ENVIRONMENTAL HEALTH ISSUES IN THE CITY OF TORONTO

By

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1.0 BACKGROUND

As Canada's most populated city, Toronto places enormous stress on its natural environment. The resource and energy needs of its two and half million residents, and the waste products that result from daily urban life, can result in air pollution, contaminated soils and polluted waterfronts, all of which can affect the health of Toronto residents. For example, the air pollutants released from the burning of fossil fuels such as gasoline, coal and oil, are commonly present in Toronto's airshed at levels that have been linked to increases in respiratory infections, hospitalizations for asthma, lung and heart disease, and non-traumatic deaths (Burnett, 1994; Thurston, 1994; MOEE, Smog Plan, 1996). With further population growth, pollutant loadings to the environment and their subsequent health impacts are expected to increase unless protective measures are taken.

The concern for environmental health becomes even more urgent when one recognizes that Toronto is situated on one of North America's most polluted ecosystems, the Great Lakes Basin. More than three hundred and sixty chemicals, about half of them organochlorine compounds, have been detected in the waters of the Great Lakes (IJC, 1993). Leaking toxic dumps, agricultural run-off, air pollution, and industrial and municipal discharges have all contributed to the pollution of the Great Lakes Basin. Although levels of some persistent toxic pollutants in the Great Lakes Basin have decreased over the last 25 years because of actions taken, current research indicates that human health can be affected by exposure levels that are common among Great Lakes residents today (Health Canada, 1997).

Contaminants of continuing concern include organochlorine compounds such as DDT, polychlorinated biphenyls (PCBs) and dioxins, heavy metals such as lead, mercury and some radioactive materials. These substances persist in the environment, accumulate in the food chain and in the human body, and have been linked to reproductive effects, neurological disorders, cancer and other chronic diseases in experimental animals, wildlife and humans (Health Canada, 1997). Toronto residents are exposed to low levels of these environmental contaminants through their food, water, air and soil.

Because many parts of Toronto have been inhabited for more than a hundred years, past industrial activities have contributed to significant soil pollution. Prior to the 1960s, industrial processing and waste handling was done in a way that resulted in considerable contamination of neighbouring communities. Persistent toxic substances such as polyaromatic hydrocarbons (PAHs), PCBs, lead and other metals can still be found in the ground today. Metals, such as lead or cadmium, that were used extensively in household paint in the past, can present a significant health hazard to occupants of older urban buildings if painted surfaces are deteriorating or disturbed.

Another issue of concern to the community involves the ubiquitous presence of power lines and radio transmitters which generate an electro-magnetic field that may affect human health. Dense urban living can be associated with an array of indoor pest problems that encourages the use of pesticides in indoor environments. Exposure to insecticides and herbicides can occur outdoors as well since home-owners and apartment dwellers alike rely upon pesticides to control outdoor pests and weeds.

It is the multiplicity of exposures to environmental contaminants that is of particular concern for human health. Scientific studies are just beginning to examine the health consequences of lifetime exposures to a multitude of pollutants. Scientists are developing increasingly sophisticated tools to measure environmental pollutants in the human body and to assess subtle human health effects. As a result, many studies can now demonstrate health effects caused by current levels of exposure that older studies could not. It can take many years however, before government regulations and pollution prevention strategies reflect advances in scientific knowledge. Consequently, compliance with regulatory standards alone cannot guarantee the health of the community.

Environmental health risks are not borne equally by all residents in a community. The environment can interact with other determinants of health to exacerbate the health risks for specific populations. For example, the very young, the elderly and those with pre-existing respiratory conditions are much more susceptible to smog episodes than others. Families with lower incomes are more likely to live near busy roads and industrial developments that can be associated with higher levels of air pollution and soil contamination. Aboriginal people and other groups who depend upon "country food" can accumulate higher levels of toxics such as mercury and PCBs in their bodies by eating fish from Lake Ontario.

This report highlights some of the ways in which the environment can affect the health of Toronto residents. It is divided into three sections: air, water, and land. The reader should note that Toronto-wide data are not always available, and therefore data have been drawn from the areas for which they were available.

2.0 AIR

2.1 Outdoor Air – Smog

Evidence collected around the world has demonstrated consistently that human health is affected by the low levels of air pollutants that are present in Toronto's air. While Toronto residents are most aware of this health connection in the summer when smog episodes are triggered by high levels of ground-level ozone, in reality, human health is affected by air pollutants in Toronto's air year round.

Smog is composed of a mixture of air pollutants including ozone, carbon monoxide, sulphur dioxide, nitrogen oxide, inhalable particulates (PM_{10}), respirable particulates ($PM_{2.5}$) and sulphates. Most of these air pollutants are emitted as by-products when fossil fuels such as coal, oil, gasoline are burned in cars, furnaces, electrical generating stations and industrial plants. A growing body of scientific evidence indicates that air pollutants have a synergistic effect on human health which is greater than the impact of individual air pollutants, and that there may be no "safe" level of exposure to the air pollutants commonly associated with the burning of fossil fuels. In this report, three air pollutants, ground-level ozone (O_3), inhalable particulates (PM_{10}) and nitrogen dioxide (NO_2) have been selected as indicators of human health and "smog" in Toronto (OMA, 1998).

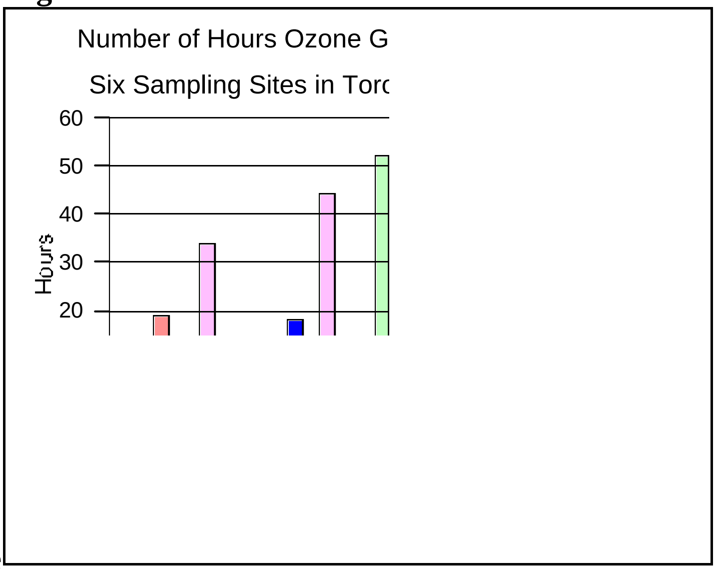
2.1.1 Ground Level Ozone (O_3)

Ground-level ozone is produced when nitrogen oxides (NO_x) that are emitted from cars, furnaces and industrial process, