000 tpy

COPC	LCR/ILCR - Recreational Swimmer			LCR/ILCR - Recreational Swimmer		
	Composite Receptor - Swimmer			Composite Receptor - Tooley Resident Swimmer		
	Baseline Case - LCR	Project Alone - ILCR	Process Upset Case – ILCR	Baseline Case - LCR	Project Alone - ILCR	Process Upset Case - ILCR
PAHs						
Benzo(a)pyrene TEQ	1.6E-07	3.3E-12	9.1E-12	4.2E-06	8.8E-11	2.4E-10
VOCs						
Bromoform	3.2E-09	3.5E-12	9.9E-12	2.4E-07	3.5E-12	9.9E-12
Carbon Tetrachloride	1.0E-07	7.9E-13	2.2E-12	2.1E-06	8.0E-13	2.2E-12
Dichloromethane	1.2E-08	1.1E-11	3.0E-11	1.1E-06	1.2E-11	3.5E-11
Chlorinated Monocyclic Aromatics						
Hexachlorobenzene	3.4E-08	5.5E-13	1.5E-12	4.3E-06	1.9E-12	5.2E-12
Pentachlorophenol	1.3E-09	6.5E-11	1.8E-10	1.5E-09	2.1E-10	5.7E-10
Inorganics						
Arsenic	2.5E-06	1.9E-09	2.7E-09	2.1E-05	3.1E-09	4.4E-09
Chemical Mixtures						
Stomach Carcinogens	1.7E-07	6.8E-12	1.9E-11	4.5E-06	9.1E-11	2.5E-10

Table 7-84 Multi-Pathway Risk Assessment –Operational Cases Cancer Risk Results for the Composite Hunter/Angler Receptor and Tooley Resident Hunter/Angler Composite Receptor at 400,000 tpy

COPC	LCR/ILCR – Hunter/Angler			LCR/ILCR – Hunter/Angler		
	Composite Receptor – Hunter/Angler			Composite Receptor - Tooley Resident Hunter/Angler		
	Baseline Case - LCR	Project Alone - ILCR	Process Upset Case – ILCR	Baseline Case - LCR	Project Alone - ILCR	Process Upset Case - ILCR
PAHs						
Benzo(a)pyrene TEQ	3.6E-06	7.9E-11	2.2E-10	7.6E-06	1.6E-10	4.5E-10
VOCs						
Bromoform	-	1.1E-12	3.0E-12	2.4E-07	1.1E-12	3.0E-12
Carbon Tetrachloride	-	3.1E-13	8.6E-13	2.0E-06	3.3E-13	9.1E-13
Dichloromethane	-	3.2E-13	9.0E-13	1.1E-06	2.0E-12	5.5E-12
Chlorinated Monocyclic Aromatics						
Hexachlorobenzene	9.8E-06	1.2E-10	3.5E-10	1.4E-05	1.3E-10	3.5E-10
Pentachlorophenol	-	8.2E-09	2.3E-08	1.6E-10	8.4E-09	2.3E-08
Inorganics						
Arsenic	1.5E-04	2.1E-08	3.1E-08	1.7E-04	2.2E-08	3.2E-08
Chemical Mixtures						
Stomach Carcinogens	3.6E-06	8.0E-11	2.2E-10	7.9E-06	1.6E-10	4.6E-10

DECOMMISSIONING AND ABANDONMENT

7.13 Risk Characterization - Decommissioning and Abandonment

Decommissioning and abandonment of the Site is not expected to occur for another several decades. Similar to the Construction Case, it is expected that decommissioning and removal of the Facility from the Site would entail short-term, localized emissions of air contaminants. While it is unlikely that these activities would significantly increase any potential risk to human health, it is expected that a more current assessment of these potential risks would be conducted prior to the commencement of decommissioning activities. Consequently, the prediction of risks to human health from decommissioning and abandonment has not been undertaken in this assessment.

7.14 Uncertainty Analysis for the Human Health Risk Assessment

In the risk assessment process, a number of conservative assumptions are required to quantitatively evaluate the risks to human health from exposure to the Project. These assumptions inherently add an element of uncertainty to the risk assessment. As a result, risk assessments tend to overstate the actual level of risk. Although many factors are considered in preparation of a risk analysis, analysis results are generally only sensitive to very few of these factors. The uncertainty analysis is included to demonstrate that assumptions used are conservative, or that the health analysis result is not sensitive to the key assumptions. The following table (Table 7-85) outlines the assumptions/uncertainties used in this risk assessment, and provides an evaluation of each assumption and an opinion as to whether the assumption will over-or-under estimate risk.

Table 7-85 Major Assumptions Used in the HHRA

Assumptions/ Uncertainty	Discussion of Conservatism	Analysis Likely to Overestimate/ Underestimate Risk
Exposure Assessment		
For analyses of non-carcinogenic exposures, infant and toddler receptors were selected.	Toddlers represent the most sensitive age group for assessing non-carcinogenic effects. Infants were included to assess the breast milk pathway. Resultant risks are generally over protective for an adult population. This approach is in accordance with standard practice (i.e., Health Canada and US EPA).	Neutral for Infants and Toddlers. Overestimate risks for Adults
Facility is not currently in operation; therefore emissions and ground level air concentrations were predicted by air dispersion models.	A substantive review of the available air models and the values used in the model was completed by the study team to ensure the results are appropriate for the assessment of health risks.	Neutral

Assumptions/ Uncertainty	Discussion of Conservatism	Analysis Likely to Overestimate/ Underestimate Risk
Behavioural and physical characteristics were assumed for receptors	After review by the study team, behavioural and physical characteristics were chosen for receptors in an attempt to overestimate potential exposures to receptors. Additional receptor assumptions are outlined below.	Overestimate
The hunter receptor was assumed to obtain all wild game from the lower Tooley watershed; while the angler receptor only caught fish from within the McLaughlin Bay Watershed.	Lower Tooley and McLaughlin Bay watersheds represent areas where the highest predicted COPC concentrations for wild game and fish were found, respectively. Although the likelihood of a hunter/angler being exclusive to these areas is very small, it will sufficiently overestimate the risks from exposure to this type of activity.	Overestimate
Estimation of ultrafine particles (Nanoparticles) using air quality emissions data	The Air Quality modeling predicts both particulate phase and vapour phase concentrations of COPC from the stack of the Thermal Treatment Facility. Form some COCP they are emitted as both a vapour (gas) and a particulate. By accounting for both phases of emissions the Study Team has captured the ultrafine (nanoparticle) phase of emissions.	Neutral
Exclusion of PCB dioxin-like congeners from the COPC list.	At the time of issuing the report it is acknowledged in Section 4.4 that there may be a low level of PCB dioxin-like congeners emitted from the facility. However, there was not enough information in the literature to complete a quantitative or even semi-quantitative assessment of the exposure and hence potential risk to receptors. The authors do not feel that this issue will result in a change to the overall risk predictions of dioxin and furans exposure, however, it is recommended that this be addressed as part of the stack monitoring program of dioxin and furans that has been proposed in the EA.	Neutral
Local farmers were assumed to grow 100% of agricultural products they consume.	The likelihood that 100% of agricultural products consumed would be grown onsite is small; however to be conservative this assumption is carried forward and thus will likely overestimate the risks to the farmer.	Overestimate
Each residential receptor is assumed to have a vegetable garden and consume 100% of their produce from the garden.	The likelihood that a local resident would grow and consume 100% of their produce from their local garden is small; however to be conservative this assumption is carried forward and thus will likely overestimate the risks to the local residents.	Overestimate

Assumptions/ Uncertainty	Discussion of Conservatism	Analysis Likely to Overestimate/ Underestimate Risk
The swimming receptor was assumed to have 16 swimming events per year at 2 hours per swimming event in the assessment area.	These conservative estimates were made by the study team based on the assumption receptors would swim only during the summer months (i.e., once a week for 4 months). Overall, these estimates likely overestimate actual swimming patterns and potential risks.	Overestimate
For assessment of carcinogenic substances, local residential and farmer were assumed to be present at their respective locations 24 hours/day, 7 days/week, 52 weeks/year for 75 years (i.e., from birth to 75 years of age).	This is a conservative assumption as the assessment did not consider any time spent away from the location during the 75 year exposure period for carcinogenic compounds.	Overestimate
Maximum predicted acute (*i.e.*, 1-h and 24-h) and chronic (*i.e.,* annual) ground-level air concentrations at each receptor location were used to evaluate all acute inhalation risk estimates.	Air quality modeling predicts the maximum concentration observed every hour over a 5 year period. It is possible that this maximum concentration may occur once (in one hour-long period over 5 years) or during multiple hour-long periods over 5 years. To be exposed, a receptor would have to be present at the same location at the same time the maximum predicated air concentration is observed; therefore the likelihood of this occurring is very small. Nevertheless, to err on the side of caution the inhalation assessment was carried out at maximum air concentrations.	Overestimate
Annual average COPC-specific ground-level air concentrations and deposition data were used to predict various environmental media concentrations (e.g., soil, garden produce, agricultural products, surface water, etc). Environmental media concentrations were predicted assuming deposition in the LRASA had already occurred for 30 years (i.e., lifespan of Facility assessed)	Location-specified deposition rates and ground level air concentrations were used to predict COPC concentrations in environmental media (soil, vegetation etc.), agricultural products and local produce. This is a conservative assumption in that in is unlikely that deposition rates would not vary over the assessment area. Additionally deposition was assumed to have occurred over the 30 year life span of the Facility. This is a conservative assumption in that it assumes the COPC concentrations would be at their maximum concentrations in environmental media.	Overestimate
Assumptions related to prediction of watershed concentrations	Estimating watershed COPC concentrations involves numerous assumptions related to the fate and transport of the COPC and physical processes such as surface run-off and soil erosion loads. US EPA (2005) guidance was followed and local and regional specific information was used to define watershed characteristics and soil erosion properties.	Neutral

Assumptions/ Uncertainty	Discussion of Conservatism	Analysis Likely to Overestimate/ Underestimate Risk
Food Chain Uptakes	Estimation of COPC uptake through the food chain involves the use of assumptions regarding many factors, including root uptake factors, air to plant transfer factors, biotransfer and Bioconcentration factors, and crop and soil ingestion rates (MOE; 2008c; US EPA, 1997).	Neutral
Derivation of Process Upset Conditions	The process upset conditions were derived by using the conservative methodology described in the HHRAP document (US EPA, 2005). The assumptions are conservative and tend to overestimate, rather than underestimate, risks. A discussion of the assumptions used in the Process Upset Cases can be found in Section 3.4.3.3. In addition, at the time of report preparation actual emission rates for the proposed Covanta facility were not available for upset conditions but it was confirmed that they believe that the use of the EPA approach is very conservative for emissions in upset conditions.	Overestimate
Laboratory method detection limits were used as background concentration for those media that were below detection limits.	The HHERA conservatively used the method detection limit for those COPC whose concentrations were not detected in environmental media. The MDL represents the maximum possible concentration of a chemical in a media sample. It is likely that actual concentrations are lower than the assessed MDL. As a result the use of an MDL is assumed to conservatively overestimate exposure.	Overestimate
The characteristics of a composite receptor have been provided by using a weighted average of the various variables, instead of considering each life-stage separately and then considering the exposure.	Both calculation methods should provide the same outcome.	Neutral
Toxicity Assessment		
Used most current toxicological values available (e.g., Health Canada, US EPA Integrated Risk Information System)	This approach is in accordance with standard practice, and provides the most current scientific basis with which to conduct a risk assessment.	Neutral
Use of surrogates	PAHs and dioxins and furans were assessed using a toxic equivalency factor (TEF) surrogate approach. The TEF approach for PAHs is based on a whole	Overestimate

Assumptions/ Uncertainty	Discussion of Conservatism	Analysis Likely to Overestimate/ Underestimate Risk
	mixture of PAH assuming that a combination is considered a dilution of a “surrogate” mixture of PAHs. The “surrogate” is generally considered a potent PAH mixture with well-defined chemistry and toxicology. The approach uses a single compound, benzo(a)pyrene (B[a]P), as the surrogate for the PAH fraction of other complex mixtures. Using this method, the risk from any PAH mixture of concern can be estimated as the product of the environmental levels of B[a]P and the estimate of risk attributable to mixtures per unit B[a]P. For dioxins, the emissions of all individual chemicals were summed to provide a total emission for the group. The chemical with the highest potency (2,3,7,8-TCDD) was chosen to represent the group and was compared to the sum of the individual emissions.	
Potential antagonistic, additive and synergistic effects of chemical mixtures from those COPC released from the Project were evaluated in this assessment.	Summation of hazard indices is only supportable when the individual compounds affect the same target organ and have similar mechanisms of action. In this risk assessment, the COPC-specific HQs and ILCRs for a receptor have been summed within each exposure scenario if the target organ and toxicologic endpoint were the same. Note, although chemicals in the environment are most often present in some sort of mixture, guidelines for the protection of human health are almost exclusively based on exposure to single chemicals. The lack of approaches to evaluate biological effects of chemical mixtures and the use of single-compound toxicity data makes their use highly speculative and thus are only provided in the HHRA for information purposes.	Neutral
Toxicity Reference Values (TRV)	For the derivation of TRVs for use in HHRA regulatory bodies adopt conservative assumptions to account for uncertainties (i.e. interspecies differences, individual variation, limitations in toxicological information, and extrapolation from acute to chronic exposures). Depending on the degree of uncertainty, typical factors will range from 100 to 10,000, with some being lower than 10 (in the case where solid human data is available).	Overestimate

Assumptions/ Uncertainty	Discussion of Conservatism	Analysis Likely to Overestimate/ Underestimate Risk
	The incorporation of these factors results in risk estimates that are extremely conservative and ensure that limited exposures above reference does concentrations will not result in adverse human health effects.	
Concentration ratios based on Regulatory Benchmarks are often derived based on policy and not only health	Benchmark values were only used where appropriate toxicological information was unavailable for a given COPC. A discussion of the appropriateness of the benchmark values used can be found in the Toxicological Profiles of the COPC **(Appendix H)**. In addition Table 7-86 provided below includes additional toxicological data retrieved as requested by the MOE, however, it did not change the conclusions of the risk assessment as shown in Table 7-87 and 7-88.	Neutral
Risk Characterization		
For evaluating exposures to non-carcinogenic COPCs, a target benchmark HQ of 0.2 was used.	The use of an HQ benchmark of 0.2 is conservative as it allows 80% of the tolerable daily intake of a chemical to be received from other sources, including background.	Neutral
ILCR set to 1 in 1,000,000 (10^{-6}) for evaluating exposures to carcinogenic COPC at the site.	This value has been adopted by MOE to represent an “acceptable” benchmark risk for carcinogenic substances. In comparison, Health Canada uses target level of risk of 10^{-5} or 1 in 100,000.	Neutral
Some potential risks identified were wholly based on the use of MDLs	As previously stated, the use of MDLs in place of actual chemical concentration is a conservative estimate meant to ensure any and all potential risks to receptors in the area have been captured. It is anticipated that actual risk levels would be below those presented in this risk assessment.	Overestimate

During the review of the July 31, 2009 HHERA Technical Study Report the MOE requested that a full review of inhalation benchmarks, guidelines, standards and criteria was performed such that the most appropriate TRVs are used in the HHRA. This process involved, verifying the underlying rationale behind each TRV labeled benchmark to determine the true nature of the value. Additionally, for each chemical where an air quality benchmark was used to calculate a concentration ratio (CR), a search of TRV values from recognized regulatory bodies such as the MOE, US EPA IRIS, Health Canada, ATSDR Minimum Risk Levels (MRL), California EPA, and RIVM was conducted to ensure that where available a reference concentration (RfC) TRV it took precedent over the use of a benchmark.

Table 7-86 provides the results for those chemicals and averaging times where benchmarks or RfCs were updated. For the remaining chemicals, either the existing RfCs were deemed to continue to be protective of health, or there were no RfCs available for those previously reported benchmarks.

Table 7-86 Updated TRVs that were retrieved for Benchmark Values Previously used in the HHRA.

COPC	Exposure Period	Previous TRV or Benchmark ($\mu g/m^3$)	New TRV ($\mu g/m^3$)
Ammonia	1-hour	3200 (CalEPA, 2008)	1182 (ATSDR, 2004)
Boron	1-hour	50 (TCEQ, 2009)	10 (ATSDR, 2007)
Acetaldehyde	1-hour	Not Evaluated	470 (CalEPA, 2008)
Formaldehyde	24-hour	65 (MOE, 2008)	9 (CalEPA, 2008)
1,1,2-trichloroethylene	Annual	54 (TCEQ, 2009)	2.3 (MOE, 2008)

Although for all chemicals these values were lower than the previous benchmarks used they did not affect the conclusions of the HHERA as presented in the July 31, 2009 report. Table 7-87 provides the results of using the updated values for the maximum ground level concentration inhalation assessment for the 140,000 tpy scenario, while Table 7-88 provides the results for the 400,000 tpy scenario. The values contained within the main body of this report were not updated to reflect these toxicity values, however, Appendix I-11 to Appendix I-14 contain all of the inhalation results using these updated values.

Table 7-87 Updated Inhalation Exposure Results at Maximum Ground Level Concentration – 140,000 tpy

COPC	Exposure Period	Air Concentration at Maximum GLC – Project Alone Case (µg/m³)	Air Concentration at Maximum GLC – Process Upset Case (µg/m³)	Previous CR Results					Updated CR Results				
				Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Ammonia	1-hour	2.0	20	-	6.1E-04	6.1E-04	0.0061	0.0061	-	0.0017	0.0017	0.017	0.017
Boron	1-hour	0.055	0.55	0.0037	0.0011	0.0048	0.011	0.015	0.019	0.0055	0.024	0.055	0.074
Acetaldehyde	1-hour	2.6E-07	2.6E-06	-	-	-	-	-	0.0091	5.6E-10	0.0091	5.6E-09	0.0091
Formaldehyde	24-hour	0.0024	0.024	0.052	3.7E-05	0.052	3.7E-04	0.052	0.38	2.6E-04	0.38	0.0026	0.38
1,1,2-trichloroethylene	Annual	7.1E-07	2.0E-06	0.0050	1.3E-08	0.0050	3.7E-08	0.0050	0.12	3.1E-07	0.12	8.7E-07	0.12

Table 7-88 Updated Inhalation Exposure Results at Maximum Ground Level Concentration – 400,000 tpy

COPC	Exposure Period	Air Concentration at Maximum GLC – Project Alone Case (µg/m³)	Air Concentration at Maximum GLC – Process Upset Case (µg/m³)	Previous CR Results					Updated CR Results				
				Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case	Baseline Case	Project Alone Case	Project Case	Process Upset Case	Process Upset Project Case
Ammonia	1-hour	4.2	33	-	0.0013	0.0013	0.010	0.010	-	0.0036	0.0036	0.028	0.028
Boron	1-hour	0.12	0.94	0.0037	0.0024	0.0061	0.019	0.023	0.019	0.012	0.031	0.094	0.11
Acetaldehyde	1-hour	4.2E-07	3.3E-06	-	-	-	-	-	0.0091	8.9E-10	0.0091	6.9E-09	0.0091
Formaldehyde	24-hour	0.0045	0.035	0.052	6.9E-05	0.052	5.4E-04	0.053	0.38	5.0E-04	0.38	0.0039	0.38
1,1,2-trichloroethylene	Annual	1.6E-06	4.4E-06	0.0050	2.9E-08	0.0050	8.2E-08	0.0050	0.12	6.9E-07	0.12	1.9E-06	0.12

7.15 Human Health Conclusions and Description of Environmental Effects

Overall, the results of the human health risk assessment indicate that it is not expected that the Project will result in any adverse health risk to local residents, farmers or other receptors in the Local Risk Assessment Study Area at 140,000 tpy. At 400,000 tpy, potential risk may exist for commercial/industrial or farmer infant receptors during periods of process upsets such as malfunctions of the air pollution control systems. Although some risk has been identified through the assessment of Baseline Case concentrations, this risk can be attributed to two significant factors:

1. Conservative modeling assumptions which overestimate the actual risk present.
   - Method detection limits were used to represent a number of chemical concentrations. This is a conservative approach as the true concentration of a COPC may be lower than the method detection limit or potentially non-existent.
   - In the absence of toddler-specific ingestion rates for homegrown produce and agricultural products, child-specific ingestion rates were used to represent the toddler. This is a conservative approach because ingestion rates are typically proportional to body weight.
2. Pre-existing natural or anthropogenic conditions which correlate to baseline risk.

7.15.1 Baseline Case and Baseline Traffic Case

Health risks were evaluated under the Baseline Case and Baseline Traffic Case scenario at each receptor location within the LRASA for all COPCs in air and other environmental media. The Baseline Case and Baseline Traffic Case is representative of pre-operational or existing conditions in the LRASA.

Acute Inhalation Health Risks

Acute inhalation health risks associated with baseline conditions were characterized by comparing measured 1-hour and 24-hour COPC concentrations with health based guidelines considered protective of human health. The resultant concentration ratio (CR) was then compared to a regulatory benchmark of 1.

The results indicate that no acute (1-hr or 24-hr) CR estimates exceeded the benchmark of 1 for the Baseline Case and Baseline Traffic Case, indicating that there is negligible risk to humans exposed to baseline air concentrations from all sources in the LRASA for a short duration.

Additionally, Baseline Case and Baseline Traffic Case CACs (including NO_2, SO_2, $PM_{2.5}$, and PM_{10}) were compared to WHO benchmarks for informational purposes. None of the relevant Baseline Case or Baseline Traffic Case CACs exceed the WHO benchmarks.

Chronic Inhalation Health Risks

Chronic inhalation health risks associated with baseline conditions were characterized by comparing measured annual average COPC concentrations with health based guidelines considered protective of human health.

Separate assessments were conducted for non-carcinogenic COPC and carcinogenic COPC. Chronic, non-cancer inhalation risks (expressed as CR values) assume that an individual in continuously exposed to a predicted annual air concentration. Carcinogenic health risks, expressed as LCRs or ILCRs, assume that individuals would be continuously exposed to the predicted annual air concentration over the course of a lifetime.

The results of the non-carcinogen analysis indicate that no chronic CR estimates exceeded the regulatory benchmark of 1 for the Baseline Case, indicating that there is negligible risk to humans exposed to baseline air concentrations from all sources in the LRASA over the long term.

Additionally, Baseline Case and Baseline Traffic Case CACs (including NO_2, SO_2, $PM_{2.5}$, and PM_{10}) were compared to WHO benchmarks for informational purposes. With the exception of Baseline Traffic Case annual nitrogen dioxide (CR = 1.1), none of the relevant Baseline Case or Baseline Traffic Case CACs exceed the WHO benchmarks. The exceedance of annual nitrogen dioxide was not unexpected as any urban area in Ontario would produce similar results. It should be noted that WHO benchmarks are not necessarily health-based and are only intended to act as guidelines for country-regulated air quality standards. When compared to the selected standards from Health Canada, this exceedance did not occur.

The results of the carcinogen assessment yielded a set of Lifetime Cancer Risk (LCR) results for each COPC, which are expressed on a total or all source basis. Since regulators have not recommended an acceptable benchmark LCR for exposure to carcinogens associated with baseline conditions, interpretation of the significance of these LCR values is difficult. Though the LCR values for some COPC exceed 1-in-1,000,000, this is not indicative of an unacceptable cancer risk level, as it incorporates all background sources, not just those specific to the proposed project.

Chronic Multi-Pathway Human Health Risks

Chronic multi-pathway health risks associated with baseline conditions were characterized by comparing measured COPC concentrations in various environmental media with health based guidelines considered protective of human health. The resultant hazard quotient (HQ) was compared to a regulatory benchmark of 0.2 (or 1 for methylmercury).

All predicted risk levels for all receptor-COPC combinations were below the regulatory benchmark of 0.2 (or 1 for methylmercury), with a few exceptions, described below. In all cases, the exceedances were deemed to be the result of conservative modeling assumptions, which in turn likely overestimated potential risks.

- Baseline Case Resident Infant – dioxins/furans and PCBs resulted in oral/dermal HQs of 3.8 and 11, respectively.
  - The risk identified was attributed entirely to the ingestion of breast milk pathway. Breast milk concentrations were modeled based on exposure of the infant's mother to measured baseline concentrations – most of which were based on MDLs, which represent an overestimation of the actual concentrations in environmental media.
- Baseline Case Resident Toddler – PCBs, arsenic, thallium resulted in an oral/dermal HQs of 0.49, 0.32, 0.25.
  - The risks identified were attributed to the ingestion of homegrown fruit and produce and soil. Modeled concentrations of PCBs, arsenic and thallium in these media were conservatively based on method detection limits and conservative model assumptions. With regards to soil and dust concentrations, arsenic is a naturally occurring element that is present in many soils across Canada. The baseline concentration (8 mg/kg) did not exceed the stringent Ontario Ministry of the Environment regulatory soil standard (11 mg/kg).
- Baseline Case Farmer Infant – dioxins/furans, PCBs and 1,2,4-trichlorobenzene resulted in oral/dermal HQs of 20, 117 and 0.21 respectively.
  - Much like the resident infant receptor, the risk identified pertaining to dioxins/furans, PCBs and 1,2,4-trichlorobenzene was attributed entirely to the ingestion of breast milk pathway. Breast milk concentrations were modeled based on exposure of the infant's mother to measured baseline concentrations – most of which were based on MDLs, which represent an overestimation of the actual concentrations in environmental media.
- Baseline Case Farmer Toddler - dioxins and furans, bromoform, chloroform, dichloromethane, 1,2,4,5-tetrachlorobenzene, antimony, arsenic, and beryllium resulted in oral/dermal HQs between 0.2 and 0.72.
  - With the exception of arsenic, all of the above mentioned exceedances were found to be primarily rooted in exposure to dairy concentrations which were conservatively based on MDLs; consequently, it is likely that these risks are overestimated.
  - With respect to arsenic (HQ = 0.57), over 70% of the risk was attributed to ingestion of dairy products (47%), as well as soil and dust (26%). Similar to the points above, dairy concentrations were conservatively based on MDLs which represent an overestimation of the actual concentration in dairy products. As previously stated, the baseline concentration of arsenic (8 mg/kg) did not exceed the stringent Ontario Ministry of the Environment regulatory soil standard (11 mg/kg).
- Baseline Case Farmer Toddler – total PCBs, carbon tetrachloride, 1,2,4-trichlorobenzene, and thallium resulted in oral/dermal HQs greater than 1.
  - All exceedances were found to be primarily rooted in exposure to dairy concentrations which were conservatively modeled as MDLs; consequently, it is likely that these risks are overestimated.

- Baseline Case Hunter/Angler Toddler – total PCBs, dioxins/furans, arsenic and cadmium resulted in oral/dermal HQs greater than 0.2.
  - All exceedances were found to be primarily rooted in exposure to fish and wild game which were conservatively modeled as MDLs; consequently, it is likely that these risks are overestimated.

In summary, the use of method detection limits to represent the concentration of COPC in food items likely over-estimated risks to those COPC with an HQ greater than 0.2. Additionally, for all COPC, the use of child-specific characteristics to represent toddler receptor consumption patterns represents a further conservative assumption which would lead to an overestimation of the potential risks.

7.15.2 140,000 tpy Operational Cases – Project Alone Case, Project Case, Process Upset Case, Process Upset Project Case and Traffic Case

Acute and chronic health risks associated with the air emissions from the Project were characterized by comparing predicted short-term and annual average concentrations with health-based guidelines considered protective of human health. Additionally, a multi-pathway assessment was conducted to determine risk levels associated with COPC in environmental media. The technical details of this assessment are similar to those of the Baseline Case. The Project Alone Case and Process Upset Case represent the contribution of the Project itself during periods of normal and upset operations, respectively. The Project Case and Process Upset Project Case represent the combined sum of the Baseline Case and the Project Alone Case/Process Upset Case. Finally, the Traffic Case represents the combined contribution of baseline conditions, off-site traffic, on-site traffic and stationary emission sources.

Acute Inhalation Health Risks

An acute inhalation assessment was conducted on predicted maximum ground level concentrations. This is expected to provide a realistically conservative and representative estimate of risk in the LRASA. An assessment of 15 receptor groupings was also conducted. For the purposes of the Process Upset assessment, it is assumed that the Facility operates under upset conditions for the entire duration of the assessment period (1- or 24-hours).

Results of the acute inhalation assessment on maximum ground level concentrations indicate that none of the predicted 1-hour or 24-hour air concentrations for all COPC at 140,000 tpy exceeded their relevant TRV for the Project Alone Case, Project Case, Process Upset Case, Process Upset Project Case or Traffic Case. Additionally, for these same COPC, health risks were not predicted at any of the 15 individual receptor groupings, which include schools, day cares, farms, current/future industrial/commercial areas, park/recreational areas, hospitals, retirement homes, and eight residential areas. Overall, it is not expected that concentrations of COPC from the Project, at 140,000 tpy, will pose any additional undue acute risk to the health of local human receptors.

Additionally, CACs (including NO_2, SO_2, $PM_{2.5}$, and PM_{10}) were compared to WHO benchmarks for informational purposes. With the exception of Process Upset Project Case 24-hr $PM_{2.5}$ (CR = 1.01) none of the relevant Baseline Case, Project Alone Case, Project Case, Process Upset Case, Process Upset Project Case or Traffic Case CACs exceed the WHO benchmarks. The exceedance of fine particulate matter is driven by baseline concentrations, and was not unexpected, as any urban area in Ontario would produce similar results. It should be noted that WHO benchmarks are not necessarily health-based and are only intended to act as guidelines for country-regulated air quality standards. When compared to the selected Canada-Wide Standard, this exceedance did not occur.

Chronic Inhalation Health Risks

Chronic health risks associated with the air emissions from the Project, and in combination with other sources of COPC, were characterized by comparing predicted annual average concentrations (including air concentrations resulting from the Project, regional sources, and measured background sources where available) with health based guidelines considered protective of human health. For the purposes of the Process Upset assessment, it is assumed that the Facility operates under upset conditions for 5% of the year with respect to CACs and metals, and for 20% of the year for all other COPC.

Separate assessments were conducted for non-carcinogenic COPC and carcinogenic COPC. Chronic, non-cancer inhalation risks (expressed as CR values) assume that an individual in continuously exposed to a predicted annual air concentration. Carcinogenic health risks, expressed as LCRs or ILCRs, assume that individuals would be continuously exposed to the predicted annual air concentration over the course of a lifetime.

The results of the non-carcinogenic assessment on maximum ground level concentrations indicate that none of the annual average concentrations of COPCs exceed their TRVs in the Project Alone Case, Project Case, Process Upset Case, Process Upset Project Case or Traffic Case at 140,000 tpy. Additionally, for these same COPC, health risks were not predicted at any of the 15 individual receptor groupings, which include schools, day cares, farms, current/future industrial/commercial areas, park/recreational areas, hospitals, retirement homes, and eight residential areas.

Additionally, CACs (including NO_2, SO_2, $PM_{2.5}$, and PM_{10}) were compared to WHO benchmarks for informational purposes. With the exception of Traffic Case annual nitrogen dioxide (CR = 1.1), none of the relevant Baseline Case, Project Alone Case, Project Case, Process Upset Case, Process Upset Project Case or Traffic Case CACs exceed the WHO benchmarks. The exceedance of nitrogen dioxide is driven by baseline concentrations, and was not unexpected, as any urban area in Ontario would produce similar results. As noted before, WHO benchmarks are not necessarily health-based and are only intended to act as guidelines for country-regulated air quality standards. When compared to the selected Health Canada standard, this exceedance did not occur.

Results of the carcinogen assessment on maximum ground level concentrations indicate that none of the ILCR values predicted for the carcinogenic COPC under the Project Alone scenario exceeded the regulatory acceptable cancer risk level of 1-in-1,000,000. Additionally, for these same COPC, health risks were not predicted at any of the 15 previously described individual receptor groupings.

Overall, it is not expected that the Project, at 140,000 tpy, will pose any adverse risk to the long-term health of local receptors.

Chronic Multi-Pathway Human Health Risks

A subset of 133 unique receptor locations in 14 receptor groupings within the LRASA were selected to undergo a multi-pathway exposure assessment to evaluate chronic exposure to COPC through contact with different local environmental media (e.g. soil, air, local produce, agricultural products, wild game and fish). With respect to the Process Upset scenarios, much like the chronic inhalation assessment, the multi-pathway assessment assumes operation under upset conditions occurs 5% of the year for metals, and 20% of the year for all other COPC.

Results of the Project Alone Case/Process Upset Case assessment indicate that, at 140,000 tpy, none of the predicted HQ or ILCR values exceeded the regulatory benchmark of 0.2 or 1-in-1,000,000, respectively. As a result, the Project itself is not expected to pose any additional undue risk to the health of local receptors. In some cases, where previously discussed Baseline Case risk existed, HQ values for the Project Case exceeded the established benchmark of 0.2. This was expected as the Project Case is the sum of Baseline Case and Project Alone Case risk estimates. In all cases, risk is entirely driven by baseline concentrations. As discussed previously above, it is expected that these baseline risk estimates are overstated due to the use of method detection limits and conservative ingestion rates.

7.15.3 400,000 tpy Operational Cases – Project Alone Case, Project Case, Process Upset Case, Process Upset Project Case and Traffic Case

Acute and chronic health risks associated with the air emissions from the Project were characterized by comparing predicted short-term and annual average concentrations with health-based guidelines considered protective of human health. Additionally, a multi-pathway assessment was conducted to determine risk levels associated with COPC in environmental media. The technical details of this assessment are similar to those of the Baseline Case and 140,000 tpy Operational Cases assessment. The Project Alone Case and Process Upset Case represent the contribution of the Project itself during periods of normal and upset operations, respectively. The Project Case and Process Upset Project Case represent the combined sum of the Baseline Case and the Project Alone Case/Process Upset Case. Finally, the Traffic Case represents the combined contribution of baseline conditions, off-site traffic, on-site traffic and stationary emission sources.

Acute Inhalation Health Risks

An acute inhalation assessment was conducted on predicted maximum ground level concentrations. This is expected to provide a realistically conservative and representative estimate of risk in the LRASA. An assessment of 15 receptor groupings was also conducted. For the purposes of the Process Upset assessment, it is assumed that the Facility operates under upset conditions for the entire duration of the assessment period (1- or 24-hours).

Results of the acute inhalation assessment on maximum ground level concentrations indicate that none of the predicted 1-hour or 24-hour air concentrations for all COPC at 400,000 tpy exceeded their relevant TRV for the Project Alone Case, Project Case, Process Upset Case, Process Upset Project Case or Traffic Case. Additionally, for these same COPC, with the exception of the current/future commercial/industrial receptor grouping, health risks were not predicted at any of the 15 individual receptor groupings, which include schools, day cares, farms, park/recreational areas, hospitals, retirement homes, and eight residential areas.

However, there was one exception for the Process Upset Case, as the maximum 1-hr concentration of hydrogen chloride modelled at the Commercial/Industrial receptor group resulted in a CR value of 1.0. This slight exceedance of the government benchmark of 1.0 occurred when the facility was operating under upset conditions where two of the three exhaust streams being affected, for the entire one hour period, and at the time of the worst meteorological conditions. The probability of this hypothetical situation actually occurring is expected to be very low.

Additionally, CACs (including NO_2, SO_2, $PM_{2.5}$, and PM_{10}) were compared to WHO benchmarks for informational purposes. With certain exceptions, none of the relevant Baseline Case, Project Alone Case, Project Case, Process Upset Case, Process Upset Project Case or Traffic Case CACs exceed the WHO benchmarks. The following CACs exceeded the WHO benchmarks:

- Process Upset Project Case 1-hr NO_2 (CR = 1.03)
- Process Upset Project Case 24-hr $PM_{2.5}$ (CR = 1.1)
- Traffic Case 1-hr NO_2 (CR = 1.3)

With the exception of Process Upset Project Case 1-hr NO_2, the exceedances are driven by baseline concentrations, and were not unexpected, as any urban area in Ontario would produce similar results. The exceedance of Process Upset Project Case nitrogen dioxide is driven by upset conditions, which conservatively assume that the Facility operates at maximum capacity while two of the three air pollution control units are not operational for the entire 1-hr exposure duration. As noted before, WHO benchmarks are not necessarily health-based and are only intended to act as guidelines for country-regulated air quality standards. When compared to the selected regulatory standards, these exceedances did not occur.

Chronic Inhalation Health Risks

Chronic health risks associated with the air emissions from the Project, and in combination with other sources of COPC, were characterized by comparing predicted annual average concentrations (including air concentrations resulting from the Project, regional sources, and measured background sources where available) with health based guidelines considered protective of human health. For the purposes of the Process Upset assessment, it is assumed that the Facility operates under upset conditions for 5% of the year with respect to CACs and metals, and for 20% of the year for all other COPC.

Separate assessments were conducted for non-carcinogenic COPC and carcinogenic COPC. Chronic, non-cancer inhalation risks (expressed as CR values) assume that an individual in continuously exposed to a predicted annual air concentration. Carcinogenic health risks, expressed as LCRs or ILCRs, assume that individuals would be continuously exposed to the predicted annual air concentration over the course of a lifetime.

The results of the non-carcinogenic assessment on maximum ground level concentrations indicate that none of the annual average concentrations of COPCs exceed their TRVs in the Project Alone Case, Project Case, Process Upset Case, Process Upset Project Case or Traffic Case at 400,000 tpy. Additionally, for these same COPC, health risks were not predicted at any of the 15 individual receptor groupings, which include schools, day cares, farms, current/future industrial/commercial areas, park/recreational areas, hospitals, retirement homes, and eight residential areas.

Additionally, CACs (including NO_2, SO_2, $PM_{2.5}$, and PM_{10}) were compared to WHO benchmarks for informational purposes. With the exception of Traffic Case annual NO_2 (CR = 1.1), none of the relevant Baseline Case, Project Alone Case, Project Case, Process Upset Case, Process Upset Project Case or Traffic Case CACs exceed the WHO benchmarks. This nitrogen dioxide exceedance is driven by baseline concentrations, and was not unexpected, as any urban area in Ontario would produce similar results. When compared to the selected Health Canada standard, this exceedance did not occur.

Results of the carcinogen assessment on maximum ground level concentrations indicate that none of the ILCR values predicted for the carcinogenic COPC under the Project Alone scenario exceeded the regulatory acceptable cancer risk level of 1-in-1,000,000. Additionally, for these same COPC, health risks were not predicted at any of the 15 previously described individual receptor groupings.

Overall, it is not expected that the Project, at 140,000 tpy, will pose any additional adverse risk to the long-term health of local receptors.

Chronic Multi-Pathway Human Health Risks

A subset of 133 unique receptor locations in 14 receptor groupings within the LRASA were selected to undergo a multi-pathway exposure assessment to evaluate chronic exposure to COPC through contact with different local environmental media (e.g. soil, air, local produce, agricultural products, wild game and fish). With respect to the Process Upset scenarios, much like the chronic inhalation assessment, the multi-pathway assessment assumes operation under upset conditions occurs 5% of the year for metals, and 20% of the year for all other COPC.

Results of the Project Alone Case/Process Upset Case assessment indicate that, at 400,000 tpy, with the exception of dioxins/furans in farmer infants, none of the predicted HQ or ILCR values exceeded the regulatory benchmark of 0.2 or 1-in-1,000,000, respectively. In some cases, where previously discussed Baseline Case risk existed, HQ values for the Project Case exceeded the established benchmark of 0.2. This was expected as the Project Case is the sum of Baseline Case and Project Alone Case risk estimates. In all cases, risk is entirely driven by baseline concentrations. As discussed previously above, it is expected that these baseline risk estimates are overstated due to the use of method detection limits and conservative ingestion rates.

The lone exception was an infant farmer modelled to be exposed to breast milk of a mother living in close proximity to the EFW facility under the Process Upset Case for dioxin and furan exposure. The farmer infant dioxin and furan HQ of 0.22 was slightly in excess of the government benchmark of 0.2. Again the Process Upset Case assumes that the Facility is operating at full capacity with two of the three exhaust streams being affected for 20% of the year. This is based on the very conservative US EPA default scenario for process upsets when there is a lack of empirical data. In addition, the sole source of food for an infant is breast milk, thus an acceptable benchmark for comparison of potential risk could have been selected as 1.0.

Overall, the results of the human health risk assessment indicate that, with the exception of a potential Process Upset scenario farm infant to dioxin and furan in breast milk, it is not expected the Facility will lead to any adverse health risks to local residents, farmers or other receptors in LRASA while operating at 400,000 tonnes/year. Regardless, in the event that a 400,000 tpy expansion of the facility is eventually contemplated, special consideration should be given at that time to ensure that Process Upset Conditions do not result in an undue risk to people living and working in the area surrounding the facility.

Overall Conclusion

Overall, the results of the human health risk assessment indicate that chemical emissions from the EFW Facility would not lead to any adverse health risks to local residents, farmers or other receptors in LRASA under either the initial operating design capacity of 140,000 tpy or the maximum design capacity of 400,000 tpy.

However, a limited number of chemicals under the Process Upset Case of the 400,000 tpy maximum design capacity resulted in slightly elevated potential risks above the government benchmarks for human health. These include:

- maximum exposure to the 1 hour hydrogen chloride concentration at the commercial/industrial receptor location resulting in a CR of 1.0 (benchmark CR=1.0);
- exposure of farmer infant to breast milk of a mother living in close proximity to the EFW facility under the Process Upset Case resulted in an infant dioxin and furan HQ of 0.22, slightly in excess of the government benchmark of 0.2.

These slight exceedances of benchmark risk levels were seen when the Thermal Treatment Facility at 400,000 tpy was operating under upset conditions, where two of the three exhaust streams are being affected for the entire one hour period, and at the time of the worst meteorological conditions. The probability of this hypothetical situation actually occurring is expected to be very low.

Regardless, in the event that a 400,000 tpy expansion of the facility is eventually contemplated, special consideration should be given at that time to ensure that Process Upset Conditions do not result in an undue risk to people living and working in the area surrounding the Facility.

8.0 ECOLOGICAL RISK ASSESSMENT

8.1 Introduction

The purpose of this ERA is to evaluate the potential that ecological receptors (*e.g.,* mammals, birds, plants, and fish) may experience adverse environmental effects as a result of exposure to chemical stressors. For this ERA, environmental effects refer to toxicologically-induced changes in the health of ecological receptors that may be exposed to COPC released into the environment, specifically the Local Risk Assessment Study Area (LRASA), as a result of Thermal Treatment related activities.

The potential for adverse environmental effects is quantified by comparing the amount of a substance that can be tolerated below which adverse environmental effects are not expected (*e.g.,* toxicity reference value (TRV) or toxicity benchmarks) to the amount of a COPC an organism is expected to be exposed to, or come into contact with, on a daily basis. The quotient of the two (referred to as an Ecological Hazard Quotient (EHQ) or a screening ratio (SR) when concentrations are compared to benchmarks), and the magnitude by which values differ from parity (*e.g.,* TRV = daily dose) is used to make inferences about the possibility of ecological risks.

In addition to COPC exposure, ecological receptors in the vicinity of the Project area may encounter non-chemical stressors such as light pollution, noise (*i.e.,* adverse sound quality) and habitat alteration. The effect of these non-chemical stressors on wildlife has not been assessed in this ERA but has been in other Jacques Whitford Technical Study Reports completed in support of the EA. The results of these assessments as they pertain to the ERA are summarized below.

- *Acoustic Assessment - Technical Study Report* (Jacques Whitford, 2009d, pg. 40);

Noise from the Project has some potential to create effects on wildlife within 300 to 500 m of construction activities and 250 to 300 m of operational process units. However, it is expected that wildlife would either naturally avoid these areas due to the human presence and activity, or would adjust to the noise. In all areas, occasional short-term loud sounds, particularly associated with construction activities, may produce retreat or startle responses in some wildlife.

- *Surface Water and Groundwater Assessment - Technical Study Report* (Jacques Whitford, 2009f, pg. 75);

The Central Lake Ontario Conservation Authority has suggested that discharge from this Site be subject to Enhanced Protection Levels; therefore, the Storm Water Management features for the Thermal Treatment Facility should be designed to the Enhanced Protection Level. Based on the combined effects associated with water resource management for the Facility, no negative effects on wildlife are anticipated.

- *Natural Environment Impact Assessment Report* (Jacques Whitford, 2009c, pg. 12).

It is expected that impacts to the terrestrial and aquatic features (*e.g.*, habitat alteration or removal) of the Site will be minimal to non-existent. Overall, the proposed development will not have a significant impact on the natural features and ecological functions of the Site provided the recommendations in the Natural Environment Impact Assessment Report are implemented.

8.2 Ecological Risk Assessment Framework

This ERA, like the HHRA, followed a recognized framework that progressed from a qualitative initial phase (*i.e.,* Problem Formulation), through exposure and hazard assessment, and concluded with a quantitative (semi-quantitative in the case of aquatic and terrestrial community-based receptors (as presented in section 8.6.2)) risk characterization (Figure 2-1). Following from this, uncertainties inherent to ERA are discussed, and conclusions and recommendations regarding ecological risk characterization presented. The risk assessment methodology for this ERA is based on a number of guidance documents, including but not limited to:

- Ontario Regulation 153/04 Record of Site Condition Regulation, Part XV.1 of the Environmental Protection Act: Guidance Protocol (MOE, 2004);
- A Framework for Ecological Risk Assessment (General Guidance) (CCME, 1996);
- Guidelines for Ecological Risk Assessment (US EPA, 1998); and
- US EPA Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities (US EPA, 1999).

8.3 Problem Formulation

As discussed in Section 2.1, the nature, scope, and goals of the risk assessment are defined in the Problem Formulation stage and established by addressing a series of key planning tasks. In the context of an ERA, the Problem Formulation stage serves to develop a focused understanding of how COPC could affect the health of ecological receptors in the LRASA.

The four key points addressed in the Problem Formulation prior to conducting the ERA are as follows.

- **Assessment Endpoint Identification**: In accordance with the objectives of this ERA, the assessment endpoints (the ecological entities and attributes to be protected) were identified (Section 8.3.1).
- **Chemical Screening**: Identification of the COPC evaluated in the ERA. This was achieved by comparing all chemicals in the emission inventory against specific physical and chemical property criteria (Section 8.3.2).

- **Identification of Ecological Receptor Locations and Receptors**: A representative group of floral and faunal species (ecological receptors) was selected from numerous locations in the LRASA (discussed in Sections 8.3.3 to 8.3.5).
- **Exposure Pathway Screening**: Identification of potential pathways and routes of ecological receptor exposure to be evaluated in the ERA (Section 8.4.1).

Results of the above points are illustrated in an Ecological Conceptual Site Model (ECSM), which provides a visual depiction of the relevant pathways linking COPC in various environmental media and biota to the ecological receptors and biota of interest in this ERA.

8.3.1 Assessment of Endpoints in ERA

Changes in individual health do not necessarily equate to eventual changes in population or community health over time. The goal of ERA is typically to identify potential risks to ecological receptors at the population level rather than at the individual level, with the notable exception being species of conservation concerns or species at risk as defined by federal and provincial regulation (*e.g., Species at Risk Act*). For the purpose of this ERA, the primary assessment endpoint was the protection of wildlife populations or communities (*i.e.,* the entity) based on predicted changes to growth, reproduction, or survival (*i.e.,* the attribute) (Suter, 2007).

8.3.2 Chemical Screening

COPC are compounds which are expected to be released from the Thermal Treatment Facility and are expected to have the potential to adversely affect ecological health if released in sufficient quantity.

A variety of sources were used to develop an expected atmospheric emissions inventory for the Project (as discussed in Section 4.0). This inventory underwent subsequent screening following nationally and internationally accepted criteria for the categorization of persistent and bio-accumulative chemicals (Environment Canada, 2006; Rodan *et al.,* 1999). Briefly, chemicals having a soil half-life greater than or equal to 182 days (6 months) and/or a log octanol-water partition coefficient (log K_{ow}) greater than or equal to five were considered persistent, and carried forward as COPC for evaluation in the ERA. Gaseous COPC were not retained for evaluation in the ERA because the inhalation pathway was not directly evaluated for ecological receptors (see Section 8.4.1). However, sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and hydrogen fluoride (HF) were retained in the ERA, specifically for the assessment of the effects on vegetation (phytotoxicity). A list of the COPC evaluated in the ERA is presented in Table 8-1.

Table 8-1 COPC Evaluated in the ERA

Metals	Chlorinated Monocyclic Aromatics	Chlorinated Polycyclic Aromatics	Polycyclic Aromatic Hydrocarbons	Volatile Organic Compounds
Antimony Arsenic Barium Beryllium Boron Cadmium Chromium (Total) Chromium (VI) Cobalt Lead Mercury (Inorganic) Methyl Mercury Nickel Phosphorus * Selenium Silver Thallium Tin Vanadium Zinc	1,2-Dichlorobenzene 1,2,4-Trichlorobenzene 1,2,4,5-Tetrachlorobenzene Pentachlorobenzene Hexachlorobenzene Pentachlorophenol	PCBs 2,3,7,8-TCDD TEQ (dioxin/furan)	Acenaphthene Acenaphthylene Anthracene Fluoranthene Fluorene Phenanthrene Benz(a)anthracene Benzo(a)pyrene Benzo(e)pyrene Benzo(a)fluorene Benzo(b)fluorene Benzo(b)fluoranthene Benzo(g,h,i)perylene Benzo(k)fluoranthene Chrysene Dibenz(a,c)anthracene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene Perylene Pyrene	Carbon Tetrachloride Chloroform Dichloromethane Trichlorofluoromethane 1,1,1-Trichloroethane Bromoform o-Terphenyl
CAC Assessed for Phytotoxicity				
Sulphur Dioxide (SO_2) Nitrogen Dioxide (NO_2) Hydrogen Fluoride (HF)				

* Phosphorus was assessed for potential risk to freshwater receptors and biota associated with sediment. In the case of the other receptors (birds, mammals, terrestrial invertebrates, and plants) the assessment was not performed as phosphorus is inherently non-toxic and is a required mineral.

8.3.3 Identification of Valued Ecosystem Components

8.3.3.1 Ecological Surveys

Comprehensive biological field surveys of the Site and the area within a 2 kilometer radius of the Site have been conducted to identify wildlife species and to assess habitat. Surveys were conducted in the aquatic environment to identify amphibian species and to determine the potential for seasonal or aquatic permanent fish habitat. The terrestrial surveys were conducted to identify plant, amphibian, reptile, bird and mammal species (Jacques Whitford, 2009c).

The results of these surveys assisted the ERA study team in the identification of Valued Ecosystem components (VECs) for the ERA. The following provides a brief summary of these surveys; individual assessment reports should be consulted for further details.

Mammalian Species

The flat, open terrain of the Site and surrounding 2 kilometers, offer few habitat opportunities for species unable to easily adapt to these conditions. Site specific wildlife surveys confirmed the presence of white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), and signs of rabbit browse, likely representing the eastern cottontail (*Sylvilagus floridanus*). It is anticipated that the Site also supports common near-urban mammalian species including striped skunk (*Mephitis mephitis*), small rodents (*e.g.,* masked shrew (*Sorex cinereus*), meadow vole (*Microtus pennsylvanicus*)), woodchuck (*Marmota monax*), and carnivorous predators including red fox (*Vulpes vulpes*) and coyote (*Canis latrans*).

Avian Species

Lake Ontario is approximately 400 m south of the Site, abutting the LRASA, and provides significant overwintering and migration staging habitat for a variety of birds along the length of its shoreline. Based on field surveys performed in 2007 and 2008, no significant roosting areas for birds or migratory stopovers existed on the Site.

The most abundant bird species observed during field surveys were common grackle (*Quiscalus quiscula*), ring-billed gull (*Larus delawarensis*), song sparrow (*Melospiza melodia*), savannah sparrow (*Passerculus sandwichensis*), and European starling (*Sturnus vulgaris*). Other species observed such as brown thrasher (*Toxostoma rufum*), willow flycatcher (*Empidonax traillii*), and eastern meadowlark (*Sturnella magna*) represent species common in shrub/successional and agricultural habitats. No nests were found on site during the mid-summer field survey in 2007, but five species with fledged young were observed, confirming on-site nesting activity for the following species: red-winged blackbird (*Agelaius phoeniceus*), house sparrow (*Passer domesticus*), eastern kingbird (*Tyrannus tyrannus*), common grackle, and savannah sparrow.

Amphibians and Reptiles

Due to the lack of permanent or vernal pool habitat onsite, very few amphibians or reptiles were expected to use the Site itself. Adaptable species, including the American toad (*Bufo americanus*), and the eastern garter snake (*Thamnophis sirtalis*) may have been present in the area, but were not seen during field surveys (Jacques Whitford, 2009c). The above listed species are all common and widespread in Ontario. They are also highly mobile species, and are able to relocate from disturbed areas providing suitable habitat is found in close proximity. The Natural Environment Impact Assessment Report (Jacques Whitford, 2009c) also noted the possible presence of the milksnake (*Lampropeltis triangulum*), a species designated as a Special Concern both provincially and nationally (NHIC, 2009).

Vegetation

Owing to the agricultural activities currently practiced on and around the Site, the Site contains a high representation of exotic species such as European buckthorn (*Rhamnus cathartica*), as well as weeds associated with agricultural fields such as common ragweed (*Ambrosia artemsiifolia)*. The native vegetation (trees, shrubs and herbaceous plants) consisted of common species of hedgerow habitats. No vegetation species of conservation concern were observed during the 2007 and 2008 site visits.

Fish

According to the Environmental Baseline Study Report (Jacques Whitford, 2009a) a total of 14 fish species were identified at the sample locations within 1 km of the Site in Tooley Creek. Due to the changing channel morphology this watercourse has the capacity to sustain both coldwater and warm water fish communities. Predators such as rainbow trout were caught in Tooley Creek, as well as several baitfish (blacknose dace (*Rhinichthys atratulus*) and creek chub (*Semotilus atromaculatus*)), panfish (pumpkinseed (*Lepomis gibbosus*)), white sucker (*Catostomus commersoni*) and a variety of other cyprinids. Fish communities associated with the creek mouths of Tooley and Robinson Creeks and the marshlands to the west at Second Marsh and McLaughlin Bay, include warm water species such as common white sucker (*Catastomus commersonii*), carp (*Cyprinus carpio*) brown bullhead (*Ameiurus nebulosus*), various sunfish (*Lepomis* spp.), yellow perch (*Perca flavescens*), northern pike (*Esox lucius*) and largemouth bass (*Micropterus salmoides*). The salmonids, with the exception of lake trout, in Lake Ontario may utilize these watercourses for spawning and rearing areas; young-of-the-year rainbow trout have been identified in spring seepage zones near the mouth of Tooley Creek (Warme Engineering and Biological Services. 2004).

8.3.4 Ecological Receptor Locations

Twenty-two ecological receptor locations were assessed in the ERA. Selection of receptor locations was based on consideration of several factors:

- Proximity to the proposed Thermal Treatment Facility (within 1 - 2 km) where the maximum ground level concentration is expected to occur for most of the COPC and characterization of the soil, sediment, surface water and biota has been conducted as part of the Environmental Baseline Study Report (Jacques Whitford, 2009a);
- Representation for each of the 14 selected watersheds;
- Representation of the habitats in the LRASA;
- Whether or not they were considered environmentally sensitive areas;
- Agricultural value (local farms from which selected agricultural produce has been collected as part of the Environmental Baseline Study Report (Jacques Whitford, 2009a));
- Recreational value (*e.g.,* bird watching, fishing); and
- Potential ecological importance (*i.e.,* habitats and species present) (NHIC, 2009; Friends of Second Marsh, 2009; Ontario Parks, (MNR, 2009)).

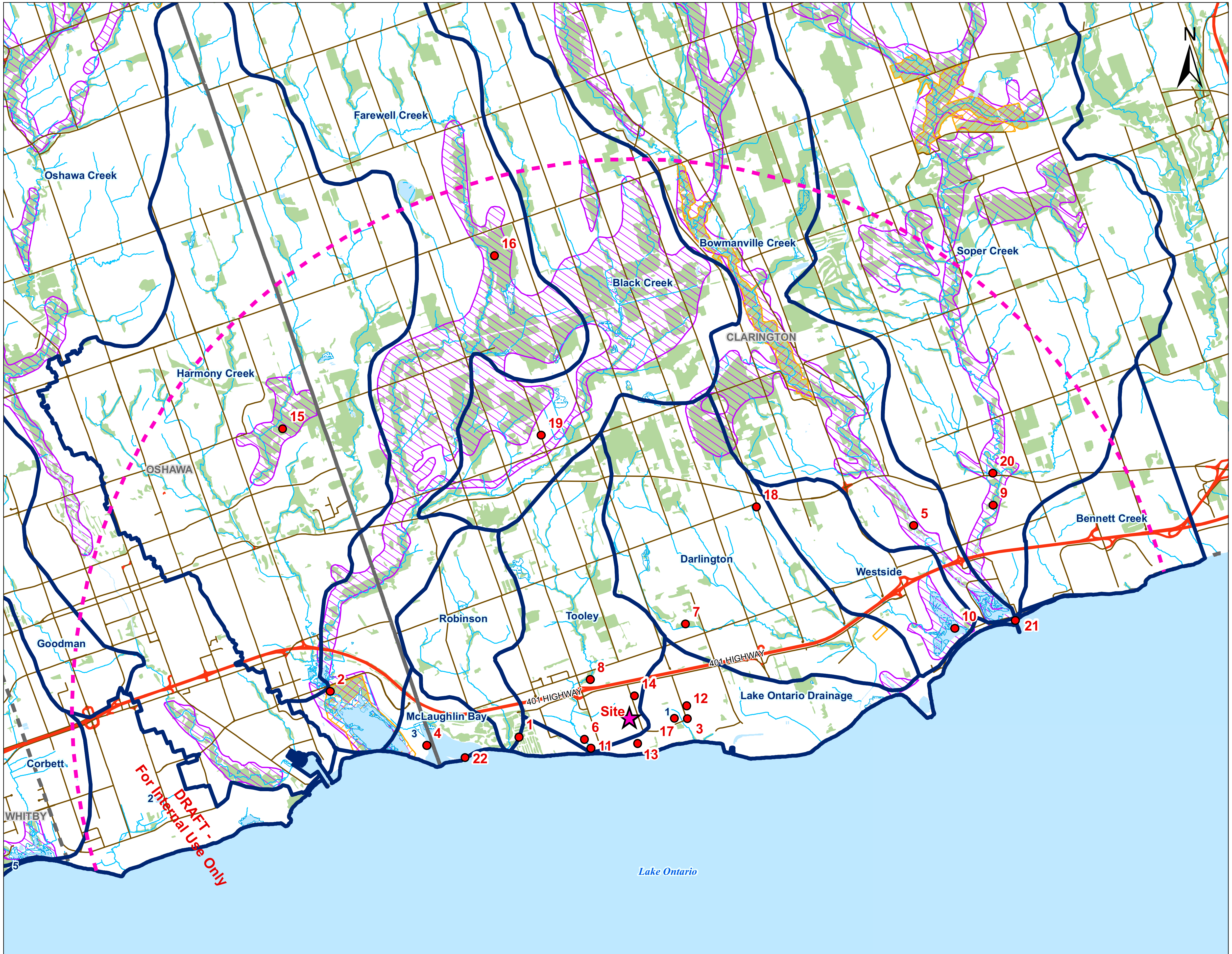
A list of the receptor locations evaluated in the ERA, along with locations identified on a map with the natural features of the LRASA (Figure 8-1), are provided in Table 8.2. An additional map (satellite image) of the LRASA and receptor locations is provided in Figure 8-2.

Table 8-2 List of Ecological Receptor Locations evaluated in the Ecological Risk Assessment

Label	Description	Habitat Type	Watershed	Approximate Distance from Facility (Km)
ECO 1	Darlington Provincial Park	T	Robinson Creek	2.1
ECO 2	Second Marsh Wildlife Area	T	Second Marsh	5.5
ECO 3	Darlington Waterfront Trail Entrance	T	Drainage - Lake Ontario	0.9
ECO 4	McLaughlin Bay Wildlife Reserve	T/A	McLaughlin Bay	3.8
ECO 5	Bowmanville Valley Conservation Area	A	Bowmanville Creek	6.3
ECO 6	Eco Baseline	T	Lower Tooley Creek	0.9
ECO 7	Baseline Rd / Rundle Rd	T/A	Darlington	2
ECO 8	Baseline Rd / Courtice Rd	T/A	Upper Tooley Creek	0.8

Label	Description	Habitat Type	Watershed	Approximate Distance from Facility (Km)
ECO 9	Soper Creek	A	Soper Creek	7.7
ECO 10	Bowmanville Marsh	A	Westside Marsh	6.2
ECO 11	South of Site	A	Lower Tooley Creek	0.8
ECO 12	Sports Fields/ Recreational	T	Drainage - Lake Ontario	1.0
ECO 13	Water pollution control plant	T	Lower Tooley Creek	0.5
ECO 14	Future Industrial	T	Lower Tooley Creek	0.4
ECO 15	Harmony Creek	T/A	Harmony Creek	8.3
ECO 16	Farewell Creek	T	Farewell/Black Creek	8.8
ECO 17	Farm A	T/A	Drainage - Lake Ontario	0.8
ECO 18	Farm B	T/A	Darlington	4.5
ECO 19	Farm C	T/A	Farewell/Black Creek	5.4
ECO 20	Robinson Creek	T/A	Soper Creek	8.0
ECO 21	Bennett Creek	T/A	Bennett Creek	7.4
ECO 22	Oshawa Creek Conservation Area	T	Oshawa Creek	2.8

Habitat Type: T = Terrestrial; A = Aquatic; T/A = Terrestrial and Aquatic.



YORK REGION AND DURHAM REGION RESIDUAL WASTE STUDY

Ecological Receptor Locations: Watersheds and Natural Features

Produced by Jacques Whitford under Licence with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2004-2009

Clarington 1 Site Area
Ecological Receptor Location
10km Local Risk Assessment Study Area
Collector
Highway
Areas of Natural and Scientific Interest
Environmental Sensitive Areas
Watershed Boundary
Wooded Area
Municipal Lower tier Boundaries
Hydrology
Watercourse
Waterbody
Wetland Area

0 0.5 1 1.5

Metres - 1:68,678

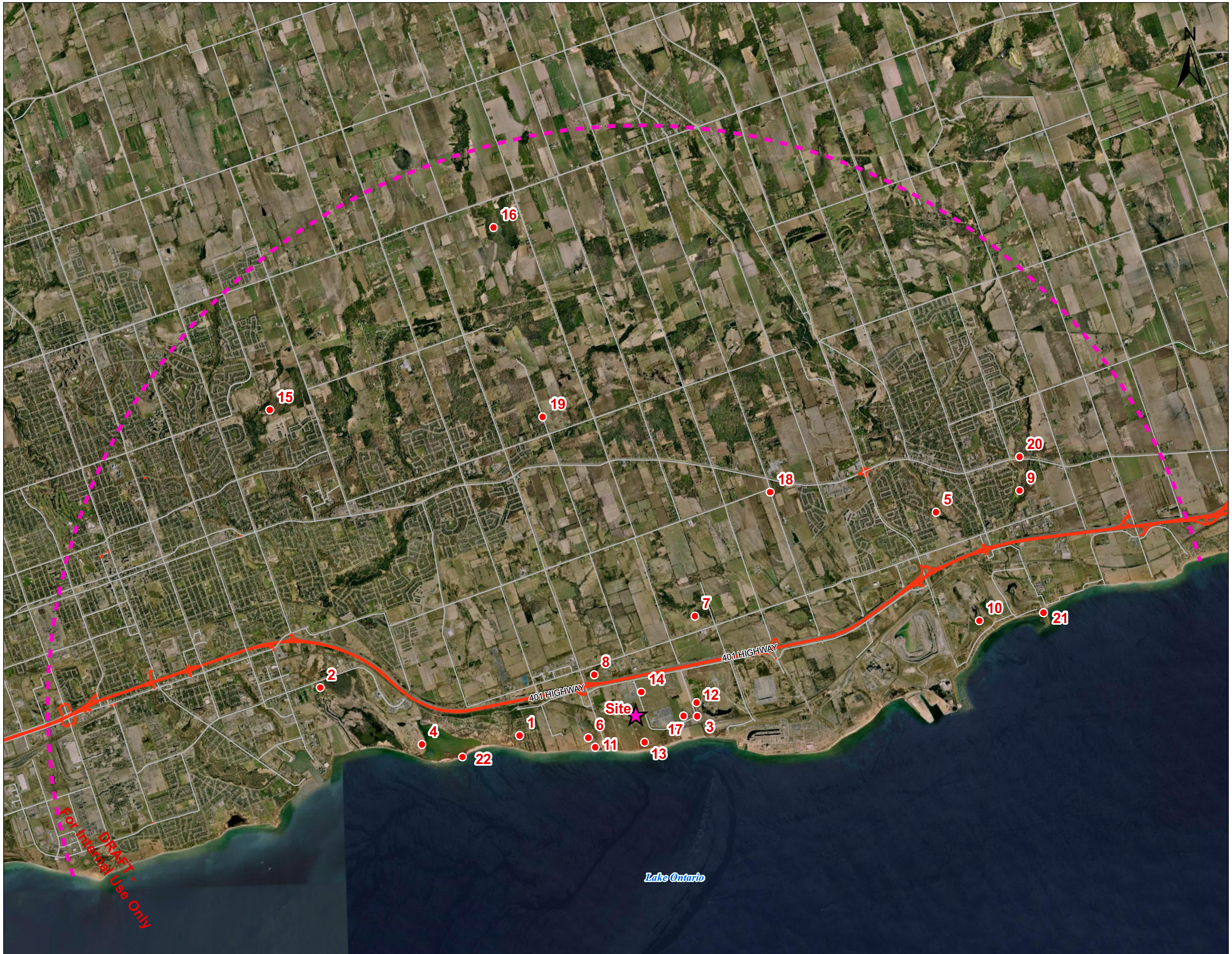
1009497-034

MB QC ON USA Area of Interest

Jacques Whitford

FIGURE NO. 8-1

Last Modified: April 29, 2009 By: S.Allen



YORK REGION AND DURHAM REGION
RESIDUAL WASTE STUDY

Ecological Receptor Location

Imagery: Apruil 2009, Google Earth Pro, Commercial License, 2008
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Ministry of Natural Resources © Queen's Printer for Ontario, 2004-2009

Clarington 1 Site Area

Ecological Receptor Location

10km Local Risk Assessment Study Area

Collector

Highway

0 0.5 1 1.5

Metres - 1:65,000

1009497-046

Jacques Whitford

FIGURE NO.

8-2

Last Modified: April 29, 2009 By: S.Allen

The following sections provide a brief description of each of the ecological receptor locations.

8.3.4.1 Darlington Provincial Park (Eco 1)

Located west of the proposed Thermal Treatment Facility, Darlington Provincial Park was chosen as an ecological receptor location primarily based on the presence of habitat suitable for terrestrial receptors. Open field habitat, meadows, and mixed forests support diverse vegetation communities as well as populations of white-tailed deer, small mammals, and many bird species.

8.3.4.2 Second Marsh Wildlife Area (Eco 2)

Slightly west of Darlington Provincial Park, the Second Marsh Wildlife Area is bordered by McLaughlin Bay to the south and HWY 401 to the north. Woodlot, wet meadow, thicket, upland, and marsh habitat provide suitable living conditions for approximately 380 plant species, 305 bird species, numerous species of mammals, reptiles, amphibians, fish and hundreds of species of insects (Friends of Second Marsh, 2009).

8.3.4.3 Darlington Waterfront Trail Entrance (Eco 3)

The Darlington Waterfront Trail Entrance, situated south-east of the proposed Thermal Treatment Facility, was chosen as an ecological receptor location based on its nature as a maintained trail. Low-lying forbs and grasses provide excellent forage and nesting habitat for small mammal species at this location, and consequently, potential hunting grounds for predators including the red fox and birds of prey.

8.3.4.4 McLaughlin Bay Wildlife Reserve (Eco 4)

The McLaughlin Bay Wildlife Reserve has been recognized as a Provincially Significant Wetland by the Ministry of Natural Resources (MNR) and as such, provides important habitat and migratory staging areas for many plants and animals. Common species utilizing this location permanently or transiently include the masked shrew, eastern cottontail rabbit, meadow vole, common muskrat, red fox, mink, white-tailed deer, red-tailed hawk, and many other mammals, birds, plants, reptiles, and amphibians. The McLaughlin Bay Wildlife Reserve is considered part of Lake Ontario and in this ERA was modeled as such.

8.3.4.5 Bowmanville Valley Conservation Area (Eco 5)

The Bowmanville Valley Conservation Area is a greenbelt situated north east of the proposed Thermal Treatment Facility. Bordered by residential dwellings, this receptor location offers wildlife refuge along the banks of Bowmanville Creek, which itself supports spawning trout populations originating from Lake Ontario. This receptor location was modeled as a primarily aquatic habitat supporting species such as mink, mallard duck, and aquatic community receptors, but also offering suitable foraging and breeding habitat for terrestrial mammals and birds.

8.3.4.6 Eco Baseline (Eco 6)

The Eco Baseline ecological receptor location is situated near the end of Courtice Road, upstream of ecological receptor location 11. Tooley Creek, meandering through this location, provides significant aquatic and riparian habitat for many aquatic and aquatic-dependent species, while a willow (*Salix* spp.) dominated tree stand and nearby cow pasture provide foraging and cover habitat for terrestrial species. Tooley Creek is known to support fish species preferring cool, clean waters (trout), as well as hardier species tolerant of warmer, more turbid water (chub, suckers). Visitation by neighbouring cattle was evident during the baseline sampling study, likely as a result of their usage of the location for forage and as a source of drinking water.

8.3.4.7 Baseline Road and Rundle Road (Eco 7)

This receptor location, situated near the intersection of Baseline Road and Rundle Road to the north east of the proposed Thermal Treatment Facility, provides a mix of aquatic and terrestrial habitat. A combined mix of open field and sheltered ravine habitat provides suitable foraging and breeding territory for mammals, birds, and aquatic species. Diverse vegetation communities (terrestrial, riparian, aquatic) also utilize this receptor location.

8.3.4.8 Baseline Road and Courtice Road (Eco 8)

This receptor location, situated near the intersection of Baseline Road and Courtice Road to the north west of the proposed Thermal Treatment Facility, provides a mix of aquatic (Tooley Creek) and terrestrial habitat similar to that described for Eco receptor location 7.

8.3.4.9 Soper Creek (Eco 9)

The Soper Creek receptor is situated to the north east of the proposed Thermal Treatment Facility and is bordered to the east by the Bowmanville Cemetery and to west by residential properties and parkland. Acting as a naturalized greenbelt and wildlife corridor between anthropogenically influenced lands, this location is characterized as field and forest habitat surrounding riparian vegetation along the banks of Soper Creek, and as such, provides valuable habitat for a wide variety of aquatic and terrestrial species.

8.3.4.10 Bowmanville Marsh (Eco 10)

The Bowmanville Marsh ecological receptor location, situated to the east of the proposed Thermal Treatment Facility, is recognized as a Provincially Significant Wetland by the MNR and as such, provides important habitat and migratory staging areas for many plants and animals. The rich habitat available for both aquatic and terrestrial species (both generalist and sensitive) combined with the ecologically valuable nature of this location makes it ideal for inclusion in this project.

8.3.4.11 South of Site, Eco Baseline S7 (Eco 11)

The South of Site, Eco Baseline S7 ecological receptor location, is situated at the end of Courtice Road, close to Lake Ontario. Tooley Creek, meandering through this location, provides significant aquatic and riparian habitat for many aquatic and aquatic-dependent species, while a willow dominated tree stand and nearby cow pasture provide foraging and cover habitat for terrestrial species. Tooley Creek is known to support fish species preferring cool, clean waters such as trout, as well as hardier species tolerant of warmer, turbid water such as chub and suckers.

8.3.4.12 Sports Fields / Recreational (Eco 12)

The Sports Fields / Recreational ecological receptor location, situated to the east of the proposed Thermal Treatment Facility, was characterized as open field habitat which was modeled to support both foraging and predatory species. While offering little in the way of natural cover, this location nonetheless represents a unique ecoregion based on this characteristic and so was deemed fit for inclusion in the assessment.

8.3.4.13 Water Pollution Control Plant (Eco 13)

The Water Pollution Control Plant ecological receptor location is situated to the south of the proposed Thermal Treatment Facility, sharing a property line. Cultivated field, open meadow, and early successional forest along fencerows support diverse vegetation communities as well as populations of mammals and birds. The use of the surrounding area for agricultural purposes (corn and alfalfa), results in the presence of suitable foraging opportunities for a variety of wildlife such as white-tailed deer, near-urban mammalian species (cottontail rabbit, raccoon), and many types of birds. Carnivores that may prey on these species are also expected to frequent this location (Warme Engineering and Biological Services, 2004).

8.3.4.14 Future Industrial (Eco 14)

The Future Industrial ecological receptor location is situated directly north of the proposed Thermal Treatment Facility. This location, representing land used for agricultural purposes (cash crops), offers unique challenges for ecological receptors utilizing this habitat for foraging purposes. The abundance of available feed and cover was deemed likely to support a wide range of terrestrial receptors, being especially important to omnivorous and granivorous birds (*i.e.,* wild turkey), but also attracting and sustaining small and large mammals alike. Rich, tilled soils sustain surface and burrowing invertebrate communities and by extension bird and mammal species which prey upon them.

8.3.4.15 Harmony Creek (Eco 15)

The Harmony Creek ecological receptor location is situated northwest of the proposed Thermal Treatment Facility, near the 10 km LRASA boundary. This location is similar in character to Eco receptor location 9 and provides valuable habitat for a wide variety of aquatic and terrestrial species.

8.3.4.16 Farewell Creek (Eco 16)

The Farewell Creek ecological receptor location is situated north of the proposed Thermal Treatment Facility, near the 10 km LRASA boundary. Early successional vegetation (field, meadow, and small trees) bordered by agricultural land and residential dwellings provides a wildlife corridor for terrestrial species, who may utilize adjacent agricultural fields for foraging purposes.

8.3.4.17 Farm A (Eco 17)

The Farm A receptor location is situated east of the proposed Thermal Treatment Facility and close to Eco receptor locations 3 and 14, thereby sharing many of the same ecological characteristics. Open habitat is prevalent (cleared land for agricultural purposes), and a minor watercourse (Osbourne Creek) meanders close by. Osbourne Creek is managed as a cool to coldwater fishery (Ian Kelsey, Central Lake Ontario Conservation Authority(CLOCA), pers. comm.).

8.3.4.18 Farm B and Farm C (Eco 18-19)

Ecological receptor locations 18 (Farm B) and 19 (Farm C), situated northeast and north of the proposed Thermal Treatment Facility, respectively, typify mixed aquatic and terrestrial habitats, the latter of which is best characterized as agricultural field.

The backyard of Farm B has been developed as a large garden extending the length of the property. It consists of numerous types of shrubs and plants and features two large mulberry trees (*Morus* sp.) which attract and feed birds.

8.3.4.19 Robinson Creek; Bennet Creek (Eco 20 & 21)

Ecological receptor locations 20 and 21, situated to the north- and southeast of the proposed Thermal Treatment Facility, respectively, are similar in character to Eco receptor location 9 and provides valuable habitat for a wide variety of aquatic and terrestrial species.

8.3.4.20 Oshawa Creek Conservation Area (Eco 22)

The final ecological receptor location, Oshawa Creek Conservation Area, is situated slightly east of ecological receptor location 1, and is similar in character.

8.3.5 Selected ERA Valued Ecosystem Components Assessed in the ERA

The purpose of this step is to identify and select a representative set of VEC that may be exposed to COPC emitted from the Thermal Treatment Facility. After reviewing the known species inventories of the LRASA and selecting receptor locations, a carefully selected, representative subset of ecological receptors was selected as the basis for this ERA. Ecological receptors were chosen for the ERA by focusing on wildlife species that were:

- Indigenous to the area;
- Most likely to receive the greatest exposure to contaminant releases due to their habitat and home range;
- Representative of various levels in the aquatic and terrestrial trophic web (*e.g.,* carnivore, herbivore, insectivore, piscivore); and
- Of cultural or economic significance (when possible).

Selection of ecological receptors ensured that each applicable habitat and trophic level in the LRASA was adequately represented. Moreover, each selected receptor was considered representative of other species occupying a similar position in the food web. In other words, results of the Risk Characterization stage for a selected ecological receptor can be used to make inferences about risk to other species occupying a similar level in the food web. For example, if results of the ERA indicate that no unacceptable risk is expected for American robin, a species that relies heavily on a diet of terrestrial invertebrates, then it can be expected that other invertivore bird species will be protected. Using these criteria, the ecological receptors assessed in the ERA are expected to provide adequate and conservative representation of the faunal and floral diversity in the LRASA.

The following mammalian species, (listed in alphabetic order), were identified as VECs for quantitative risk evaluation in the ERA:

- Common muskrat (*Ondatra zibethicus*);
- Eastern cottontail rabbit (*Sylvilagus floridanus*);
- Masked shrew (*Sorex cinereus*);
- Meadow vole (*Microtus pennsylvanicus*);
- Mink (*Mustela vison*);
- Red fox (*Vulpes vulpes*); and
- White-tailed deer (*Odocoileus virginianus*).

The following avian species, listed in alphabetic order, were identified as VECs for quantifiable risk evaluation in the ERA:

- American robin (*Turdus migratorius*);
- Belted kingfisher (*Ceryle alcyon*);
- Great blue heron (*Ardes herodias*);
- Mallard duck (*Anas platyrhynchos*);
- Red-tailed hawk (*Buteo jamaicensis*); and
- Wild turkey (*Meleagris gallopavo*).

A detailed summary of paramaters used for modelling each VEC (*e.g.,* body weight, water ingestion rate, dietary composition, and food intake rate) is provided in Appendix L. Briefly, for avian and mammalian receptors, food ingestion rates were calculated according to Nagy (1987), water ingestion rates from Calder and Braun (1983), and soil ingestion rates as modified from Beyer *et al.* (1994).

Common Muskrat *(Ondatra zibethicus)*

Source:http://blogs.evergreen.edu/coleman/

The muskrat (*Ondatra zibethicus*) is a highly aquatic rodent that is common throughout Canada except in the extreme north, living in saltwater and brackish marshes, freshwater creeks, streams, lakes, marshes and ponds (US EPA, 1993). It weighs approximately 1.17 kg. Home ranges vary depending on aquatic habitat and are approximately 0.048 ha to 0.17 ha (US EPA, 1993). Muskrats are prey for many species including foxes, hawks, minks, and otters, and feed mainly on aquatic vegetation, although they will consume terrestrial vegetation, benthic invertebrates, young birds, reptiles, amphibians, and fish (US EPA, 1993). Active year-round (US EPA, 1993), muskrats consume approximately 0.12 kg of wet weight food per day and 0.11 L of water or its equivalent per day. The muskrat is one of the most valuable fur animals in North America (US EPA, 1993). For this ERA, the muskrat's diet is modeled as including 12.5% terrestrial plant material, 80% aquatic plant material, 2.5% terrestrial mammals, 2.5% fish, and 2.5% benthic invertebrates, making it predominantly a primary consumer. Based on its consumption of these foods, the muskrat is estimated to incidentally ingest 9.9 x 10^{-5} kg/day of dry soil, and 2.1 x 10^{-3} kg/day of dry sediment.

Eastern Cottontail Rabbit (*Sylvilagus floridanus*)

The eastern cottontail rabbit *(Sylvilagus floridanus)* is the most widely distributed medium-sized rabbit (US EPA, 1993) and is found throughout Southern Canada in a variety of habitats including glades and woodlands, deserts, swamps, prairies, hardwood forests, rain forests, and boreal forests (US EPA, 1993). The eastern cottontail rabbit measures 35 to 43 cm in length and weighs 0.7 to 1.8 kg with females being slightly larger than the males (US EPA, 1993). Home range varies with season and gender. Males tend to have a larger home range from approximately 3.1 ha in fall to 7.8 ha in summer. Female home ranges vary from 1.5 ha in fall to 2.8 ha in spring (US EPA, 1993). The eastern cottontail rabbit is prey for large carnivorous birds and mammals and is also an important game animal (US EPA, 1993). The dietary composition of the eastern cottontail rabbit varies with the season. During the growing season they consume herbaceous plants (*e.g.*, grasses, clover etc.) and during the winter season they consume woody vines, shrubs and trees (US EPA, 1993). The eastern cottontail rabbit consumes approximately 0.24 kg of wet weight food per day, and 0.12 L of water or its equivalent per day, and for this ERA, is modeled as ingesting 100% terrestrial plant material, making it a primary consumer. Based on its consumption of these foods, the eastern cottontail rabbit is estimated to incidentally ingest 3.9 x 10^{-3} kg/day of dry soil.

Masked Shrew *(Sorex cinereus)*

Source:http://www.nps.gov/cebr/naturescien ce/images/Masked_Shrew.jpg

The masked shrew (*Sorex cinereus*) is the most widely distributed shrew in North America, and is found throughout most of Canada (Lee, 2001). It is common in moist environments and inhabits open and closed forests, meadows, riverbanks, lakeshores, and willow thickets (Lee, 2001). The masked shrew weighs approximately 0.005 kg (US EPA, 1993) and has home ranges varying from 0.2 to 0.6 ha in size (Saunders, 1988). Masked shrews are preyed upon by many small predators such as weasels, hawks, falcons, owls, domestic cats, foxes, snakes, and short-tailed shrews (Lee, 2001). The masked shrew does not hibernate (NWF, 2003) and feeds year-round on insect larvae (dormant insects in winter), ants, beetles, crickets, grasshoppers, spiders, harvestmen, centipedes, slugs, snails, and seeds and fungi (NWF, 2003; Lee 2001). It consumes approximately 0.003 kg of wet-weight food per day and 0.001 L of water or its equivalent per day. For this ERA, the shrew's diet is modeled as including 2.5% terrestrial plant material and 97.5% terrestrial invertebrates, making it predominantly a secondary consumer. Based on its consumption of these foods, the masked shrew is estimated to incidentally ingest approximately 4.4 x 10^{-5} kg/day of dry soil.

Meadow Vole *(Microtus pennsylvanicus)*

Source:http://talkaboutwildlife.ca/images/v6/ photographers/brent_johner/250/mead

The meadow vole (*Microtus pennsylvanicus*) is a small rodent (approximately 0.042 kg) which makes its burrows along surface runways in grasses or other herbaceous vegetation (US EPA. 1993). It is active year-round and is the most widely distributed small grazing herbivore in North America, inhabiting moist to wet habitats including grassy fields, marshes, and bogs (US EPA, 1993). Meadow voles are found throughout Canada, roughly to the limit of the tree line in the north. Home ranges vary considerably, from less than 0.0002 ha to greater than 0.0830 ha (US EPA, 1993). Meadow voles are a major prey item for predators such as hawks and foxes, and they feed primarily on vegetation such as grasses, leaves, sedges, seeds, roots, bark, fruits, and fungi, but will occasionally feed on insects and animal matter (US EPA, 1993; Neuburger, 1999). Meadow voles consume approximately 0.011 kg of wet-weight food per day and 0.006 L of water or its equivalent per day. For this ERA, the Meadow vole's diet is modeled as including 98% terrestrial plant material and 2% terrestrial invertebrates, making it predominantly a primary consumer. Based on its consumption of these foods, the Meadow vole is estimated to incidentally ingest approximately 3.2 x 10^{-5} kg/day of dry soil.

Mink *(Mustela vison)*

Source: Microsoft Clip Art Image Gallery

The mink (*Mustela vison*) weighs approximately 0.85 kg and is the most abundant and widely distributed carnivorous mammal in North America (US EPA, 1993). Mink are found throughout the continental portion of Canada, including Newfoundland, except in the most barren portions of northwestern Quebec and eastern Nunavut. Mink are active year-round and are associated with aquatic habitats such as rivers, streams, lakes, ditches, swamps, marshes, and backwater areas (US EPA, 1993). Home ranges vary considerably and can be between 0.78 ha to 380 ha (US EPA, 1993). Feeding extensively on small mammals, fish, amphibians, and crustaceans, as well as birds, reptiles, and insects depending on the season (US EPA, 1993), mink consume approximately 0.22 kg of wet weight food per day and 0.09 L of water or its equivalent per day. For this ERA, the mink's diet is modeled as including 55% small mammal or bird prey, 35% freshwater fish, and 10% benthic invertebrates, making it predominantly a secondary or tertiary consumer. Based on its consumption of these foods, the mink is estimated to incidentally ingest approximately 3.6 x 10^{-4} kg/day of dry soil, and 7.8 x 10^{-4} kg/day of dry sediment.

Red Fox *(Vulpes vulpes)*

The red fox (*Vulpes vulpes*) weighs approximately 4.5 kg, and is found throughout continental Canada but prefers areas with broken and diverse upland habitats (US EPA, 1993). Family territories consist of home ranges of individuals from the same family, and vary from approximately 57 ha to over 3000 ha (US EPA, 1993). Foxes are active year-round and prey heavily on small mammals such as voles, mice and rabbits, and will consume birds, insects, fruits, berries, and nuts; they are noted scavengers (US EPA, 1993). Red foxes consume approximately 0.76 kg of wet weight food per day and 0.38 L of water or its equivalent per day. For this ERA, the red fox's diet is modeled as including 10% terrestrial plant material, 5% terrestrial invertebrates, and 85% small mammal and bird prey, making it predominantly a secondary consumer. Based on its consumption of these foods, the red fox is estimated to incidentally ingest 3.0 x 10^{-3} kg/day of dry soil.

White-tailed Deer *(Odocoileus virginianus)*

The white-tailed deer (*Odocoileus virginianus*) is North America's most abundant and widely distributed large herbivore. They are a sexually dimorphic ungulate, with males weighing an average of 90 kg, compared to females at 60 kg (Alberta Gov, 1998). In the northern limits of their range, males will frequently exceed 100 kg (CWS & CWF, 2007). In Canada, white-tailed deer are found occupying a variety of terrestrial habitats from the east coast to south-central British Columbia. The home range of the white-tailed deer is quite small, generally less than 100 ha, but can be much larger depending on availability of food, water, and cover (Dewey, 2003; Sample, *et al.* 1996). White-tailed deer are entirely herbivorous, feeding on a wide variety of woody browse and herbaceous forage. In the spring and summer months, buds, grasses, herbs, and forbs comprise a major portion of the diet. In autumn and winter, deer will forage more on twigs, buds, acorns, corn, and even conifers (Dewey, 2003; CWS & CWF, 2009). On average, a white-tailed deer will consume approximately 4.6 kg of wet-weight food per day and 3.9 L of water or its equivalent per day (roughly 60 kg female). For this ERA, the white-tailed deer's diet is modeled as including 100% terrestrial plant material, making it a primary consumer. Based on its consumption of these foods, the white-tailed deer is estimated to incidentally ingest 3.8×10^{-2} kg/day of dry soil.

American Robin (*Turdus migratorius)*

Source: Microsoft Clip Art

The American robin (*Turdus migratorius*) is a medium-sized bird (approximately 0.08 kg; US EPA, 1993) that occurs throughout most of Canada during the breeding season and overwinters predominantly in the United States, but may be found in mild areas of Canada (CWS & CWF, 2009). Migration south from Ontario begins roughly in October and extends into November, and late migrants may still be seen in early December. Breeding adults typically return to southern Ontario around early March (migratory information; Environment Canada, 2005). Access to fresh water, protected nesting habitat, and foraging areas are important to the American robin. Nesting habitat includes moist forest, swamps, open woodlands, orchards, parks, and lawns (US EPA, 1993), and the American robin is well adapted to urban living, as well as having a summer range that extends up to the tundra. Foraging home ranges (for fruit, earthworms, and insects) are approximately 1500 m^2 to 8100 m^2 (US EPA, 1993). The American robin consumes approximately 0.065 kg of wet weight food per day and 0.01 L of water or its equivalent per day. For this ERA, the American robin's diet is modeled as including 52% terrestrial plant material and 48% soil invertebrates. Based on its consumption of these foods the American robin is estimated to incidentally ingest 4.9 x 10^{-4} kg/day of dry soil. For this Project, the American robin was considered a primary to secondary consumer. Despite the migratory patterns of robins, it was assumed for this ERA that they conservatively spend all 12 months of the year in the Project Area.

Belted Kingfisher *(Ceryle alcyon)*

Source:http://dsf.chesco.org/ccparks/lib/ccparks/

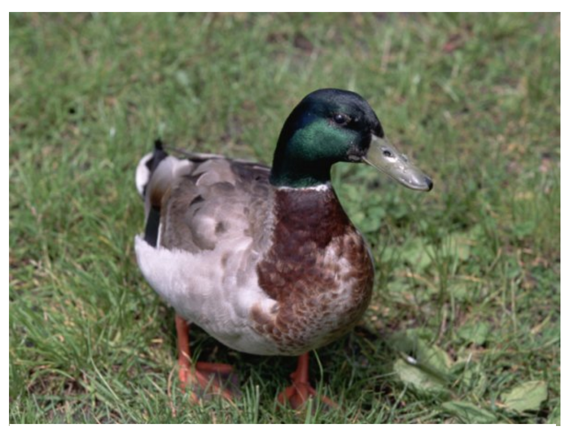
The belted kingfisher (*Ceryle alcyon*) occurs throughout southern Canada (as far north as James Bay, across the northern portions of the Prairie Provinces, into the Yukon in the west, and into northern Quebec and southern Labrador in the east). In southern Ontario, Belted kingfishers may be seen from early April until approximately November (migratory information; Environment Canada, 2005). Belted kingfishers are typically found along rivers and streams, lake and pond edges, or on seacoasts and estuaries (US EPA, 1993). They usually nest in burrows in a steep bank, preferably near water, and the tunnels may extend as far as 5 m before ending in a nest chamber. The Belted kingfisher weighs approximately 0.15 kg. Feeding territory sizes range from approximately 2 ha to greater than 10 ha (assuming a watercourse width of 50 m), depending on the season (US EPA, 1993). Feeding primarily on fish, they prefer stream riffles and waters that are free from thick vegetation in order to see their prey (US EPA, 1993). Belted kingfishers will also consume aquatic invertebrates, insects, mammals, birds, reptiles and amphibians (US EPA, 1993). They consume approximately 0.06 kg of wet weight food per day and 0.02 L of water or its equivalent per day. The belted kingfisher's diet is modeled as including 5% terrestrial invertebrates, 10% terrestrial mammals, 15% benthic invertebrates, and 70% freshwater fish. Based on its consumption of aquatic prey the belted kingfisher is estimated to incidentally ingest 3.5 x 10^{-4} kg/day of dry sediment. As a result of terrestrial prey consumption and incidental soil ingestion occurring while burrowing, the belted kingfisher is estimated to consume 8.4 x 10^{-4} kg/day of dry soil. For this Project the belted kingfisher was considered a tertiary consumer. Despite the migratory patterns of this bird, it was assumed that the kingfisher would be found in the LRASA for all 12 months of the year.

Great Blue Heron (*Ardes herdias)*

Source: Microsoft Clip Art Image Gallery

The great blue heron is a large wading bird (greater than 1m tall), weighing approximately 2.2 kg (US EPA, 1993). During the summer months, great blue herons can be found breeding in all provinces, except for Newfoundland and Labrador (also not found in Northern Territories). Great blue herons will overwinter in Canada only on the British Columbia and southern Maritime coasts (CWS & CWF, 2009). Great blue herons primarily inhabit aquatic and marine areas, spending most of their time foraging for fish in shallow waters of lakes, rivers, streams etc. Population density is highly variable since great blue herons are colonial nesters, occasionally forming colonies of several hundred nests per hectare (US EPA, 1993). Foraging distances from the colony are also variable, but typically less than 10 km (US EPA, 1993). The great blue heron feeds predominantly on small freshwater fish. Based on US EPA (1993), the great blue heron diet is modeled as being comprised of fish (94%), aquatic invertebrates (5%), and a small portion of birds and mammals (1%). Adults consume approximately 0.4 kg of wet weight food per day and 0.1 L of water or its equivalent per day. The great blue heron is a piscivore (type of carnivore) and is classified as tertiary consumers within the ecosystem (CCME, 1997). Based on its consumption of these foods, the great blue heron is estimated to incidentally ingest 4.14 x 10^{-4} kg/day of dry freshwater sediment. For this Project it was assumed this species will be found in the LRASA for all 12 months of the year.

Mallard Duck (Anas platyrhynchos)



Source: Microsoft Clip Art Image Gallery

The mallard duck *(Anas platyrhynchos)* is found throughout Europe, Asia, western and central North America (although generally not found in northern Quebec, Labrador, Newfoundland or the Maritime provinces), nesting near woodland lakes and streams, or in freshwater and tidal marshes, and adapting well to human activity in urban areas. The mallard duck weighs approximately 1.16 kg. Home range sizes vary from approximately 40 ha to 1,400 ha (US EPA, 1993). The mallard duck feeds primarily on aquatic invertebrates as ducklings and adults during the breeding season and on aquatic and terrestrial plants during the non-breeding season (CWS & CWF, 2009). In southern Ontario, mallard ducks may be seen from early spring until late fall, coinciding with the northern migration and breeding season (migratory information; Environment Canada, 2005). Breeding females consume approximately 0.61 kg of wet weight food per day and 0.07 L of water or its equivalent per day. The mallard duck's diet is modeled as including 12.5% terrestrial plant material, 12.5% aquatic plant material, and 75% benthic invertebrates. Based on its consumption of these foods the mallard duck is estimated to incidentally ingest 4.4 x 10^{-4} kg/day of dry soil and 1.2 x 10^{-2} kg/day of dry sediment. The mallard duck is an aquatic omnivore, and can be classified as either a primary or tertiary consumer depending on its diet (CCME, 1997). For this Project the mallard duck was considered as a tertiary consumer. Despite the migratory pattern of this species, it was assumed that they will be found in the LRASA for 12 months of the year.

Red Tailed Hawk (*Buteo jamajcensis*)

Source: Microsoft Clip Art Image

The red-tailed hawk (*Buteo jamaicensis*) is the most common and widespread hawk in North America (Cornell Lab of Ornithology, 2003). The red-tailed Hawk weighs approximately 1.1 kg (US EPA, 1993). It breeds throughout southern Canada except in Newfoundland (Tufts, 1986). Northern populations of the red-tailed hawk are migratory, while populations from southern Canada southward may be year-round residents (US EPA, 1993; Cornell Lab of Ornithology, 2003). They are typically found in open areas with scattered, elevated perches in a wide range of habitats including scrub deserts, plains and montane grasslands, agricultural fields, pastures, urban parks, patchy coniferous and deciduous woodlands, and tropical rainforests (Arnold and Dewey, 2002). Red-tailed hawks prefer a mixed landscape containing old fields, wetlands, and pastures for foraging, interspersed with groves of woodland, bluffs, or streamside trees for perching and nesting (US EPA, 1993). Red-tailed hawk home ranges vary in size from approximately 85 ha to greater than 2400 ha, depending on the habitat (US EPA, 1993; Arnold and Dewey, 2002). They generally hunt from an elevated perch, feeding primarily (approximately 80% to 85% of diet) on small rodents such as mice, voles, shrews, rabbits, and squirrels, as well as birds and reptiles (Arnold and Dewey, 2002). They consume approximately 0.19 kg of wet weight food per day and 0.06 L of water or its equivalent per day. The red-tailed hawks diet is modeled as including 100% terrestrial mammals. Based on its consumption of these foods, the red-tailed hawk is estimated to incidentally ingest approximately 6.6 x 10^{-4} kg/day of dry soil. For this Project the red-tailed hawk was considered a tertiary consumer and was considered to spend 12 months of the year in the LRASA.

Wild Turkey (*Meleagris gallopavo*)

Source:http://mayo.personcounty.net/Wildlife%20Page/Wild%20Turkey.jpg

The wild turkey (*Meleagris gallopavo*) is one of the most popular game birds in North America. Hunting of wild turkey is permitted in the LRASA from late April to late May (MNR, 2008). They are a large ground-dwelling, non-migratory bird with an average body weight of 4.2 kg for hens, and 7.4 kg for males (Dunning, 1993; in Sample et *al.*, 1996). Although widely distributed through most of the US and Mexico, wild turkeys inhabit only the Southernmost parts of Canada (Cornell Lab of Ornithology, 2003). The wild turkey is primarily herbivorous, consuming a diet of nuts, seeds, fruits, buds, grasses, and insects when available (Cornell Lab or Ornithology, 2003; Sample *et al*., 1996). Habitat typically consists of forest, open woodland, or agricultural areas, with abundant water supply. During winter months wild turkeys will live in groups of similar-sex individuals. For this Project the wild turkey was assumed to spend all 12 months of the year in the LRASA (migratory information; Environment Canada, 2005). The home range of the wild turkeys is highly variable, depending on availability of food, water, cover and season. Home ranges have been reported for the wild turkey at less than 200 hectares in winter, to more than 800 hectares in spring (Sample *et al*., 1996). The wild turkey consumes approximately 0.9 kg of wet weight food per day and 0.15 Liters of water or its equivalent per day (estimated using female body weight). The wild turkey's diet is modeled as including 90.0% terrestrial plant material and 10% soil invertebrates. The wild turkey is an herbivore and is classified as a primary consumer within the ecosystem (CCME, 1997). Based on its consumption of these foods, the wild turkey is estimated to incidentally ingest 2.8 x 10^{-2} kg/day of dry soil. For this ERA, this species was considered to spend 12 months of the year in the LRASA.

8.3.5.1 Community-Based Ecological Receptors

The primary exposure pathway for some flora and fauna is from direct contact with a single abiotic environmental medium (*e.g.,* soil). Accordingly, toxicity benchmarks are commonly derived based on COPC media concentrations and the adverse environmental effects thresholds for organisms that reside/rely on those media. Additionally, these benchmarks are typically generated using toxicity data for not one, but several species that rely on that medium, and are intended to represent a COPC concentration that will be protective of most, if not all species associated with that medium. For these reasons, the following ecological receptors were evaluated in this ERA at the community level, rather than as individual species:

- Freshwater receptors (*i.e*. fish, aquatic plants);
- Terrestrial plants;
- Benthic invertebrates; and
- Soil invertebrates.

8.3.5.2 Amphibians and Reptiles

To perform a quantitative ERA, appropriate toxicological data (*i.e.,* chronic, species specific) for ecological receptors is required. In a review of vertebrate toxicological data from 1972 to 1998, less than 3% of studies were conducted with amphibians and only 1.4% for reptiles (Sparling *et al*., 2000). Toxicological information for amphibians and reptiles is available from several publications including:

- Ecotoxicology of Amphibians and Reptiles (Sparling *et al.,* 2000);
- RATL: A Database of Reptile and Amphibian Toxicity Literature (Pauli *et al.* 2000) that updates the older Canadian Wildlife Service report, A Review and Evaluation of the Amphibian Toxicological Literature (1989): Technical Report Series No. 61;
- Ecotoxicity of Chemicals to Amphibians (Devillers and Exbrayat 1992);
- The US EPA's ECOTOX database (http://cfpub.epa.gov/ecotox/ (US EPA, 2008)) contains numerous results of amphibian and reptile toxicity tests; and
- The California Wildlife Biology, Exposure Factor, and Toxicity Database (Cal/Ecotox http://oehha.ca.gov/cal_ecotox/) contains a few references to limited physiological and toxicity data for amphibians and reptiles.

However, a review of these sources confirms that for most organic contaminants, with the possible exception of polychlorinated biphenyls (PCBs), organochlorine pesticides (OCs) and some metals, there is a lack of information on chronic toxicology and bioavailability of contaminants. Mainly body burden and acute toxicity (exposure durations of 96 hours or less) data are available, and the vast majority of laboratory amphibian toxicity tests have focused on changes to embryonic and larval life stages occurring from water-borne contaminant exposure only. Although embryonic and larval lifestages are recognized as being sensitive to environmental contaminants, Birge *et al.* and Suter *et al.,* (1975 and 1987 respectively *in* Sparling *et al.,* 2000) note that egg complement (number of viable eggs produced per female) and fecundity are more sensitive endpoints during the life history of organisms. These endpoints are related to maternal (*i.e.,* adult terrestrial) exposure and accumulation of environmental contaminants and to date, the current state of knowledge on amphibian and reptilian toxicology and exposure characterization (*e.g.,* from diffusion across the amphibian skin) is simply not adequate to permit an assessment of risk to adult receptors.

No amphibian or reptile species were identified during field programs conducted in July 2007 around the LRASA. Due to the lack of permanent or vernal pool habitat within the LRASA, very few reptiles and amphibians are expected to use the Site itself. Adaptable species, including the American toad (*Bufo* *americanus*) and the eastern garter snake (*Thamnophis sirtalis*) may be present in the hedgerow areas onsite, but were not seen during field surveys. These species are common and widespread in Ontario; they are also highly mobile species, and are able to relocate from disturbed areas providing suitable habitat is found in close proximity.

8.3.5.3 Species at Risk or Conservation Concern

Species at Risk (SARs) are defined as any wildlife species listed in Schedule 1 of *SARA* as "Extirpated", "Endangered" or "Threatened". Species of Conservation Concern include those that have a provincial ranking S3 and below as well as those designated as "Endangered", "Threatened" or of "Special Concern" federally or provincially.

It is difficult in ERAs to quantitatively address potential chemical risk to SARs and species of Conservation Concern, often due to the fact that species-specific quantitative information is lacking on their diet, inadvertent soil ingestion and water intake. Therefore, to accommodate these species in this ERA, ecological receptors found within the same class (occupying similar ecological niches) and within a similar trophic level (for which there is well established quantitative data), were used as surrogates.

Species at Risk or of Conservation Concern identified within the LRASA (based on a desktop search of Provincial and Federal databases (including but not limited to the Natural Heritage Information Centre's website (NHIC, 2009)), and the surrogate VEC (where appropriate) used to determine potential chemical exposure and risk in the ERA, is provided in Table 8.3. Twelve avian species, three vascular plant species, three insect species, four amphibian/reptile species, and one fish species were identified as potentially occurring within the LRASA. No mammalian SARs or Species of Conservation Concern were identified within the LRASA.

Table 8-3 Species at Risk or Conservation Concern in the LRASA.

Common Name	Scientific Name	MNR[1]	COSEWIC[2]	SARA[3] Rank	Observed During Field Survey?	Surrogate Species
Reptiles and Amphibians						
Blanding's Turtle	*Emydoidea blandingii*	Threatened	Threatened	S3	No	See Section 8.3.5.2
Stinkpot Turtle	*Sternotherus odoratus*	Threatened	Threatened	S3	No	See Section 8.3.5.2
Milksnake	*Lampropeltis triangulum*	Special Concern	Special Concern	S3[6]	No	See Section 8.3.5.2
Northern Map Turtle	*Graptemys geographica*	-	Special Concern	S1[4]	No	See Section 8.3.5.2
Fish						
Kiyi	*Coregonus kiyi*	Special Concern, Extinct	Special Concern, Extinct	S3	No	See Section 8.3.5.1
Avian Species						
Chimney Shift	*Chaetura pelagica*	Secure	Threatened	S4B	No	American Robin
Loggerhead Shrike	*Lanius ludovicianus*	Endangered	Endangered	S2B[5]	No	Red-tailed Hawk
Henslow's Sparrow	*Ammodramus henslowii*	Endangered	Endangered	S1B	No	American Robin/Wild Turkey
Least Bittern	*Ixobrychus exilis*	Threatened	Threatened	S3B	No	Great Blue Heron
Black-crowned Night-Heron	*Nycticorax nycticorax*	-	-	S3B	No	Great Blue Heron
Black Tern	*Chlidonias niger*	Special	Not At Risk	S3B	No	American Robin/Great Blue

Common Name	Scientific Name	MNR[1]	COSEWIC[2]	SARA[3] Rank	Observed During Field Survey?	Surrogate Species
		Concern				Heron
Red-shouldered Hawk	*Buteo lineatus*	-	Not At Risk	S4B[7]	No	Red-tailed Hawk
Cerulean Warbler	*Dendroica cerulea*	-	Special Concern	S1	No	American Robin/Wild Turkey
Hooded Warbler	*Wilsonia citrina*	-	Threatened	S1[4]	No	American Robin/Wild Turkey
Northern Bobwhite	*Colinus virginianus*	Endangered	Endangered	S1S2	No	American Robin
King Rail	*Rallus elegans*	Endangered	Endangered	S2B	No	Great Blue Heron
Yellow-breasted Chat	*Icteria virens*	Special Concern	Special Concern	S2S3B	No	American Robin/Wild Turkey
Lepidopterans						
Monarch	*Danaus plexippus*	-	Special Concern	S1	No	NA
Odonates						
Swamp Darner	*Epiaeschna heros*	-	-	S2S3	No	NA
Variegated Meadowhawk	*Sympetrum corruptum*	-	-	S3	No	NA
Vegetation Species						
Bushy Cinquefoil	*Potentilla supina ssp. paradoxa*	-	-	S4[7]	No	These species have not been identified within the LRASA during the 2007/2008 field suveys. Community
American Ginseng	*Panax quinquefolius*	-	Endangered	S1	No	

Common Name	Scientific Name	MNR[1]	COSEWIC[2]	SARA[3] Rank	Observed During Field Survey?	Surrogate Species
Butternut	*Juglans cinerea*	-	Endangered	S1	No	benchmarks when divided by an UF of 3 do not afford a level of protection at the individual level. Accordingly these species were not quantitatively assessed in this ERA.

Notes

[1] MNR, 2008

[2] COSEWIC, 2007

[3] SARA, 2007

[4] S1: Schedule 1 is the official list of species that are classified as extirpated, endangered, threatened, and of special concern (SARA, 2007)

[5] S2: Schedule 2 species listed in Schedule 2 are species that had been designated as endangered or threatened, and have yet to be re-assessed by COSEWIC using revised criteria. Once these species have been re-assessed, they may be considered for inclusion in Schedule 1 (SARA, 2007)

[6] S3: Schedule 3 species listed in Schedule 3 are species that had been designated as special concern, and have yet to be re-assessed by COSEWIC using revised criteria. Once these species have been re-assessed, they may be considered for inclusion in Schedule 1. (SARA, 2007)

[7] S4: Apparently secure; uncommon but not rare; some cause for long-term concern due to declines or other factors.

NA –not applicable

"-" – Information not available

8.4 Exposure Assessment

8.4.1 Exposure Pathway Screening and Conceptual Site Models

An exposure pathway is the potential route that a VEC can be expected to be exposed to COPC. For terrestrial wildlife receptors (*i.e.,* birds and mammals), exposure to COPC may occur through the following routes:

- dermal contact with soils;
- inhalation;
- ingestion of soil and water (*i.e.,* as a result of feeding, drinking, and grooming); and,
- ingestion of plants or prey species that have accumulated chemicals from the soil, and other media.

For aquatic organisms (*e.g.,* fish and aquatic (benthic) invertebrates) exposure to COPC may occur through the following routes:

- ingestion of sediment (*e.g.,* fish may ingest sediment contained within prey species);
- ingestion of aquatic prey;
- contact with sediment (*e.g.,* in the case of aquatic invertebrates and aquatic plants); and,
- ingestion / contact with surface water.

The principal exposure pathway for soil invertebrates, terrestrial plants, and aquatic plants is from direct contact with their associated media. For terrestrial plants and soil invertebrates, exposure to COPC in soil are responsible for most exposure, while contaminated sediments provide the most likely source of COPC exposure to aquatic benthic invertebrates and aquatic plants.

Potential exposure media and routes of exposure for VECs, and a rationale for the inclusion or exclusion from this ERA, are presented in Table 8-4.

Table 8-4 Rationale for Exposure Pathways Evaluated For Avian and Mammalian Receptors

Exposure Pathway	Inclusion in ERA	Rationale
Soil (and Sediment) Ingestion	✓	During the Project Cases, airborne emissions will deposit directly onto the soil and water. Wildlife species consume soil (and sediment) during foraging, preening and grooming. Therefore, this exposure pathway was evaluated in the ERA for receptors.
Ingestion of Terrestrial Vegetation, Soil Invertebrates and Small Mammal Prey	✓	During the Project Cases, gaseous and fugitive dust emissions may deposit directly onto plant surfaces and soils. COPC may subsequently be taken up into plants that are food sources for wildlife. Consumption of plants and/or soil invertebrates could expose certain VECs to COPC. Therefore, this exposure pathway was evaluated for wildlife receptors. Certain VECs also have the potential to be exposed to COPC via ingestion of prey that have themselves been exposed. For this reason, ingestion of prey was evaluated in the ERA.
Dermal Contact	×	Although mammals, birds and freshwater receptors may be exposed to COPC by direct contact with surface water and soil, absorption of COPC through the skin is not generally considered a major route of exposure (with few exceptions). The current state of knowledge on dermal toxicity does not permit a sound evaluation of risks from this type of exposure. Therefore, the dermal exposure route was not evaluated in the ERA.
Inhalation	✓	Wildlife may be exposed to COPC through inhalation of airborne emissions from the Project. Due to the conservative approach used in the HHRA for the evaluation of health risks from this pathway, inhalation was not explicitly considered in the ERA. Alternatively, it was concluded that if no unacceptable risks were estimated for human health, ecological receptors were assumed to be protected as well.
Water Ingestion/Contact	✓	During the Project Cases, COPC emitted may be deposited on nearby surface water bodies. Water bodies may receive COPC input via transport from terrestrial media (*i.e.,* surface soil runoff and groundwater discharge). Ecological receptors may be exposed to COPC concentrations in surface water if they drink from these sources or live within them (trough gill uptake).

Exposure Pathway	Inclusion in ERA	Rationale
Ingestion of Aquatic Invertebrates, Aquatic Plants and Fish	✓	During the Project Cases, COPC could enter surface water bodies and be taken up by fish, invertebrates, and aquatic vegetation. Wildlife (*e.g.*, muskrat) may then ingest "contaminated" prey or plants and become subsequently exposed to COPC.

8.4.2 Ecological Conceptual Site Model

The ECSM constructed for this ERA provides a simplified representation of the exposure pathways linking COPC emitted from Project related activities to each identified VEC (see **Figure 8-3**). Exposure pathways are designated in the ECSM by arrows leading from one compartment to another compartment, and boxes with an "✓" denote relevance to a particular VEC.

Each VEC was not necessarily evaluated at all receptor locations for this ERA. VECs were evaluated at a given location based on the type of habitat present at that location. The list of VECs evaluated at each receptor location, along with the primary habitat type at each location, is provided in Table 8-5.

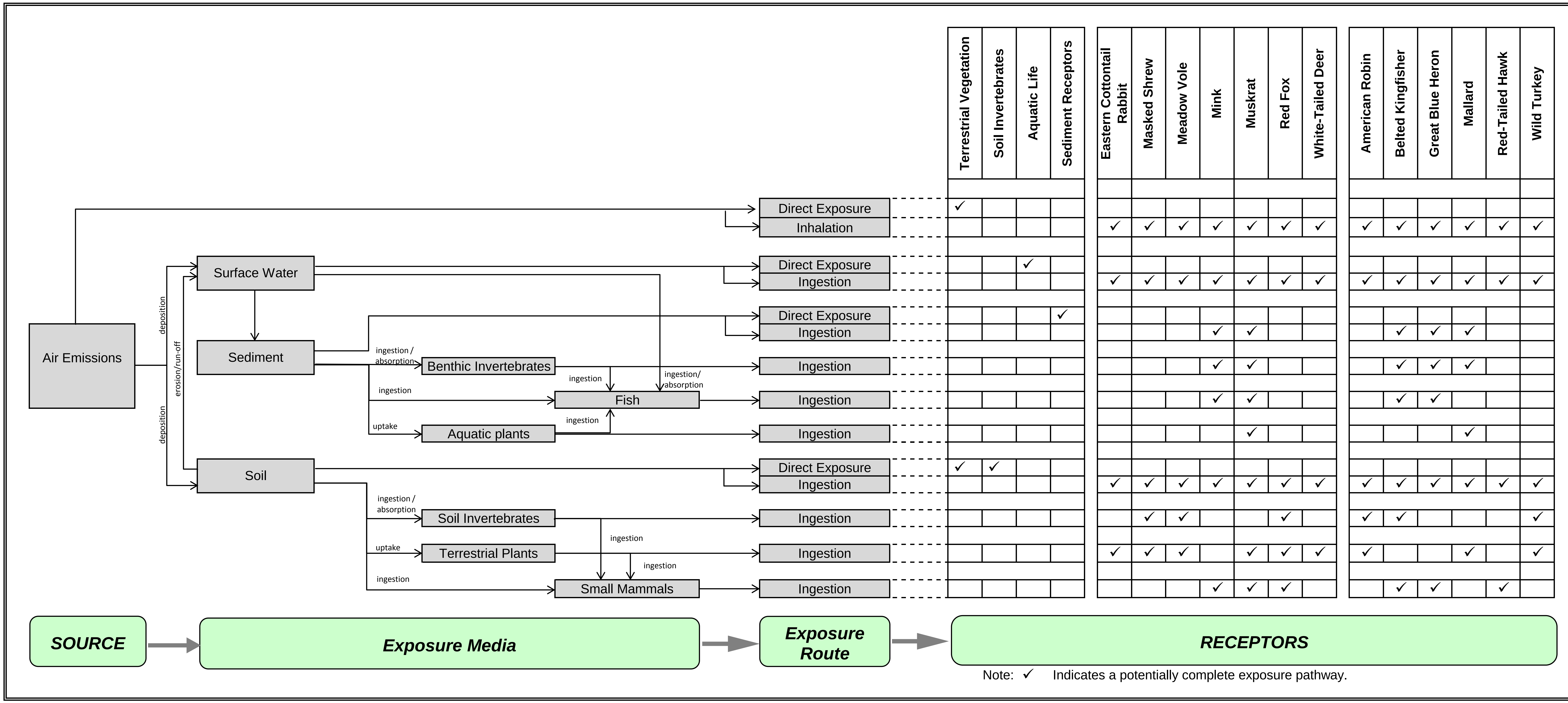


Figure 8-3: Ecological Conceptual Site Model Used in the ERA

Table 8-5 Specific Receptor Locations and VECs

Receptor Locations	Primary Habitat[1]	VEC																
		Common Muskrat	Eastern Cottontail Rabbit	White-Tailed Deer	Masked Shrew	Meadow Vole	Mink	Red Fox	American Robin	Belted Kingfisher	Great Blue Heron	Mallard	Red-Tailed Hawk	Wild Turkey	Terrestrial Plants	Soil Invertebrates	Aquatic Life[2]	Benthic Invertebrates
Darlington Provincial Park	T	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓		
Second Marsh Wildlife Area	T	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓		
Darlington Waterfront Trail Entrance	T	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓		
McLaughlin Bay Wildlife Reserve	T/A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bowmanville Valley Conservation Area	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Eco Baseline	T	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓		
Baseline Rd / Rundle Rd	T/A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Baseline Rd/Courtice Rd	T/A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Soper Creek	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Receptor Locations	Primary Habitat1	VEC																
		Common Muskrat	Eastern Cottontail Rabbit	White-Tailed Deer	Masked Shrew	Meadow Vole	Mink	Red Fox	American Robin	Belted Kingfisher	Great Blue Heron	Mallard	Red-Tailed Hawk	Wild Turkey	Terrestrial Plants	Soil Invertebrates	Aquatic Life2	Benthic Invertebrates
Bowmanville Marsh	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
South of Site, eco baseline S7	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sports Fields/ Recreational	T	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓		
Water pollution control plant	T	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓		
Future Industrial	T	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓		
Harmony Creek	T/A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Farewell Creek	T	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓		
Farm A	T/A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Farm B	T/A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Receptor Locations	Primary Habitat[1]	VEC																
		Common Muskrat	Eastern Cottontail Rabbit	White-Tailed Deer	Masked Shrew	Meadow Vole	Mink	Red Fox	American Robin	Belted Kingfisher	Great Blue Heron	Mallard	Red-Tailed Hawk	Wild Turkey	Terrestrial Plants	Soil Invertebrates	Aquatic Life[2]	Benthic Invertebrates
Farm C	T/A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Robinson Creek	T/A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bennett Creek	T/A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Oshawa Creek Conservation Area	T	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓		

Notes: [1]Primary habitat-T/A (terrestrial and aquatic); T (terrestrial); A (aquatic)

[2]Freshwater receptors (*i.e.*, fish) assumed to be present in all water bodies within a receptor location

8.4.3 Derivation of Exposure Point Concentrations

Using modeled emission and deposition rates for each COPC, environmental fate modeling was used to generate COPC concentrations in various environmental media and biota (soil, water, sediment, terrestrial plants, small (prey) mammals, and fish), for the Project Alone, and Process Upset Cases (Section 6.0). EPCs for the remaining biota (soil invertebrates, benthic invertebrates, aquatic plants) were calculated using COPC-specific uptake factors (UP) also known as bioaccumulation or bioconcentration factors (BAF/BCF) that describe the relationship between a specified chemical in a given abiotic medium to various types of biota (*e.g.*, the uptake of vanadium from sediment by aquatic plants). A detailed description of these uptake factors is provided in **Appendix K**.

The generalized equation used to calculate a COPC concentration in biotic tissue (such as soil invertebrates from a soil concentration) is as follows:

$$EPC_i = EPC_{soil} \; x \; UP$$

where:

EPC_i	exposure point concentration in biological compartment *i* (mg/kg wet weight)
EPC_{soil}	exposure point concentration in soil (mg/kg dry weight)
UP	Uptake Factor from soil to target biotic tissue *i* (dimensionless)

An analogous equation is used to calculate EPCs (on a mg/kg wet tissue basis) using water (mg/L) or sediment (mg/kg dry sediment) EPC calculations. Predicted EPCs for all ecological receptor locations are summarized in **Appendix M**.

For the Baseline Case assessment, EPCs for soil, water, sediment, terrestrial plants, terrestrial (small) mammals, and fish were derived from empirical measurements (Jacques Whitford 2009a) and not through fate and transport modelling (see section 5.1). For some COPC, however, empirical data was not obtained for each of these biota, and uptake factors (UP) were used to predict COPC concentrations where possible (**Appendix K**).

For all media other than soil, maximum measured concentrations were chosen as the appropriate exposure point concentrations.If a chemical was not detected in any of the samples, the baseline concentration was presented as the maximum laboratory method detection limit (MDL). However, as soil was considered to be sufficiently characterized during the baseline study, maximum measured concentrations, maximum MDLs, or the 95th upper confidence limits of the mean (UCLM) were used as exposure point concentrations, based on professional judgement (Section 5.1.2). A similar methodology was followed for concentrations of inorganics in small mammals.

These are generally considered as conservative approaches for estimating potential exposures for the purposes of completing human health or ecological risk assessments (Health Canada, 2004). Several methods were considered to deal with non-detects in this assessment, including use of one half of the laboratory MDL, use of the full laboratory MDL, or alternatively, assigning a randomly generated value between 0 and the laboratory MDL as the concentration. While it is acknowledged that in the case of baseline non-detects COPC concentrations may range anywhere between 0 and the laboratory MDL, the use of the laboratory MDL was considered a conservative and protective measure in the ERA.

8.4.4 Average Daily Dose for Mammalian and Avian Receptors

For mammalian and avian ecological receptors, exposure was calculated as the average daily dose (ingested), or ADD. The ADD can be defined as the amount of a COPC an ecological receptor might be exposed to on a mg/kg-bw/day basis. For each ecological receptor and COPC, the ADD was calculated by summing the intake from each applicable exposure pathway. The generalized equation for ADD is as follows:

$$ADD_j = IF_j \text{ x } AF_j \text{ x } EPC_j$$

For exposure pathway ‘j‘,

where: IF_j Intake Factor (kg contaminated medium/kg body weight - day)

AF_j Absorption Factor (default value of 1), and

EPC_j Exposure Point Concentration (mg chemical/kg medium)

The Intake Factor (IF) is not specific to each COPC, but is a characteristic of the receptor being evaluated. The IF was calculated for each exposure pathway using the receptor‘s medium-specific ingestion rate (IR), the fraction of the time spent on site (f_{site}, assumed to equal 100% for this ERA for all species excluding those known to overwinter outside of southern Ontario (American robin, belted kingfisher, great blue heron, and mallard duck)) and the receptor‘s body weight (BW) as follows:

$$IF_j = (IR_j \text{ x } f_{site})/BW$$

For details related to the body weight, dietary composition (plant, insect, prey), water, and soil ingestion rates for each of the receptors evaluated in the ERA, refer to **Appendix L**.

8.4.5 Exposure Analysis for Community-Based Receptors

The exposure assessment for community-based receptors does not require the use of UP or ADD calculations. Each of these receptors is primarily associated with a single environmental medium (*e.g.,* terrestrial plants and soil), and the potential for adverse environmental effects can be characterized by comparing COPC concentrations in each medium with corresponding toxicity benchmarks or appropriate guidelines. Therefore, the EPC associated with the relevant environmental medium for each community-based receptor is used as the exposure estimate in this ERA (relevant media are identified in the ECSM; Figure 8-3). Terrestrial plant exposure to the specific CAC (sulphur dioxide, nitrogen dioxide, hydrogen fluoride) was assessed using maximum predicted 1-hour, 24-hour, and annual average concentrations. Concentrations of CAC were calculated using atmospheric modeling, as described in Section 6.0.

8.5 Toxicity Assessment

The objective of the toxicity assessment is to identify the potential adverse health effects associated with each COPC as a consequence of chronic oral exposure. Using this knowledge, a Toxicity Reference Value (TRV) is generated, which defines the chronic daily dose of a COPC below which unacceptable adverse effects are not expected to occur. TRVs are specific to each COPC and ecological receptor evaluated in the ERA.

TRVs used in this risk assessment were determined from studies where endpoints were derived from the administered dose, rather than the absorbed dose (*i.e.*, absorbed / retained concentration of contaminant in the organ or body). This is a conservative approach because compounds are often administered in a more available form than would be found in the environment.

8.5.1 Derivation of Oral Toxicity Reference Values for Mammalian and Avian Receptors

The toxicological database in support of a TRV preferably includes a number of chronic or multi-generational exposure studies involving exposure of relevant test species (*i.e.,* the ecological receptor of interest or a phytogenetically similar species) to appropriate chemical forms of the substance of interest. Ideally, one or more relevant biological endpoints such as growth, reproductive effects, or survival were measured in the study. Databases that meet this requirement are available for some chemicals, but in most cases, available toxicity data is limited to studies conducted with laboratory animals (*e.g.,* mammals: mice, rats, rabbits; birds: quail, chicken, and ducks).

Toxicity Reference Values for this ERA are based on dose response studies, typically conducted with laboratory animals where the lowest observed adverse effects level (LOAEL) or no observed adverse effects level (NOAEL) has been quantified.

The preferred toxicity measure used for derivation of TRVs in this ERA is the LOAEL; however, in the absence of a suitable LOAEL, NOAEL-based TRVs were used. Generally, LOAELs used towards TRV derivation are based on long-term growth or survival, or sub-lethal reproductive effects determined from chronic exposure studies. As such, these endpoints are relevant to the maintenance of wildlife populations. The LOAEL represents a threshold dose at which adverse outcomes are likely to become evident (Sample *et al.,* 1996). This threshold is considered an appropriate endpoint for ERA since TRVs are used as the denominator in the ecological hazard quotient (EHQ) calculation (see section 8.6). Hazard quotients calculated with NOAEL-based TRVs are more conservative since NOAELs relate to the threshold at which no individual environmental effects from COPC exposure are observed.

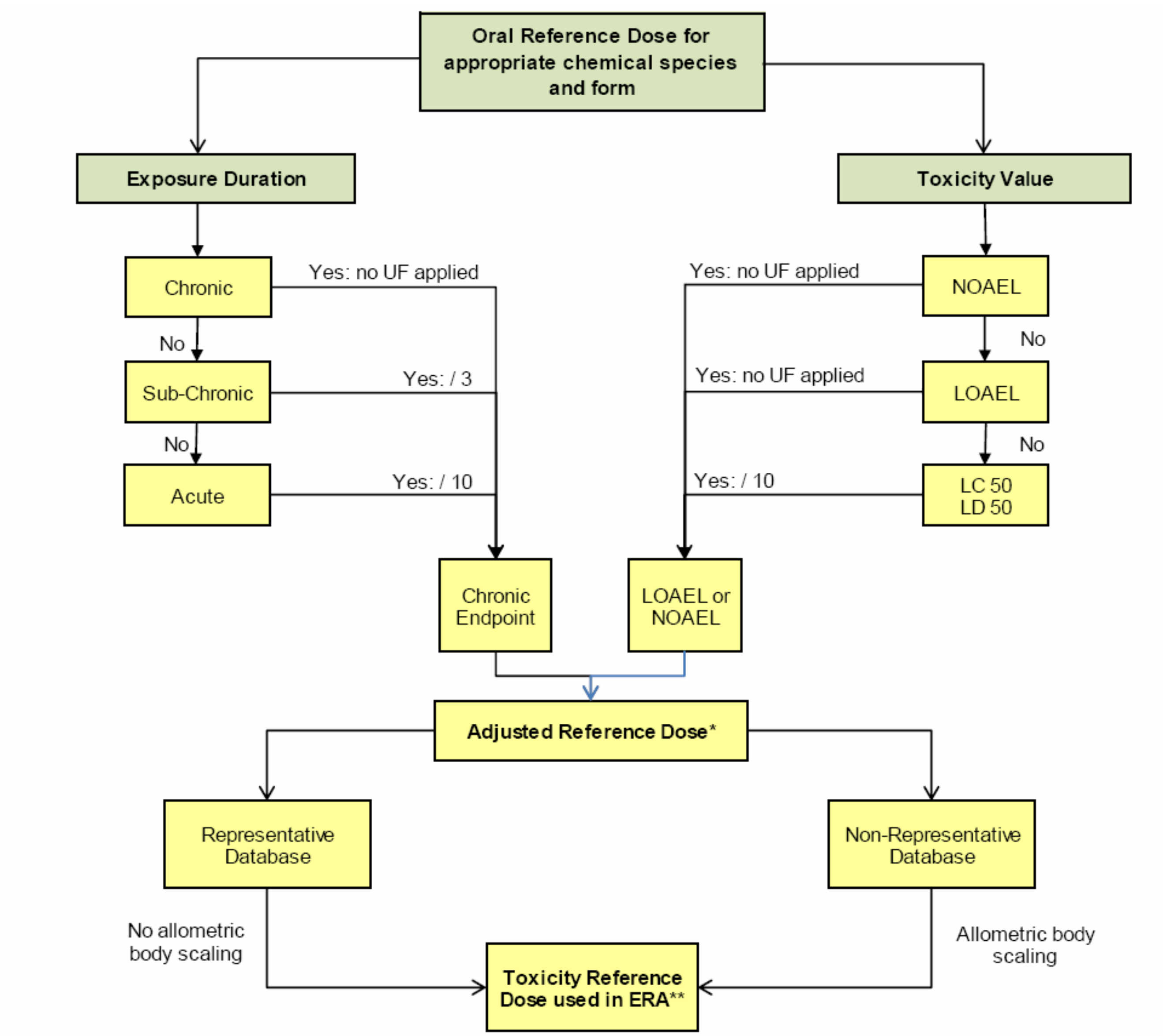
Numerous sources were reviewed to obtain the most relevant TRVs for VECs. Information sources included, but were not limited to:

- Ontario Regulation 153/04 Record of Site Condition Regulation, Part XV.1 of the Environmental Protection Act: Guidance Protocol (MOE, 2004);
- Oak Ridge National Laboratory Toxicity Benchmarks for Wildlife (Sample et al., 1996);
- US Environmental Protection Agency's Ecological Soil Screening documents;
- Agency for Toxic Substances and Disease Registry (ATSDR);
- Canadian Environmental Protection Act (CEPA), Priority Substance List Assessment Reports; and
- Primary scientific literature.

A detailed discussion regarding the sources of toxicity data and TRV derivation can be found in **Appendix J**.

8.5.2 Uncertainly Factors Applied in TRV Derivation

In human toxicology it has been standard practice to use toxicity data derived from laboratory animals (such as mice) and apply various safety, or uncertainty factors (UF) to obtain values that are assumed to be conservatively applicable to human individuals. These UFs have typically used factors of 10 in order to estimate risks to humans from animal data, with additional factors of 10 applied depending on what other assumptions are made (usually five more levels of uncertainty); therefore, UFs in human toxicology can range up to 10^5. Documentation from the US EPA (2002) recognizes that uncertainty factors can "build" upon each other to unreasonable magnitudes, and indicates that uncertainty values should range between 1 and 10, although values of 3 or 10 for ERAs are preferred. Figure 8-4 provides



*A NOAEL can be used if no appropriate LOAEL is available but the resultant RfD should be considered more conservative than if it was derived using a LOAEL. Refer to document text for details and application towards species at risk or conservation concern.

**No inter-class UF is used to derive TRVs (i.e., mammalian data is not adjusted for avian TRV).

Figure 8-4 Uncertainty Factors Used for Derivation of Ecological TRVs

8.5.3 Uncertainty Factors for Exposure Duration

In cases where a search of scientific data indicates a lack of chronic studies for a particular contaminant, UFs may be applied to adjust toxicity data to a chronic exposure basis. Acute studies are those that are of short duration, generally less than one week. Sub-chronic exposures are of longer duration (generally less than 90 days), but may be considered equivalent to a chronic study if a critical life stage (such as the gestational period) is included. Chronic exposures would generally be greater than 90 days in length, exceeding 50% of the animal's lifespan, or including a reproductive period. Jacques Whitford applies an UF of 3 (half an order of magnitude on a log scale) to adjust from sub-chronic to chronic, and 10 to adjust from acute to chronic. It should be noted that preference is given to longer duration exposure assessments in cases where published data are available, and acute data are relied on only when absolutely necessary.

8.5.4 Uncertainty Factors for Toxicity Endpoint

In cases where a search of scientific data indicates the absence of reproductive or other performance-based toxicity endpoints that would indicate a potential for adverse environmental effects at the population level, other less sensitive toxicity endpoints may be considered. Where only a lethal dose (LD_{50}) is available, Jacques Whitford applies an UF of 10 (an order of magnitude) to derive a LOAEL from LD_{50} data. Again, it should be noted that preference is always given to sub-lethal data, and lethal data are relied on only when absolutely necessary.

Jacques Whitford does not adjust NOAEL values upwards to estimate LOAEL values. Where the only chronic endpoint available is a NOAEL, it is used directly and reported as such in the discussion of uncertainties. Ecological hazard quotients based on the NOAEL may be permitted to exceed a value of 1.0 since the NOAEL is not an endpoint that signifies toxicological outcomes.

8.5.5 Uncertainty Factors for Individual Risk

In ERA the focus of the assessment is normally to provide protection for wildlife at the population level and TRVs based on LOAELs are preferably used in the calculation of risk. This is in contrast to human toxicology and human health risk assessment, where protection of individuals is of paramount concern.
An exception to this occurs in ERA when federally or provincially designated species at risk or conservation concern are evaluated. To ensure that these species are afforded an appropriate level of protection in ERA, Jacques Whitford uses TRVs that are based on NOAELs; if NOAELs are not available and LOAELs are used in the calculation of risk, then the acceptable threshold for toxicity is modified downward from 1.0 to 0.33 (reduced by a half order of magnitude; see Risk Characterization) in-line with guidance from Ohio EPA (2008).

8.5.6 Body Weight Scaling Factors

In ecological risk assessment, toxicity of contaminants to wildlife is typically assessed based on toxicity data for relatively few species, most often laboratory animals such as mice, rats, chickens and ducks where acute (e.g. LD_{50}, LC_{50}) and chronic (e.g. NOAEL, LOAEL) toxicity endpoints are measured. It is standard practice, and a fundamental step in the ERA process, to modify the laboratory generated toxicological data to make them applicable to wildlife receptors. A number of methods have been used to extrapolate toxicity data between laboratory and wildlife species, and include the use of uncertainty factors, application of acute based extrapolation factors (derived using LD_{50}, HD_5 and standard deviation) to reproductive toxicity data (*e.g*. Baril *et al*., 1994; Luttik *et al*, 2005), interspecies correlation estimation (ICE) models (Raimondo *et al*., 2007) and allometric scaling (Travis and White, 1988; Chappell, 1992; Mineau *et al*., 1996; Sample *et al*., 1996; Knopper *et al.,* 2009).

Each of these methods had positive and negative attributes, and none can be considered the most appropriate method for extrapolating toxicity data between laboratory and wildlife species. Ultimately, the choice in methods for use in the ERA comes to scientific defensibility, practicality, utility and professional judgment. For this ERA, an allometric scaling factor of body mass raised to the exponent of 0.75 for both mammalian and avian receptors was applied (Knopper *et al.,* 2009). Details of the rationale for this scaling factor are provided in **Appendix J**.

8.5.7 Inhalation Toxicity

The inhalation pathway as an exposure pathway for wildlife receptors is rarely considered in ERA since wildlife exposures to COPC via the inhalation pathway are usually considered to be negligible in comparison with their exposure from soil and dietary pathways (including pathways associated with grooming). An alternative to conducting a quantitative risk assessment based on the inhalation pathway for ecological receptors is to examine potential risk to human health via the inhalation pathway. It is reasonable to suggest that human exposure TRVs for airborne contaminants are likely to be lower than equivalent TRVs for ecological receptors given that:

- there is an extensive body of literature and regulations to protect humans against adverse health from air pollutants;
- the level of protection afforded to humans focuses on the health of individuals, and often sensitive health outcomes (such as childhood asthma) and is therefore more protective than is generally afforded to ecological receptors;
- the exposure durations that are considered for human receptors are often longer (*i.e.,* up to 70 years) than would be considered usual for ecological receptors; and
- the health outcomes for human receptors often include considerations such as whether a potential for cancer exists, for which very low ambient air concentrations may be required, which is not a consideration for ecological receptors.

Therefore, provided that human receptors are adequately protected against inhalation exposures to maximum ground level concentrations of COPC, then ecological receptors should be equally protected.

8.5.8 Derivation of Benchmarks for Community-Based Receptors

8.5.8.1 Freshwater Receptor Toxicity

Individual freshwater species were not evaluated in the ERA; rather toxicity assessments were based on freshwater quality screening guidelines or COPC-specific toxicity benchmarks that are protective of aquatic life. Guidelines and benchmarks used in this ERA are found in **Appendix J**.

8.5.8.2 Sediment Receptor Toxicity

Individual freshwater sediment species were not evaluated in the ERA; rather toxicity assessments were based on freshwater sediment quality screening benchmarks or guidelines that are considered protective of aquatic sediment life for each COPC. Benchmarks used in this ERA are found in **Appendix J**.

8.5.8.3 Soil Invertebrate Toxicity

Individual soil invertebrate species were not evaluated in this ERA; rather toxicity assessments were based on soil screening benchmarks that are protective of terrestrial invertebrate life for each COPC. Benchmarks used in this ERA are found in **Appendix J**.

8.5.8.4 Phytotoxicity

Individual plant species were not evaluated in the ERA; rather toxicity assessments were based on phytotoxicity benchmarks that are protective of plant life for each COPC. Phytotoxicity benchmarks used in this ERA are found in **Appendix J**. Special consideration was given to sulphur dioxide, nitrogen dioxide, and hydrogen fluoride effects on terrestrial plants. A detailed discussion regarding these CACs, including benchmark values used, can be found below.

8.5.8.5 Phytotoxicity Benchmarks used for Criteria Air Contaminants – Sulphur Dioxide and Nitrogen Oxides

High concentrations of sulphur dioxide and nitrogen oxides can produce acute and chronic injuries in vegetation, which is first observed on the plant foliage. A detailed discussion of the phytotoxicity symptoms that can occur on the plant foliage can be found in **Appendix J**.

The applicable air quality standards for protection of the environment that were considered in the assessment in the effect of sulphur dioxide and nitrogen oxides on vegetation were the National Ambient Air Quality Objectives (NAAQOs), the Canadian and Ontario Air Quality Objectives (in the case of SO_2 the levels are very similar; the NO_2 levels are only available from NAAQOs), and the World Health Organization standards. The NAAQOs were established by the federal government in the early 1970s to protect human health and the environment by setting objectives for the following common air pollutants: carbon monoxide, nitrogen dioxide, ozone, sulphur dioxide and total suspended particulates.

The objectives are denoted as “Desirable”, “Acceptable” and “Tolerable”. The Federal Objectives are defined as follows:

- The **Maximum Desirable** Level is the long-term goal for air quality and provides a basis for anti-degradation policy for unpolluted parts of the country, and for the continuing development of control technology;
- The **Maximum Acceptable** Level is intended to provide adequate protection against effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well-being; and,
- The **Maximum Tolerable** Level denotes time-based concentrations of air contaminants beyond which, due to a diminishing margin of safety, appropriate action is required to protect the health of the general population.

The World Health Organization (WHO) has developed air quality standards which address the protection of vegetation and of the forested ecosystem (and lichens) from sulphur dioxide (WHO, 2000a) with levels of 100 $\mu g/m^3$ for the averaging period of 24 hours and 30 (20 $\mu g/m^3$ for lichens) for the annual period. In the case of nitrogen dioxide WHO (2000b) describes two different types of effect threshold: critical levels and critical loads. The critical level (CLE) is the concentration in the atmosphere above which direct adverse effects on receptors, such as plants, ecosystems or materials, may occur. CLEs are expressed in terms of exposure ($\mu g/m^3$ and exposure duration), while critical loads (CLO) are expressed in terms of deposition (kg N/ha per year). As reported by the WHO (2000) the CLE for NOx (NO + NO_2, expressed as NO_2 in $\mu g/m^3$) is 30 $\mu g/m^3$ as an annual mean and 75 $\mu g/m^3$ as a 24-hour mean. The CLO was established at 30 kg N/ha year. These phytotoxicity benchmarks were primarily used in this ERA for the evaluation of the SO_2 and NO_2 effects emissions on the vegetation.

In addition, given the fact that air quality standards are presented for all the averaging time periods (1 hour, 24 hours and annual) only in the NAAQOs standards (and since they are applicable benchmarks in Canada), these standards were also used for the evaluation of potential effects on vegetation from the Project emissions. Specifically, the Maximum Acceptable Level was used as the threshold for conducting the risk assessment of sulphur dioxide and nitrogen dioxide on vegetation. A summary of the O. Reg. 419/05, NAAQOs and WHO is provided in Table 8-6.

Table 8-6 Summary of Air Quality Standards for Ontario and NAAQOs for Phytotoxicity

CAC	Averaging Time Period	Ontario Reg. 419/05 Sched. 3	Ontario's Ambient Air Quality Criteria	National Ambient Air Quality Objectives			World Health Organization
				Maximum Desirable	Maximum Acceptable	Maximum Tolerable	
Sulphur dioxide µg/m³	1 hour	690	690	450	900	-	-
	24 hour	275	275	150	300	800	100
	Annual	N/A	55	30	60	-	30 / 20^F
Nitrogen dioxide µg/m³	1 hour	NA	400	-	400	1000	-
	24 hour	NA	200	-	200	300	75
	Annual	N/A	N/A	60	100	-	30

Notes: F = Forest Ecosystem

8.5.8.6 Phytotoxicity Benchmarks used for Criteria Air Contaminants – Hydrogen Fluoride (HF)

In Ontario according the MOE O. Reg. 419/05 the standard for gaseous fluorides as HF (based on vegetation protection in the growing season) for the 24-hour averaging period is 0.86 µg/m^3 while the 30-day standard is 0.34 µg/m^3. The O. Reg. 419/05 24-hour standard for total fluorides as HF (growing season) is 1.72 µg/m^3 (0.69 µg/m^3; 30-day standard) while the 24-hour standard for total fluorides as HF (non-growing season) is 3.44 µg/m^3 (1.38 µg/m^3; 30-day standard) (MOE, 2005b). A summary of the O. Reg. 419/05 and NAAQOs is provided in Table 8-7.

Table 8-7 Summary of Air Quality Standards for Ontario and NAAQOs for HF Phytotoxicity

CAC	Averaging Time Period	Ontario Reg. 419/05 Sched. 3			National Ambient Air Quality Objectives
		Fluorides (as HF) gaseous (growing season)	Fluorides (as HF) total (growing season)	Fluorides (as HF) total (non-growing season)	Reference Level
Fluorides ($\mu g/m^3$)	1 hour	-	-	-	-
	24 hour	0.86	1.72	3.44	1.1
	30 day	0.34	0.69	1.38	-
	Annual	-	-	-	0.5

The World Health Organization does not have sufficient information to derive air quality guidelines for fluoride; however in terms of protecting vegetation from the effects of fluoride, the WHO has recognized that fluoride concentrations in ambient air should be less than 1 $\mu g/m^3$ (WHO, 2000). The threshold used in evaluating the effects of HF on vegetation was the Ontario Reg.419/05 (gaseous HF, growing season) as it provides the most conservative level of comparison for the 24 hour exposure (the 30 day averaging time was not used as Project emission data was not available).

8.6 Ecological Risk Characterization

The purpose of the Risk Characterization step in ERA is to evaluate the evidence linking COPC with adverse environmental effects by combining information from the exposure and toxicity assessments. The potential for adverse environmental effects is quantified by comparing the dose of a substance that can be tolerated, or below which adverse environmental effects are not expected (*e.g.,* TRV), to the expected daily dose (ADD), the amount of a COPC an organism is expected to be exposed to on a daily basis. The quotient of the two is referred to as an ecological hazard quotient (EHQ, analogous to HQs used in the HHRA) and can be expressed as:

$$EHQ = \frac{\text{average daily dose (ADD)}}{\text{toxicity reference value (TRV)}}$$

The magnitude by which values differ from parity (*i.e.,* TRV = daily dose) is used to make inferences about the possibility of ecological risks.

EHQs were calculated for each VEC, taking into consideration all applicable exposure pathways. For example, the EHQ for the meadow vole was calculated as the sum of EHQs for each of its relevant exposure pathways:

$$EHQ_{\text{meadow vole}} = EHQ_{\text{vegetation ingestion}} + EHQ_{\text{soil ingestion}} + EHQ_{\text{invertebrate ingestion}} + EHQ_{\text{water ingestion}}$$

For the assessment of potential risk to community-based VECs (*e.g.,* freshwater receptors), the EPC of the associated environmental media was divided by benchmarks where available, (rather than dividing an ADD by a TRV, as was used for birds and mammals). Preference was given to Ontario specific media guidelines (Ontario Regulation 153/04 ecotoxicological components, Provincial Water Quality Objectives (PWQO) (MOE, 1999b), Provincial Sediment Quality Guidelines (PSQG) (MOE, 1993)). For COPC where appropriate guidelines were not available, benchmarks based on toxicity studies were chosen instead. In this manner either a Screening Ratio (SR) was calculated if the comparator was a generic Provincial guideline, or an EHQ if the comparator was a benchmark based on toxicity.

An EHQ or SR of less than or equal to 1.0 indicates that the exposure concentration for the evaluated scenario is less than or at the threshold of toxicity (or guideline as appropriate). Given the conservative approach to the ERA, it is likely that no adverse environmental effect would occur at EHQs or SRs less than or equal to 1.0. Conversely, an EHQ or SR greater than 1.0 does not necessarily indicate that adverse effects will occur. In these cases, values greater than 1.0 indicate that there is a possibility of adverse ecological effects and indicate the need for further review of both predicted exposure levels and effects benchmarks.

If it is ultimately determined that the EHQ or SR is indeed greater than 1.0, potential mitigation and/or monitoring options should be considered and implemented to ensure the conservative nature of risk assessment has overestimated potential risks and that actual harm to the environment does not occur.

8.6.1 Chemical Interactions and Additivity of Hazard Quotients

Risk assessments are complicated by the fact that most toxicological studies are conducted using a single chemical whereas environmental exposures generally involve more than one COPC. Calculating an EHQ for exposure to mixtures of COPC is problematic because all COPC do not have the same modes of action, target endpoints, or magnitudes of toxicity. Chemicals in a mixture may interact in four general ways to elicit a response:

- **Non-interacting** – chemicals have no effect in combination with each other; the toxicity of the mixture is the same as the toxicity of the most toxic component of the mixture;
- **Additive** – chemicals have similar targets and modes of action but do not interact, the hazard for exposure to the mixture is simply the sum of hazards for the individual chemicals;

- **Synergistic** – there is a positive interaction among the chemicals such that the response is greater than would be expected if the chemicals acted independently or in an additive manner; and
- **Antagonistic** – there is a negative interaction among the chemicals such that the response is less than would be expected if the chemicals acted independently or in an additive manner.

There are chemical classes that have similar modes of action and target organs, and in these cases, a more appropriate characterization of risk is achieved by summing the EHQ for each compound. In this ERA, EHQs for PAHs were summed to derive a single conservative EHQ index (mammals and birds only). Hazard quotients for inorganic COPC were evaluated independently because unlike PAHs, they generally have specific toxicities, different modes of action, and different target organs.

The following sections characterize risk for each assessment scenario evaluated in the ERA.

8.6.2 Ecological Risk Assessment Baseline Case: 140,000 tpy

8.6.2.1 Deposition from Atmospheric Emissions - Baseline Case

Baseline Case EHQs and SRs provide an indication of potential adverse environmental effects (*i.e.,* risk) to VECs resulting from exposure to COPC released to the atmosphere from existing activities that take place in the LRASA.

Empirically measured concentrations of COPC in environmental media and biota were used in the assessment of potential risk to ecological receptors from COPC exposure in the Baseline Case (Jacques Whitford 2009a). In cases where empirical measurements were not available, media-to-biota uptake factors were relied on to calculate COPC concentrations. Maximum Baseline Case EHQs and screening ratios (SR) generated for each COPC and VEC are presented in Tables 8-8 to 8-12. Detailed results for the Baseline ERA are provided in Appendix N. These EHQ and SR were based on EPCs derived for the entire LRASA and not for specific receptor locations, as was the case for other scenarios (*i.e.*, a single representative baseline soil concentration was used for all receptor locations).

For mammals and birds all COPC had EHQs less than 1.0, with the exception of selenium in the case of the mink (EHQ = 1.8), and vanadium in the case of the American robin, belted kingfisher, mallard duck and wild turkey (EHQs = 1.6, 1.5, 3.9, and 2.6, respectively).

As discussed in Section 8.6, in cases where EHQs/SRs exceed 1.0, it is necessary to examine both the predicted exposure levels and effects benchmarks, in order to further qualify and understand the effects of any predicted risk. Measured baseline concentrations of selenium and vanadium in environmental media were not different from those typical of similar sites in southern Ontario (Environmental Baseline Study Report, Jacques Whitford, 2009a), and as such, the predicted EHQ for mammals and birds, though greater than 1.0, is not expected to be any different for these receptors living in other similar locations in Ontario. In this case, the exceedance of the toxicity threshold for baseline present day concentrations highlights the conservatism in the ERA.

For freshwater receptors, a number of COPC were identified with EHQs or SRs greater than 1.0: anthracene, flouranthene, benzo(a)anthracene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene and dibenzo(a,h)anthracene, PCBs (total), hexachlorobenzene, hexavalent chromium, phosphorus, vanadium and zinc. For benthic invertebrates, total chromium and phosphorus in sediment was associated with potential risk as SRs of 1.2 and 1.1 were estimated, respectively.

The freshwater receptor SR of the above listed PAHs varied from 5 to 500. Four surface water samples were collected from the Site and analyzed for PAHs, and in all four samples no PAHs were detected at the laboratory MDL of 0.01 µg/L (Jacques Whitford 2009a). The freshwater receptor SR was calculated by dividing the PAH laboratory MDL by the PWQO values (MOE, 1999b). In this ERA, laboratory MDLs were used as baseline concentrations in the absence of actual measured concentrations (Section 8.4.3). As PWQOs for PAHs are lower than the laboratory MDL, estimated SR were consequently greater than 1.0. It is unlikely that freshwater receptors at present day conditions (*i.e.*, Baseline case) within the LRASA are actually at the predicted level of unacceptable risk and this prediction is almost certainly explained by the use of the laboratory MDL as the exposure concentration in the ERA rather than a true surface water concentration.

For PCBs, a screening ratio of 20 was estimated for freshwater receptors. Six surface water samples were collected from the Site and analyzed for PCBs, and in all six samples, PCBs were not detected at the laboratory MDL of 0.02 µg/L (Jacques Whitford 2009a). The freshwater receptor SR was calculated by dividing the PCB laboratory MDL by the PWQO value. As was the case for PAHs, the laboratory MDL was used as the surface water PCB concentration, primarily to maintain conservatism in the ERA. The PWQO (0.001 µg/L) is lower than the laboratory MDL and as a result, a SR greater than 1.0 was estimated. It is unlikely that freshwater receptors at present day conditions (*i.e.*, Baseline case) within the LRASA are actually at the predicted level of unacceptable risk and this prediction is almost certainly explained by the use of the laboratory MDL rather than a true surface water concentration. It is important to note that the measured concentrations of PCBs in sediment (where PCBs are expected to be tightly bound to the particulate matter) are below the PSQG (MOE, 1993)). Similarly, in the case of measured baseline concentrations of PCBs in fish (where PCBs easily bioaccumulate), most of the values were at the detection limit or very close to the detection limit of 0.02 (mg/kg). Moreover, freshwater receptors were observed during field surveys and did not show signs of toxicosis. Therefore it can be concluded that estimated risk to freshwater receptors could be a function of the detection limit.

Of the chlorinated monocyclic aromatics, only hexachlorobenzene had a SR greater than 1.0 in the case of the freshwater receptor. As noted for PAHs and PCBs, the elevated screening ratio was due to the use of the laboratory MDL reported as the baseline concentration (six water samples were collected, and hexachlorobenzene was not detected in any of them (Jacques Whitford 2009a)). It is unlikely that freshwater receptors at present day conditions (*i.e*., Baseline case) within the LRASA are actually at the predicted level of unacceptable risk and this prediction is almost certainly explained by the use of the laboratory MDL rather than a true surface water concentration.

Hexavalent chromium was not detected in any of six surface water samples collected during the baseline study, however a SR of 10 was calculated based on the PWQO value (0.001 mg/L) and the laboratory MDL reported (0.01mg/L). Given that no hexavalent chromium was detected it is unlikely that freshwater receptors at present day conditions (*i.e.*, Baseline case) at the Site are actually at the predicted level of unacceptable risk.

Phosphorus was detected only twice in six surface water samples collected during the baseline study (0.05 mg/L and 0.16 mg/L, respectively). Although both of these detected concentrations exceed the PWQO of 0.03 mg/L, only the maximum concentration was considered in this assessment, which is very conservative. Given the number of surface water phosphorus non-detects and the difference between the two detected concentrations, a large degree of uncertainty is associated with the risk estimated for freshwater receptors. Nonetheless, potential risk to these receptors as a result of existing baseline conditions could not be ruled out. In sediment, baseline SRs of 1.2 and 1.1 were estimated for total chromium and phosphorus, respectively. Given that the maximum measured sediment chromium and phosphorus concentrations were used in the ERA (32 and 680 mg/kg), potential risk to biota associated with sediment could not be ruled out. Elevated baseline phosphorus concentrations are not wholly unexpected in the LRASA, given the high degree of fertilizers applied to agricultural fields and residential lawns, which ultimately find their way into natural waterways.

Vanadium, detected at a maximum surface water concentration of 0.008 mg/L (5 detections out of 6 samples collected), marginally exceeded the PWQO of 0.006 mg/L used as the freshwater screening value in the ERA. Potential risk to freshwater receptors as a result of existing baseline vanadium concentrations could not be ruled out.

In the case of zinc a SR of 2.3 was estimated for freshwater receptors. In sediment, the zinc SR was well below 1.0, indicating no predicted risk to biota associated with sediment. Nonetheless, as the surface water zinc concentration was based on measured concentrations (maximum, 0.045 mg/L) potential risk to these receptors as a result of existing baseline zinc concentrations could not be ruled out.

During the Baseline Sampling campaign (Jacques Whitford, 2009a), several species of fish, inhabiting different feeding niches were observed to inhabit the waterbodies within the LRASA. Predatory species (invertivores/carnivores) such as rainbow trout, sunfish, creek chub, and dace were confirmed present, and generally communities of these fish require substantial populations of invertebrates in order to thrive. Similarly, detritivores and planktivores such as white sucker and banded killifish, respectively, were also confirmed present. The presence of these fish communities suggests that existing baseline conditions within the LRASA are sufficient to sustain the freshwater communities (including the benthic invertebrates as their prey items). Overall, it is important to note that baseline concentrations of COPC either measured, or below their respective detection limits, were determined to be no different than any other similar area in southern Ontario. Therefore, the reported EHQs and SRs values are expected to be generally similar to other unimpacted areas in Ontario, and do not likely represent actual risk especially in the case of freshwater receptors and benthic invertebrates.

8.6.2.2 Exposure of Vegetation to SO_2, NO_2 and HF

Baseline SO_2 and NO_2 concentrations were well below the Maximum Acceptable NAAQO for each of the 1-hour, 24-hour, and annual averaging periods. The baseline SO_2 concentrations were also below the phytotoxicity benchmarks identified by the WHO Air Quality Guidelines for the 24-hour and annual averaging periods. The WHO Air Quality Guideline does not provide a phytotoxicity standard for the 1-hour averaging time for SO_2 or NO_2, so a comparison could not be conducted. The baseline NO_2 concentrations for 24-hour averaging period were below the phytotoxicity benchmarks described by WHO Air Quality Guidelines; however, the annual baseline NO_2 concentration of 37 $\mu g/m^3$ was greater than the annual WHO guideline for NO_2 of 30 $\mu g/m^3$.

Visual inspection of vegetation during the baseline sampling program (Jacques Whitford, 2009a), and natural environment assessments (Jacques Whitford, 2009c) revealed healthy vegetation communities showing no evidence of NO_2 related stress. Baseline concentrations of HF were not measured and so a comparison against applicable objectives/guidelines could not be conducted (Tables 8-13 to 8-15).

8.6.3 Construction Case

A qualitative ecological assessment of the Construction Case was undertaken. Construction activities for the Project would include:

- site preparation (e.g., clearing, cut and fill, site levelling) and foundations;
- structural steel erection and major equipment delivery; and,
- process equipment installation, piping, electrical work, etc.

Construction emissions are expected to occur intermittently during daylight hours over the duration of the construction period (about 30 months). The number of large trucks travelling on and off site during the construction period on a daily basis is expected to be less than the daily number of waste truck deliveries anticipated during normal operation of the Facility. There will likely be a greater volume of passenger vehicle traffic to and from the site during construction (from the construction labour force) relative to Facility operation; however passenger vehicles have much lower emissions than heavy trucks (Jacques Whitford, 2009b). Therefore the off-site air quality effects due to vehicle traffic during the construction period are expected to be no greater than those during normal operation of the Facility.

Dust emissions from construction activities could have a temporary effect on local air quality. These emissions are associated with land clearing, ground excavation, cut-and-fill operations and equipment traffic on the site. Generally, fugitive dust emissions are: (1) proportional to the disturbed land area and the level of construction activity; (2) limited to periods of the day and week when the construction activities take place; and (3) vary substantially from day to day with varying meteorological conditions. Under dry, windy conditions, wet suppression can be used to control these fugitive dust sources.

Vehicles on the construction site are sources of exhaust emissions from fuel combustion. Construction activities such as welding, use of solvents, sand blasting and painting can also affect air quality in the construction area. These activities are typically localized and can be mitigated through implementation of vehicle and equipment maintenance programs.

The emissions from construction of the Facility are not expected to be different from those occurring on other medium-sized construction sites in Ontario. Relative to operational emissions, construction emissions will be minor, short-term and transitory, and therefore, it is expected that the assessment of operational scenarios (Section 7.7.3) will be protective of any potential ecological health risks that could arise during periods of construction.

8.6.4 Project Alone Case Assessment Scenario: 140,000 tpy

Project Case EHQs and SRs provide an indication of potential adverse environmental effects (*i.e.*, risk) to VECs resulting from exposure to COPC released to the atmosphere from the proposed Thermal Treatment Facility alone.

8.6.4.1 Deposition from Atmospheric Emissions

Maximum Project Alone Case EHQs and SRs generated for each COPC and VEC are provided in Tables 8-8 to 8-12.

Detailed results and tables of the Project Alone Case scenario (including the receptor location where each maximum EHQ/SR is predicted) are provided in Appendix N. The highest predicted risk associated with the Project Alone Case (SR = 0.15) was reported in the case of thallium for freshwater receptors at Ecological Receptor Location 8 (Eco 8), which corresponds to the Baseline Road and Courtice Road receptor location. This predicted SR is roughly 7 times lower than the threshold of toxicity (*e.g.,* 1.0). EHQs/SRs did not exceed 1.0 for any of the ecological receptors at any of the receptor locations evaluated in the ERA. These results suggest that atmospheric Project Alone Case emissions are not expected to present adverse environmental risks to mammalian, avian, or community-based receptors exposed to COPC.

8.6.4.2 Exposure of Vegetation to SO_2, NO_2 and HF

Project Alone SO_2 and NO_2 concentrations estimated at each ecological receptor locations did not exceed their respective Maximum Acceptable NAAQOs. Similarly, the 24-hour and annual SO_2 and NO_2 concentrations did not exceed the phytotoxicity benchmarks of the WHO Air Quality Guidelines. In the case of HF, for which no NAAQO or WHO guidelines or objectives were available, the HF emissions were compared against the Ontario Regulation 419/05 Air Pollution – Local Air Quality, Schedule 3, 24-hour averaging period benchmark for gaseous fluorides (as HF) during the growing season (MOE, 2005b). No exceedance of this benchmark was noted. Phytotoxicity as a result of Project Alone emissions is, therefore, not expected for SO_2, NO_2, or HF during any averaging period (Tables 8-13 to 8-15).

8.6.5 Project Case Assessment Scenario: 140,000 tpy

Project Case EHQs and SRs provide an indication of potential adverse environmental effects (*i.e.*, risk) to VECs resulting from exposure to COPC released to the atmosphere from both the Thermal Treatment Facility and existing baseline conditions (*i.e.*, existing emissions facilities) in the LRASA. Consequently, EHQs/SRs for this assessment scenario should be higher than those from either the Baseline or Project Alone Case. However given that the contribution of the Project Alone Case in most cases (as presented in section 8.6.2) is not substantial (most of the time a few orders of magnitude lower than those reported in the Baseline Case) the EHQ/SRs are often similar to the values reported in the Baseline Case.

8.6.5.1 Deposition from Atmospheric Emissions

Maximum Project Case EHQs and SRs generated for each COPC and VEC are presented in Tables 8-8 to 8-12. Detailed results and of the Project Case scenario, including locations of maximum predicted values, are provided in **Appendix N.**

For mammals and birds all COPC had EHQs less than 1.0, with the exception of selenium in the case of the mink (EHQ = 1.8), and vanadium in the case of the American robin, belted kingfisher, mallard duck, and wild turkey receptors (EHQs = 1.6, 1.5, 3.9, and 2.6, respectively).

For freshwater receptors, a number of COPC were identified with EHQs or SRs greater than 1.0: anthracene flouranthene, benzo(a)anthracene, benzo(g,h,i)perylene, benzo(k)flouranthene, chrysene, dibenzo(a,h)anthracene), PCBs (total), hexachlorobenzene, hexavalent chromium, phosphorus, thallium, vanadium, and zinc. For benthic invertebrates, total chromium and phosphorus were identified as COPC with EHQs or SRs greater than 1.0.

All COPC associated with potential risk to terrestrial, freshwater, and sediment receptors possessed elevated EHQs/SRs due entirely to baseline concentrations (most of them non-detects, as discussed in Section 8.6.2.1). Contribution from the Project Alone is, therefore, not deemed to be substantive. As predicted risk associated with the Project Case scenario is driven entirely by baseline COPC concentrations, similar conclusions to those reached in Section 8.6.2.1 apply here: no unacceptable risk is expected for terrestrial, freshwater, or sediment receptors as a result of exposure to COPC with the exception of vanadium and zinc in surface water, total chromium in sediment, and phosphorus in both surface water and sediment, which only marginally exceeded their respective guidelines. The reported EHQs and SRs values are expected to be generally similar to other unimpacted areas in Ontario.

8.6.5.2 Exposure of Vegetation to SO_2, NO_2 and HF

Project Case SO_2 and NO_2 concentrations were marginally higher than those reported from empirical baseline measurements, and were deemed to be driven almost exclusively by existing baseline conditions. Similarly to what was concluded for the Baseline Case, in the Project Case phytotoxicity of NO_2 during the annual averaging period was estimated, although actual contributions from the Facility are negligible. The highest annual concentration at any of the receptors was 37 μg/m^3 compared to the WHO Guideline of 30 μg/m^3. These annual NO_2 exceedances are exclusively due to the baseline conditions (37 μg/m^3) since the annual contributions from the Facility are negligible. As discussed in section 8.6.2.2 the current plant communities showed no evidence of NO_2 related stress. Therefore it is not expected that the Project Case NO_2 emissions will pose a risk to the plant communities. Estimation of Project Case HF emissions could not be conducted as baseline data was not available (Tables 8-13 to 8-15).

8.6.6 Process Upset Case: 140,000 tpy

8.6.6.1 Deposition from Atmospheric Emissions

Intermittent processes such as start-ups, shut-downs and possible malfunctions, generally referred to as “upsets”, can result in short-term emissions to the atmosphere that may be higher than those during normal operational conditions. The potential for adverse effects to ecological receptors was evaluated for the “upset” conditions.

These process upset emission rates provide a very conservative estimate of worst-case emission rates that could be expected over the course of an operating year.

The Process Upset Case EHQs/SRs provide an indication of potential adverse environmental effects (*i.e.,* risk) to VECs resulting from exposure to COPC released to the atmosphere from the Thermal Treatment Facility in the LRASA in a case of start-ups, shut-downs or possible malfunctions.

Maximum Process Upset Case EHQs/SRs generated for each COPC and VEC are presented in Tables 8-8 to 8-12. Detailed results and tables of the Process Upset Case scenario (including locations where maximums are expected to occur) are provided in **Appendix N.**

Process Upset Case emissions are not expected to present adverse environmental risks to mammalian, avian, and community-based receptors exposed to COPC.

8.6.6.2 Exposure of Vegetation to SO_2, NO_2 and HF

Process Upset Case SO_2 and NO_2 concentrations estimated at each ecological receptor location did not exceed their respective Maximum Acceptable NAAQOs or the WHO Air Quality Guidelines where available. In the case of HF, for which no NAAQO or WHO guidelines or objectives were available, the Ontario Regulation 419/05 *Air Pollution – Local Air Quality*, Schedule 3 24-hour averaging period benchmark for gaseous fluorides (as HF) during the growing season (MOE, 2005b) was used. No exceedance of this benchmark was noted. Phytotoxicity as a result of Process Upset Case emissions is therefore not expected for SO_2, NO_2 or HF during any averaging period (Tables 8-13 to 8-15).

8.6.7 Process Upset Project Case: 140,000 tpy

8.6.7.1 Deposition from Atmospheric Emissions

Evaluation of the Process Upset Project Case consisted of the assessment of risks to ecological receptors due to exposure to the total concentrations of COPC released to the atmosphere. This includes the ecological risks from the existing concentrations of COPC in the environmental media (*i.e*. Baseline Case) and the predicted increases in chemical concentrations from the operation of the Facility during upset conditions (*i.e*. the Process Upset Case). These ecological risks represent the potential environment effects (risks) of ecological receptor exposure to atmospheric emissions (above existing concentrations) with the addition of the Thermal Treatment Facility operating during upset conditions in the LRASA.

As in the Baseline Case, the same COPCs were identified to present a potential risk to mammalian and avian receptors, (selenium and vanadium, respectively).

For freshwater receptors: anthracene, flouranthene, benzo(a)anthracene, benzo(g,h,i)perylene, benzo(k)flouranthene, chrysene dibenzo(a,h)anthracene, PCBs (total), hexachlorobenzene, hexavalent chromium, phosphorus, silver, thallium, vanadium, and zinc, were associated with potential risk, as their respective SRs were greater than 1.0. For benthic invertebrates, total chromium and phosphorus were associated with potential risk with SRs marginally exceeding 1.0.

All COPC associated with potential risk to terrestrial, freshwater, and sediment receptors possessed elevated EHQs/SRs due entirely to baseline concentrations (most of them non-detects, as discussed in Section 8.6.2.1). Contribution from Process Upsets is, therefore, not deemed to be substantive. As predicted risk associated with the Process Upset Project Case scenario is driven entirely by baseline COPC concentrations, similar conclusions to those reached in Section 8.6.2.1 apply here; no risk is expected for terrestrial, freshwater, or sediment receptors as a result of exposure to COPC with the exception of selenium and vanadium to birds and mammals, zinc and phosphorus in freshwater, and total chromium and phosphorus in sediment. The reported EHQs and SRs values are expected to be generally similar to other unimpacted areas in Ontario.

8.6.7.2 Exposure of Vegetation to SO_2, NO_2 and HF

Process Upset Project Case SO_2 and NO_2 concentrations were marginally higher than those reported from empirical baseline measurements, and were deemed to be driven almost exclusively by existing baseline conditions. Similar to the Project Case, the only exceedances of any air quality guidelines for the Process Upset Project Case occurred for NO_2 during the annual averaging period where the maximum concentration was 37 µg/m^3 which is greater than the WHO Air Quality Guidelines (30 µg/m^3). These exceedances were also primarily due to the baseline conditions and therefore it is not expected that the Project Upset Case NO_2 emissions will pose a risk to plant communities within the LRASA. Estimation of Process Upset Project Case HF emissions could not be conducted as baseline data was not available (Tables 8-23 to 8-25).

The following tables characterize risk for each 140,000 tonne per year assessment scenario evaluated in the ERA. EHQs/SRs greater than the threshold of 1.0 are bolded.

Table 8-8 Ecological Hazard Quotient Summary for Mammalian Receptors: 140,000 tpy Scenario

COPC	Eastern Cottontail Rabbit					Masked Shrew					Meadow Vole					Mink				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Polycyclic Aromatic Hydrocarbons																				
Low Molecular Weight PAHs																				
Acenaphthene	7.9E-06	7.2E-11	7.9E-06	2.0E-10	7.9E-06	1.2E-05	6.4E-11	1.2E-05	1.8E-10	1.2E-05	1.1E-05	9.8E-11	1.1E-05	2.8E-10	1.1E-05	1.4E-06	1.2E-11	1.4E-06	3.3E-11	1.4E-06
Acenaphthylene	1.2E-06	1.5E-11	1.2E-06	4.3E-11	1.2E-06	1.1E-05	1.5E-11	1.1E-05	4.2E-11	1.1E-05	2.6E-06	2.1E-11	2.6E-06	5.8E-11	2.6E-06	9.2E-07	9.0E-12	9.2E-07	2.5E-11	9.2E-07
Anthracene	4.2E-06	3.5E-11	4.2E-06	9.9E-11	4.2E-06	1.1E-05	6.0E-11	1.1E-05	1.7E-10	1.1E-05	6.4E-06	5.1E-11	6.4E-06	1.4E-10	6.4E-06	9.2E-07	9.2E-12	9.2E-07	2.6E-11	9.2E-07
Fluoranthene	3.0E-05	2.4E-10	3.0E-05	6.6E-10	3.0E-05	1.3E-05	5.8E-10	1.3E-05	1.6E-09	1.3E-05	4.0E-05	3.6E-10	4.0E-05	1.0E-09	4.0E-05	1.2E-06	1.9E-10	1.2E-06	5.4E-10	1.2E-06
Fluorene	2.1E-05	5.0E-11	2.1E-05	1.4E-10	2.1E-05	1.3E-05	6.2E-11	1.3E-05	1.7E-10	1.3E-05	2.8E-05	7.0E-11	2.8E-05	2.0E-10	2.8E-05	1.5E-06	2.8E-11	1.5E-06	7.9E-11	1.5E-06
Phenanthrene	6.9E-05	3.7E-10	6.9E-05	1.0E-09	6.9E-05	7.3E-06	6.1E-10	7.3E-06	1.7E-09	7.3E-06	8.8E-05	5.3E-10	8.8E-05	1.5E-09	8.8E-05	2.1E-06	2.3E-10	2.1E-06	6.5E-10	2.1E-06
TOTAL LMW PAH EHQ =	1.3E-04	7.8E-10	1.3E-04	2.2E-09	1.3E-04	6.7E-05	1.4E-09	6.7E-05	3.9E-09	6.7E-05	1.8E-04	1.1E-09	1.8E-04	3.1E-09	1.8E-04	8.0E-06	4.8E-10	8.0E-06	1.3E-09	8.0E-06
High Molecular Weight PAHs																				
Benz(a)anthracene	1.8E-05	5.6E-10	1.8E-05	1.6E-09	1.8E-05	6.5E-05	2.2E-10	6.5E-05	6.3E-10	6.5E-05	3.2E-05	7.5E-10	3.2E-05	2.1E-09	3.2E-05	8.7E-06	3.5E-10	8.7E-06	9.7E-10	8.7E-06
Benzo(a)pyrene	2.2E-04	2.7E-09	2.2E-04	7.6E-09	2.2E-04	1.1E-04	1.3E-09	1.1E-04	3.6E-09	1.1E-04	2.9E-04	3.5E-09	2.9E-04	9.9E-09	2.9E-04	6.7E-06	1.9E-09	6.7E-06	5.5E-09	6.7E-06
Benzo(e)pyrene	1.6E-05	2.3E-07	1.6E-05	6.5E-07	1.6E-05	1.2E-06	1.9E-08	1.2E-06	5.4E-08	1.2E-06	2.0E-05	3.0E-07	2.0E-05	8.4E-07	2.1E-05	4.7E-06	4.3E-09	4.7E-06	1.2E-08	4.7E-06
Benzo(a)fluorene	--	6.2E-10	6.2E-10	1.7E-09	1.7E-09	--	4.0E-10	4.0E-10	1.1E-09	1.1E-09	--	8.3E-10	8.3E-10	2.3E-09	2.3E-09	--	2.3E-09	2.4E-09	6.5E-09	6.6E-09
Benzo(b)fluorene	--	1.3E-09	1.3E-09	3.6E-09	3.6E-09	--	2.9E-10	2.9E-10	8.3E-10	8.3E-10	--	1.7E-09	1.7E-09	4.6E-09	4.6E-09	--	2.1E-09	2.1E-09	5.8E-09	5.9E-09
Benzo(b)fluoranthene	2.6E-05	2.0E-10	2.6E-05	5.7E-10	2.6E-05	6.6E-05	4.3E-10	6.6E-05	1.2E-09	6.6E-05	4.3E-05	3.2E-10	4.3E-05	9.1E-10	4.3E-05	8.7E-06	1.7E-09	8.7E-06	4.8E-09	8.7E-06
Benzo(g,h,i)perylene	2.4E-05	3.5E-07	2.5E-05	9.9E-07	2.5E-05	2.2E-04	3.6E-08	2.2E-04	1.0E-07	2.2E-04	4.2E-05	4.6E-07	4.3E-05	1.3E-06	4.3E-05	1.1E-05	4.1E-08	1.1E-05	1.1E-07	1.1E-05
Benzo(k)fluoranthene	2.1E-05	1.1E-09	2.1E-05	3.2E-09	2.1E-05	6.5E-05	4.2E-10	6.5E-05	1.2E-09	6.5E-05	3.6E-05	1.5E-09	3.6E-05	4.2E-09	3.6E-05	8.7E-06	4.6E-10	8.7E-06	1.3E-09	8.7E-06

Table 8-8 Ecological Hazard Quotient Summary for Mammalian Receptors: 140,000 tpy Scenario

COPC	Eastern Cottontail Rabbit					Masked Shrew					Meadow Vole					Mink				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chrysene	4.8E-05	7.6E-10	4.8E-05	2.1E-09	4.8E-05	6.7E-05	7.3E-10	6.7E-05	2.1E-09	6.7E-05	7.1E-05	1.1E-09	7.1E-05	3.0E-09	7.1E-05	9.8E-06	9.2E-10	9.9E-06	2.6E-09	9.9E-06
Dibenz(a,c)anthracene	1.1E-05	4.1E-08	1.1E-05	1.2E-07	1.1E-05	2.2E-04	4.3E-09	2.2E-04	1.2E-08	2.2E-04	2.6E-05	5.3E-08	2.6E-05	1.5E-07	2.6E-05	9.6E-06	2.3E-08	9.6E-06	6.5E-08	9.7E-06
Dibenz(a,h)anthracene	1.1E-05	2.9E-08	1.1E-05	8.0E-08	1.1E-05	2.2E-04	2.6E-09	2.2E-04	7.2E-09	2.2E-04	2.6E-05	3.7E-08	2.6E-05	1.0E-07	2.6E-05	9.6E-06	1.0E-09	9.6E-06	2.8E-09	9.6E-06
Indeno(1,2,3-cd)pyrene	1.8E-05	4.5E-09	1.8E-05	1.3E-08	1.8E-05	2.2E-04	3.7E-09	2.2E-04	1.0E-08	2.2E-04	3.4E-05	5.9E-09	3.4E-05	1.7E-08	3.4E-05	9.6E-06	7.0E-09	9.6E-06	2.0E-08	9.6E-06
Perylene	4.1E-06	1.7E-07	4.3E-06	4.9E-07	4.6E-06	4.5E-05	1.3E-08	4.5E-05	3.8E-08	4.5E-05	7.4E-06	2.2E-07	7.7E-06	6.2E-07	8.1E-06	6.5E-06	1.1E-09	6.5E-06	3.1E-09	6.5E-06
Pyrene	1.4E-04	1.1E-08	1.4E-04	3.1E-08	1.4E-04	7.4E-05	1.8E-08	7.4E-05	4.9E-08	7.4E-05	1.9E-04	1.7E-08	1.9E-04	4.7E-08	1.9E-04	9.4E-06	2.9E-09	9.4E-06	8.2E-09	9.4E-06
TOTAL HMW PAH EHQ =	5.6E-04	8.5E-07	5.6E-04	2.4E-06	5.6E-04	0.0014	9.1E-08	0.0014	2.6E-07	0.0014	8.2E-04	1.1E-06	8.2E-04	3.1E-06	8.2E-04	1.0E-04	9.0E-08	1.0E-04	2.5E-07	1.0E-04
TOTAL LMW AND HMW PAH EHQ =	6.9E-04	8.5E-07	6.9E-04	2.4E-06	7.0E-04	0.0015	9.2E-08	0.0015	2.6E-07	0.0015	9.9E-04	1.1E-06	1.0E-03	3.1E-06	1.0E-03	1.1E-04	9.0E-08	1.1E-04	2.5E-07	1.1E-04
Dioxins and Furans																				
2,3,7,8-TCDD Equivalent	0.011	1.2E-04	0.011	3.4E-04	0.011	0.053	0.0012	0.054	0.0033	0.057	0.011	1.3E-04	0.011	3.6E-04	0.012	0.020	0.0016	0.022	0.0046	0.025
PCB																				
Aroclor 1254 (Total PCBs)	0.0097	1.1E-06	0.0097	3.0E-06	0.0097	0.010	6.5E-07	0.010	1.8E-06	0.010	0.0058	9.0E-07	0.0058	2.5E-06	0.0058	0.010	8.1E-04	0.011	0.0023	0.012
Chlorinated Monocyclic Aromatics																				
1,2-Dichlorobenzene	0.0035	1.5E-09	0.0035	4.1E-09	0.0035	1.6E-04	1.1E-09	1.6E-04	3.2E-09	1.6E-04	0.0019	8.9E-10	0.0019	2.5E-09	0.0019	1.1E-04	1.7E-08	1.1E-04	4.7E-08	1.1E-04
1,2,4-Trichlorobenzene	0.0051	3.4E-11	0.0051	9.5E-11	0.0051	4.3E-04	5.0E-11	4.3E-04	1.4E-10	4.3E-04	0.0048	3.6E-11	0.0048	1.0E-10	0.0048	1.2E-04	1.8E-09	1.2E-04	5.0E-09	1.2E-04
1,2,4,5-Tetrachlorobenzene	0.0012	1.4E-09	0.0012	3.8E-09	0.0012	4.1E-04	4.2E-09	4.1E-04	1.2E-08	4.1E-04	0.0011	1.5E-09	0.0011	4.2E-09	0.0011	0.0013	1.9E-07	0.0013	5.4E-07	0.0013
Pentachlorobenzene	0.0010	1.0E-08	0.0010	2.9E-08	0.0010	6.1E-04	1.0E-07	6.1E-04	2.8E-07	6.1E-04	9.6E-04	1.3E-08	9.6E-04	3.6E-08	9.6E-04	0.0011	1.2E-06	0.0011	3.3E-06	0.0011
Hexachlorobenzene	8.7E-04	7.1E-10	8.7E-04	2.0E-09	8.7E-04	5.2E-04	2.5E-09	5.2E-04	6.9E-09	5.2E-04	8.3E-04	7.7E-10	8.3E-04	2.2E-09	8.3E-04	9.2E-04	4.7E-07	9.2E-04	1.3E-06	9.2E-04

Table 8-8 Ecological Hazard Quotient Summary for Mammalian Receptors: 140,000 tpy Scenario

COPC	Eastern Cottontail Rabbit					Masked Shrew					Meadow Vole					Mink				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Pentachlorophenol	2.6E-05	3.8E-06	3.0E-05	1.1E-05	3.6E-05	2.0E-04	3.7E-07	2.0E-04	1.0E-06	2.0E-04	3.6E-05	4.8E-06	4.0E-05	1.4E-05	4.9E-05	0.0018	1.4E-06	0.0018	3.9E-06	0.0018
Chlorinated Solvents and Derivatives																				
Carbon Tetrachloride	0.0017	7.0E-10	0.0017	2.0E-09	0.0017	1.6E-04	1.0E-09	1.6E-04	2.9E-09	1.6E-04	0.0016	7.3E-10	0.0016	2.1E-09	0.0016	2.7E-05	2.9E-09	2.7E-05	8.1E-09	2.7E-05
Chloroform	2.0E-04	1.1E-10	2.0E-04	3.1E-10	2.0E-04	2.2E-05	1.6E-10	2.2E-05	4.5E-10	2.2E-05	1.9E-04	1.1E-10	1.9E-04	3.2E-10	1.9E-04	1.3E-06	1.7E-10	1.3E-06	4.8E-10	1.3E-06
Dichloromethane	0.0055	1.1E-07	0.0055	3.0E-07	0.0055	0.0018	1.6E-07	0.0018	4.5E-07	0.0018	0.0052	1.1E-07	0.0052	3.2E-07	0.0052	1.5E-05	1.2E-07	1.5E-05	3.4E-07	1.5E-05
Trichlorofluoromethane (Freon 11)	1.6E-04	1.2E-08	1.6E-04	3.5E-08	1.6E-04	1.5E-05	1.8E-08	1.5E-05	5.1E-08	1.5E-05	1.5E-04	1.3E-08	1.5E-04	3.6E-08	1.5E-04	1.4E-06	3.3E-08	1.5E-06	9.2E-08	1.5E-06
Chlorinated Alkanes/Alkenes																				
1,1,1-Trichloroethane	1.5E-05	6.7E-11	1.5E-05	1.9E-10	1.5E-05	1.3E-06	5.5E-11	1.3E-06	1.6E-10	1.3E-06	8.2E-06	4.1E-11	8.2E-06	1.2E-10	8.2E-06	3.6E-07	1.8E-10	3.6E-07	5.1E-10	3.6E-07
Other Organics																				
Bromoform	7.1E-04	2.2E-08	7.1E-04	6.1E-08	7.1E-04	3.6E-05	1.7E-08	3.6E-05	4.9E-08	3.6E-05	3.9E-04	1.4E-08	3.9E-04	3.8E-08	3.9E-04	4.9E-06	5.0E-08	5.0E-06	1.4E-07	5.1E-06
O-Terphenyl	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Inorganics																				
Antimony	0.47	1.1E-04	0.47	1.6E-04	0.47	0.20	8.9E-05	0.20	1.3E-04	0.20	0.45	1.1E-04	0.45	1.5E-04	0.45	0.0095	1.2E-04	0.0096	1.8E-04	0.0096
Arsenic	0.020	2.8E-06	0.020	4.0E-06	0.020	0.10	8.2E-07	0.10	1.2E-06	0.10	0.042	3.7E-06	0.042	5.3E-06	0.042	0.022	1.4E-06	0.022	2.1E-06	0.022
Barium	0.016	6.2E-08	0.016	8.9E-08	0.016	0.0030	1.6E-08	0.0030	2.3E-08	0.0030	0.020	8.0E-08	0.020	1.2E-07	0.020	0.0029	1.0E-08	0.0029	1.5E-08	0.0029
Beryllium	0.100	1.1E-05	0.100	1.7E-05	0.100	0.023	7.9E-06	0.023	1.2E-05	0.023	0.11	1.4E-05	0.11	2.0E-05	0.11	0.056	3.9E-06	0.056	5.7E-06	0.056
Boron	0.27	1.5E-04	0.27	2.1E-04	0.27	0.064	1.5E-05	0.064	2.2E-05	0.064	0.26	1.4E-04	0.26	2.0E-04	0.26	0.067	1.6E-06	0.067	2.3E-06	0.067
Cadmium	0.085	2.4E-04	0.085	3.5E-04	0.085	0.50	0.0020	0.50	0.0029	0.50	0.11	3.3E-04	0.12	4.8E-04	0.12	0.043	9.6E-06	0.044	0.0014	0.044

Table 8-8 Ecological Hazard Quotient Summary for Mammalian Receptors: 140,000 tpy Scenario

COPC	Eastern Cottontail Rabbit					Masked Shrew					Meadow Vole					Mink				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chromium (Total)	0.11	9.5E-06	0.11	1.4E-05	0.11	0.35	3.4E-06	0.35	4.9E-06	0.35	0.17	1.2E-05	0.17	1.8E-05	0.17	0.054	2.0E-05	0.054	2.9E-05	0.054
Chromium VI	1.1E-04	3.5E-07	1.1E-04	5.1E-07	1.1E-04	2.2E-04	1.2E-07	2.2E-04	1.8E-07	2.2E-04	1.5E-04	4.6E-07	1.6E-04	6.7E-07	1.6E-04	0.0039	1.5E-07	0.0039	2.2E-07	0.0039
Cobalt	0.0071	8.7E-06	0.0071	1.3E-05	0.0071	0.020	3.5E-06	0.020	5.0E-06	0.020	0.012	1.2E-05	0.012	1.7E-05	0.012	0.0025	9.5E-06	0.0025	1.4E-05	0.0025
Lead	0.029	2.2E-04	0.029	3.2E-04	0.029	0.19	5.3E-04	0.19	7.6E-04	0.19	0.051	3.2E-04	0.051	4.7E-04	0.051	0.0085	4.8E-05	0.0085	7.0E-05	0.0085
Mercury - Inorganic	0.0049	1.6E-05	0.0049	2.4E-05	0.0049	0.012	4.3E-04	0.012	6.2E-04	0.013	0.0063	3.2E-05	0.0063	4.7E-05	0.0063	0.0089	1.4E-04	0.0091	2.1E-04	0.0091
Methyl Mercury	1.0E-04	2.1E-05	1.2E-04	3.0E-05	1.3E-04	0.044	0.0037	0.047	0.0054	0.049	5.1E-04	5.6E-05	5.7E-04	8.1E-05	6.0E-04	0.067	8.8E-04	0.068	0.0013	0.068
Nickel	0.048	3.2E-04	0.049	4.7E-04	0.049	0.40	7.3E-04	0.40	0.0011	0.40	0.078	4.4E-04	0.078	6.4E-04	0.078	0.034	4.5E-04	0.034	6.5E-04	0.034
Selenium	0.29	4.7E-05	0.29	6.8E-05	0.29	1.0	1.3E-05	1.0	1.9E-05	1.0	0.42	6.1E-05	0.42	8.8E-05	0.42	**1.8**	8.7E-05	**1.8**	1.3E-04	**1.8**
Silver	2.3E-04	2.1E-06	2.3E-04	3.0E-06	2.4E-04	0.0020	1.3E-06	0.0020	1.8E-06	0.0020	3.5E-04	2.7E-06	3.5E-04	3.9E-06	3.5E-04	1.3E-04	1.6E-06	1.3E-04	2.3E-06	1.3E-04
Thallium	0.040	0.0023	0.042	0.0034	0.043	0.42	0.0045	0.42	0.0065	0.42	0.055	0.0024	0.057	0.0035	0.058	0.019	6.0E-04	0.019	8.6E-04	0.019
Tin	0.0016	6.3E-06	0.0016	9.1E-06	0.0016	0.013	1.5E-05	0.013	2.2E-05	0.013	0.0029	9.1E-06	0.0029	1.3E-05	0.0029	6.2E-04	9.1E-05	7.1E-04	1.3E-04	7.5E-04
Vanadium	0.040	4.3E-06	0.040	6.2E-06	0.040	0.071	2.9E-06	0.071	4.2E-06	0.071	0.056	4.8E-06	0.056	6.9E-06	0.056	0.021	1.8E-06	0.021	2.6E-06	0.021
Zinc	0.18	5.9E-05	0.18	8.5E-05	0.18	0.46	2.7E-04	0.46	4.0E-04	0.46	0.24	8.0E-05	0.24	1.2E-04	0.24	0.12	2.6E-04	0.12	3.8E-04	0.12

"--" - Quantitative assessment of COPC could not be performed due to lack of suitable toxicity data or empirically measured concentrations.

Table 8-9 Ecological Hazard Quotient Summary for Mammalian Receptors: 140,000 tpy Scenario (Continued)

COPC	Muskrat					Red Fox					White-tailed Deer				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Polycyclic Aromatic Hydrocarbons															
Low Molecular Weight PAHs															
Acenaphthene	1.4E-06	2.6E-11	1.4E-06	7.2E-11	1.4E-06	1.2E-06	7.7E-12	1.2E-06	2.1E-11	1.2E-06	2.8E-06	2.7E-11	2.8E-06	7.5E-11	2.8E-06
Acenaphthylene	9.8E-07	1.8E-11	9.8E-07	5.0E-11	9.8E-07	6.8E-07	3.2E-12	6.8E-07	9.1E-12	6.8E-07	3.0E-07	5.7E-12	3.0E-07	1.6E-11	3.0E-07
Anthracene	1.2E-06	2.3E-11	1.2E-06	6.6E-11	1.2E-06	9.3E-07	4.4E-12	9.3E-07	1.2E-11	9.3E-07	1.4E-06	1.3E-11	1.4E-06	3.5E-11	1.4E-06
Fluoranthene	2.9E-06	4.7E-10	2.9E-06	1.3E-09	2.9E-06	3.2E-06	3.3E-11	3.2E-06	9.4E-11	3.2E-06	1.2E-05	8.1E-11	1.2E-05	2.3E-10	1.2E-05
Fluorene	2.2E-06	6.2E-11	2.2E-06	1.7E-10	2.2E-06	2.3E-06	8.2E-12	2.3E-06	2.3E-11	2.3E-06	7.7E-06	1.8E-11	7.7E-06	5.2E-11	7.7E-06
Phenanthrene	5.4E-06	6.0E-10	5.4E-06	1.7E-09	5.4E-06	6.2E-06	4.6E-11	6.2E-06	1.3E-10	6.2E-06	2.6E-05	1.3E-10	2.6E-05	3.7E-10	2.6E-05
TOTAL LMW PAH EHQ =	1.4E-05	1.2E-09	1.4E-05	3.4E-09	1.4E-05	1.5E-05	9.9E-11	1.5E-05	2.8E-10	1.5E-05	5.0E-05	2.8E-10	5.0E-05	7.7E-10	5.0E-05
High Molecular Weight PAHs															
Benz(a)anthracene	9.7E-06	9.5E-10	9.7E-06	2.7E-09	9.7E-06	6.4E-06	5.4E-11	6.4E-06	1.5E-10	6.4E-06	5.1E-06	2.1E-10	5.1E-06	5.9E-10	5.1E-06
Benzo(a)pyrene	1.8E-05	4.4E-09	1.8E-05	1.2E-08	1.8E-05	2.4E-05	2.5E-10	2.4E-05	7.0E-10	2.4E-05	8.5E-05	1.0E-09	8.5E-05	2.9E-09	8.5E-05
Benzo(e)pyrene	1.1E-06	1.6E-08	1.1E-06	4.4E-08	1.1E-06	4.5E-06	2.0E-08	4.5E-06	5.7E-08	4.6E-06	6.0E-06	8.9E-08	6.1E-06	2.5E-07	6.3E-06
Benzo(a)fluorene	--	3.2E-09	3.2E-09	8.9E-09	8.9E-09	--	8.3E-11	1.1E-10	2.3E-10	3.0E-10	--	2.4E-10	2.4E-10	6.6E-10	6.6E-10
Benzo(b)fluorene	--	2.3E-09	2.3E-09	6.4E-09	6.4E-09	--	1.2E-10	1.9E-10	3.4E-10	5.4E-10	--	4.9E-10	4.9E-10	1.4E-09	1.4E-09
Benzo(b)fluoranthene	1.0E-05	4.7E-09	1.0E-05	1.3E-08	1.0E-05	7.1E-06	2.9E-11	7.1E-06	8.2E-11	7.1E-06	8.3E-06	6.9E-11	8.3E-06	1.9E-10	8.3E-06
Benzo(g,h,i)perylene	1.0E-05	1.0E-07	1.0E-05	2.9E-07	1.1E-05	9.2E-06	3.1E-08	9.3E-06	8.6E-08	9.3E-06	7.6E-06	1.4E-07	7.7E-06	3.8E-07	8.0E-06
Benzo(k)fluoranthene	9.8E-06	1.3E-09	9.9E-06	3.6E-09	9.9E-06	6.6E-06	1.0E-10	6.6E-06	2.9E-10	6.6E-06	6.2E-06	4.3E-10	6.2E-06	1.2E-09	6.2E-06

Table 8-9 Ecological Hazard Quotient Summary for Mammalian Receptors: 140,000 tpy Scenario (Continued)

COPC	Muskrat					Red Fox					White-tailed Deer				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chrysene	1.2E-05	2.5E-09	1.2E-05	7.0E-09	1.2E-05	9.0E-06	8.5E-11	9.0E-06	2.4E-10	9.0E-06	1.7E-05	2.7E-10	1.7E-05	7.7E-10	1.7E-05
Dibenz(a,c)anthracene	9.3E-06	4.7E-08	9.4E-06	1.3E-07	9.5E-06	8.1E-06	3.6E-09	8.1E-06	1.0E-08	8.1E-06	2.6E-06	1.6E-08	2.7E-06	4.4E-08	2.7E-06
Dibenz(a,h)anthracene	9.3E-06	3.2E-09	9.3E-06	8.9E-09	9.4E-06	8.1E-06	2.5E-09	8.1E-06	7.0E-09	8.1E-06	2.6E-06	1.1E-08	2.7E-06	3.1E-08	2.7E-06
Indeno(1,2,3-cd)pyrene	9.8E-06	1.5E-08	9.8E-06	4.2E-08	9.8E-06	8.7E-06	4.5E-10	8.7E-06	1.3E-09	8.7E-06	5.2E-06	1.7E-09	5.2E-06	4.7E-09	5.2E-06
Perylene	3.9E-06	1.2E-08	3.9E-06	3.2E-08	4.0E-06	4.4E-06	1.5E-08	4.4E-06	4.2E-08	4.4E-06	1.2E-06	6.7E-08	1.3E-06	1.9E-07	1.4E-06
Pyrene	1.8E-05	7.7E-09	1.8E-05	2.2E-08	1.8E-05	1.7E-05	1.4E-09	1.7E-05	4.0E-09	1.7E-05	5.2E-05	3.8E-09	5.2E-05	1.1E-08	5.2E-05
TOTAL HMW PAH EHQ =	1.2E-04	2.2E-07	1.2E-04	6.1E-07	1.2E-04	1.1E-04	7.4E-08	1.1E-04	2.1E-07	1.1E-04	2.0E-04	3.3E-07	2.0E-04	9.1E-07	2.0E-04
TOTAL LMW AND HMW PAH EHQ =	1.3E-04	2.2E-07	1.3E-04	6.2E-07	1.4E-04	1.3E-04	7.4E-08	1.3E-04	2.1E-07	1.3E-04	2.5E-04	3.3E-07	2.5E-04	9.1E-07	2.5E-04
Dioxins and Furans															
2,3,7,8-TCDD Equivalent	0.0022	3.8E-04	0.0026	0.0011	0.0032	0.019	7.3E-05	0.019	2.1E-04	0.019	0.011	1.2E-04	0.011	3.3E-04	0.011
PCB															
Aroclor 1254 (Total PCBs)	0.0015	3.1E-05	0.0016	8.6E-05	0.0016	0.011	1.0E-06	0.011	2.9E-06	0.011	0.0095	7.2E-07	0.0095	2.0E-06	0.0095
Chlorinated Monocyclic Aromatics															
1,2-Dichlorobenzene	2.7E-04	7.3E-09	2.7E-04	2.1E-08	2.7E-04	4.8E-04	3.4E-09	4.8E-04	9.5E-09	4.8E-04	0.0035	2.5E-09	0.0035	7.0E-09	0.0035
1,2,4-Trichlorobenzene	3.4E-04	1.5E-10	3.4E-04	4.2E-10	3.4E-04	7.4E-04	1.0E-10	7.4E-04	2.9E-10	7.4E-04	0.0052	5.8E-11	0.0052	1.6E-10	0.0052
1,2,4,5-Tetrachlorobenzene	1.3E-04	1.4E-08	1.3E-04	3.8E-08	1.3E-04	0.0013	3.4E-09	0.0013	9.6E-09	0.0013	0.0012	1.9E-09	0.0012	5.2E-09	0.0012
Pentachlorobenzene	1.1E-04	3.0E-07	1.1E-04	8.3E-07	1.1E-04	0.0011	1.4E-08	0.0011	3.9E-08	0.0011	0.0010	9.2E-09	0.0010	2.6E-08	0.0010
Hexachlorobenzene	9.2E-05	6.9E-08	9.2E-05	1.9E-07	9.2E-05	9.7E-04	2.5E-09	9.7E-04	6.9E-09	9.7E-04	8.8E-04	1.1E-09	8.8E-04	3.0E-09	8.8E-04

Table 8-9 Ecological Hazard Quotient Summary for Mammalian Receptors: 140,000 tpy Scenario (Continued)

COPC	Muskrat					Red Fox					White-tailed Deer				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Pentachlorophenol	4.1E-05	2.8E-07	4.1E-05	7.7E-07	4.1E-05	0.0011	3.2E-07	0.0011	9.0E-07	0.0011	9.9E-06	1.4E-06	1.1E-05	4.0E-06	1.4E-05
Chlorinated Solvents and Derivatives															
Carbon Tetrachloride	1.7E-04	3.5E-09	1.7E-04	9.9E-09	1.7E-04	2.2E-04	1.3E-09	2.2E-04	3.6E-09	2.2E-04	0.0017	1.2E-09	0.0017	3.4E-09	0.0017
Chloroform	2.8E-05	4.4E-10	2.8E-05	1.2E-09	2.8E-05	2.5E-05	1.5E-10	2.5E-05	4.3E-10	2.5E-05	2.0E-04	1.9E-10	2.0E-04	5.3E-10	2.0E-04
Dichloromethane	8.9E-04	1.9E-07	8.9E-04	5.3E-07	8.9E-04	6.9E-04	1.4E-07	7.0E-04	3.8E-07	7.0E-04	0.0056	1.9E-07	0.0056	5.3E-07	0.0056
Trichlorofluoromethane (Freon 11)	1.7E-05	6.4E-08	1.8E-05	1.8E-07	1.8E-05	2.0E-05	2.0E-08	2.0E-05	5.7E-08	2.0E-05	1.6E-04	2.2E-08	1.6E-04	6.0E-08	1.6E-04
Chlorinated Alkanes/Alkenes															
1,1,1-Trichloroethane	1.7E-06	4.0E-10	1.7E-06	1.1E-09	1.7E-06	2.0E-06	1.1E-10	2.0E-06	3.1E-10	2.0E-06	1.5E-05	1.2E-10	1.5E-05	3.3E-10	1.5E-05
Other Organics															
Bromoform	8.2E-05	1.4E-07	8.2E-05	3.8E-07	8.3E-05	8.8E-05	3.4E-08	8.8E-05	9.6E-08	8.9E-05	7.2E-04	3.8E-08	7.2E-04	1.1E-07	7.2E-04
O-Terphenyl	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Inorganics															
Antimony	0.036	9.5E-06	0.036	1.4E-05	0.036	0.066	1.7E-05	0.066	2.5E-05	0.066	0.47	1.1E-04	0.47	1.6E-04	0.47
Arsenic	0.0040	2.1E-07	0.0040	3.0E-07	0.0040	0.011	3.0E-07	0.011	4.4E-07	0.011	0.0065	1.5E-06	0.0065	2.2E-06	0.0065
Barium	0.0019	7.8E-09	0.0019	1.1E-08	0.0019	0.0029	7.5E-09	0.0029	1.1E-08	0.0029	0.0060	2.4E-08	0.0060	3.5E-08	0.0060
Beryllium	0.019	2.9E-06	0.019	4.2E-06	0.019	0.060	2.0E-06	0.060	2.8E-06	0.060	0.099	1.0E-05	0.099	1.5E-05	0.099
Boron	0.022	9.5E-06	0.022	1.4E-05	0.022	0.092	1.9E-05	0.092	2.7E-05	0.092	0.28	1.5E-04	0.28	2.1E-04	0.28
Cadmium	0.012	4.5E-05	0.013	6.5E-05	0.013	0.050	5.0E-05	0.050	7.2E-05	0.050	0.032	9.1E-05	0.032	1.3E-04	0.032

Table 8-9 Ecological Hazard Quotient Summary for Mammalian Receptors: 140,000 tpy Scenario (Continued)

COPC	Muskrat					Red Fox					White-tailed Deer				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chromium (Total)	0.037	1.1E-06	0.037	1.6E-06	0.037	0.027	1.3E-06	0.027	1.9E-06	0.027	0.035	3.6E-06	0.035	5.2E-06	0.035
Chromium VI	6.8E-04	2.5E-08	6.8E-04	3.7E-08	6.8E-04	9.2E-05	4.7E-08	9.2E-05	6.8E-08	9.2E-05	7.1E-05	1.3E-07	7.1E-05	1.9E-07	7.1E-05
Cobalt	0.0019	7.9E-07	0.0019	1.1E-06	0.0019	0.0021	2.2E-06	0.0021	3.2E-06	0.0021	0.0021	3.3E-06	0.0021	4.8E-06	0.0021
Lead	0.0091	2.0E-05	0.0091	2.9E-05	0.0091	0.0075	3.0E-05	0.0075	4.3E-05	0.0075	0.0090	8.0E-05	0.0091	1.2E-04	0.0091
Mercury - Inorganic	0.0015	4.1E-04	0.0017	5.6E-04	0.0018	0.0013	1.4E-05	0.0013	2.0E-05	0.0013	0.0049	1.2E-05	0.0049	1.8E-05	0.0049
Methyl Mercury	0.0021	2.8E-05	0.0021	4.1E-05	0.0021	0.0020	1.1E-04	0.0021	1.5E-04	0.0022	9.2E-05	2.0E-05	1.1E-04	2.8E-05	1.2E-04
Nickel	0.011	3.3E-05	0.011	4.8E-05	0.011	0.024	5.6E-05	0.025	8.1E-05	0.025	0.016	1.2E-04	0.016	1.7E-04	0.017
Selenium	0.15	5.2E-06	0.15	7.6E-06	0.15	0.53	5.0E-06	0.53	7.3E-06	0.53	0.11	1.8E-05	0.11	2.6E-05	0.11
Silver	3.8E-05	1.6E-07	3.8E-05	2.3E-07	3.8E-05	1.2E-04	2.5E-07	1.2E-04	3.6E-07	1.2E-04	8.3E-05	8.0E-07	8.4E-05	1.2E-06	8.4E-05
Thallium	0.012	1.7E-04	0.012	2.4E-04	0.012	0.029	0.0015	0.030	0.0022	0.031	0.032	0.0023	0.034	0.0033	0.035
Tin	3.1E-04	3.0E-06	3.1E-04	4.3E-06	3.1E-04	6.9E-04	5.6E-06	7.0E-04	8.1E-06	7.0E-04	4.6E-04	2.3E-06	4.6E-04	3.3E-06	4.6E-04
Vanadium	0.016	4.2E-07	0.016	6.0E-07	0.016	0.015	8.4E-07	0.015	1.2E-06	0.015	0.029	3.9E-06	0.029	5.7E-06	0.029
Zinc	0.025	1.2E-05	0.025	1.7E-05	0.025	0.078	9.1E-06	0.078	1.3E-05	0.078	0.069	2.2E-05	0.069	3.2E-05	0.069

"--" - Quantitative assessment of COPC could not be performed due to lack of suitable toxicity data or empirically measured concentrations.

Table 8-10 Ecological Hazard Quotient Summary for Avian Receptors: 140,000 tpy Scenario

COPC	American Robin					Belted Kingfisher					Great Blue Heron				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Polycyclic Aromatic Hydrocarbons															
Low Molecular Weight PAHs															
Acenaphthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Acenaphthylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluorene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL LMW PAH EHQ =	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
High Molecular Weight PAHs															
Benz(a)anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(e)pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)fluorene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(b)fluorene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 8-10 Ecological Hazard Quotient Summary for Avian Receptors: 140,000 tpy Scenario

COPC	American Robin					Belted Kingfisher					Great Blue Heron				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chrysene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibenz(a,c)anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL HMW PAH EHQ =	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL LMW AND HMW PAH EHQ =	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dioxins and Furans															
2,3,7,8-TCDD Equivalent	0.0036	6.2E-05	0.0037	1.7E-04	0.0038	0.0021	2.8E-04	0.0023	7.9E-04	0.0028	0.0012	2.0E-04	0.0014	5.5E-04	0.0018
PCB															
Aroclor 1254 (Total PCBs)	0.0049	2.6E-07	0.0049	7.1E-07	0.0049	0.0022	3.4E-04	0.0025	9.4E-04	0.0031	0.0012	2.5E-04	0.0014	6.9E-04	0.0019
Chlorinated Monocyclic Aromatics															
1,2-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4,5-Tetrachlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pentachlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachlorobenzene	0.0023	2.7E-09	0.0023	7.6E-09	0.0023	0.0015	1.6E-06	0.0015	4.5E-06	0.0015	0.0015	1.9E-06	0.0015	5.2E-06	0.0015

Table 8-10 Ecological Hazard Quotient Summary for Avian Receptors: 140,000 tpy Scenario

COPC	American Robin					Belted Kingfisher					Great Blue Heron				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Pentachlorophenol	2.1E-04	9.0E-06	2.2E-04	2.5E-05	2.3E-04	0.0027	4.8E-06	0.0027	1.3E-05	0.0027	0.0016	3.1E-06	0.0016	8.8E-06	0.0016
Chlorinated Solvents and Derivatives															
Carbon Tetrachloride	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloroform	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichlorofluoromethane (Freon 11)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chlorinated Alkanes/Alkenes															
1,1,1-Trichloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other Organics															
Bromoform	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
O-Terphenyl	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Inorganics															
Antimony	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic	0.0099	7.9E-07	0.0099	1.1E-06	0.0099	0.0089	5.6E-07	0.0089	8.2E-07	0.0089	0.0030	4.0E-07	0.0030	5.8E-07	0.0030
Barium	0.012	4.9E-08	0.012	7.1E-08	0.012	0.0017	9.0E-09	0.0017	1.3E-08	0.0017	9.6E-04	8.2E-09	9.6E-04	1.2E-08	9.6E-04
Beryllium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Boron	0.13	6.5E-05	0.13	9.4E-05	0.13	0.023	4.6E-07	0.023	6.7E-07	0.023	0.013	1.2E-07	0.013	1.7E-07	0.013
Cadmium	0.31	0.0011	0.31	0.0016	0.31	0.030	0.0019	0.032	0.0027	0.033	0.0040	0.0011	0.0051	0.0016	0.0056

Table 8-10 Ecological Hazard Quotient Summary for Avian Receptors: 140,000 tpy Scenario

COPC	American Robin					Belted Kingfisher					Great Blue Heron				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chromium (Total)	0.35	1.9E-05	0.35	2.8E-05	0.35	0.15	5.6E-05	0.15	8.1E-05	0.15	0.034	3.3E-05	0.034	4.8E-05	0.034
Chromium VI	3.1E-04	1.8E-06	3.1E-04	2.6E-06	3.1E-04	0.027	1.0E-06	0.027	1.5E-06	0.027	0.017	6.4E-07	0.017	9.2E-07	0.017
Cobalt	0.062	5.6E-05	0.062	8.2E-05	0.062	0.026	7.7E-05	0.026	1.1E-04	0.026	0.0037	4.5E-05	0.0037	6.5E-05	0.0037
Lead	0.070	3.2E-04	0.071	4.7E-04	0.071	0.017	7.3E-05	0.017	1.1E-04	0.018	0.0022	3.5E-05	0.0022	5.0E-05	0.0023
Mercury - Inorganic	0.019	3.4E-04	0.020	4.9E-04	0.020	0.031	4.3E-04	0.031	6.2E-04	0.031	0.035	2.5E-04	0.035	3.6E-04	0.035
Methyl Mercury	0.072	0.0063	0.079	0.0091	0.082	0.41	0.0056	0.42	0.0081	0.42	0.30	0.0040	0.31	0.0058	0.31
Nickel	0.17	5.4E-04	0.17	7.9E-04	0.17	0.045	6.8E-04	0.046	9.8E-04	0.046	0.014	4.0E-04	0.014	5.7E-04	0.014
Selenium	0.12	1.1E-05	0.12	1.5E-05	0.12	0.42	2.7E-05	0.42	3.9E-05	0.42	0.27	2.0E-05	0.27	2.9E-05	0.27
Silver	0.0052	1.5E-05	0.0052	2.2E-05	0.0052	9.1E-04	1.5E-05	9.2E-04	2.1E-05	9.3E-04	3.7E-04	1.2E-05	3.8E-04	1.7E-05	3.9E-04
Thallium	0.23	0.0046	0.23	0.0067	0.24	0.050	4.7E-04	0.051	6.9E-04	0.051	0.017	3.8E-05	0.017	5.5E-05	0.017
Tin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium	**1.6**	1.6E-04	**1.6**	2.3E-04	**1.6**	**1.5**	1.1E-04	**1.5**	1.5E-04	**1.5**	0.55	1.1E-04	0.55	1.7E-04	0.55
Zinc	0.77	3.4E-04	0.77	5.0E-04	0.77	0.24	9.2E-04	0.24	0.0013	0.24	0.10	5.5E-04	0.10	7.9E-04	0.10

"--" - Quantitative assessment of COPC could not be performed due to lack of suitable toxicity data or empirically measured concentrations.

Table 8-11 Ecological Hazard Quotient Summary for Avian Receptors: 140,000 tpy Scenario (Continued)

COPC	Duck (Mallard)					Red-tailed Hawk					Wild Turkey				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Polycyclic Aromatic Hydrocarbons															
Low Molecular Weight PAHs															
Acenaphthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Acenaphthylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluorene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL LMW PAH EHQ =	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
High Molecular Weight PAHs															
Benz(a)anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(e)pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)fluorene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(b)fluorene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 8-11 Ecological Hazard Quotient Summary for Avian Receptors: 140,000 tpy Scenario (Continued)

COPC	Duck (Mallard)					Red-tailed Hawk					Wild Turkey				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chrysene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibenz(a,c)anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL HMW PAH EHQ =	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL LMW AND HMW PAH EHQ =	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dioxins and Furans															
2,3,7,8-TCDD Equivalent	5.4E-04	1.2E-04	6.6E-04	3.3E-04	8.7E-04	7.5E-04	1.8E-06	7.6E-04	5.2E-06	7.6E-04	0.0011	1.2E-05	0.0011	3.5E-05	0.0011
PCB															
Aroclor 1254 (Total PCBs)	0.0011	4.8E-06	0.0011	1.3E-05	0.0011	0.0010	1.0E-07	0.0010	2.9E-07	0.0010	0.0020	3.2E-07	0.0020	8.9E-07	0.0020
Chlorinated Monocyclic Aromatics															
1,2-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4,5-Tetrachlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pentachlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachlorobenzene	6.9E-04	7.7E-07	6.9E-04	2.1E-06	6.9E-04	0.0013	3.1E-09	0.0013	8.8E-09	0.0013	0.0021	1.2E-09	0.0021	3.3E-09	0.0021

Table 8-11 Ecological Hazard Quotient Summary for Avian Receptors: 140,000 tpy Scenario (Continued)

COPC	Duck (Mallard)					Red-tailed Hawk					Wild Turkey				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Pentachlorophenol	1.2E-05	1.4E-06	1.3E-05	3.9E-06	1.6E-05	0.0015	3.8E-09	0.0015	1.1E-08	0.0015	4.8E-05	5.3E-06	5.3E-05	1.5E-05	6.2E-05
Chlorinated Solvents and Derivatives															
Carbon Tetrachloride	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloroform	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichlorofluoromethane (Freon 11)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chlorinated Alkanes/Alkenes															
1,1,1-Trichloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other Organics															
Bromoform	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
O-Terphenyl	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Inorganics															
Antimony	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic	0.0088	1.5E-07	0.0088	2.1E-07	0.0088	0.0014	9.7E-09	0.0014	1.4E-08	0.0014	0.0070	5.3E-07	0.0070	7.6E-07	0.0070
Barium	0.011	1.9E-08	0.011	2.7E-08	0.011	0.0012	1.8E-09	0.0012	2.6E-09	0.0012	0.014	5.5E-08	0.014	8.0E-08	0.014
Beryllium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Boron	0.034	7.6E-06	0.034	1.1E-05	0.034	0.011	2.7E-07	0.011	3.9E-07	0.011	0.081	4.2E-05	0.081	6.1E-05	0.081
Cadmium	0.067	9.0E-05	0.067	1.3E-04	0.067	0.027	1.1E-06	0.027	1.5E-06	0.027	0.064	2.0E-04	0.064	2.8E-04	0.064

Table 8-11 Ecological Hazard Quotient Summary for Avian Receptors: 140,000 tpy Scenario (Continued)

COPC	Duck (Mallard)					Red-tailed Hawk					Wild Turkey				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chromium (Total)	0.36	2.6E-06	0.36	3.8E-06	0.36	0.016	4.8E-07	0.016	7.0E-07	0.016	0.13	8.7E-06	0.13	1.3E-05	0.13
Chromium VI	0.0056	2.2E-07	0.0056	3.2E-07	0.0056	1.4E-04	4.5E-08	1.4E-04	6.6E-08	1.4E-04	1.2E-04	1.0E-06	1.2E-04	1.5E-06	1.2E-04
Cobalt	0.032	7.4E-06	0.032	1.1E-05	0.032	0.0051	5.2E-06	0.0051	7.5E-06	0.0051	0.031	2.6E-05	0.031	3.8E-05	0.031
Lead	0.028	5.1E-05	0.028	7.4E-05	0.028	0.0016	2.9E-06	0.0016	4.2E-06	0.0016	0.020	1.2E-04	0.020	1.7E-04	0.020
Mercury - Inorganic	0.0094	0.0034	0.013	0.0049	0.014	7.2E-04	5.6E-06	7.2E-04	8.1E-06	7.3E-04	0.013	1.0E-04	0.014	1.5E-04	0.014
Methyl Mercury	5.4E-05	5.1E-04	5.7E-04	7.4E-04	8.0E-04	0.0013	1.5E-06	0.0013	2.2E-06	0.0013	0.0062	5.6E-04	0.0067	8.2E-04	0.0070
Nickel	0.043	5.9E-05	0.043	8.6E-05	0.043	0.0091	1.2E-05	0.0092	1.7E-05	0.0092	0.037	1.8E-04	0.037	2.6E-04	0.037
Selenium	0.28	2.0E-06	0.28	2.8E-06	0.28	0.061	1.1E-07	0.061	1.6E-07	0.061	0.051	6.8E-06	0.051	9.9E-06	0.051
Silver	6.1E-04	1.8E-06	6.1E-04	2.6E-06	6.2E-04	3.1E-04	2.1E-07	3.1E-04	3.1E-07	3.1E-04	0.0016	1.0E-05	0.0016	1.5E-05	0.0016
Thallium	0.072	7.7E-04	0.073	0.0011	0.073	0.013	0.0010	0.015	0.0015	0.015	0.11	0.0039	0.12	0.0057	0.12
Tin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium	**3.9**	7.5E-05	**3.9**	1.1E-04	**3.9**	0.27	8.8E-06	0.27	1.3E-05	0.27	**2.6**	2.1E-04	**2.6**	3.0E-04	**2.6**
Zinc	0.31	5.7E-05	0.31	8.2E-05	0.31	0.078	5.4E-07	0.078	7.8E-07	0.078	0.23	8.0E-05	0.23	1.2E-04	0.23

"--" - Quantitative assessment of COPC could not be performed due to lack of suitable toxicity data or empirically measured concentrations.

Table 8-12 Ecological Hazard Quotient and Screening Ratio Summary for Community-Based Receptors: 140,000 tpy Scenario

COPC	Terrestrial Plants					Terrestrial Soil Invertebrates					Freshwater Receptors					Freshwater Benthic Invertebrates				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Polycyclic Aromatic Hydrocarbons																				
Low Molecular Weight PAHs																				
Acenaphthene	--	--	--	--	--	0.0017	9.1E-09	0.0017	2.5E-08	0.0017	8.3E-05	4.6E-08	8.3E-05	1.3E-07	8.3E-05	8.6E-04	1.9E-08	8.6E-04	5.2E-08	8.6E-04
Acenaphthylene	--	--	--	--	--	0.0017	2.1E-09	0.0017	6.0E-09	0.0017	1.1E-04	4.8E-08	1.1E-04	1.3E-07	1.1E-04	8.8E-04	1.4E-08	8.8E-04	3.9E-08	8.8E-04
Anthracene	0.0013	6.5E-09	0.0013	1.8E-08	0.0013	0.0013	6.5E-09	0.0013	1.8E-08	0.0013	**13**	0.0015	**13**	0.0043	**13**	0.23	5.3E-06	0.23	1.5E-05	0.23
Fluoranthene	0.0013	6.4E-08	0.0013	1.8E-07	0.0013	0.0013	6.4E-08	0.0013	1.8E-07	0.0013	**13**	0.016	**13**	0.044	**13**	0.067	3.3E-05	0.067	9.2E-05	0.067
Fluorene	--	--	--	--	--	0.0017	9.0E-09	0.0017	2.5E-08	0.0017	0.10	4.8E-05	0.10	1.3E-04	0.10	0.26	1.6E-05	0.26	4.3E-05	0.26
Phenanthrene	2.5E-04	6.6E-08	2.5E-04	1.9E-07	2.5E-04	2.5E-04	6.6E-08	2.5E-04	1.9E-07	2.5E-04	0.33	9.6E-04	0.33	0.0027	0.34	0.089	5.5E-05	0.089	1.5E-04	0.089
High Molecular Weight PAHs																				
Benz(a)anthracene	0.0013	3.6E-09	0.0013	1.0E-08	0.0013	0.0013	3.6E-09	0.0013	1.0E-08	0.0013	**13**	4.6E-04	**13**	0.0013	**13**	0.16	1.6E-05	0.16	4.6E-05	0.16
Benzo(a)pyrene	5.0E-04	6.3E-09	5.0E-04	1.8E-08	5.0E-04	5.0E-04	6.3E-09	5.0E-04	1.8E-08	5.0E-04	0.0049	3.0E-07	0.0049	8.4E-07	0.0049	0.054	6.4E-05	0.054	1.8E-04	0.054
Benzo(e)pyrene	--	--	--	--	--	--	3.8E-08	3.8E-08	1.1E-07	1.1E-07	--	2.7E-06	2.7E-06	7.5E-06	7.5E-06	--	2.8E-07	2.8E-07	7.9E-07	7.9E-07
Benzo(a)fluorene	--	--	--	--	--	--	1.6E-08	1.6E-08	4.4E-08	4.4E-08	--	1.2E-06	1.2E-06	3.5E-06	3.5E-06	--	3.4E-07	3.4E-07	9.5E-07	9.5E-07
Benzo(b)fluorene	--	--	--	--	--	--	1.1E-08	1.1E-08	3.0E-08	3.0E-08	--	1.8E-06	1.8E-06	5.1E-06	5.1E-06	--	2.3E-07	2.3E-07	6.5E-07	6.5E-07
Benzo(b)fluoranthene	--	--	--	--	--	0.0028	1.8E-08	0.0028	5.1E-08	0.0028	0.0064	4.1E-07	0.0064	1.2E-06	0.0064	4.3E-04	2.3E-07	4.3E-04	6.6E-07	4.3E-04
Benzo(g,h,i)perylene	0.0013	8.9E-08	0.0013	2.5E-07	0.0013	0.0013	8.9E-08	0.0013	2.5E-07	0.0013	**500**	0.14	**500**	0.40	**500**	0.29	0.0030	0.30	0.0084	0.30
Benzo(k)fluoranthene	0.0013	7.2E-09	0.0013	2.0E-08	0.0013	0.0013	7.2E-09	0.0013	2.0E-08	0.0013	**50**	9.0E-04	**50**	0.0025	**50**	0.21	3.0E-05	0.21	8.3E-05	0.21
Chrysene	0.0013	1.3E-08	0.0013	3.7E-08	0.0013	0.0013	1.3E-08	0.0013	3.7E-08	0.0013	**100**	0.0088	**100**	0.025	**100**	0.15	4.2E-05	0.15	1.2E-04	0.15

Table 8-12 Ecological Hazard Quotient and Screening Ratio Summary for Community-Based Receptors: 140,000 tpy Scenario

COPC	Terrestrial Plants					Terrestrial Soil Invertebrates					Freshwater Receptors					Freshwater Benthic Invertebrates				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Dibenz(a,c)anthracene	--	--	--	--	--	0.0028	2.5E-08	0.0028	7.0E-08	0.0028	0.020	6.7E-06	0.020	1.9E-05	0.020	3.7E-04	1.9E-06	3.8E-04	5.4E-06	3.8E-04
Dibenz(a,h)anthracene	--	--	--	--	--	0.0028	8.8E-09	0.0028	2.5E-08	0.0028	**5.0**	7.9E-05	**5.0**	2.2E-04	**5.0**	0.83	1.9E-04	0.83	5.3E-04	0.83
Indeno(1,2,3-cd)pyrene	0.0013	1.9E-08	0.0013	5.3E-08	0.0013	0.0013	1.9E-08	0.0013	5.3E-08	0.0013	0.016	1.1E-06	0.016	3.2E-06	0.016	0.25	4.2E-04	0.25	0.0012	0.25
Perylene	--	--	--	--	--	5.6E-04	8.3E-09	5.6E-04	2.3E-08	5.6E-04	0.0084	2.5E-07	0.0084	6.9E-07	0.0084	1.7E-04	8.0E-08	1.7E-04	2.2E-07	1.7E-04
Pyrene	--	--	--	--	--	0.0028	7.3E-07	0.0028	2.0E-06	0.0028	5.6E-04	8.5E-07	5.6E-04	2.4E-06	5.6E-04	0.10	8.5E-05	0.10	2.4E-04	0.10
Dioxins and Furans																				
2,3,7,8-TCDD Equivalent	--	--	--	--	--	3.5E-06	7.8E-08	3.6E-06	2.2E-07	3.7E-06	0.32	4.1E-04	0.32	0.0012	0.33	7.9E-05	2.6E-05	1.0E-04	7.2E-05	1.5E-04
PCB																				
Aroclor 1254 (Total PCBs)	0.0013	1.2E-06	0.0013	3.4E-06	0.0013	0.020	2.0E-05	0.020	5.5E-05	0.020	**20**	0.0079	**20**	0.022	**20**	0.71	0.011	0.73	0.031	0.75
Chlorinated Monocyclic Aromatics																				
1,2-Dichlorobenzene	0.0020	1.3E-09	0.0020	3.5E-09	0.0020	0.0020	1.3E-09	0.0020	3.5E-09	0.0020	0.60	1.9E-04	0.60	5.4E-04	0.60	0.0011	1.3E-07	0.0011	3.7E-07	0.0011
1,2,4-Trichlorobenzene	0.0033	9.3E-11	0.0033	2.6E-10	0.0033	0.0033	9.3E-11	0.0033	2.6E-10	0.0033	0.0042	1.1E-07	0.0042	3.0E-07	0.0042	0.0014	1.2E-08	0.0014	3.3E-08	0.0014
1,2,4,5-Tetrachlorobenzene	--	--	--	--	--	0.0010	1.2E-08	0.0010	3.3E-08	0.0010	0.33	8.2E-05	0.33	2.3E-04	0.33	1.1E-04	4.0E-08	1.1E-04	1.1E-07	1.1E-04
Pentachlorobenzene	--	--	--	--	--	5.0E-04	9.2E-08	5.0E-04	2.6E-07	5.0E-04	0.0039	2.6E-06	0.0039	7.3E-06	0.0039	9.1E-05	1.5E-06	9.2E-05	4.1E-06	9.5E-05
Hexachlorobenzene	3.3E-04	1.7E-09	3.3E-04	4.7E-09	3.3E-04	3.3E-04	1.7E-09	3.3E-04	4.7E-09	3.3E-04	**7.7**	0.0019	**7.7**	0.0053	**7.7**	7.9E-05	3.1E-07	7.9E-05	8.7E-07	8.0E-05
Pentachlorophenol	2.4E-04	1.7E-07	2.4E-04	4.8E-07	2.4E-04	2.4E-04	1.7E-07	2.4E-04	4.8E-07	2.4E-04	0.020	4.6E-04	0.020	0.0013	0.021	6.0E-06	4.6E-08	6.1E-06	1.3E-07	6.1E-06
Chlorinated Solvents and Derivatives																				
Carbon Tetrachloride	0.0010	4.1E-12	0.0010	1.1E-11	0.0010	0.0010	4.1E-12	0.0010	1.1E-11	0.0010	3.6E-04	6.0E-08	3.6E-04	1.7E-07	3.6E-04	1.8E-04	9.1E-09	1.8E-04	2.5E-08	1.8E-04

Table 8-12 Ecological Hazard Quotient and Screening Ratio Summary for Community-Based Receptors: 140,000 tpy Scenario

COPC	Terrestrial Plants					Terrestrial Soil Invertebrates					Freshwater Receptors					Freshwater Benthic Invertebrates				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chloroform	--	--	--	--	--	--	--	--	--	--	8.2E-05	1.8E-08	8.2E-05	5.0E-08	8.2E-05	2.5E-04	5.8E-09	2.5E-04	1.6E-08	2.5E-04
Dichloromethane	--	--	--	--	--	--	--	--	--	--	7.6E-05	2.0E-06	7.8E-05	5.6E-06	8.1E-05	0.0038	6.0E-07	0.0038	1.7E-06	0.0038
Trichlorofluoromethane (Freon 11)	--	--	--	--	--	--	--	--	--	--	4.2E-04	1.3E-05	4.4E-04	3.8E-05	4.6E-04	4.2E-04	3.0E-06	4.2E-04	8.5E-06	4.3E-04
Chlorinated Alkanes/Alkenes																				
1,1,1-Trichloroethane	--	--	--	--	--	--	--	--	--	--	0.050	2.8E-05	0.050	7.8E-05	0.050	6.5E-05	3.2E-08	6.5E-05	9.0E-08	6.5E-05
Other Organics																				
Bromoform	--	--	--	--	--	--	--	--	--	--	0.0083	2.1E-04	0.0085	5.8E-04	0.0089	2.3E-04	7.2E-07	2.3E-04	2.0E-06	2.3E-04
O-Terphenyl	--	--	--	--	--	--	--	--	--	--	--	4.0E-06	4.0E-06	1.1E-05	1.1E-05	--	1.6E-06	1.6E-06	4.3E-06	4.3E-06
Inorganics																				
Antimony	0.050	2.4E-05	0.050	3.5E-05	0.050	0.050	2.4E-05	0.050	3.5E-05	0.050	0.25	1.6E-04	0.25	2.3E-04	0.25	2.3E-04	3.3E-08	2.3E-04	4.8E-08	2.3E-04
Arsenic	0.40	2.4E-06	0.40	3.4E-06	0.40	0.40	2.4E-06	0.40	3.4E-06	0.40	0.40	9.8E-05	0.40	1.4E-04	0.40	0.33	2.4E-06	0.33	3.4E-06	0.33
Barium	0.12	4.5E-07	0.12	6.5E-07	0.12	0.12	4.5E-07	0.12	6.5E-07	0.12	0.41	1.1E-05	0.41	1.6E-05	0.41	0.038	4.1E-08	0.038	6.0E-08	0.038
Beryllium	0.18	7.5E-05	0.18	1.1E-04	0.18	0.18	7.5E-05	0.18	1.1E-04	0.18	0.091	1.3E-05	0.091	1.9E-05	0.091	0.093	2.1E-05	0.093	3.0E-05	0.093
Boron	0.44	6.2E-05	0.44	9.0E-05	0.44	0.44	6.2E-05	0.44	9.0E-05	0.44	0.30	8.9E-04	0.30	0.0013	0.30	--	--	--	--	--
Cadmium	0.042	1.6E-04	0.042	2.4E-04	0.042	0.042	1.6E-04	0.042	2.4E-04	0.042	0.20	0.016	0.22	0.023	0.22	0.83	1.0E-03	0.83	0.0014	0.83
Chromium (Total)	0.030	2.2E-07	0.030	3.2E-07	0.030	0.030	2.2E-07	0.030	3.2E-07	0.030	0.67	3.0E-04	0.67	4.3E-04	0.67	**1.2**	1.9E-06	**1.2**	2.8E-06	**1.2**
Chromium VI	--	3.0E-06	3.0E-06	4.3E-06	4.3E-06	--	3.0E-06	3.0E-06	4.3E-06	4.3E-06	**10**	3.7E-04	**10**	5.4E-04	**10**	5.0E-04	1.8E-09	5.0E-04	2.6E-09	5.0E-04
Cobalt	0.18	2.5E-05	0.18	3.7E-05	0.18	0.18	2.5E-05	0.18	3.7E-05	0.18	0.56	0.0075	0.56	0.011	0.57	0.013	6.6E-07	0.013	9.6E-07	0.013

Table 8-12 Ecological Hazard Quotient and Screening Ratio Summary for Community-Based Receptors: 140,000 tpy Scenario

COPC	Terrestrial Plants					Terrestrial Soil Invertebrates					Freshwater Receptors					Freshwater Benthic Invertebrates				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Lead	0.14	3.8E-04	0.14	5.5E-04	0.14	0.0099	2.7E-05	0.0100	3.9E-05	0.0100	0.20	0.0041	0.20	0.0059	0.21	0.42	5.9E-04	0.42	8.5E-04	0.42
Mercury - Inorganic	0.0070	2.6E-04	0.0073	3.8E-04	0.0074	0.0070	2.6E-04	0.0073	3.8E-04	0.0074	0.50	0.0026	0.50	0.0038	0.50	0.25	0.13	0.38	0.19	0.44
Methyl Mercury	1.4E-04	1.2E-05	1.5E-04	1.7E-05	1.6E-04	1.4E-04	1.2E-05	1.5E-04	1.7E-05	1.6E-04	0.75	3.8E-04	0.75	5.4E-04	0.75	--	1.3E-05	1.3E-05	1.8E-05	1.8E-05
Nickel	0.082	1.4E-04	0.082	2.1E-04	0.082	0.082	1.4E-04	0.082	2.1E-04	0.082	0.24	0.0040	0.24	0.0058	0.25	0.63	4.1E-04	0.63	5.9E-04	0.63
Phosphorus	--	--	--	--	--	--	--	--	--	--	**5.3**	0.0018	**5.3**	0.0026	**5.3**	**1.1**	3.1E-07	**1.1**	4.5E-07	**1.1**
Selenium	0.10	9.5E-07	0.10	1.4E-06	0.10	0.10	9.5E-07	0.10	1.4E-06	0.10	0.050	5.6E-06	0.050	8.1E-06	0.050	0.068	1.9E-07	0.068	2.8E-07	0.068
Silver	0.010	5.5E-06	0.010	7.9E-06	0.010	0.010	5.5E-06	0.010	7.9E-06	0.010	1.0	0.039	1.0	0.057	**1.1**	--	--	--	--	--
Thallium	1.0	0.010	1.0	0.015	1.0	--	--	--	--	--	1.0	0.15	**1.1**	0.22	**1.2**	0.50	0.0016	0.50	0.0023	0.50
Tin	0.20	2.3E-04	0.20	3.3E-04	0.20	0.0050	5.7E-06	0.0050	8.2E-06	0.0050	0.0056	7.9E-05	0.0056	1.1E-04	0.0057	3.4E-04	2.4E-07	3.4E-04	3.5E-07	3.4E-04
Vanadium	0.14	5.4E-06	0.14	7.9E-06	0.14	0.14	5.4E-06	0.14	7.9E-06	0.14	**1.3**	7.5E-05	**1.3**	1.1E-04	**1.3**	0.30	4.6E-06	0.30	6.7E-06	0.30
Zinc	0.13	7.9E-05	0.13	1.1E-04	0.13	0.13	7.9E-05	0.13	1.1E-04	0.13	**2.3**	0.012	**2.3**	0.017	**2.3**	0.68	1.2E-04	0.68	1.7E-04	0.68

"--" - Quantitative assessment of COPC could not be performed due to lack of suitable toxicity data or empirically measured concentrations.

Table 8-13 Emitted SO_2 Concentrations at Each Receptor Location (µg m^{-3}) and Corresponding Phytotoxicity Benchmarks: 140,000 tpy Scenario

Receptor	Name	Baseline			Project Alone			Project Case			Process Upset Case			Process Upset Project Case		
		1 Hour	24 Hour	Annual	1- Hour	24 Hour	Annual	1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual
Eco 1	Darlington Provincial Park	19	19	5.9	5.0	0.77	0.024	25	20	5.9	80	12	0.043	100	32	6.0
Eco 2	Second Marsh Wildlife Area				2.5	0.37	0.015	22	20	5.9	41	6.0	0.026	60	25	5.9
Eco 3	Darlington Waterfront Trail				10	1.3	0.037	30	21	6.0	162	21	0.065	181	40	6.0
Eco 4	McLaughlin Bay Wildlife Reserve				2.4	0.81	0.021	22	20	5.9	39	13	0.036	59	32	6.0
Eco 5	Bowmanville Valley Cons. Area				1.7	0.36	0.016	21	20	5.9	28	5.8	0.028	47	25	6.0
Eco 6	Eco Baseline				7.9	0.92	0.017	27	20	5.9	110	15	0.030	129	34	6.0
Eco 7	Baseline Road & Rundle Road				4.5	0.92	0.051	24	20	6.0	72	15	0.090	92	34	6.0
Eco 8	Baseline Road & Courtice Road				9.4	1.7	0.036	29	21	6.0	150	28	0.063	170	47	6.0
Eco 9	Soper Creek				1.4	0.34	0.013	21	20	5.9	23	5.4	0.023	42	25	5.9
Eco 10	Bowmanville Marsh				1.8	0.37	0.019	21	20	5.9	28	5.9	0.034	48	25	6.0
Eco 11	South of Site, Eco Baseline S7				6.5	0.88	0.010	26	20	5.9	74	14	0.017	94	33	5.9
Eco 12	Sports Fields				12	0.82	0.035	32	20	6.0	196	13	0.062	215	32	6.0
Eco 13	Water Pollution Control Plant				5.7	0.84	0.021	25	20	5.9	92	13	0.036	111	33	6.0
Eco 14	Future Industrial				16	1.7	0.018	35	21	5.9	251	27	0.031	271	47	6.0
Eco 15	Harmony Creek				0.94	0.36	0.0074	20	20	5.9	15	5.7	0.013	35	25	5.9
Eco 16	Farewell Creek				1.0	0.29	0.0076	21	20	5.9	16	4.7	0.013	36	24	5.9
Eco 17	Farm A				10	1.4	0.033	29	21	6.0	160	22	0.058	179	41	6.0
Eco 18	Farm B				3.2	0.81	0.026	23	20	5.9	51	13	0.046	70	32	6.0
Eco 19	Farm C				1.5	0.52	0.012	21	20	5.9	24	8.3	0.020	44	28	5.9
Eco 20	Robinson Creek				3.3	0.63	0.024	23	20	5.9	53	10	0.043	73	29	6.0
Eco 21	Bennett Creek				1.2	0.24	0.014	21	20	5.9	19	3.8	0.024	38	23	5.9
Eco 22	Oshawa Creek Conservation Area				1.8	0.54	0.012	21	20	5.9	29	8.6	0.021	49	28	5.9
NAAQO (Maximum Acceptable)		**900**	**300**	**60**	**900**	**300**	**60**	**900**	**300**	**60**	**900**	**300**	**60**	**900**	**300**	**60**
World Health Organization		**-**	**100**	**30 / 20 F**	**-**	**100**	**30 / 20 F**	**-**	**100**	**30 / 20 F**	**-**	**100**	**30 / 20 F**	**-**	**100**	**30 / 20 F**

NAAQO: National Ambient Air Quality Objectives
F – Forest ecosystem

Table 8-14 Emitted NO_2 Concentrations at Each Receptor Location (μg m^{-3}) and Corresponding Phytotoxicity Benchmarks: 140,000 tpy Scenario

Receptor	Name	Baseline			Project Alone			Project Case			Process Upset Case			Process Upset Project Case		
		1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual
Eco 1	Darlington Provincial Park				17	2.7	0.084	82	61	**37**	28	4.3	0.087	93	63	**37**
Eco 2	Second Marsh Wildlife Area				8.8	1.3	0.052	73	60	**37**	14	2.1	0.053	79	60	**37**
Eco 3	Darlington Waterfront Trail				35	4.5	0.13	100	63	**37**	57	7.3	0.13	122	66	**37**
Eco 4	McLaughlin Bay Wildlife Reserve				8.4	2.8	0.072	73	61	**37**	14	4.6	0.074	78	63	**37**
Eco 5	Bowmanville Valley Cons. Area				6.0	1.3	0.054	71	59	**37**	10	2.1	0.056	74	60	**37**
Eco 6	Eco Baseline				27	3.2	0.059	92	61	**37**	39	5.2	0.061	103	63	**37**
Eco 7	Baseline Road & Rundle Road				16	3.2	0.18	80	61	**37**	25	5.2	0.18	90	63	**37**
Eco 8	Baseline Road & Courtice Road				32	6.0	0.12	97	64	**37**	53	10	0.13	118	68	**37**
Eco 9	Soper Creek				5.0	1.2	0.046	70	59	**37**	8.1	1.9	0.047	73	60	**37**
Eco 10	Bowmanville Marsh				6.1	1.3	0.067	71	59	**37**	10	2.1	0.069	74	60	**37**
Eco 11	South of Site, Eco Baseline S7	65	58	**37**	22	3.1	0.034	87	61	**37**	26	5.0	0.036	91	63	**37**
Eco 12	Sports Fields				42	2.9	0.12	107	61	**37**	69	4.6	0.13	133	63	**37**
Eco 13	Water Pollution Control Plant				20	2.9	0.071	84	61	**37**	32	4.8	0.073	97	63	**37**
Eco 14	Future Industrial				54	5.9	0.062	119	64	**37**	89	10	0.064	153	68	**37**
Eco 15	Harmony Creek				3.3	1.2	0.026	68	59	**37**	5.3	2.0	0.026	70	60	**37**
Eco 16	Farewell Creek				3.5	1.0	0.026	68	59	**37**	5.8	1.7	0.027	70	60	**37**
Eco 17	Farm A				34	4.7	0.11	99	63	**37**	56	7.7	0.12	121	66	**37**
Eco 18	Farm B				11	2.8	0.090	76	61	**37**	18	4.5	0.093	82	63	**37**
Eco 19	Farm C				5.2	1.8	0.040	70	60	**37**	8.5	2.9	0.042	73	61	**37**
Eco 20	Robinson Creek				12	2.2	0.084	76	60	**37**	19	3.6	0.087	83	62	**37**
Eco 21	Bennett Creek				4.1	0.8	0.047	69	59	**37**	6.6	1.4	0.048	71	60	**37**
Eco 22	Oshawa Creek Conservation Area				6.3	1.9	0.042	71	60	**37**	10	3.0	0.044	75	61	**37**
NAAQO (Maximum Acceptable)		**400**	**200**	**100**	**400**	**200**	**100**	**400**	**200**	**100**	**400**	**200**	**100**	**400**	**200**	**100**
World Health Organization		**-**	**75**	**30**	**-**	**75**	**30**	**-**	**75**	**30**	**-**	**75**	**30**	**-**	**75**	**30**

NAAQO: National Ambient Air Quality Objectives

Table 8-15 Emitted HF Concentrations at Each Receptor Location (µg m^{-3}) and Corresponding Phytotoxicity Benchmarks: 140,000 tpy Scenario

Receptor	Name	Baseline			Project Alone			Project Case			Process Upset Case			Process Upset Project Case		
		1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual
Eco 1	Darlington Provincial Park				0.13	0.020	6.28E-04	NA	NA	NA	1.3	0.20	0.00091	NA	NA	NA
Eco 2	Second Marsh Wildlife Area				0.066	0.010	3.84E-04	NA	NA	NA	0.66	0.10	0.00056	NA	NA	NA
Eco 3	Darlington Waterfront Trail				0.26	0.033	9.60E-04	NA	NA	NA	2.6	0.33	0.0014	NA	NA	NA
Eco 4	McLaughlin Bay Wildlife Reserve				0.063	0.021	5.33E-04	NA	NA	NA	0.63	0.21	0.00077	NA	NA	NA
Eco 5	Bowmanville Valley Cons. Area				0.044	0.0094	4.04E-04	NA	NA	NA	0.44	0.094	0.00059	NA	NA	NA
Eco 6	Eco Baseline				0.20	0.024	4.38E-04	NA	NA	NA	1.8	0.24	0.00063	NA	NA	NA
Eco 7	Baseline Road & Rundle Road				0.12	0.024	0.0013	NA	NA	NA	1.2	0.24	0.0019	NA	NA	NA
Eco 8	Baseline Road & Courtice Road				0.24	0.044	9.26E-04	NA	NA	NA	2.4	0.44	0.0013	NA	NA	NA
Eco 9	Soper Creek				0.037	0.0086	3.41E-04	NA	NA	NA	0.37	0.086	0.00049	NA	NA	NA
Eco 10	Bowmanville Marsh				0.045	0.0095	4.97E-04	NA	NA	NA	0.45	0.095	0.00072	NA	NA	NA
Eco 11	South of Site, Eco Baseline S7	NA	NA	NA	0.17	0.023	2.56E-04	NA	NA	NA	1.2	0.23	0.00037	NA	NA	NA
Eco 12	Sports Fields				0.31	0.021	9.12E-04	NA	NA	NA	3.1	0.21	0.0013	NA	NA	NA
Eco 13	Water Pollution Control Plant				0.15	0.022	5.30E-04	NA	NA	NA	1.5	0.22	0.00077	NA	NA	NA
Eco 14	Future Industrial				0.40	0.044	4.60E-04	NA	NA	NA	4.0	0.44	0.00067	NA	NA	NA
Eco 15	Harmony Creek				0.024	0.0092	1.90E-04	NA	NA	NA	0.24	0.092	0.00028	NA	NA	NA
Eco 16	Farewell Creek				0.026	0.008	1.97E-04	NA	NA	NA	0.26	0.076	0.00029	NA	NA	NA
Eco 17	Farm A				0.26	0.035	8.55E-04	NA	NA	NA	2.6	0.35	0.0012	NA	NA	NA
Eco 18	Farm B				0.082	0.021	6.69E-04	NA	NA	NA	0.82	0.21	0.0010	NA	NA	NA
Eco 19	Farm C				0.039	0.013	3.01E-04	NA	NA	NA	0.39	0.13	0.00044	NA	NA	NA
Eco 20	Robinson Creek				0.086	0.016	6.25E-04	NA	NA	NA	0.86	0.16	0.00091	NA	NA	NA
Eco 21	Bennett Creek				0.030	0.0062	3.48E-04	NA	NA	NA	0.30	0.062	0.00050	NA	NA	NA
Eco 22	Oshawa Creek Conservation Area				0.047	0.014	3.15E-04	NA	NA	NA	0.47	0.14	0.00046	NA	NA	NA
NAAQO (Maximum Acceptable)		-	**0.86** [1]	-	-	**0.86** [1]	-	-	**0.86** [1]	-	-	**0.86** [1]	-	-	**0.86** [1]	-

NAAQO: National Ambient Air Quality Objectives

1. NAAQO not available for HF. Benchmark is Ontario Reg. 419/05 Schedule 3 for gaseous fluorides (as HF) during the growing season (MOE, 2005b).

NA – Baseline data not available for HF. Project Case and Process Upset Project Case scenarios can therefore not be quantified.

"-" – No benchmark available for this time period.

8.6.8 Traffic Case: 140,000 tpy

Current offsite vehicle emissions prior to the start up of the Thermal Treatment Facility were based on traffic volume estimates provided by URS Canada Inc. These traffic estimates were combined with the existing baseline ambient air conditions in the airshed to produce the baseline traffic case.

Emissions from vehicle operation (*e.g.*, onsite vehicles and waste/ash trucks) associated with the proposed Facility and existing/baseline vehicular traffic were assessed in conjunction with the Facility air emissions to determine the net impact from all potential emissions onsite and offsite.

The assessment was conducted for the receptor locations in close proximity to the roads on which traffic into the proposed Facility would travel. This methodology is expected to be conservative as it assumes that the maximum predicted concentration due to vehicle traffic occurs simultaneously with the maximum predicted concentration from onsite emissions (Jacques Whitford, 2009e).

8.6.8.1 Effects on Vegetation from SO_2 and NO_2 Traffic Case Emissions

The concentrations of SO_2 and NO_2 were assessed at six ecological receptor locations based on traffic impacts at these locations. Two cases were assessed: Baseline Traffic Case (Off-Site Traffic + Background Ambient Concentration) and Traffic Case (Measured Background + Baseline Off-Site Traffic + Project On-Site Traffic + Project On-Site Stationary).

The SO_2 emissions were found to comply with the NAAQO and WHO phytotoxicity benchmarks (where available) in both scenarios for their respective 1-hour, 24-hour and annual averaging periods.

The NO_2 emissions were found to comply with the NAAQO for all receptors in the case of the one hour averaging period.

For the 24-hour averaging period only the emissions at receptor location 14 (Future Industrial) were found to exceed the 24-hour phytotoxicity benchmark of the WHO Air Quality Guideline (75 µg/m^3) in the Baseline Traffic Case (94 µg/m^3). However, in the Traffic Case, receptor locations 6, 12, and 14, (Eco Baseline, Sports Fields, and Future Industrial) were found to exceed the 24-hour phytotoxicity benchmark (76, 76, and 101 µg/m^3, respectively). These concentrations were deemed to be driven almost exclusively by the existing baseline conditions.

Similarly, the NO_2 concentrations for the annual averaging period at all six receptor locations exceeded the phytotoxicity WHO Air Quality Guideline of 30 µg/m^3 for both cases, with the concentrations in the Traffic Case only marginally increasing from the baseline conditions. Specifically, the Baseline Traffic Case ranged from 38 µg/m^3 to 44 µg/m^3, while the concentrations for Traffic Case also ranged from 38 µg/m^3 to 44 µg/m^3.

Results are summarized in Tables 8-16 and 8-18. Bolded values represent benchmark exceedance.

Table 8-16 Traffic Case SO_2 Concentrations (µg m^{-3}) and Corresponding Phytotoxicity Benchmarks: 140,000 tpy Scenario

Receptor	Description	Baseline Off-Site Traffic + Background Concentration (ug/m^3)			Total Project Impact (Project Off-Site Traffic + Measured Background + Project On-Site Emissions) (ug/m^3)		
		1 Hr	24 Hr	Annual	1 Hr	24 Hr	Annual
Eco 3	Darlington Waterfront Trail	20	19	5.9	30	21	6.0
Eco 6	Eco Baseline	20	19	5.9	27	20	6.0
Eco 11	South of Site, Eco Baseline S7	20	19	5.9	25	20	5.9
Eco 12	Sports Fields	20	19	5.9	32	20	6.0
Eco 13	Water Pollution Control Plant	20	19	5.9	26	20	6.0
Eco 14	Future Industrial	20	19	6.0	36	21	6.0
NAAQO (Maximum Acceptable)		**900**	**300**	**60**	**900**	**300**	**60**
World Health Organization		**-**	**100**	**20**	**-**	**100**	**20**

Table 8-17 Traffic Case NO_2 Concentrations (µg m^{-3}) and Corresponding Phytotoxicity Benchmarks: 140,000 tpy Scenario

Receptor	Description	Baseline Off-Site Traffic + Background Concentration (ug/m^3)			Total Project Impact (Project Off-Site Traffic + Measured Background + Project On-Site Emissions) (ug/m^3)		
		1 Hr	24 Hr	Annual	1 Hr	24 Hr	Annual
Eco 3	Darlington Waterfront Trail	121	70	**39**	157	75	**39**
Eco 6	Eco Baseline	121	73	**38**	146	**76**	**39**
Eco 11	South of Site, Eco Baseline S7	119	69	**38**	135	72	**38**
Eco 12	Sports Fields	122	73	**39**	167	**76**	**40**
Eco 13	Water Pollution Control Plant	117	69	**38**	138	72	**39**

Receptor	Description	Baseline Off-Site Traffic + Background Concentration (ug/m^3)			Total Project Impact (Project Off-Site Traffic + Measured Background + Project On-Site Emissions) (ug/m^3)		
		1 Hr	24 Hr	Annual	1 Hr	24 Hr	Annual
Eco 14	Future Industrial	129	**94**	**44**	193	**101**	**44**
NAAQO (Maximum Acceptable)		**400**	**200**	**100**	**400**	**200**	**100**
World Health Organization		**-**	**75**	**30**	**-**	**75**	**30**

8.6.9 Construction Case: 400,000 tpy

The construction case for the 400,000 tpy scenario was not expected to differ from that of the 140,000 tpy scenario. Please refer to Section 8.6.3 for a qualitative risk evaluation of construction activities.

8.6.10 Project Alone Case Assessment Scenario: 400,000 tpy

Project Case EHQs or SRs provide an indication of potential adverse environmental effects (*i.e.*, risk) to VECs resulting from exposure to COPC released to the atmosphere from the proposed Thermal Treatment Facility alone.

8.6.10.1 Deposition from Atmospheric Emissions

Maximum Project Alone Case EHQs or SRs generated for each COPC and VEC are provided in Tables 8-18 to 8-22.

Detailed results and tables of the Project Alone Case scenario (including the receptor location where each maximum EHQ/SR was predicted) are provided in Appendix N. The highest predicted risk associated with the Project Alone Case (SR = 0.50) was reported in the case of thallium for freshwater receptors at Ecological Receptor Location 8 (Eco 8), which corresponds to the Baseline and Courtice Road receptor location. This predicted SR is roughly 2 times lower than the threshold of toxicity (*e.g.,* 1.0). EHQs/SRs did not exceed 1.0 for any of the ecological receptors at any of the receptor locations evaluated in the ERA. These results suggest that atmospheric Project Alone Case emissions are not expected to present adverse environmental risks to mammalian, avian, or community-based receptors exposed to COPC.

8.6.10.2 Exposure of Vegetation to SO_2, NO_2 and HF

Project Alone SO_2 and NO_2 concentrations estimated at each ecological receptor locations did not exceed their respective Maximum Acceptable NAAQOs. Similarly, the 24-hour and annual SO_2 and NO_2 concentrations did not exceed the phytotoxicity WHO Air Quality Guidelines. However, HF, for which no NAAQO or WHO guidelines or objectives were available, was compared against the Ontario Regulation 419/05 Air Pollution – Local Air Quality, Schedule 3, 24-hour averaging period benchmark for gaseous fluorides (as HF) during the growing season (MOE, 2005b). No exceedance of this benchmark was noted. Phytotoxicity as a result of Project Alone emissions is, therefore, not expected for SO_2, NO_2, or HF during any averaging period (Tables 8-23 to 8-25).

8.6.11 Project Case Assessment Scenario: 400,000 tpy

Project Case EHQs and SRs provide an indication of potential adverse environmental effects (*i.e.*, risk) to VECs resulting from exposure to COPC released to the atmosphere from both the Thermal Treatment Facility and existing baseline conditions (*i.e*., existing emissions facilities) in the LRASA. Consequently, EHQs/SRs for this assessment scenario should be higher than those from either the Baseline or Project Alone Case. However given that the contribution of the Project Alone Case in most cases (as presented in section 8.6.11) is not substantial (most of the time a few orders of magnitude lower than those reported in the Baseline Case) the EHQ/SRs are often similar to the values reported in the Baseline Case.

8.6.11.1 Deposition from Atmospheric Emissions

Maximum Project Case EHQs and SRs generated for each COPC and VEC are presented in Tables 8-18 to 8-22. Detailed results and of the Project Case scenario, including locations of maximum predicted values, are provided in **Appendix N.**

For mammals and birds all COPC had EHQs less than 1.0, with the exception of selenium in the case of the mink receptor (EHQ = 1.8), and vanadium in the case of the American robin, belted kingfisher, mallard duck, and wild turkey receptors (EHQs = 1.6, 1.4, 3.2, and 2.6, respectively).

For freshwater receptors, a number of COPC were identified with EHQs or SRs greater than 1.0: anthracene flouranthene, benzo(a)anthracene, benzo(g,h,i)perylene, benzo(k)flouranthene, chrysene, dibenzo(a,h)anthracene), PCBs (total), hexachlorobenzene, hexavalent chromium, phosphorus, silver, thallium, vanadium, and zinc. COPC identified with EHQs or SRs greater than 1.0 for benthic invertebrates include total chromium and phosphorus.

All COPC associated with potential risk to terrestrial, freshwater, and sediment receptors possessed elevated EHQs/SRs due entirely to baseline concentrations (most of them non-detects, as discussed in Section 8.6.9.1). Contribution from the Project Alone is, therefore, not deemed to be substantive. As predicted risk associated with the Project Case scenario is driven entirely by baseline COPC concentrations, similar conclusions to those reached in Section 8.6.9.1 apply here: no risk is expected for terrestrial, freshwater, or sediment receptors as a result of exposure to COPC with the exception of selenium and vanadium to birds and mammals, zinc and phosphorus in freshwater, and total chromium and phosphorus in sediment. The reported EHQ and SR values are expected to be generally similar to other unimpacted areas in Ontario.

8.6.11.2 Exposure of Vegetation to SO_2, NO_2 and HF

Project Case SO_2 and NO_2 concentrations were marginally higher than those reported from empirical baseline measurements, and were deemed to be driven almost exclusively by existing baseline conditions. Similarly to what was concluded for the Baseline scenario, Project Case phytotoxicity of NO_2 during the annual averaging period is estimated, although actual contributions from the Facility are negligible. The highest annual concentration at any of the receptors was 37 μg/m^3 compared to the WHO Guideline of 30 μg/m^3. These annual NO_2 exceedances are almost exclusively due to the baseline conditions (37 μg/m^3) since the annual contributions from the Facility are negligible. As discussed in section 8.6.2.2 the current plant communities showed no evidence of NO_2 related stress. Therefore it is not expected that the Project Case NO_2 emissions will pose a risk to the plant communities. Estimation of Project Case HF emissions could not be conducted as baseline data was not available (Tables 8-23 to 8-25).

8.6.12 Process Upset Case: 400,000 tpy

8.6.12.1 Deposition from Atmospheric Emissions

Intermittent processes such as start-ups, shut-downs and possible malfunctions, generally referred to as "upsets", can result in short-term emissions to the atmosphere that may be higher than those during normal operational conditions. The potential for adverse effects to ecological receptors was evaluated for the "upset" conditions.

These process upset emission rates provide a very conservative estimate of worst-case emission rates that could be expected over the course of an operating year.

The Process Upset Case EHQs/SRs provide an indication of potential adverse environmental effects (*i.e.,* risk) to VECs resulting from exposure to COPC released to the atmosphere from the Thermal Treatment Facility in the LRASA in a case of start-ups, shut-downs or possible malfunctions.

Maximum Process Upset Case EHQs/SRs generated for each COPC and VEC are presented in Tables 8-18 to 8-22. Detailed results and tables of the Process Upset Case scenario (including locations where maximums are expected to occur) are provided in **Appendix N.**

Process Upset Case emissions are not expected to present adverse environmental risks to mammalian, avian, and community-based receptors exposed to COPC, with the possible exception of benzo(g,h,i)perylene in surface water. An elevated SR of 1.1 was estimated for freshwater receptors at Ecological Receptor Location 17 (Eco 17), which corresponds to the Farm A receptor location. The benchmark used in this assessment for benzo(g,h,i)perylene is the PWQO value, currently set at 2 x 10^{-8} mg/L by the MOE. It is worth nothing that this value is designated as an interim PWQO set for emergency purposes based on the best information available at the time of the PWQO publication (1999). Because of this limitation, the document states to employ caution when applying this value. Therefore the marginal exceedance of this value is not expected to represent a risk for freshwater receptors.

8.6.12.2 Exposure of Vegetation to SO_2, NO_2 and HF

Process Upset Case SO_2 and NO_2 concentrations estimated at each ecological receptor location did not exceed their respective Maximum Acceptable NAAQOs or the WHO Air Quality Guidelines where available, with the exception of NO_2 at Eco Receptor Location 8 (Baseline Road and Courtice Road), which marginally exceeded the WHO Guideline (78 µg/m^3 vs. 75 µg/m^3) during the 24 hour averaging period. Process upsets are assumed to occur during the worst-case metereological conditions, and as such, actual risk to plant communities at this receptor location as a result of NO_2 is expected to be almost negligible. In the case of HF, for which no NAAQO or WHO guidelines or objectives were available, was instead compared against the Ontario Regulation 419/05 *Air Pollution – Local Air Quality*, Schedule 3 24-hour averaging period benchmark for gaseous fluorides (as HF) during the growing season (MOE, 2005b) was used. No exceedance of this benchmark was noted. Phytotoxicity as a result of Process Upset Case emissions is therefore not expected for SO_2, NO_2 or HF during any averaging period (Tables 8-23 to 8-25).

8.6.13 Process Upset Project Case: 400,000 tpy

8.6.13.1 Deposition from Atmospheric Emissions

Evaluation of the Process Upset Project Case consisted of the assessment of risks to ecological receptors due to exposure to the total concentrations of COPC released to the atmosphere. This includes the ecological risks from the existing concentrations of COPC in the environmental media (*i.e*. Baseline Case) and the predicted increases in chemical concentrations from the operation of the Facility during upset conditions (*i.e*. the Process Upset Case). These ecological risks represent the potential environment effects (risks) of ecological receptor exposure to atmospheric emissions (above existing concentrations) with the addition of the Thermal Treatment Facility operating during upset conditions in the LRASA.

As in the Baseline Case, the same COPC were identified to present a potential risk to mammalian and avian receptors, (selenium and vanadium, respectively).

For freshwater receptors: anthracene, flouranthene, benzo(a)anthracene, benzo(g,h,i)perylene, benzo(k)flouranthene, chrysene dibenzo(a,h)anthracene, PCBs (total), hexachlorobenzene, hexavalent chromium, phosphorus, silver, thallium, vanadium, and zinc were associated with potential risk, as their respective SRs were greater than 1.0. For benthic invertebrates total chromium and phosphorus were identified with SRs greater than 1.0.

All COPC associated with potential risk to terrestrial, freshwater, and sediment receptors possessed elevated EHQs/SRs due entirely to baseline concentrations (most of them non-detects, as discussed in Section 8.6.9.1), with the possible exception of benzo(g,h,i)perylene in surface water. Contribution from Process Upsets is, therefore, not deemed to be substantive. As predicted risk associated with the Process Upset Project Case scenario is driven entirely by baseline COPC concentrations, similar conclusions to those reached in Section 8.6.9.1 apply here; no risk is expected for terrestrial, freshwater, or sediment receptors as a result of exposure to COPC with the exception of selenium and vanadium to birds and mammals, zinc and phosphorus in freshwater, and total chromium and phosphorus in sediment. The reported EHQs and SRs values are expected to be generally similar to other unimpacted areas in Ontario.

Potential risk to freshwater receptors as a result of benzo(g,h,i)perylene in surface water could not be entirely attributed to baseline conditions. However, given the low confidence assigned to the PWQO benchmark used in this assessment (Section 8.6.13.1), and the overall SR contribution from the Baseline Case *vs.* that from the Process Upset Case (500:1.1), Process Upset Case risk from benzo(g,h,i)perylene in surface water is not considered to be substantial.

8.6.13.2 Exposure of Vegetation to SO_2, NO_2 and HF

Process Upset Project Case SO_2 and NO_2 concentrations were marginally higher than those reported from empirical baseline measurements, and were deemed to be driven almost exclusively by existing baseline conditions. Similar to the Project Case, the only exceedances of any air quality guidelines for the Process Upset Project Case occurred for NO_2 during the annual averaging period where the maximum concentration was 37 μg/m^3. These exceedances were also primarily due to the baseline conditions (37 μg/m^3) which were greater than the WHO Air Quality Guidelines (30 μg/m^3) and therefore it is not expected that the Project Upset Case NO_2 emissions will pose a risk to the plant communities Estimation of Process Upset Project Case HF emissions could not be conducted as baseline data was not available (Tables 8-23 to 8-25).

The following tables characterize risk for each 400,000 tpy assessment scenario evaluated in the ERA. EHQs/SRs greater than the threshold of 1.0 are bolded.

Table 8-18 Ecological Hazard Quotient Summary for Mammalian Receptors: 400,000 tpy Scenario

COPC	Eastern Cottontail Rabbit					Masked Shrew					Meadow Vole					Mink				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Polycyclic Aromatic Hydrocarbons																				
Low Molecular Weight PAHs																				
Acenaphthene	7.9E-06	2.3E-10	7.9E-06	6.4E-10	7.9E-06	1.2E-05	2.0E-10	1.2E-05	5.7E-10	1.2E-05	1.1E-05	3.1E-10	1.1E-05	8.7E-10	1.1E-05	1.4E-06	3.3E-11	1.4E-06	9.2E-11	1.4E-06
Acenaphthylene	1.2E-06	4.8E-11	1.2E-06	1.3E-10	1.2E-06	1.1E-05	4.8E-11	1.1E-05	1.3E-10	1.1E-05	2.6E-06	6.6E-11	2.6E-06	1.8E-10	2.6E-06	9.2E-07	2.5E-11	9.2E-07	7.1E-11	9.2E-07
Anthracene	4.2E-06	1.1E-10	4.2E-06	3.1E-10	4.2E-06	1.1E-05	1.9E-10	1.1E-05	5.3E-10	1.1E-05	6.4E-06	1.6E-10	6.4E-06	4.5E-10	6.4E-06	9.2E-07	2.6E-11	9.2E-07	7.2E-11	9.2E-07
Fluoranthene	3.0E-05	7.3E-10	3.0E-05	2.0E-09	3.0E-05	1.3E-05	1.8E-09	1.3E-05	5.1E-09	1.3E-05	4.0E-05	1.1E-09	4.0E-05	3.1E-09	4.0E-05	1.2E-06	5.4E-10	1.2E-06	1.5E-09	1.2E-06
Fluorene	2.1E-05	1.6E-10	2.1E-05	4.5E-10	2.1E-05	1.3E-05	2.0E-10	1.3E-05	5.5E-10	1.3E-05	2.8E-05	2.2E-10	2.8E-05	6.2E-10	2.8E-05	1.5E-06	7.9E-11	1.5E-06	2.2E-10	1.5E-06
Phenanthrene	6.9E-05	1.2E-09	6.9E-05	3.2E-09	6.9E-05	7.3E-06	1.9E-09	7.3E-06	5.4E-09	7.3E-06	8.8E-05	1.7E-09	8.8E-05	4.6E-09	8.8E-05	2.1E-06	6.5E-10	2.1E-06	1.8E-09	2.1E-06
TOTAL LMW PAH EHQ =	1.3E-04	2.4E-09	1.3E-04	6.8E-09	1.3E-04	6.7E-05	4.4E-09	6.7E-05	1.2E-08	6.7E-05	1.8E-04	3.5E-09	1.8E-04	9.9E-09	1.8E-04	8.0E-06	1.4E-09	8.0E-06	3.8E-09	8.0E-06
High Molecular Weight PAHs																				
Benz(a)anthracene	1.8E-05	1.7E-09	1.8E-05	4.7E-09	1.8E-05	6.5E-05	7.0E-10	6.5E-05	2.0E-09	6.5E-05	3.2E-05	2.3E-09	3.2E-05	6.3E-09	3.2E-05	8.7E-06	9.7E-10	8.7E-06	2.7E-09	8.7E-06
Benzo(a)pyrene	2.2E-04	6.2E-09	2.2E-04	1.7E-08	2.2E-04	1.1E-04	4.0E-09	1.1E-04	1.1E-08	1.1E-04	2.9E-04	8.1E-09	2.9E-04	2.2E-08	2.9E-04	6.7E-06	5.5E-09	6.7E-06	1.5E-08	6.7E-06
Benzo(e)pyrene	1.6E-05	4.9E-07	1.6E-05	1.3E-06	1.7E-05	1.2E-06	4.2E-08	1.2E-06	1.1E-07	1.3E-06	2.0E-05	6.3E-07	2.1E-05	1.7E-06	2.2E-05	4.7E-06	1.2E-08	4.7E-06	3.3E-08	4.7E-06
Benzo(a)fluorene	--	1.4E-09	1.4E-09	3.9E-09	3.9E-09	--	1.2E-09	1.2E-09	3.5E-09	3.5E-09	--	1.9E-09	1.9E-09	5.2E-09	5.2E-09	--	6.6E-09	6.6E-09	1.8E-08	1.8E-08
Benzo(b)fluorene	--	2.7E-09	2.7E-09	7.5E-09	7.5E-09	--	9.0E-10	9.0E-10	2.5E-09	2.5E-09	--	3.6E-09	3.6E-09	9.7E-09	9.7E-09	--	5.8E-09	5.9E-09	1.6E-08	1.6E-08
Benzo(b)fluoranthene	2.6E-05	6.1E-10	2.6E-05	1.7E-09	2.6E-05	6.6E-05	1.4E-09	6.6E-05	3.8E-09	6.6E-05	4.3E-05	9.8E-10	4.3E-05	2.7E-09	4.3E-05	8.7E-06	4.9E-09	8.7E-06	1.4E-08	8.7E-06
Benzo(g,h,i)perylene	2.4E-05	7.5E-07	2.5E-05	2.0E-06	2.6E-05	2.2E-04	8.2E-08	2.2E-04	2.2E-07	2.2E-04	4.2E-05	9.6E-07	4.3E-05	2.6E-06	4.5E-05	1.1E-05	1.1E-07	1.1E-05	3.2E-07	1.2E-05
Benzo(k)fluoranthene	2.1E-05	2.6E-09	2.1E-05	7.0E-09	2.1E-05	6.5E-05	1.3E-09	6.5E-05	3.7E-09	6.5E-05	3.6E-05	3.4E-09	3.6E-05	9.3E-09	3.6E-05	8.7E-06	1.3E-09	8.7E-06	3.6E-09	8.7E-06

Table 8-18 Ecological Hazard Quotient Summary for Mammalian Receptors: 400,000 tpy Scenario

COPC	Eastern Cottontail Rabbit					Masked Shrew					Meadow Vole					Mink				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chrysene	4.8E-05	2.4E-09	4.8E-05	6.7E-09	4.8E-05	6.7E-05	2.3E-09	6.7E-05	6.5E-09	6.7E-05	7.1E-05	3.4E-09	7.1E-05	9.5E-09	7.1E-05	9.8E-06	2.6E-09	9.9E-06	7.2E-09	9.9E-06
Dibenz(a,c)anthracene	1.1E-05	9.2E-08	1.1E-05	2.5E-07	1.2E-05	2.2E-04	1.2E-08	2.2E-04	3.2E-08	2.2E-04	2.6E-05	1.2E-07	2.6E-05	3.2E-07	2.6E-05	9.6E-06	6.5E-08	9.7E-06	1.8E-07	9.8E-06
Dibenz(a,h)anthracene	1.1E-05	6.0E-08	1.1E-05	1.6E-07	1.1E-05	2.2E-04	5.7E-09	2.2E-04	1.5E-08	2.2E-04	2.6E-05	7.8E-08	2.6E-05	2.1E-07	2.6E-05	9.6E-06	2.8E-09	9.6E-06	7.8E-09	9.6E-06
Indeno(1,2,3-cd)pyrene	1.8E-05	1.4E-08	1.8E-05	3.9E-08	1.8E-05	2.2E-04	1.2E-08	2.2E-04	3.3E-08	2.2E-04	3.4E-05	1.8E-08	3.4E-05	5.1E-08	3.4E-05	9.6E-06	2.0E-08	9.6E-06	5.5E-08	9.7E-06
Perylene	4.1E-06	3.7E-07	4.4E-06	9.9E-07	5.1E-06	4.5E-05	2.8E-08	4.5E-05	7.7E-08	4.5E-05	7.4E-06	4.7E-07	7.9E-06	1.3E-06	8.7E-06	6.5E-06	2.9E-09	6.5E-06	8.0E-09	6.5E-06
Pyrene	1.4E-04	3.5E-08	1.4E-04	9.8E-08	1.4E-04	7.4E-05	5.6E-08	7.4E-05	1.6E-07	7.5E-05	1.9E-04	5.3E-08	1.9E-04	1.5E-07	1.9E-04	9.4E-06	8.3E-09	9.4E-06	2.3E-08	9.4E-06
TOTAL HMW PAH EHQ =	5.6E-04	1.8E-06	5.6E-04	4.9E-06	5.7E-04	0.0014	2.1E-07	0.0014	5.7E-07	0.0014	8.2E-04	2.3E-06	8.2E-04	6.3E-06	8.2E-04	1.0E-04	2.5E-07	1.0E-04	7.0E-07	1.0E-04
TOTAL LMW AND HMW PAH EHQ =	6.9E-04	1.8E-06	7.0E-04	4.9E-06	7.0E-04	0.0015	2.1E-07	0.0015	5.8E-07	0.0015	9.9E-04	2.3E-06	1.0E-03	6.3E-06	0.0010	1.1E-04	2.5E-07	1.1E-04	7.1E-07	1.1E-04
Dioxins and Furans																				
2,3,7,8-TCDD Equivalent	0.011	2.8E-04	0.011	6.3E-04	0.011	0.053	0.0038	0.057	0.0056	0.059	0.011	3.0E-04	0.012	6.6E-04	0.012	0.020	0.0050	0.025	0.0073	0.028
PCB																				
Aroclor 1254 (Total PCBs)	0.0097	3.3E-06	0.0097	9.2E-06	0.0097	0.010	2.0E-06	0.010	5.7E-06	0.010	0.0058	2.8E-06	0.0058	7.9E-06	0.0058	0.010	0.0023	0.012	0.0063	0.016
Chlorinated Monocyclic Aromatics																				
1,2-Dichlorobenzene	0.0035	4.1E-09	0.0035	1.1E-08	0.0035	1.6E-04	3.2E-09	1.6E-04	8.9E-09	1.6E-04	0.0019	2.5E-09	0.0019	7.0E-09	0.0019	1.1E-04	4.7E-08	1.1E-04	1.3E-07	1.1E-04
1,2,4-Trichlorobenzene	0.0051	9.6E-11	0.0051	2.7E-10	0.0051	4.3E-04	1.4E-10	4.3E-04	3.9E-10	4.3E-04	0.0048	1.0E-10	0.0048	2.8E-10	0.0048	1.2E-04	5.1E-09	1.2E-04	1.4E-08	1.2E-04
1,2,4,5-Tetrachlorobenzene	0.0012	3.8E-09	0.0012	1.1E-08	0.0012	4.1E-04	1.3E-08	4.1E-04	3.7E-08	4.1E-04	0.0011	4.2E-09	0.0011	1.2E-08	0.0011	0.0013	5.4E-07	0.0013	1.5E-06	0.0013
Pentachlorobenzene	0.0010	3.3E-08	0.0010	9.2E-08	0.0010	6.1E-04	3.2E-07	6.1E-04	9.0E-07	6.1E-04	9.6E-04	4.1E-08	9.6E-04	1.1E-07	9.6E-04	0.0011	3.3E-06	0.0011	9.2E-06	0.0011
Hexachlorobenzene	8.7E-04	1.9E-09	8.7E-04	5.4E-09	8.7E-04	5.2E-04	7.8E-09	5.2E-04	2.2E-08	5.2E-04	8.3E-04	2.1E-09	8.3E-04	5.9E-09	8.3E-04	9.2E-04	1.3E-06	9.2E-04	3.7E-06	9.2E-04

Table 8-18 Ecological Hazard Quotient Summary for Mammalian Receptors: 400,000 tpy Scenario

COPC	Eastern Cottontail Rabbit					Masked Shrew					Meadow Vole					Mink				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Pentachlorophenol	2.6E-05	7.9E-06	3.4E-05	2.2E-05	4.7E-05	2.0E-04	8.3E-07	2.0E-04	2.3E-06	2.0E-04	3.6E-05	1.0E-05	4.6E-05	2.8E-05	6.3E-05	0.0018	4.3E-06	0.0018	1.2E-05	0.0018
Chlorinated Solvents and Derivatives																				
Carbon Tetrachloride	0.0017	1.4E-09	0.0017	4.0E-09	0.0017	1.6E-04	2.1E-09	1.6E-04	5.9E-09	1.6E-04	0.0016	1.5E-09	0.0016	4.2E-09	0.0016	2.7E-05	6.0E-09	2.7E-05	1.7E-08	2.7E-05
Chloroform	2.0E-04	3.1E-10	2.0E-04	8.6E-10	2.0E-04	2.2E-05	4.5E-10	2.2E-05	1.3E-09	2.2E-05	1.9E-04	3.2E-10	1.9E-04	9.0E-10	1.9E-04	1.3E-06	4.8E-10	1.3E-06	1.4E-09	1.3E-06
Dichloromethane	0.0055	3.1E-07	0.0055	8.6E-07	0.0055	0.0018	4.5E-07	0.0018	1.3E-06	0.0018	0.0052	3.2E-07	0.0052	9.0E-07	0.0052	1.5E-05	3.4E-07	1.5E-05	9.5E-07	1.6E-05
Trichlorofluoromethane (Freon 11)	1.6E-04	3.5E-08	1.6E-04	9.7E-08	1.6E-04	1.5E-05	5.1E-08	1.5E-05	1.4E-07	1.5E-05	1.5E-04	3.6E-08	1.5E-04	1.0E-07	1.5E-04	1.4E-06	9.3E-08	1.5E-06	2.6E-07	1.7E-06
Chlorinated Alkanes/Alkenes																				
1,1,1-Trichloroethane	1.5E-05	1.9E-10	1.5E-05	5.3E-10	1.5E-05	1.3E-06	1.6E-10	1.3E-06	4.4E-10	1.3E-06	8.2E-06	1.2E-10	8.2E-06	3.3E-10	8.2E-06	3.6E-07	5.1E-10	3.6E-07	1.4E-09	3.6E-07
Other Organics																				
Bromoform	7.1E-04	4.5E-08	7.1E-04	1.3E-07	7.1E-04	3.6E-05	3.6E-08	3.6E-05	1.0E-07	3.7E-05	3.9E-04	2.8E-08	3.9E-04	7.8E-08	3.9E-04	4.9E-06	1.0E-07	5.0E-06	2.9E-07	5.2E-06
O-Terphenyl	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Inorganics																				
Antimony	0.47	3.5E-04	0.47	5.1E-04	0.47	0.20	2.9E-04	0.20	4.2E-04	0.20	0.45	3.4E-04	0.45	5.0E-04	0.45	0.0095	4.2E-04	0.0099	6.0E-04	0.010
Arsenic	0.020	9.0E-06	0.020	1.3E-05	0.020	0.10	2.7E-06	0.10	3.8E-06	0.10	0.042	1.2E-05	0.042	1.7E-05	0.042	0.022	4.8E-06	0.022	7.0E-06	0.022
Barium	0.016	2.0E-07	0.016	2.9E-07	0.016	0.0030	5.3E-08	0.0030	7.7E-08	0.0030	0.020	2.6E-07	0.020	3.8E-07	0.020	0.0029	3.5E-08	0.0029	5.0E-08	0.0029
Beryllium	0.100	3.7E-05	0.100	5.3E-05	0.100	0.023	2.6E-05	0.023	3.7E-05	0.023	0.11	4.4E-05	0.11	6.4E-05	0.11	0.056	1.3E-05	0.056	1.9E-05	0.056
Boron	0.27	4.7E-04	0.27	6.8E-04	0.27	0.064	4.9E-05	0.064	7.1E-05	0.064	0.26	4.4E-04	0.26	6.4E-04	0.26	0.067	5.3E-06	0.067	7.7E-06	0.067
Cadmium	0.085	7.8E-04	0.085	0.0011	0.086	0.50	0.0064	0.51	0.0093	0.51	0.11	0.0011	0.12	0.0016	0.12	0.043	0.0032	0.046	0.0047	0.047

Table 8-18 Ecological Hazard Quotient Summary for Mammalian Receptors: 400,000 tpy Scenario

COPC	Eastern Cottontail Rabbit					Masked Shrew					Meadow Vole					Mink				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chromium (Total)	0.11	3.1E-05	0.11	4.5E-05	0.11	0.35	1.1E-05	0.35	1.6E-05	0.35	0.17	4.0E-05	0.17	5.9E-05	0.17	0.054	6.8E-05	0.054	9.9E-05	0.054
Chromium VI	1.1E-04	1.1E-06	1.1E-04	1.7E-06	1.1E-04	2.2E-04	4.0E-07	2.2E-04	5.8E-07	2.2E-04	1.5E-04	1.5E-06	1.6E-04	2.2E-06	1.6E-04	0.0039	5.1E-07	0.0039	7.4E-07	0.0039
Cobalt	0.0071	2.8E-05	0.0071	4.1E-05	0.0071	0.020	1.1E-05	0.020	1.6E-05	0.020	0.012	3.8E-05	0.012	5.5E-05	0.012	0.0025	3.2E-05	0.0026	4.6E-05	0.0026
Lead	0.029	7.2E-04	0.030	0.0011	0.030	0.19	0.0017	0.19	0.0025	0.19	0.051	0.0010	0.052	0.0015	0.052	0.0085	1.5E-04	0.0086	2.2E-04	0.0087
Mercury - Inorganic	0.0049	5.0E-05	0.0049	7.3E-05	0.0049	0.012	0.0013	0.013	0.0019	0.014	0.0063	9.9E-05	0.0064	1.4E-04	0.0064	0.0089	3.6E-04	0.0093	5.2E-04	0.0094
Methyl Mercury	1.0E-04	6.6E-05	1.7E-04	9.5E-05	2.0E-04	0.044	0.012	0.056	0.018	0.061	5.1E-04	1.8E-04	6.9E-04	2.6E-04	7.7E-04	0.067	0.0022	0.069	0.0032	0.070
Nickel	0.048	0.0010	0.050	0.0015	0.050	0.40	0.0024	0.41	0.0034	0.41	0.078	0.0014	0.079	0.0021	0.080	0.034	0.0015	0.035	0.0022	0.036
Selenium	0.29	1.5E-04	0.29	2.2E-04	0.29	1.0	4.3E-05	1.0	6.2E-05	1.0	0.42	2.0E-04	0.42	2.9E-04	0.42	**1.8**	2.9E-04	**1.8**	4.2E-04	**1.8**
Silver	2.3E-04	6.8E-06	2.4E-04	9.8E-06	2.4E-04	0.0020	4.1E-06	0.0020	5.9E-06	0.0020	3.5E-04	8.8E-06	3.6E-04	1.3E-05	3.6E-04	1.3E-04	5.4E-06	1.4E-04	7.9E-06	1.4E-04
Thallium	0.040	0.0075	0.047	0.011	0.051	0.42	0.015	0.43	0.021	0.44	0.055	0.0077	0.062	0.011	0.066	0.019	0.0018	0.020	0.0026	0.021
Tin	0.0016	2.0E-05	0.0016	3.0E-05	0.0016	0.013	4.9E-05	0.013	7.1E-05	0.013	0.0029	2.9E-05	0.0029	4.3E-05	0.0029	6.2E-04	3.1E-04	9.2E-04	4.4E-04	0.0011
Vanadium	0.040	1.4E-05	0.040	2.0E-05	0.040	0.071	9.4E-06	0.071	1.4E-05	0.071	0.056	1.5E-05	0.056	2.2E-05	0.056	0.021	5.6E-06	0.021	8.1E-06	0.021
Zinc	0.18	1.9E-04	0.18	2.8E-04	0.18	0.46	8.9E-04	0.47	0.0013	0.47	0.24	2.6E-04	0.24	3.8E-04	0.24	0.12	8.7E-04	0.12	0.0013	0.12

"--" - Quantitative assessment of COPC could not be performed due to lack of suitable toxicity data or empirically measured concentrations.

Table 8-19 Ecological Hazard Quotient Summary for Mammalian Receptors: 400,000 tpy Scenario (Continued)

COPC	Muskrat					Red Fox					White-tailed Deer				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Polycyclic Aromatic Hydrocarbons															
Low Molecular Weight PAHs															
Acenaphthene	1.4E-06	7.2E-11	1.4E-06	2.0E-10	1.4E-06	1.2E-06	2.4E-11	1.2E-06	6.8E-11	1.2E-06	2.8E-06	8.5E-11	2.8E-06	2.4E-10	2.8E-06
Acenaphthylene	9.8E-07	5.0E-11	9.8E-07	1.4E-10	9.8E-07	6.8E-07	9.1E-12	6.8E-07	2.5E-11	6.8E-07	3.0E-07	1.8E-11	3.0E-07	5.0E-11	3.0E-07
Anthracene	1.2E-06	6.6E-11	1.2E-06	1.8E-10	1.2E-06	9.3E-07	1.4E-11	9.3E-07	3.9E-11	9.3E-07	1.4E-06	4.0E-11	1.4E-06	1.1E-10	1.4E-06
Fluoranthene	2.9E-06	1.3E-09	2.9E-06	3.7E-09	2.9E-06	3.2E-06	1.0E-10	3.2E-06	2.9E-10	3.2E-06	1.2E-05	2.5E-10	1.2E-05	7.0E-10	1.2E-05
Fluorene	2.2E-06	1.7E-10	2.2E-06	4.9E-10	2.2E-06	2.3E-06	2.3E-11	2.3E-06	6.4E-11	2.3E-06	7.7E-06	5.8E-11	7.7E-06	1.6E-10	7.7E-06
Phenanthrene	5.4E-06	1.7E-09	5.4E-06	4.7E-09	5.4E-06	6.2E-06	1.4E-10	6.2E-06	4.0E-10	6.2E-06	2.6E-05	4.1E-10	2.6E-05	1.2E-09	2.6E-05
TOTAL LMW PAH EHQ =	1.4E-05	3.4E-09	1.4E-05	9.4E-09	1.4E-05	1.5E-05	3.1E-10	1.5E-05	8.7E-10	1.5E-05	5.0E-05	8.6E-10	5.0E-05	2.4E-09	5.0E-05
High Molecular Weight PAHs															
Benz(a)anthracene	9.7E-06	2.7E-09	9.7E-06	7.4E-09	9.7E-06	6.4E-06	1.6E-10	6.4E-06	4.6E-10	6.4E-06	5.1E-06	6.3E-10	5.1E-06	1.8E-09	5.1E-06
Benzo(a)pyrene	1.8E-05	1.2E-08	1.8E-05	3.4E-08	1.8E-05	2.4E-05	5.8E-10	2.4E-05	1.6E-09	2.4E-05	8.5E-05	2.4E-09	8.5E-05	6.5E-09	8.5E-05
Benzo(e)pyrene	1.1E-06	3.4E-08	1.1E-06	9.2E-08	1.2E-06	4.5E-06	4.3E-08	4.6E-06	1.2E-07	4.6E-06	6.0E-06	1.9E-07	6.2E-06	5.1E-07	6.5E-06
Benzo(a)fluorene	--	8.9E-09	8.9E-09	2.5E-08	2.5E-08	--	2.1E-10	2.6E-10	5.8E-10	7.3E-10	--	5.3E-10	5.3E-10	1.5E-09	1.5E-09
Benzo(b)fluorene	--	6.4E-09	6.4E-09	1.8E-08	1.8E-08	--	2.6E-10	4.2E-10	7.2E-10	1.1E-09	--	1.0E-09	1.0E-09	2.8E-09	2.8E-09
Benzo(b)fluoranthene	1.0E-05	1.3E-08	1.0E-05	3.7E-08	1.0E-05	7.1E-06	8.9E-11	7.1E-06	2.5E-10	7.1E-06	8.3E-06	2.0E-10	8.3E-06	5.6E-10	8.3E-06
Benzo(g,h,i)perylene	1.0E-05	2.8E-07	1.0E-05	7.8E-07	1.1E-05	9.2E-06	6.5E-08	9.3E-06	1.8E-07	9.4E-06	7.6E-06	2.9E-07	7.9E-06	7.8E-07	8.4E-06
Benzo(k)fluoranthene	9.8E-06	3.6E-09	9.9E-06	1.0E-08	9.9E-06	6.6E-06	2.4E-10	6.6E-06	6.6E-10	6.6E-06	6.2E-06	9.6E-10	6.2E-06	2.6E-09	6.2E-06

Table 8-19 Ecological Hazard Quotient Summary for Mammalian Receptors: 400,000 tpy Scenario (Continued)

COPC	Muskrat					Red Fox					White-tailed Deer				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chrysene	1.2E-05	7.0E-09	1.2E-05	2.0E-08	1.2E-05	9.0E-06	2.7E-10	9.0E-06	7.5E-10	9.0E-06	1.7E-05	8.6E-10	1.7E-05	2.4E-09	1.7E-05
Dibenz(a,c)anthracene	9.3E-06	1.3E-07	9.5E-06	3.7E-07	9.7E-06	8.1E-06	8.0E-09	8.1E-06	2.2E-08	8.2E-06	2.6E-06	3.5E-08	2.7E-06	9.6E-08	2.7E-06
Dibenz(a,h)anthracene	9.3E-06	7.8E-09	9.4E-06	2.2E-08	9.4E-06	8.1E-06	5.3E-09	8.1E-06	1.4E-08	8.1E-06	2.6E-06	2.3E-08	2.7E-06	6.3E-08	2.7E-06
Indeno(1,2,3-cd)pyrene	9.8E-06	4.2E-08	9.8E-06	1.2E-07	9.9E-06	8.7E-06	1.4E-09	8.7E-06	3.9E-09	8.7E-06	5.2E-06	5.2E-09	5.2E-06	1.5E-08	5.3E-06
Perylene	3.9E-06	2.4E-08	3.9E-06	6.6E-08	4.0E-06	4.4E-06	3.2E-08	4.4E-06	8.6E-08	4.5E-06	1.2E-06	1.4E-07	1.4E-06	3.8E-07	1.6E-06
Pyrene	1.8E-05	2.2E-08	1.8E-05	6.1E-08	1.8E-05	1.7E-05	4.5E-09	1.7E-05	1.3E-08	1.7E-05	5.2E-05	1.2E-08	5.2E-05	3.3E-08	5.3E-05
TOTAL HMW PAH EHQ =	1.2E-04	5.8E-07	1.2E-04	1.6E-06	1.2E-04	1.1E-04	1.6E-07	1.1E-04	4.3E-07	1.1E-04	2.0E-04	6.9E-07	2.0E-04	1.9E-06	2.0E-04
TOTAL LMW AND HMW PAH EHQ =	1.3E-04	5.9E-07	1.4E-04	1.6E-06	1.4E-04	1.3E-04	1.6E-07	1.3E-04	4.3E-07	1.3E-04	2.5E-04	6.9E-07	2.5E-04	1.9E-06	2.5E-04
Dioxins and Furans															
2,3,7,8-TCDD Equivalent	0.0022	0.0012	0.0033	0.0017	0.0039	0.019	2.3E-04	0.019	3.6E-04	0.019	0.011	2.7E-04	0.011	6.2E-04	0.011
PCB															
Aroclor 1254 (Total PCBs)	0.0015	8.6E-05	0.0016	2.4E-04	0.0018	0.011	3.3E-06	0.011	9.2E-06	0.011	0.0095	2.2E-06	0.0095	6.2E-06	0.0095
Chlorinated Monocyclic Aromatics															
1,2-Dichlorobenzene	2.7E-04	2.1E-08	2.7E-04	5.8E-08	2.7E-04	4.8E-04	9.5E-09	4.8E-04	2.7E-08	4.8E-04	0.0035	7.0E-09	0.0035	2.0E-08	0.0035
1,2,4-Trichlorobenzene	3.4E-04	4.2E-10	3.4E-04	1.2E-09	3.4E-04	7.4E-04	2.9E-10	7.4E-04	8.1E-10	7.4E-04	0.0052	1.6E-10	0.0052	4.6E-10	0.0052
1,2,4,5-Tetrachlorobenzene	1.3E-04	3.8E-08	1.3E-04	1.1E-07	1.3E-04	0.0013	9.7E-09	0.0013	2.7E-08	0.0013	0.0012	5.2E-09	0.0012	1.5E-08	0.0012
Pentachlorobenzene	1.1E-04	8.3E-07	1.1E-04	2.3E-06	1.1E-04	0.0011	3.9E-08	0.0011	1.1E-07	0.0011	0.0010	2.9E-08	0.0010	8.1E-08	0.0010
Hexachlorobenzene	9.2E-05	1.9E-07	9.2E-05	5.4E-07	9.3E-05	9.7E-04	6.9E-09	9.7E-04	1.9E-08	9.7E-04	8.8E-04	3.0E-09	8.8E-04	8.4E-09	8.8E-04

Table 8-19 Ecological Hazard Quotient Summary for Mammalian Receptors: 400,000 tpy Scenario (Continued)

COPC	Muskrat					Red Fox					White-tailed Deer				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Pentachlorophenol	4.1E-05	6.0E-07	4.1E-05	1.6E-06	4.2E-05	0.0011	6.8E-07	0.0011	1.8E-06	0.0011	9.9E-06	3.0E-06	1.3E-05	8.2E-06	1.8E-05
Chlorinated Solvents and Derivatives															
Carbon Tetrachloride	1.7E-04	7.3E-09	1.7E-04	2.0E-08	1.7E-04	2.2E-04	2.7E-09	2.2E-04	7.5E-09	2.2E-04	0.0017	2.5E-09	0.0017	7.1E-09	0.0017
Chloroform	2.8E-05	1.2E-09	2.8E-05	3.4E-09	2.8E-05	2.5E-05	4.3E-10	2.5E-05	1.2E-09	2.5E-05	2.0E-04	5.4E-10	2.0E-04	1.5E-09	2.0E-04
Dichloromethane	8.9E-04	5.3E-07	8.9E-04	1.5E-06	8.9E-04	6.9E-04	3.8E-07	7.0E-04	1.1E-06	7.0E-04	0.0056	5.3E-07	0.0056	1.5E-06	0.0056
Trichlorofluoromethane (Freon 11)	1.7E-05	1.8E-07	1.8E-05	5.0E-07	1.8E-05	2.0E-05	5.7E-08	2.0E-05	1.6E-07	2.0E-05	1.6E-04	6.1E-08	1.6E-04	1.7E-07	1.6E-04
Chlorinated Alkanes/Alkenes															
1,1,1-Trichloroethane	1.7E-06	1.1E-09	1.7E-06	3.1E-09	1.7E-06	2.0E-06	3.1E-10	2.0E-06	8.7E-10	2.0E-06	1.5E-05	3.3E-10	1.5E-05	9.2E-10	1.5E-05
Other Organics															
Bromoform	8.2E-05	2.8E-07	8.2E-05	7.8E-07	8.3E-05	8.8E-05	7.1E-08	8.9E-05	2.0E-07	8.9E-05	7.2E-04	7.9E-08	7.2E-04	2.2E-07	7.2E-04
O-Terphenyl	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Inorganics															
Antimony	0.036	3.2E-05	0.036	4.6E-05	0.036	0.066	5.5E-05	0.066	7.9E-05	0.067	0.47	3.5E-04	0.47	5.1E-04	0.47
Arsenic	0.0040	6.6E-07	0.0040	9.6E-07	0.0040	0.011	9.7E-07	0.011	1.4E-06	0.011	0.0065	4.8E-06	0.0065	7.0E-06	0.0065
Barium	0.0019	2.6E-08	0.0019	3.8E-08	0.0019	0.0029	2.5E-08	0.0029	3.6E-08	0.0029	0.0060	7.7E-08	0.0060	1.1E-07	0.0060
Beryllium	0.019	9.6E-06	0.019	1.4E-05	0.019	0.060	6.3E-06	0.060	9.2E-06	0.060	0.099	3.4E-05	0.099	4.9E-05	0.099
Boron	0.022	3.1E-05	0.022	4.5E-05	0.022	0.092	6.1E-05	0.092	8.8E-05	0.092	0.28	4.8E-04	0.28	7.0E-04	0.28
Cadmium	0.012	1.5E-04	0.013	2.2E-04	0.013	0.050	1.6E-04	0.050	2.3E-04	0.050	0.032	2.9E-04	0.032	4.3E-04	0.033

Table 8-19 Ecological Hazard Quotient Summary for Mammalian Receptors: 400,000 tpy Scenario (Continued)

COPC	Muskrat					Red Fox					White-tailed Deer				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chromium (Total)	0.037	3.7E-06	0.037	5.3E-06	0.037	0.027	4.1E-06	0.027	6.0E-06	0.027	0.035	1.2E-05	0.035	1.7E-05	0.035
Chromium VI	6.8E-04	8.1E-08	6.8E-04	1.2E-07	6.8E-04	9.2E-05	1.5E-07	9.2E-05	2.2E-07	9.2E-05	7.1E-05	4.3E-07	7.2E-05	6.3E-07	7.2E-05
Cobalt	0.0019	2.5E-06	0.0019	3.7E-06	0.0019	0.0021	7.2E-06	0.0021	1.0E-05	0.0021	0.0021	1.1E-05	0.0021	1.5E-05	0.0021
Lead	0.0091	6.4E-05	0.0091	9.3E-05	0.0091	0.0075	9.6E-05	0.0076	1.4E-04	0.0076	0.0090	2.6E-04	0.0092	3.7E-04	0.0093
Mercury - Inorganic	0.0015	8.6E-04	0.0021	0.0011	0.0023	0.0013	4.2E-05	0.0013	6.1E-05	0.0013	0.0049	3.8E-05	0.0049	5.5E-05	0.0049
Methyl Mercury	0.0021	7.0E-05	0.0021	1.0E-04	0.0022	0.0020	3.4E-04	0.0024	4.9E-04	0.0025	9.2E-05	6.2E-05	1.5E-04	8.9E-05	1.8E-04
Nickel	0.011	1.1E-04	0.011	1.6E-04	0.011	0.024	1.8E-04	0.025	2.6E-04	0.025	0.016	3.9E-04	0.017	5.6E-04	0.017
Selenium	0.15	1.7E-05	0.15	2.5E-05	0.15	0.53	1.6E-05	0.53	2.4E-05	0.53	0.11	5.8E-05	0.11	8.5E-05	0.11
Silver	3.8E-05	5.1E-07	3.8E-05	7.3E-07	3.9E-05	1.2E-04	7.9E-07	1.2E-04	1.2E-06	1.2E-04	8.3E-05	2.6E-06	8.6E-05	3.8E-06	8.7E-05
Thallium	0.012	5.5E-04	0.012	7.9E-04	0.013	0.029	0.0049	0.034	0.0071	0.036	0.032	0.0074	0.039	0.011	0.042
Tin	3.1E-04	1.0E-05	3.2E-04	1.4E-05	3.2E-04	6.9E-04	1.8E-05	7.1E-04	2.6E-05	7.2E-04	4.6E-04	7.3E-06	4.7E-04	1.1E-05	4.7E-04
Vanadium	0.016	1.3E-06	0.016	1.9E-06	0.016	0.015	2.7E-06	0.015	4.0E-06	0.015	0.029	1.3E-05	0.029	1.8E-05	0.029
Zinc	0.025	4.0E-05	0.025	5.7E-05	0.025	0.078	3.0E-05	0.078	4.3E-05	0.078	0.069	7.2E-05	0.069	1.0E-04	0.069

"--" - Quantitative assessment of COPC could not be performed due to lack of suitable toxicity data or empirically measured concentrations.

Table 8-20 Ecological Hazard Quotient Summary for Avian Receptors: 400,000 tpy Scenario

COPC	American Robin					Belted Kingfisher					Great Blue Heron				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baselin e	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Polycyclic Aromatic Hydrocarbons															
Low Molecular Weight PAHs															
Acenaphthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Acenaphthylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluorene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL LMW PAH EHQ =	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
High Molecular Weight PAHs															
Benz(a)anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(e)pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)fluorene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(b)fluorene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 8-20 Ecological Hazard Quotient Summary for Avian Receptors: 400,000 tpy Scenario

COPC	American Robin					Belted Kingfisher					Great Blue Heron				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baselin e	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chrysene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibenz(a,c)anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL HMW PAH EHQ =	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL LMW AND HMW PAH EHQ =	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dioxins and Furans															
2,3,7,8-TCDD Equivalent	0.0036	2.0E-04	0.0038	3.0E-04	0.0039	0.0021	8.7E-04	0.0029	0.0013	0.0033	0.0012	6.1E-04	0.0018	8.8E-04	0.0021
PCB															
Aroclor 1254 (Total PCBs)	0.0049	8.0E-07	0.0049	2.2E-06	0.0049	0.0022	9.5E-04	0.0031	0.0026	0.0048	0.0012	7.0E-04	0.0019	0.0019	0.0031
Chlorinated Monocyclic Aromatics															
1,2-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4,5-Tetrachlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pentachlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachlorobenzene	0.0023	8.5E-09	0.0023	2.4E-08	0.0023	0.0015	4.5E-06	0.0015	1.3E-05	0.0015	0.0015	5.2E-06	0.0015	1.5E-05	0.0015

Table 8-20 Ecological Hazard Quotient Summary for Avian Receptors: 400,000 tpy Scenario

COPC	American Robin					Belted Kingfisher					Great Blue Heron				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Pentachlorophenol	2.1E-04	1.9E-05	2.3E-04	5.2E-05	2.6E-04	0.0027	1.5E-05	0.0027	4.2E-05	0.0027	0.0016	9.7E-06	0.0016	2.7E-05	0.0016
Chlorinated Solvents and Derivatives															
Carbon Tetrachloride	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloroform	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichlorofluoromethane (Freon 11)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chlorinated Alkanes/Alkenes															
1,1,1-Trichloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other Organics															
Bromoform	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
O-Terphenyl	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Inorganics															
Antimony	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic	0.0099	2.6E-06	0.0099	3.7E-06	0.0099	0.0089	1.9E-06	0.0089	2.7E-06	0.0089	0.0030	1.3E-06	0.0030	1.9E-06	0.0030
Barium	0.012	1.6E-07	0.012	2.3E-07	0.012	0.0017	3.0E-08	0.0017	4.4E-08	0.0017	9.6E-04	2.7E-08	9.6E-04	4.0E-08	9.6E-04
Beryllium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Boron	0.13	2.1E-04	0.13	3.0E-04	0.13	0.023	1.5E-06	0.023	2.2E-06	0.023	0.013	4.0E-07	0.013	5.8E-07	0.013
Cadmium	0.31	0.0036	0.32	0.0052	0.32	0.030	0.0063	0.036	0.0091	0.039	0.0040	0.0037	0.0077	0.0054	0.0093

Table 8-20 Ecological Hazard Quotient Summary for Avian Receptors: 400,000 tpy Scenario

COPC	American Robin					Belted Kingfisher					Great Blue Heron				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baselin e	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chromium (Total)	0.35	6.3E-05	0.35	9.1E-05	0.35	0.15	1.9E-04	0.15	2.7E-04	0.15	0.034	1.1E-04	0.035	1.6E-04	0.035
Chromium VI	3.1E-04	5.9E-06	3.2E-04	8.5E-06	3.2E-04	0.027	3.4E-06	0.027	4.9E-06	0.027	0.017	2.1E-06	0.017	3.1E-06	0.017
Cobalt	0.062	1.8E-04	0.062	2.6E-04	0.062	0.026	2.6E-04	0.026	3.8E-04	0.027	0.0037	1.5E-04	0.0038	2.2E-04	0.0039
Lead	0.070	0.0010	0.071	0.0015	0.072	0.017	2.5E-04	0.018	3.6E-04	0.018	0.0022	1.0E-04	0.0023	1.5E-04	0.0024
Mercury - Inorganic	0.019	0.0010	0.020	0.0015	0.021	0.031	0.0011	0.032	0.0015	0.032	0.035	6.1E-04	0.035	8.8E-04	0.035
Methyl Mercury	0.072	0.020	0.093	0.029	0.10	0.41	0.014	0.43	0.020	0.43	0.30	0.0098	0.31	0.014	0.32
Nickel	0.17	0.0018	0.17	0.0026	0.17	0.045	0.0023	0.047	0.0033	0.048	0.014	0.0013	0.015	0.0019	0.016
Selenium	0.12	3.5E-05	0.12	5.0E-05	0.12	0.42	9.0E-05	0.42	1.3E-04	0.42	0.27	6.6E-05	0.27	9.6E-05	0.27
Silver	0.0052	4.9E-05	0.0053	7.2E-05	0.0053	9.1E-04	4.9E-05	9.5E-04	7.1E-05	9.8E-04	3.7E-04	4.0E-05	4.1E-04	5.7E-05	4.3E-04
Thallium	0.23	0.015	0.24	0.022	0.25	0.050	0.0015	0.052	0.0022	0.052	0.017	1.3E-04	0.017	1.9E-04	0.017
Tin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium	**1.6**	5.1E-04	**1.6**	7.4E-04	**1.6**	**1.5**	3.5E-04	**1.5**	5.1E-04	**1.5**	0.55	3.3E-04	0.55	4.8E-04	0.55
Zinc	0.77	0.0011	0.77	0.0016	0.77	0.24	0.0031	0.24	0.0045	0.24	0.10	0.0018	0.11	0.0027	0.11

"--" - Quantitative assessment of COPC could not be performed due to lack of suitable toxicity data or empirically measured concentrations.

Table 8-21 Ecological Hazard Quotient Summary for Avian Receptors: 400,000 tpy Scenario (Continued)

COPC	Duck (Mallard)					Red-tailed Hawk					Wild Turkey				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Polycyclic Aromatic Hydrocarbons															
Low Molecular Weight PAHs															
Acenaphthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Acenaphthylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluorene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL LMW PAH EHQ =	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
High Molecular Weight PAHs															
Benz(a)anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(e)pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)fluorene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(b)fluorene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 8-21 Ecological Hazard Quotient Summary for Avian Receptors: 400,000 tpy Scenario (Continued)

COPC	Duck (Mallard)					Red-tailed Hawk					Wild Turkey				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chrysene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibenz(a,c)anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL HMW PAH EHQ =	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL LMW AND HMW PAH EHQ =	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dioxins and Furans															
2,3,7,8-TCDD Equivalent	5.4E-04	3.6E-04	9.0E-04	5.2E-04	0.0011	7.5E-04	4.7E-06	7.6E-04	9.3E-06	7.6E-04	0.0011	3.5E-05	0.0011	6.2E-05	0.0011
PCB															
Aroclor 1254 (Total PCBs)	0.0011	1.3E-05	0.0011	3.7E-05	0.0011	0.0010	3.3E-07	0.0010	9.2E-07	0.0010	0.0020	1.0E-06	0.0020	2.8E-06	0.0020
Chlorinated Monocyclic Aromatics															
1,2-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4,5-Tetrachlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pentachlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachlorobenzene	6.9E-04	2.2E-06	6.9E-04	6.0E-06	6.9E-04	0.0013	8.8E-09	0.0013	2.5E-08	0.0013	0.0021	3.3E-09	0.0021	9.2E-09	0.0021

Table 8-21 Ecological Hazard Quotient Summary for Avian Receptors: 400,000 tpy Scenario (Continued)

COPC	Duck (Mallard)					Red-tailed Hawk					Wild Turkey				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Pentachlorophenol	1.2E-05	3.0E-06	1.5E-05	8.1E-06	2.0E-05	0.0015	8.8E-09	0.0015	2.4E-08	0.0015	4.8E-05	1.1E-05	5.9E-05	3.0E-05	7.8E-05
Chlorinated Solvents and Derivatives															
Carbon Tetrachloride	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloroform	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichlorofluoromethane (Freon 11)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chlorinated Alkanes/Alkenes															
1,1,1-Trichloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Other Organics															
Bromoform	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
O-Terphenyl	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Inorganics															
Antimony	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic	0.0088	4.6E-07	0.0088	6.7E-07	0.0088	0.0014	3.1E-08	0.0014	4.6E-08	0.0014	0.0070	1.7E-06	0.0070	2.5E-06	0.0070
Barium	0.011	6.2E-08	0.011	9.0E-08	0.011	0.0012	6.0E-09	0.0012	8.8E-09	0.0012	0.014	1.8E-07	0.014	2.6E-07	0.014
Beryllium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Boron	0.034	2.4E-05	0.034	3.4E-05	0.034	0.011	8.7E-07	0.011	1.3E-06	0.011	0.081	1.4E-04	0.081	2.0E-04	0.081
Cadmium	0.067	3.0E-04	0.067	4.4E-04	0.067	0.027	3.4E-06	0.027	5.0E-06	0.027	0.064	6.4E-04	0.065	9.2E-04	0.065

Table 8-21 Ecological Hazard Quotient Summary for Avian Receptors: 400,000 tpy Scenario (Continued)

COPC	Duck (Mallard)					Red-tailed Hawk					Wild Turkey				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chromium (Total)	0.36	7.8E-06	0.36	1.1E-05	0.36	0.016	1.6E-06	0.016	2.3E-06	0.016	0.13	2.8E-05	0.13	4.1E-05	0.13
Chromium VI	0.0056	6.4E-07	0.0056	9.2E-07	0.0056	1.4E-04	1.5E-07	1.4E-04	2.1E-07	1.4E-04	1.2E-04	3.4E-06	1.2E-04	4.9E-06	1.2E-04
Cobalt	0.032	2.2E-05	0.032	3.2E-05	0.032	0.0051	1.7E-05	0.0051	2.4E-05	0.0051	0.031	8.5E-05	0.031	1.2E-04	0.031
Lead	0.028	1.7E-04	0.028	2.4E-04	0.028	0.0016	9.3E-06	0.0016	1.4E-05	0.0016	0.020	3.8E-04	0.021	5.5E-04	0.021
Mercury - Inorganic	0.0094	0.0083	0.017	0.012	0.021	7.2E-04	1.7E-05	7.4E-04	2.5E-05	7.4E-04	0.013	3.1E-04	0.014	4.5E-04	0.014
Methyl Mercury	5.4E-05	0.0017	0.0018	0.0025	0.0025	0.0013	4.8E-06	0.0013	7.0E-06	0.0013	0.0062	0.0018	0.0080	0.0026	0.0088
Nickel	0.043	1.9E-04	0.043	2.7E-04	0.044	0.0091	3.8E-05	0.0092	5.5E-05	0.0092	0.037	5.8E-04	0.037	8.4E-04	0.037
Selenium	0.28	6.1E-06	0.28	8.8E-06	0.28	0.061	3.6E-07	0.061	5.2E-07	0.061	0.051	2.2E-05	0.051	3.2E-05	0.051
Silver	6.1E-04	5.3E-06	6.2E-04	7.7E-06	6.2E-04	3.1E-04	6.9E-07	3.1E-04	1.0E-06	3.1E-04	0.0016	3.2E-05	0.0016	4.7E-05	0.0016
Thallium	0.072	0.0023	0.075	0.0034	0.076	0.013	0.0033	0.017	0.0048	0.018	0.11	0.013	0.13	0.019	0.13
Tin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium	**3.9**	2.4E-04	**3.9**	3.5E-04	**3.9**	0.27	2.8E-05	0.27	4.1E-05	0.27	**2.6**	6.8E-04	**2.6**	9.8E-04	**2.6**
Zinc	0.31	1.9E-04	0.31	2.8E-04	0.31	0.078	1.7E-06	0.078	2.5E-06	0.078	0.23	2.6E-04	0.23	3.8E-04	0.23

"--" - Quantitative assessment of COPC could not be performed due to lack of suitable toxicity data or empirically measured concentrations.

Table 8-22 Ecological Hazard Quotient and Screening Ratio Summary for Community-Based Receptors: 400,000 tpy Scenario

COPC	Terrestrial Plants					Terrestrial Soil Invertebrates					Freshwater Receptors					Freshwater Benthic Invertebrates				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Polycyclic Aromatic Hydrocarbons																				
Low Molecular Weight PAHs																				
Acenaphthene	--	--	--	--	--	0.0017	2.9E-08	0.0017	8.0E-08	0.0017	8.3E-05	1.3E-07	8.3E-05	3.6E-07	8.3E-05	8.6E-04	5.3E-08	8.6E-04	1.5E-07	8.6E-04
Acenaphthylene	--	--	--	--	--	0.0017	6.7E-09	0.0017	1.9E-08	0.0017	1.1E-04	1.4E-07	1.1E-04	3.8E-07	1.1E-04	8.8E-04	3.9E-08	8.8E-04	1.1E-07	8.8E-04
Anthracene	0.0013	2.1E-08	0.0013	5.8E-08	0.0013	0.0013	2.1E-08	0.0013	5.8E-08	0.0013	**13**	0.0043	**13**	0.012	**13**	0.23	1.5E-05	0.23	4.2E-05	0.23
Fluoranthene	0.0013	2.0E-07	0.0013	5.7E-07	0.0013	0.0013	2.0E-07	0.0013	5.7E-07	0.0013	**13**	0.044	**13**	0.12	**13**	0.067	9.2E-05	0.067	2.6E-04	0.067
Fluorene	--	--	--	--	--	0.0017	2.9E-08	0.0017	8.0E-08	0.0017	0.10	1.3E-04	0.10	3.8E-04	0.10	0.26	4.4E-05	0.26	1.2E-04	0.26
Phenanthrene	2.5E-04	2.1E-07	2.5E-04	5.9E-07	2.5E-04	2.5E-04	2.1E-07	2.5E-04	5.9E-07	2.5E-04	0.33	0.0027	0.34	0.0076	0.34	0.089	1.5E-04	0.089	4.3E-04	0.090
High Molecular Weight PAHs																				
Benz(a)anthracene	0.0013	1.1E-08	0.0013	3.2E-08	0.0013	0.0013	1.1E-08	0.0013	3.2E-08	0.0013	**13**	0.0013	**13**	0.0036	**13**	0.16	4.6E-05	0.16	1.3E-04	0.16
Benzo(a)pyrene	5.0E-04	2.0E-08	5.0E-04	5.6E-08	5.0E-04	5.0E-04	2.0E-08	5.0E-04	5.6E-08	5.0E-04	0.0049	8.4E-07	0.0049	2.4E-06	0.0049	0.054	1.8E-04	0.054	5.0E-04	0.055
Benzo(e)pyrene	--	--	--	--	--	--	1.2E-07	1.2E-07	3.4E-07	3.4E-07	--	7.5E-06	7.5E-06	2.1E-05	2.1E-05	--	7.9E-07	7.9E-07	2.2E-06	2.2E-06
Benzo(a)fluorene	--	--	--	--	--	--	5.0E-08	5.0E-08	1.4E-07	1.4E-07	--	3.5E-06	3.5E-06	9.7E-06	9.7E-06	--	9.6E-07	9.6E-07	2.7E-06	2.7E-06
Benzo(b)fluorene	--	--	--	--	--	--	3.4E-08	3.4E-08	9.6E-08	9.6E-08	--	5.1E-06	5.1E-06	1.4E-05	1.4E-05	--	6.5E-07	6.5E-07	1.8E-06	1.8E-06
Benzo(b)fluoranthene	--	--	--	--	--	0.0028	5.8E-08	0.0028	1.6E-07	0.0028	0.0064	1.2E-06	0.0064	3.3E-06	0.0064	4.3E-04	6.6E-07	4.3E-04	1.8E-06	4.4E-04
Benzo(g,h,i)perylene	0.0013	2.8E-07	0.0013	7.9E-07	0.0013	0.0013	2.8E-07	0.0013	7.9E-07	0.0013	**500**	0.40	**500**	**1.1**	**501**	0.29	0.0084	0.30	0.024	0.32
Benzo(k)fluoranthene	0.0013	2.3E-08	0.0013	6.3E-08	0.0013	0.0013	2.3E-08	0.0013	6.3E-08	0.0013	**50**	0.0025	**50**	0.0071	**50**	0.21	8.4E-05	0.21	2.3E-04	0.21
Chrysene	0.0013	4.2E-08	0.0013	1.2E-07	0.0013	0.0013	4.2E-08	0.0013	1.2E-07	0.0013	**100**	0.025	**100**	0.070	**100**	0.15	1.2E-04	0.15	3.3E-04	0.15

Table 8-22 Ecological Hazard Quotient and Screening Ratio Summary for Community-Based Receptors: 400,000 tpy Scenario

COPC	Terrestrial Plants					Terrestrial Soil Invertebrates					Freshwater Receptors					Freshwater Benthic Invertebrates				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Dibenz(a,c)anthracene	--	--	--	--	--	0.0028	7.9E-08	0.0028	2.2E-07	0.0028	0.020	1.9E-05	0.020	5.3E-05	0.020	3.7E-04	5.4E-06	3.8E-04	1.5E-05	3.9E-04
Dibenz(a,h)anthracene	--	--	--	--	--	0.0028	2.8E-08	0.0028	7.8E-08	0.0028	**5.0**	2.2E-04	**5.0**	6.2E-04	**5.0**	0.83	5.3E-04	0.83	0.0015	0.83
Indeno(1,2,3-cd)pyrene	0.0013	6.0E-08	0.0013	1.7E-07	0.0013	0.0013	6.0E-08	0.0013	1.7E-07	0.0013	0.016	3.2E-06	0.016	8.9E-06	0.017	0.25	0.0012	0.25	0.0033	0.25
Perylene	--	--	--	--	--	5.6E-04	2.6E-08	5.6E-04	7.3E-08	5.6E-04	0.0084	6.9E-07	0.0084	1.9E-06	0.0084	1.7E-04	2.3E-07	1.7E-04	6.3E-07	1.7E-04
Pyrene	--	--	--	--	--	0.0028	2.3E-06	0.0028	6.5E-06	0.0028	5.6E-04	2.4E-06	5.6E-04	6.7E-06	5.6E-04	0.10	2.4E-04	0.10	6.7E-04	0.10
Dioxins and Furans																				
2,3,7,8-TCDD Equivalent	--	--	--	--	--	3.5E-06	2.5E-07	3.8E-06	3.7E-07	3.9E-06	0.32	0.0013	0.33	0.0018	0.33	7.9E-05	7.9E-05	1.6E-04	1.1E-04	1.9E-04
PCB																				
Aroclor 1254 (Total PCBs)	0.0013	3.9E-06	0.0013	1.1E-05	0.0013	0.020	6.2E-05	0.020	1.7E-04	0.020	**20**	0.022	**20**	0.062	**20**	0.71	0.031	0.75	0.087	0.80
Chlorinated Monocyclic Aromatics																				
1,2-Dichlorobenzene	0.0020	4.0E-09	0.0020	1.1E-08	0.0020	0.0020	4.0E-09	0.0020	1.1E-08	0.0020	0.60	5.5E-04	0.60	0.0015	0.60	0.0011	3.7E-07	0.0011	1.0E-06	0.0011
1,2,4-Trichlorobenzene	0.0033	2.9E-10	0.0033	8.2E-10	0.0033	0.0033	2.9E-10	0.0033	8.2E-10	0.0033	0.0042	3.0E-07	0.0042	8.4E-07	0.0042	0.0014	3.3E-08	0.0014	9.2E-08	0.0014
1,2,4,5-Tetrachlorobenzene	--	--	--	--	--	0.0010	3.7E-08	0.0010	1.0E-07	0.0010	0.33	2.3E-04	0.33	6.4E-04	0.33	1.1E-04	1.1E-07	1.1E-04	3.2E-07	1.1E-04
Pentachlorobenzene	--	--	--	--	--	5.0E-04	2.9E-07	5.0E-04	8.2E-07	5.0E-04	0.0039	7.3E-06	0.0039	2.1E-05	0.0039	9.1E-05	4.2E-06	9.5E-05	1.2E-05	1.0E-04
Hexachlorobenzene	3.3E-04	5.4E-09	3.3E-04	1.5E-08	3.3E-04	3.3E-04	5.4E-09	3.3E-04	1.5E-08	3.3E-04	**7.7**	0.0053	**7.7**	0.015	**7.7**	7.9E-05	8.8E-07	8.0E-05	2.5E-06	8.1E-05
Pentachlorophenol	2.4E-04	5.5E-07	2.4E-04	1.5E-06	2.4E-04	2.4E-04	5.5E-07	2.4E-04	1.5E-06	2.4E-04	0.020	0.0014	0.021	0.0040	0.024	6.0E-06	1.4E-07	6.2E-06	4.0E-07	6.4E-06
Chlorinated Solvents and Derivatives																				
Carbon Tetrachloride	0.0010	9.5E-12	0.0010	2.7E-11	0.0010	0.0010	9.5E-12	0.0010	2.7E-11	0.0010	3.6E-04	1.2E-07	3.6E-04	3.5E-07	3.6E-04	1.8E-04	1.9E-08	1.8E-04	5.3E-08	1.8E-04

Table 8-22 Ecological Hazard Quotient and Screening Ratio Summary for Community-Based Receptors: 400,000 tpy Scenario

COPC	Terrestrial Plants					Terrestrial Soil Invertebrates					Freshwater Receptors					Freshwater Benthic Invertebrates				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Chloroform	--	--	--	--	--	--	--	--	--	--	8.2E-05	5.1E-08	8.2E-05	1.4E-07	8.2E-05	2.5E-04	1.6E-08	2.5E-04	4.5E-08	2.5E-04
Dichloromethane	--	--	--	--	--	--	--	--	--	--	7.6E-05	5.7E-06	8.1E-05	1.6E-05	9.1E-05	0.0038	1.7E-06	0.0038	4.7E-06	0.0038
Trichlorofluoromethane (Freon 11)	--	--	--	--	--	--	--	--	--	--	4.2E-04	3.8E-05	4.6E-04	1.1E-04	5.3E-04	4.2E-04	8.5E-06	4.3E-04	2.4E-05	4.4E-04
Chlorinated Alkanes/Alkenes																				
1,1,1-Trichloroethane	--	--	--	--	--	--	--	--	--	--	0.050	7.8E-05	0.050	2.2E-04	0.050	6.5E-05	9.1E-08	6.5E-05	2.5E-07	6.5E-05
Other Organics																				
Bromoform	--	--	--	--	--	--	--	--	--	--	0.0083	4.3E-04	0.0088	0.0012	0.0095	2.3E-04	1.5E-06	2.3E-04	4.2E-06	2.3E-04
O-Terphenyl	--	--	--	--	--	--	--	--	--	--	--	1.1E-05	1.1E-05	3.1E-05	3.1E-05	--	4.4E-06	4.4E-06	1.2E-05	1.2E-05
Inorganics																				
Antimony	0.050	7.7E-05	0.050	1.1E-04	0.050	0.050	7.7E-05	0.050	1.1E-04	0.050	0.25	5.4E-04	0.25	7.8E-04	0.25	2.3E-04	1.1E-07	2.3E-04	1.6E-07	2.3E-04
Arsenic	0.40	7.6E-06	0.40	1.1E-05	0.40	0.40	7.6E-06	0.40	1.1E-05	0.40	0.40	3.3E-04	0.40	4.8E-04	0.40	0.33	8.0E-06	0.33	1.2E-05	0.33
Barium	0.12	1.4E-06	0.12	2.1E-06	0.12	0.12	1.4E-06	0.12	2.1E-06	0.12	0.41	3.8E-05	0.41	5.5E-05	0.41	0.038	1.4E-07	0.038	2.0E-07	0.038
Beryllium	0.18	2.4E-04	0.18	3.5E-04	0.18	0.18	2.4E-04	0.18	3.5E-04	0.18	0.091	4.0E-05	0.091	5.9E-05	0.091	0.093	6.5E-05	0.093	9.4E-05	0.093
Boron	0.44	2.0E-04	0.44	2.9E-04	0.44	0.44	2.0E-04	0.44	2.9E-04	0.44	0.30	0.0030	0.30	0.0043	0.30	--	--	--	--	--
Cadmium	0.042	5.3E-04	0.042	7.7E-04	0.042	0.042	5.3E-04	0.042	7.7E-04	0.042	0.20	0.054	0.25	0.078	0.28	0.83	0.0034	0.84	0.0049	0.84
Chromium (Total)	0.030	7.2E-07	0.030	1.0E-06	0.030	0.030	7.2E-07	0.030	1.0E-06	0.030	0.67	9.9E-04	0.68	0.0014	0.68	**1.2**	6.4E-06	**1.2**	9.3E-06	**1.2**
Chromium VI	--	9.6E-06	9.6E-06	1.4E-05	1.4E-05	--	9.6E-06	9.6E-06	1.4E-05	1.4E-05	**10**	0.0013	**10**	0.0018	**10**	5.0E-04	6.0E-09	5.0E-04	8.6E-09	5.0E-04
Cobalt	0.18	8.1E-05	0.18	1.2E-04	0.18	0.18	8.1E-05	0.18	1.2E-04	0.18	0.56	0.025	0.58	0.037	0.59	0.013	2.2E-06	0.013	3.2E-06	0.013

Table 8-22 Ecological Hazard Quotient and Screening Ratio Summary for Community-Based Receptors: 400,000 tpy Scenario

COPC	Terrestrial Plants					Terrestrial Soil Invertebrates					Freshwater Receptors					Freshwater Benthic Invertebrates				
	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case	Baseline	Project Alone	Project Case	Process Upset Case	Process Upset Project Case
Lead	0.14	0.0012	0.14	0.0018	0.14	0.0099	8.7E-05	0.010	1.3E-04	0.010	0.20	0.012	0.21	0.018	0.22	0.42	0.0018	0.42	0.0026	0.42
Mercury - Inorganic	0.0070	7.9E-04	0.0078	0.0011	0.0081	0.0070	7.9E-04	0.0078	0.0011	0.0081	0.50	0.0065	0.51	0.0095	0.51	0.25	0.33	0.58	0.48	0.73
Methyl Mercury	1.4E-04	3.9E-05	1.8E-04	5.6E-05	2.0E-04	1.4E-04	3.9E-05	1.8E-04	5.6E-05	2.0E-04	0.75	9.3E-04	0.75	0.0013	0.75	--	4.2E-05	4.2E-05	6.1E-05	6.1E-05
Nickel	0.082	4.7E-04	0.082	6.8E-04	0.082	0.082	4.7E-04	0.082	6.8E-04	0.082	0.24	0.013	0.25	0.020	0.26	0.63	0.0014	0.63	0.0020	0.63
Phosphorus	--	--	--	--	--	--	--	--	--	--	**5.3**	0.0060	**5.3**	0.0087	**5.3**	**1.1**	1.1E-06	**1.1**	1.5E-06	**1.1**
Selenium	0.10	3.1E-06	0.10	4.5E-06	0.10	0.10	3.1E-06	0.10	4.5E-06	0.10	0.050	1.9E-05	0.050	2.7E-05	0.050	0.068	6.4E-07	0.068	9.3E-07	0.068
Silver	0.010	1.8E-05	0.010	2.6E-05	0.010	0.010	1.8E-05	0.010	2.6E-05	0.010	1.0	0.13	**1.1**	0.19	**1.2**	--	--	--	--	--
Thallium	1.0	0.034	1.0	0.049	1.0	--	--	--	--	--	1.0	0.50	**1.5**	0.72	**1.7**	0.50	0.0053	0.51	0.0077	0.51
Tin	0.20	7.3E-04	0.20	0.0011	0.20	0.0050	1.8E-05	0.0050	2.7E-05	0.0050	0.0056	2.7E-04	0.0058	3.8E-04	0.0059	3.4E-04	8.1E-07	3.4E-04	1.2E-06	3.4E-04
Vanadium	0.14	1.8E-05	0.14	2.5E-05	0.14	0.14	1.8E-05	0.14	2.5E-05	0.14	**1.3**	2.2E-04	**1.3**	3.2E-04	**1.3**	0.30	1.3E-05	0.30	2.0E-05	0.30
Zinc	0.13	2.6E-04	0.13	3.7E-04	0.13	0.13	2.6E-04	0.13	3.7E-04	0.13	**2.3**	0.039	**2.3**	0.056	**2.3**	0.68	4.0E-04	0.68	5.8E-04	0.68

"--" - Quantitative assessment of COPC could not be performed due to lack of suitable toxicity data or empirically measured concentrations.

Table 8-23 Emitted SO_2 Concentrations at Each Receptor Location (µg m^{-3}) and Corresponding Phytotoxicity Benchmarks: 400,000 tpy Scenario

Receptor	Name	Baseline			Project Alone			Project Case			Process Upset Case			Process Upset Project Case		
		1 Hour	24 Hour	Annual	1- Hour	24 Hour	Annual	1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual
Eco 1	Darlington Provincial Park	19	19	5.9	14	1.4	0.054	34	21	6.0	170	19	0.092	190	38	6.0
Eco 2	Second Marsh Wildlife Area				7.4	1.0	0.038	27	20	6.0	89	13	0.065	108	32	6.0
Eco 3	Darlington Waterfront Trail				22	2.3	0.071	42	22	6.0	203	29	0.12	223	48	6.0
Eco 4	McLaughlin Bay Wildlife Reserve				6.6	2.1	0.046	26	21	6.0	77	25	0.079	97	44	6.0
Eco 5	Bowmanville Valley Cons. Area				4.0	0.92	0.041	24	20	6.0	48	11	0.070	68	30	6.0
Eco 6	Eco Baseline				14	1.6	0.030	34	21	6.0	171	19	0.050	191	39	6.0
Eco 7	Baseline Road & Rundle Road				11	2.0	0.11	31	21	6.0	139	24	0.18	159	44	6.1
Eco 8	Baseline Road & Courtice Road				25	3.8	0.072	44	23	6.0	295	45	0.12	315	65	6.0
Eco 9	Soper Creek				3.3	0.82	0.035	23	20	6.0	41	10	0.059	61	29	6.0
Eco 10	Bowmanville Marsh				4.2	0.89	0.046	24	20	6.0	51	11	0.078	71	30	6.0
Eco 11	South of Site, Eco Baseline S7				11	1.7	0.019	31	21	5.9	141	22	0.032	160	41	6.0
Eco 12	Sports Fields				27	1.9	0.065	46	21	6.0	236	24	0.11	256	43	6.0
Eco 13	Water Pollution Control Plant				28	2.0	0.043	48	21	6.0	346	24	0.072	366	43	6.0
Eco 14	Future Industrial				33	3.3	0.040	53	23	6.0	379	39	0.068	399	58	6.0
Eco 15	Harmony Creek				2.2	0.90	0.020	22	20	5.9	27	11	0.033	47	30	6.0
Eco 16	Farewell Creek				2.5	0.77	0.019	22	20	5.9	31	9.1	0.032	50	28	6.0
Eco 17	Farm A				20	2.5	0.061	39	22	6.0	209	31	0.10	229	50	6.0
Eco 18	Farm B				6.0	1.9	0.064	26	21	6.0	72	23	0.11	92	43	6.0
Eco 19	Farm C				3.6	1.2	0.028	23	21	6.0	44	15	0.047	64	34	6.0
Eco 20	Robinson Creek				7.1	1.6	0.059	27	21	6.0	86	19	0.10	106	39	6.0
Eco 21	Bennett Creek				3.0	0.66	0.033	23	20	6.0	36	7.9	0.056	56	27	6.0
Eco 22	Oshawa Creek Conservation Area				5.0	1.2	0.029	25	20	6.0	60	15	0.049	80	34	6.0
NAAQO (Maximum Acceptable)		**900**	**300**	**60**	**900**	**300**	**60**	**900**	**300**	**60**	**900**	**300**	**60**	**900**	**300**	**60**
World Health Organization		**-**	**100**	**30 / 20 F**	**-**	**100**	**30 / 20 F**	**-**	**100**	**30 / 20 F**	**-**	**100**	**30 / 20 F**	**-**	**100**	**30 / 20 F**

NAAQO: National Ambient Air Quality Objectives
F – Forest ecosystem

Table 8-24 Emitted NO_2 Concentrations at Each Receptor Location (μg m^{-3}) and Corresponding Phytotoxicity Benchmarks: 400,000 tpy Scenario

Receptor	Name	Baseline			Project Alone			Project Case			Process Upset Case			Process Upset Project Case		
		1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual
Eco 1	Darlington Provincial Park	65	58	**37**	49	5.0	0.19	113	63	**37**	72	7.5	0.19	136	66	**37**
Eco 2	Second Marsh Wildlife Area				25	3.6	0.13	90	62	**37**	37	5.3	0.13	102	64	**37**
Eco 3	Darlington Waterfront Trail				78	8.0	0.24	142	66	**37**	84	12	0.24	148	70	**37**
Eco 4	McLaughlin Bay Wildlife Reserve				23	7.2	0.16	87	65	**37**	33	11	0.16	98	69	**37**
Eco 5	Bowmanville Valley Cons. Area				14	3.2	0.14	78	61	**37**	20	4.7	0.14	85	63	**37**
Eco 6	Eco Baseline				49	5.6	0.10	114	64	**37**	72	7.5	0.10	137	66	**37**
Eco 7	Baseline Road & Rundle Road				39	6.8	0.37	104	65	**37**	58	10	0.37	122	68	**37**
Eco 8	Baseline Road & Courtice Road				86	13	0.25	151	71	**37**	126	19	0.25	190	**78**	**37**
Eco 9	Soper Creek				11	2.8	0.12	76	61	**37**	17	4.2	0.12	82	62	**37**
Eco 10	Bowmanville Marsh				15	3.1	0.16	79	61	**37**	21	4.5	0.16	86	63	**37**
Eco 11	South of Site, Eco Baseline S7				39	6.0	0.066	104	64	**37**	58	8.9	0.066	123	67	**37**
Eco 12	Sports Fields				92	6.5	0.23	157	65	**37**	90	10	0.23	154	68	**37**
Eco 13	Water Pollution Control Plant				97	7.0	0.15	162	65	**37**	144	10	0.15	208	68	**37**
Eco 14	Future Industrial				115	11	0.14	179	70	**37**	165	17	0.14	230	75	**37**
Eco 15	Harmony Creek				7.5	3.1	0.068	72	61	**37**	11	4.6	0.068	76	63	**37**
Eco 16	Farewell Creek				8.8	2.6	0.066	73	61	**37**	13	3.9	0.066	77	62	**37**
Eco 17	Farm A				68	8.5	0.21	133	67	**37**	87	12	0.21	151	71	**37**
Eco 18	Farm B				21	6.5	0.22	85	65	**37**	31	10	0.22	95	68	**37**
Eco 19	Farm C				13	4.3	0.10	77	62	**37**	18	6.3	0.10	83	65	**37**
Eco 20	Robinson Creek				25	5.6	0.20	89	64	**37**	36	8.2	0.20	101	66	**37**
Eco 21	Bennett Creek				11	2.3	0.11	75	61	**37**	15	3.3	0.11	80	62	**37**
Eco 22	Oshawa Creek Conservation Area				17	4.0	0.10	82	62	**37**	25	6.0	0.10	90	64	**37**
NAAQO (Maximum Acceptable)		**400**	**200**	**100**	**400**	**200**	**100**	**400**	**200**	**100**	**400**	**200**	**100**	**400**	**200**	**100**
World Health Organization		**-**	**75**	**30**	**-**	**75**	**30**	**-**	**75**	**30**	**-**	**75**	**30**	**-**	**75**	**30**

NAAQO: National Ambient Air Quality Objectives

Table 8-25 Emitted HF Concentrations at Each Receptor Location (μg m^{-3}) and Corresponding Phytotoxicity Benchmarks: 400,000 tpy Scenario

Receptor	Name	Baseline			Project Alone			Project Case			Process Upset Case			Process Upset Project Case		
		1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual	1 Hour	24 Hour	Annual
Eco 1	Darlington Provincial Park	NA	NA	NA	0.36	0.037	0.0014	NA	NA	NA	2.8	0.30	0.0020	NA	NA	NA
Eco 2	Second Marsh Wildlife Area				0.19	0.027	0.0010	NA	NA	NA	1.4	0.20	0.0014	NA	NA	NA
Eco 3	Darlington Waterfront Trail				0.58	0.059	0.0018	NA	NA	NA	3.3	0.46	0.0026	NA	NA	NA
Eco 4	McLaughlin Bay Wildlife Reserve				0.17	0.054	0.0012	NA	NA	NA	1.3	0.40	0.0017	NA	NA	NA
Eco 5	Bowmanville Valley Cons. Area				0.10	0.024	0.0011	NA	NA	NA	0.78	0.18	0.0015	NA	NA	NA
Eco 6	Eco Baseline				0.37	0.041	7.6E-04	NA	NA	NA	2.8	0.31	0.0011	NA	NA	NA
Eco 7	Baseline Road & Rundle Road				0.29	0.051	0.0028	NA	NA	NA	2.3	0.40	0.0039	NA	NA	NA
Eco 8	Baseline Road & Courtice Road				0.64	0.098	0.0019	NA	NA	NA	4.8	0.74	0.0026	NA	NA	NA
Eco 9	Soper Creek				0.085	0.021	8.9E-04	NA	NA	NA	0.67	0.16	0.0013	NA	NA	NA
Eco 10	Bowmanville Marsh				0.11	0.023	0.0012	NA	NA	NA	0.83	0.17	0.0017	NA	NA	NA
Eco 11	South of Site, Eco Baseline S7				0.29	0.044	4.9E-04	NA	NA	NA	2.3	0.35	6.9E-04	NA	NA	NA
Eco 12	Sports Fields				0.68	0.048	0.0017	NA	NA	NA	3.8	0.38	0.0024	NA	NA	NA
Eco 13	Water Pollution Control Plant				0.72	0.052	0.0011	NA	NA	NA	5.6	0.39	0.0015	NA	NA	NA
Eco 14	Future Industrial				0.85	0.084	0.0010	NA	NA	NA	6.2	0.64	0.0014	NA	NA	NA
Eco 15	Harmony Creek				0.056	0.023	5.0E-04	NA	NA	NA	0.44	0.18	7.1E-04	NA	NA	NA
Eco 16	Farewell Creek				0.065	0.020	4.9E-04	NA	NA	NA	0.50	0.15	6.9E-04	NA	NA	NA
Eco 17	Farm A				0.51	0.063	0.0016	NA	NA	NA	3.4	0.50	0.0022	NA	NA	NA
Eco 18	Farm B				0.16	0.049	0.0017	NA	NA	NA	1.2	0.38	0.0023	NA	NA	NA
Eco 19	Farm C				0.093	0.032	7.1E-04	NA	NA	NA	0.72	0.25	0.0010	NA	NA	NA
Eco 20	Robinson Creek				0.18	0.042	0.0015	NA	NA	NA	1.4	0.32	0.0021	NA	NA	NA
Eco 21	Bennett Creek				0.078	0.017	8.5E-04	NA	NA	NA	0.59	0.13	0.0012	NA	NA	NA
Eco 22	Oshawa Creek Conservation Area				0.13	0.030	7.4E-04	NA	NA	NA	1.0	0.24	0.0010	NA	NA	NA
NAAQO (Maximum Acceptable)		-	**0.86** [1]	-	-	**0.86** [1]	-	-	**0.86** [1]	-	-	**0.86** [1]	-	-	**0.86** [1]	-

NAAQO: National Ambient Air Quality Objectives

1. NAAQO not available for HF. Benchmark is Ontario Reg. 419/05 Schedule 3 for gaseous fluorides (as HF) during the growing season (MOE, 2005b).

NA – Baseline data not available for HF. Project Case and Process Upset Project Case scenarios can therefore not be quantified.

"-" – No benchmark available for this time period.

8.6.14 Traffic Case: 400,000 tpy

Current offsite vehicle emissions prior to the start up of the Thermal Treatment Facility were based on traffic volume estimates provided by URS Canada Inc. These traffic estimates were combined with the existing baseline ambient air conditions in the airshed to produce the baseline traffic case.

Emissions from vehicle operation (*e.g.*, onsite vehicles and waste/ash trucks) associated with the proposed Facility and existing/baseline vehicular traffic were assessed in conjunction with the Facility air emissions to determine the net impact from all potential emissions onsite and offsite.

The assessment was conducted for the receptor locations in close proximity to the roads on which traffic into the proposed Facility would travel. This methodology is expected to be conservative as it assumes that the maximum predicted concentration due to vehicle traffic occurs simultaneously with the maximum predicted concentration from onsite emissions (Jacques Whitford, 2009e).

8.6.14.1 Effects on Vegetation from SO_2 and NO_2 Traffic Case Emissions

The concentrations of SO_2 and NO_2 were assessed at six ecological receptor locations based on traffic impacts at these locations. Two scenarios were assessed: Baseline Traffic Case (Off-Site Traffic + Background Ambient Concentration) and Traffic Case (Measured Background + Baseline Off-Site Traffic + Project On-Site Traffic + Project On-Site Stationary).

The SO_2 emissions were found to comply with the NAAQO and WHO phytotoxicity benchmarks (where available) in both scenarios for their respective 1-hour, 24-hour and annual averaging periods.

In the case of the NO_2 emissions in the Baseline Traffic Case, one exceedance of the 24-hour WHO Air Quality Guideline (75 µg/m^3) occurred at receptor 14 (Future Industrial) (94 µg/m^3). The annual concentrations at all six receptor locations exceeded the annual phytotoxicity WHO Air Quality Guideline (30 µg/m^3) in the Baseline Traffic Case (with values ranging from 38 µg/m^3 to 42 µg/m^3). In the Traffic Case, the 24-hour NO_2 concentrations at five of the six ecological receptor locations exceeded the WHO Air Quality Guideline (75 µg/m^3); however, these concentrations were mainly driven by the concentrations of NO_2 occurring in the Baseline Traffic Case. Similarly, the annual NO_2 concentrations at all six receptor locations in the Traffic Case were only marginally greater than the annual concentrations in the Baseline Traffic Case.

Results of the traffic case scenarios are summarized in Tables 8-26 and 8-27.

Table 8-26 Traffic Case SO_2 Concentrations (µg m^{-3}) and Corresponding Phytotoxicity Benchmarks: 400,000 tpy Scenario

Receptor	Description	Baseline Off-Site Traffic + Background Concentration (ug/m^3)			Total Project Impact (Project Off-Site Traffic + Measured Background + Project On-Site Emissions) (ug/m^3)		
		1 Hr	24 Hr	Annual	1 Hr	24 Hr	Annual
Eco 3	Darlington Waterfront Trail	20	19	5.9	36	22	6.0
Eco 6	Eco Baseline	20	19	5.9	34	21	6.0
Eco 11	South of Site, Eco Baseline S7	20	19	5.9	31	21	6.0
Eco 12	Sports Fields	20	19	5.3	37	21	6.0
Eco 13	Water Pollution Control Plant	20	19	5.9	48	21	6.0
Eco 14	Future Industrial	20	19	6.0	54	23	6.0
NAAQO (Maximum Acceptable)		**900**	**300**	**60**	**900**	**300**	**60**
World Health Organization		**-**	**100**	**20**	**-**	**100**	**20**

Table 8-27 Traffic Case NO_2 Concentrations (µg m^{-3}) and Corresponding Phytotoxicity Benchmarks: 400,000 tpy Scenario

Receptor	Description	Baseline Off-Site Traffic + Background Concentration (ug/m^3)			Total Project Impact (Project Off-Site Traffic + Measured Background + Project On-Site Emissions) (ug/m^3)		
		1 Hr	24 Hr	Annual	1 Hr	24 Hr	Annual
Eco 3	Darlington Waterfront Trail	121	70	**39**	179	**78**	**39**
Eco 6	Eco Baseline	121	73	**38**	122	**78**	**39**
Eco 11	South of Site, Eco Baseline S7	117	69	**38**	158	75	**38**
Eco 12	Sports Fields	122	73	**39**	182	**79**	**40**
Eco 13	Water Pollution Control Plant	117	69	**38**	216	**76**	**39**
Eco 14	Future Industrial	129	**94**	**44**	254	**107**	**45**
NAAQO (Maximum Acceptable)		**400**	**200**	**100**	**400**	**200**	**100**
World Health Organization		**-**	**75**	**30**	**-**	**75**	**30**

8.6.15 Decommissioning and Abandonment

Decommissioning and abandonment of the Site is not expected to occur for several decades. Similar to the Construction Case, it is expected that decommissioning and removal of the Facility from the Site would entail short-term, localized emissions of air contaminants. While it is unlikely that these activities would significantly increase any potential risk to ecological health, it is expected that a more current assessment of these potential risks would be conducted prior to the commencement of decommissioning activities. Consequently, the prediction of risks to ecological health from decommissioning and abandonment has not been undertaken in this assessment.

8.7 Risk Characterization for Species at Risk

In order to assess the possible risk of COPC exposure to the avian SARs and species of conservation concern occurring within the LRASA, surrogate species were identified and assessed, based on an examination of their role in ecological food webs, their specific ecological niches and their trophic relations. As stated in Section 8.5.5, to ensure that these species are afforded an appropriate level of protection in ERA, TRVs based on NOAELs were preferentially selected; however, if NOAELs were not available but LOAELs were used in the calculation of risk, then the acceptable threshold for toxicity was modified downward from 1.0 to 0.33. Moreover, based on the body mass scaling approach used in the derivation of TRVs, larger animals have lower TRVs than smaller animals so, for example, larger great blue herons have lower TRVs than the smaller least bittern so using a larger surrogate is a protective and conservative assessment approach.

For both the 140,000 tpy and 400,000 tpy scenarios, under the Baseline case, Project Case and Process Upset Project Case:

- EHQ for American Robin were greater than 0.33 for exposure to vanadium and zinc (1.6 and 0.77)
- EHQ for wild turkey was greater than 0.33 for exposure to vanadium (2.6); and
- EHQ for great blue heron was greater than 0.33 for exposure to vanadium (0.55)

These results suggest that the avian SAR for which robin, turkey and heron act as surrogates may be at unacceptable risk from exposure. However, these EHQs are entirely driven by the findings in the baseline case as discussed in section 8.6.2.1, and were determined to be no different than any other similar areas in southern Ontario (Environmental Baseline Study, Jacques Whitford, 2009a). Given that the migratory aspects of these VECs were not taken into consideration and that the surrogate species were considered to spend 100 % of their time within the LRASA (and thus obtain all food resources from the LRASA), the EHQs for birds exceeding the acceptable toxicity threshold of 0.33 for zinc and vanadium do not necessarily represent an unacceptable risk to the SAR population within the LRASA.

8.8 Risk Characterization for Inhalation Route of Exposure

As discussed in Section 8.5.7 the current state of knowledge on inhalation toxicity does not permit an ecological relevant quantitative assessment of this pathway for most COPC. As an alternative to conducting a quantitative risk assessment based on the inhalation pathway for ecological receptors, human receptor exposure to average annual COPC concentrations was used as a surrogate for ecological risk assuming that if humans are adequately protected against inhalation risks, so too will ecological receptors.

Results of the HHRA (Section 7.0) indicated that no chronic Concentration Ratio (CR) estimates for individual COPC exceeded the benchmark of 1 for the Baseline Case, Project Alone Case, Project Case, Process Upset Case, Process Upset Project Case or Traffic Case in the 140,000 tpy scenario, indicating that there is negligible risk to humans exposed to air concentrations from all sources in the LRASA for a long-term duration. Similarly, results also indicate that no acute (1-hr or 24-hr) CR estimates for individual COPC exceeded the benchmark of 1 for all assessment cases in the 140,000 tpy scenario, indicating that there is negligible risk to humans exposed to air concentrations from all sources in the LRASA (including sensitive receptors) for short durations. Based on the results obtained from the human assessment, no risk from individual COPC is expected for all ecological receptors present within LRASA for the 140,000 tpy assessment scenario.

For the 400,000 tpy assessment scenario, one group of human health receptors (corresponding closest to a single ecological receptor location, Eco 6 (Eco Baseline)), the 1-hr hydrogen chloride narrowly exceeded the regulatory benchmark for the Process Upset Case (the frequency analysis (Section 7.12.1.1) at which this hypothetical Case would occur is expected to be very low). In the determination of this risk value, it was assumed that the Facility was operating under upset conditions for the entire one hour period, and that this occurred at the same time as the worst case meteorological conditions. Because the probability of this scenario actually occurring is very low, human (and by extension ecological) receptors are unlikely to be at risk from hydrogen chloride during Process Upsets. For all other COPC, no CR estimates for individual COPC exceeded the benchmark of 1 for the Baseline Case, Project Alone Case, Project Case, Process Upset Case, Process Upset Project Case or Traffic Case in the 400,000 tpy assessment scenario, indicating that there is negligible risk to humans exposed to air concentrations from all sources in the LRASA for a long-term duration.

8.9 Risk Characterization for Project Related Activities

In addition to COPC exposure, ecological receptors in the vicinity of the Project area may encounter non-chemical stressors (*e.g.,* noise, habitat alteration). Noise from the Project has some potential to affect wildlife within 300 to 500 m of construction activities and 250 to 300 m of operational process units. However, it is expected that wildlife would either naturally avoid these areas due to the human presence and activity, or would adjust to the noise (Jacques Whitford, 2009d). In terms of water discharge, Storm Water Management features for the Thermal Treatment facility will be designed to the Enhanced Protection Level for discharge and based on the combined effects associated with water resource management for the Facility, no negative ecological effects are anticipated (Jacques Whitford, 2009f). Further, natural features and ecological functions of the Site should not be impacted provided the recommendations in the Natural Environment Impact Assessment Report are implemented (Jacques Whitford, 2009c).

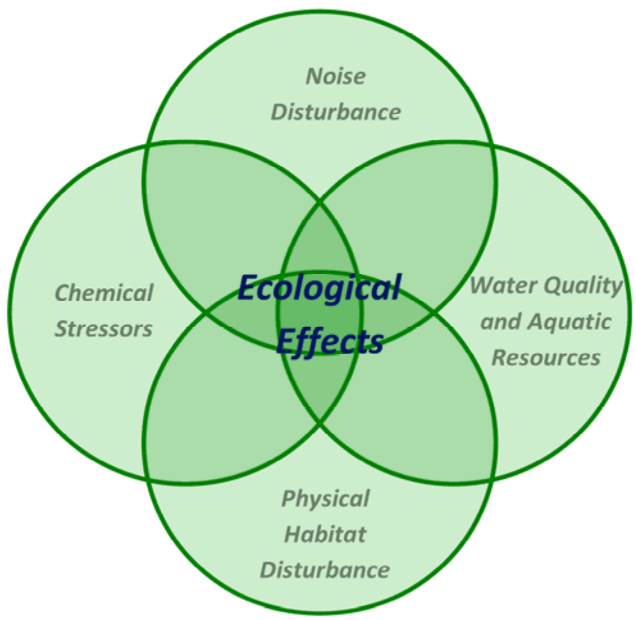


Figure 8-5 Possible Ecological Effects of Project Related Activities

Thus, these possible ecological effects induced by each of the chemical and non-chemical stressors are not mutually exclusive and wildlife living within the LRASA may be affected by all four independently or in combination (areas where circles overlap). As illustrated in Figure 8-5 above The combination of chemical (Project emissions of COPC) and non-chemical stressors (noise, habitat alteration), are not expected to have an unacceptable effect on ecological receptors within LRASA.

8.10 ERA Uncertainty Analysis

Uncertainty is inherent to many aspects of predicting health risks to VECs. The level of uncertainty depends upon the availability and quality of information, as well as the variability associated with many of the processes and factors being considered. When conducting risk assessments, it is standard practice to implement conservative assumptions (i.e., to make assumptions that are inherently biased towards safety) when uncertainty is encountered. This strategy generally results in an overestimation of actual risk, which helps ensure that the overall ERA conclusions would be protective of the health of ecological receptors. The following sections outline the main sources of uncertainty in this ERA.

8.10.1 Food Chain Interactions

Limited "real world" data exist that allow quantification of the true relationship between a chemical in an environmental medium and chemical transfer through the food chain. Only a few classes of chemicals appear to be magnified through the food chain. These substances include methyl mercury, PCBs, some chlorinated pesticides (such as DDT), and some PCDD/PCDF compounds. These substances all have a tendency to partition into fatty tissue rather than water. They are also resistant to natural degradation processes by metabolic enzymes. PAHs are also classes of hydrophobic chemicals present in the environment. Although these hydrocarbons are hydrophobic, they can be metabolized and/or excreted by some invertebrates and most vertebrates. For this reason, food chain magnification does not tend to occur with PAHs, although they can still be accumulated to some extent by many wildlife species. For other organic substances, the extent of food chain magnification is not well understood. Among the inorganic chemicals, some, such as zinc are subject to biological regulation. Others, such as thallium and mercury, appear to have high potential for bioaccumulation, and still others, such as methyl mercury, undergo biomagnification in the food chain. The extent of food chain magnification is a source of uncertainty that is addressed by using a conservative approach to uptake of COPC.

8.10.2 Selection of Chemicals of Potential Concern

As discussed earlier, the list of possible COPC was compiled using emission inventories from similar facilities (*e.g.,* Peel Incinerator), and federal and/or provincial identified/regulated air chemicals. COPC retained for multi-pathway analysis were compiled on the basis of their bioaccumulative potential and persistence in the environment. The list of COPC was extensive for a facility of this nature and it is unlikely that any additional COPC would be emitted from the Project that could affect ecological receptors.

8.10.3 Inhalation Pathway

The current state of inhalation toxicology literature does not permit a quantitative assessment of risk for most COPC. Very little is known regarding species sensitivity relationships across taxonomic orders or classes for health outcomes from inhalation exposure. Consequently, the use of uptake factors or allometric scaling is not recommended because there is little assurance of what values will be protective. This ERA did not explicitly evaluate the potential risks to ecological receptors from exposure to COPC via the inhalation pathway even though, given the nature of the Project, it is assumed that terrestrial receptors would be exposed to certain COPC in this manner. Instead, potential risk to human health via the inhalation pathway was used as an indicator of ecological inhalation risk based on the ascertation that provided that human receptors are adequately protected against inhalation exposures to maximum ground level concentrations of COPC, then ecological receptors should be protected as well. Given that the level of protection afforded to humans focuses on the health of individuals and often sensitive health outcomes (such as childhood asthma), it is reasonable to assume that human exposure TRVs for airborne contaminants are likely to be lower than equivalent TRVs for ecological receptors. As such, using the results of the human health inhalation pathway assessment is a conservative and protective method of assessing inhalation risk to ecological receptors.

8.10.4 Selection of Appropriate VECs and VEC Characterization

The VECs evaluated in this ERA were carefully selected to include receptors that are present in the LRASA, and could collectively provide a representation of vital components of the food web (*i.e.,* omnivore, herbivore). As such, these VECs are expected to be representative of other species that may be present on the Site and exposed to COPC. For this ERA it has been assumed that each receptor spends its entire life cycle in the assessment areas (12 months per year within the LRASA), even if life history traits suggest the receptor undertakes yearly migration.

The use of VECs is intended to limit the number of ecological receptors to a reasonable number. The VECs selected are considered to be consistently present in the assessment areas and to be exposed to the COPC via relevant exposure pathways. Therefore, it is reasonable to assume that conclusions that are reached in respect of VECs can be generalized to other biota that might use the LRASA.

For each VEC, the estimated exposure to COPC was dependent on attributes such as water, food, and soil intake and dietary composition. These attributes were characterized through extensive reviews of the available scientific literature. Where VEC-specific values were unavailable, body weight based estimation was utilized (*i.e.,* estimation of food requirements using Nagy's (1987) equations). Refer to **Appendix L** for more information.

8.10.5 Uncertainty Factors Applied to TRV Derivation

For several COPC, the available toxicity database is very limited. Consequently, TRVs for these substances were occasionally based on less-than-optimal toxicological studies. These TRVs were not necessarily specific to the VECs from the Site, reproductive or population-level endpoints, or of chronic duration. Uncertainty factors were, therefore, often necessary to modify available toxicological data for use in the ERA. The UF used were scientifically based and were applied in a manner that is consistent with regulatory guidance.

The preferred measure of toxicity for TRVs in this ERA is the chronic LOAEL. For certain COPC the only chronic endpoints available were NOAELs. In this situation, the NOAEL was used as the TRV (without the application of uncertainty factors). The decision not to apply uncertainty factors to translate a NOAEL to a LOAEL is a conservative measure to avoid overestimating the LOAEL (and consequently underestimating potential risks). For mammalian VECs, NOAEL-based TRVs were used for the following COPC: PAHs (low and high molecular weight), hexachlorobenzene, pentachlorophenol, carbon tetrachloride, 1,1,1-trichloroethane, bromoform, barium, beryllium, total chromium, chromium VI, cobalt, lead, and inorganic mercury. For avian VECs, a NOAEL based TRV was used for cadmium, total chromium, cobalt, lead, and nickel.

Toxicological testing of environmental contaminants is not nearly as extensive for avian species as it is for mammalian species. As a result, avian TRVs for many COPC are unavailable. This disparity is primarily due to the widely accepted practice of applying mammalian toxicity data for use in human health risk assessments and establishing other human health-based guidelines (*e.g.,* tolerable intake levels). Cross-class extrapolation for TRVs is not advised (Ohio EPA, 2003, 2008) and the possible uncertainty associated with the extrapolation of mammalian toxicity data for the purpose of generating avian TRVs was considered unacceptable for this ERA. The exception to this is with the case of PAHs. The U.S. EPA (2008) identified nearly 5,500 papers with possible toxicity data for either birds or mammals exposed to high and low molecular weight PAHs. Of those meeting the Eco-SSL acceptability criteria (46 papers), only two contained data concerning avian species and Eco-SSLs were not derived for birds due to data limitations. However, during the Eco-SSL literature review it was observed that for the compounds that had toxicological results for bird species, mammals were always more sensitive (Kapustka, 2004). On the basis of this observation, it has been suggested that mammalian TRVs can be assumed to be protective of avian species also (Kapustka, 2004), and Jacques Whitford has followed this approach for PAHs.

8.10.6 TRV Derivation

The toxicological database in support of a TRV for VEC preferably includes a number of chronic or multi-generational exposure studies involving exposure of relevant test species (*i.e.,* the ecological receptor of interest or a phylogenetically similar species) to appropriate chemical forms of the substance of interest. Ideally, one or more relevant biological endpoints such as growth, reproductive effects, or survival were measured in the study. Databases that meet this requirement are available for some chemicals, but in most cases, available toxicity data is limited to studies conducted with laboratory animals (*e.g.,* mammals: mice, rats, rabbits; birds: quail, chicken, and ducks). For use in ERA these laboratory data are often modified to account for taxonomic (*e.g.,* genus, family, order) and exposure duration differences (*e.g.,* conversion from sub-chronic to chronic) by using uncertainty, and body mass differences between the lab and wildlife species using an allometric scaling approach (U.S. EPA, 1995; Duke and Taggart 2000; Ohio EPA 2008). Comments from a reviewer of this ERA suggested that toxicity data should be obtained to derive TRVs from species that are closely related or with similar gut physiology to the VEC assessed in the ERA.

The U.S. EPA Ecotox database, Cal/Ecotox database and primary literature (search conducted using several article depositories (*e.g.,* Google Scholar/Web of Science/PubMed/BIOSIS)) were consulted to determine the feasibility of using VEC-specific toxicity data or closely related species in the quantitative ERA, in place of the industry standard of using toxicity data from a defensible and suitable test species. The U.S. EPA Ecotox and Cal/Ecotox databases are comprehensive sources of toxicological effects of chemicals on wildlife (*e.g.,* the U.S. EPA Ecotox database includes more than 400,000 test records covering 5,900 aquatic and terrestrial species and 8,400 chemicals) and the primary source of data for both databases is peer-reviewed literature.

For the first portion of this exercise the U.S. EPA Ecotox database and the Cal/Ecotox database were searched for toxicity data for six VECs (red fox, mink, white-tailed deer, wild turkey, great blue heron, and American robin) and five COPC (arsenic, vanadium, pentachlorophenol, hexachlorobenzene, and carbon tetrachloride) assessed in this ERA. These VEC were selected because they inhabit a variety of ecological niches (*e.g.* primary, secondary, and tertiary consumers) and the COPC represent both organic and inorganic chemicals.

A search of both databases revealed a paucity of data for all VEC/COPC combinations, and in general, aside from a few metals and pesticides, toxicity data were not available for the chosen VECs. A single exception to this was a LOAEL of 25 mg/kg hexachlorobenzene for mink. When adjusted to a daily dose this LOAEL is 3.4 mg HCB/kg-bw/day, a similar but less conservative TRV than the TRV used in the ERA (2.6 mg/kg/d).

As a corroborating line of evidence to determine the feasibility of preferentially using species specific toxicity data rather than laboratory data, primary scientific literature was searched for toxicity information for the above mentioned COPC for one mammalian and avian VEC (white tailed deer and wild turkey). The search revealed that some information regarding arsenic toxicity was available for the white-tailed deer, however, upon deeper investigation it was determined that the data would not suffice for use in an ERA because the studies were highly anecdotal in nature and did not follow a dose-response experimental approach defined *a priori*, thus utilizing a *post hoc* data analysis. It was concluded that there were no TRVs specific to turkey or white-tailed deer exposed to the aforementioned chemicals that were appropriate as the basis for a scientifically defensible quantitative COPC assessment.

As a final line of evidence to evaluate the use of laboratory species toxicity data as an alternative to either species-specific or surrogate species toxicity data, the aforementioned sources were searched for toxicity data for closely related surrogate species (*e.g.,* within the same class, with similar gut physiology) for the white tailed deer (ruminants including sheep and cattle) and red fox (domestic dog). In many cases no toxicity data could be found for the closely related surrogate species and in the cases where data were available, results indicated that cross-species and indeed cross-study toxicity data vary on a case by case basis. For example, NOAELs derived in one study may exceed LOAELs derived by another, and likewise, COPC-specific intraspecies LOAELs/NOAELs may vary by as much as one order of magnitude. One trend noted more often than not is the apparent conservatism associated with the use of body mass scaled TRVs; these were often lower than the surrogate TRV.

8.10.7 Use of Body Mass Scaled TRVs

The MOE released a memo dated May 14, 2009 stating that there is insufficient data to indicate whether acute scaling values have any validity to chronic effects data and until sufficient evidence is provided, MOE will no longer accept the application of allometric dose scaling developed using acute toxicity information for estimating chronic effects data. While it is true that the use of allometric dose scaling draws heavily from acute rather than chronic data, this is not by itself enough to discount the approach and indeed, some studies have validated the allometric exponent with chronic data. The allometric scaling approach is used by Environment Canada and Health Canada for the derivation of mammalian TRVs (or critical toxicity values; CTVs) for chemical substances assessed under the Chemicals Management Plan, is suggested by Ohio EPA in their ERA guidance (2008), and supported by scientific research.

Of the 54 COPC quantitatively assessed for mammals, 26 TRVs were potentially body mass scaled (only when the test species was lighter than the VEC). Of the 20 COPC quantitatively assessed for birds, 13 were potentially body mass scaled. Under the Baseline Case, the American robin, belted kingfisher, mallard duck and wild turkey all have HQs greater than 1.0 for exposure to vanadium. The vanadium TRV used in this ERA was body mass scaled. To illustrate the effect of body mass scaling on the quantitative assessment of risk, EHQs derived using the body mass scaled vanadium TRV and the non-body mass scaled TRV are presented in Table 8-28 below.

Table 8-28 Comparison of Scaled *vs.* Non-scaled TRVs and Associated EHQs

Species	Unadjusted TRV [a] (mg/kg-bw/day)	EHQ based on Unadjusted TRV	Body Mass Scaled TRV [b] (mg/kg-bw/day)	EHQ based on Body Mass Scaled TRV
American Robin	0.23	1.6	0.23 [c]	1.6
Belted Kingfisher	0.23	1.4	0.22	1.5
Mallard Duck	0.23	2.2	0.13	3.9
Wild Turkey	0.23	1.1	0.095	2.6

a. Based on oral exposure of 1-day old chicks to sodium metavanadate at concentrations of 0, 3, 6 and 12 mg/kg in food over a period of 5 weeks, *ad libitum.* Final TRV is a based on chronic LOAEL. Refer to Appendix J for TRV derivation and source.

b. Scaling approach discussed in Section 8.5.6 and Appendix J.

c. Allometric body mass scaling not applied as TRVs are not scaled upwards when the modelled species is smaller than the laboratory test species.

As can be seen in Table 8-28, use of body-mass scaling of TRVs results in a more conservative estimate of risk to VEC compared to using an unadjusted TRV. Using the most extreme example in the wild turkey, the scaled TRV is nearly 2.5 times more conservative than the unadjusted TRV. In other words, use of unadjusted TRVs tends to underestimate possible magnitude risk of VEC exposure to COPC but does not alter the conclusion that possible unacceptable risk exists.

8.10.8 Exposure Prediction Limitations

For the Project Alone, Project Case, Process Upset, and Process Upset Project Cases various models were used to estimate air emissions and environmental fate of COPC for the purpose of generating EPCs. These modeling exercises were carried out in a way that is expected to result in conservative estimates that overstate the actual level of risk. It is important to recognize that the modeled air emissions data are also inherently conservative. Therefore, the calculated risks to VECs that result from these data are also highly conservative. For the Baseline Case assessment, EPCs for soil, water, sediment, terrestrial plants, terrestrial (small) mammal, and fish were derived from empirical measurements. For some COPC, however, empirical data was not obtained and uptake factors (UP) were used to predict COPC concentrations in certain media and biota.

8.10.9 Chemical Speciation

The fate, food chain interactions, and toxicity of a number of inorganic elements depend to a large extent upon their chemical form. As such, conservative assumptions about chemical form, bioavailability, and absorption across the gut were generally carried forward in the risk assessment, and the potential for exposure is likely to be overstated. For example, it was assumed that 100% of each ingested COPC is absorbed from ingested soil or food, and is available to the organism as a potentially toxic substance. This may be reasonable for some COPC but would be highly conservative for others.

8.10.10 Environmental Fate and Transport

The environmental fate and transport of COPC was modeled following US EPA and similar fate and transport models. Although the overall model structures are reliable, the quality of many of the parameter values describing the environmental fate and partitioning of COPC varies. For some COPC and/or environmental media, the environmental fate and transport parameters are uncertain, and in the face of this, conservative assumptions were implemented that may overstate the likely environmental concentrations and exposure of wildlife to these and other substances.

8.10.11 Summary of Assumptions and Uncertainty in the ERA

The assumptions/uncertainties used in this ERA are provided in Table 8-29, along with an evaluation of each.

Table 8-29 Summary of ERA Assumptions/Uncertainties

Assumptions/Uncertainty	Justification
Receptor Characteristics	
Assumed all ecological receptors spend 100% of life on site.	Amount of time on site is highly variable (for certain VECs), but will not exceed 100%. Migration patterns of some species (*e.g.* American robin) that may take them out of the LRASA (and therefore lower their potential exposure) during much of the year have not been incorporated into this assessment.
Intake Parameters for VECs (*e.g.,* food ingestion rate) are highly dependent on modeled values, and other literary sources (*i.e.*, US EPA 1993)	Site-specific information is not available
Food chain interactions	Chemical transfer through the food chain (*i.e,* biomagnification) is relatively unknown for many chemicals. These uncertainties are dealt with in a conservative manner in the ERA.
Exposure Assessment	

Assumptions/Uncertainty	Justification
Exposure Prediction Limitation	Various models were used to estimate air emissions and environmental fate of COPC for the purpose of generating EPCs. These modeling exercises were carried out in a way that is expected to result in conservative estimates that overstate the actual level of risk.
Toxicity Assessment	
Allometric scaling was applied to laboratory generated TRVs to derive TRVs for VEC.	Extremely limited or no toxicity data is available for VEC species assessed in this ERA so the industry standard of applying allometric scaling to laboratory derived TRVs was used.
Chemical speciation is often unknown	Conservative assumptions regarding chemical form were applied (*i.e.,* assumed 100% of ingested COPC is absorbed and available to the VEC as a potentially toxic substance).
Risk Characterization	
Ecological risks from the inhalation pathway	Given uncertainties in assessing risk to ecological receptors from the inhalation pathway, results of the HHRA were used. It is assumed that a lack of unacceptable risk in the HHRA is also indicative of a lack of unacceptable risk to ecological receptors
An Ecological Hazard Quotient or Screening Ratio of 1.0 is used as the threshold for potential risk to VECs (but not SAR species)	Due to the incorporation of background concentrations into this ERA, this threshold value was considered conservative and appropriate.

8.11 ERA Conclusions

The purpose of the ERA was to evaluate the potential ecological risk of receptor exposure to Project COPC in the LRASA, and to predict the potential for adverse environmental health effects at receptor locations for specified scenarios.

The following is a summary of ERA conclusions and discussion of potential effects:

- In most cases risk estimates for ecological receptors exposed to Project COPC were orders of magnitude below the benchmark of 1.0;
- The ERA determined that EHQs were all below their benchmark for exposure of avian and mammalian receptors to COPC emissions from all cases, with the exception of vanadium for birds and selenium for mammals, which were driven entirely by existing baseline concentrations. Baseline media concentrations within the LRASA are not expected to differ from any other

unimpacted site in southern Ontario. The vanadium TRV for birds, and the selenium TRV for mammals selected for use in this ERA are highly conservative values;

- In cases where the EHQs and SRs (freshwater and/or sediment receptors) were greater than 1.0, in nearly every instance it was the result of using a laboratory detection limit in place of actual measured baseline concentrations (because COPC was non-detected) in the calculation. Consequently, predicted risks reflect the highly conservative nature of the ERA rather than actual potential risk; and
- SO_2, NO_2, and HF concentrations in the environment related to the Project are not expected to affect plant communities within the LRASA. The NO_2, background values were found to exceed the WHO phytotoxicity benchmarks; however visual inspection of the plant communities revealed healthy vegetation with no evidence of NO_2 related stress.

Overall, the results of the ecological risk assessment indicate that chemical emissions from the EFW Facility would not lead to any adverse ecological risks to receptors or species at risk in LRASA under either the initial operating design capacity of 140,000 tpy or the maximum design capacity of 400,000 tpy. In addition, a combination of the chemical and non-chemical stressors (noise, habitat alteration), is not expected to have an unacceptable effect on ecological receptors within LRASA.

However, a potential unacceptable risk was estimated for freshwater receptors exposed to benzo(g,h,i)perylene (SR=1.1), marginally in excess of the Provincial benchmark (SR=1.0), as a result of Process Upsets. Slight exceedances of benchmark risk levels were seen when the EFW Facility at 400,000 tpy was operating under upset conditions, where two of the three exhaust streams are being affected for the entire one hour period, and at the time of the worst meteorological conditions. The probability of this hypothetical situation actually occurring is expected to be very low.

9.0 SUMMARY OF CONCLUSIONS

The HHERA considers and assesses the effects of the Project, including cumulative effects, within the Local Risk Assessment Study Area. The objective of the HHERA was to evaluate the potential for people and the environment to be adversely affected as a result of COPC emissions from the Project. Ground level air concentrations were modeled as part of the Air Quality Technical Study (Jacques Whitford, 2009b). Annual deposition of persistent COPC was modeled at receptor locations for input into the multi-media HHERA. Seven cases were evaluated in the HHERA, as follows:

- Baseline Case
- Baseline Traffic Case (Inhalation Assessment Only)
- Project Alone Case
- Project Case
- Process Upset Case
- Process Upset Project Case
- Traffic Case (Inhalation Assessment Only)

Overall, the results of the human health risk assessment indicate that chemical emissions from the EFW Facility would not lead to any adverse health risks to local residents, farmers or other receptors in LRASA under either the initial operating design capacity of 140,000 tpy or the maximum design capacity of 400,000 tpy.

However, a limited number of chemicals under the Process Upset Case of the 400,000 tpy maximum design capacity resulted in slightly elevated potential risks above the government benchmarks for human health. These include:

- maximum exposure to the 1 hour hydrogen chloride concentration at the commercial/industrial receptor location resulting in a CR of 1.0 (benchmark CR=1.0);
- exposure of farmer infant to breast milk of a mother living in close proximity to the EFW facility under the Process Upset Case resulted in an infant dioxin and furan HQ of 0.22, slightly in excess of the government benchmark of 0.2.

Overall, the results of the ecological risk assessment indicate that chemical emissions from the EFW Facility would not lead to any adverse ecological risks to receptors or species at risk in LRASA under either the initial operating design capacity of 140,000 tpy or the maximum design capacity of 400,000 tpy. In addition, a combination of the chemical and non-chemical stressors (noise, habitat alteration), is not expected to have an unacceptable effect on ecological receptors within LRASA.

However, a potential unacceptable risk was estimated for freshwater receptors exposed to benzo(g,h,i)perylene (HQ=1.1), marginally in excess of the Provincial benchmark (HQ=1.0), as a result of Process Upsets.

These slight exceedances of benchmark risk levels were seen when the EFW Facility at 400,000 tpy was operating under upset conditions, where two of the three exhaust streams are being affected for the entire one hour period, and at the time of the worst meteorological conditions. The probability of this hypothetical situation actually occurring is expected to be very low.

Regardless, in the event that a 400,000 tpy expansion of the facility is eventually contemplated, special consideration should be given at that time to ensure that Process Upset Conditions do not result in an undue risk to people living and working in the area surrounding the facility or to ecological receptors.

10.0 CLOSURE

This Report has been prepared by Jacques Whitford Limited. The assessment represents the conditions at the subject property only at the time of the assessment, and is based on the information referenced and contained in the Report. The conclusions presented herein respecting current conditions, and potential future conditions are at the subject property resulting from the Project, represent the best judgment of the assessor based on current scientific standards. Jacques Whitford attests that to the best of our knowledge, the information presented in this Report is accurate. The use of this Report for other Projects without written permission of Durham Region, York Region and Jacques Whitford is solely at the user's own risk.

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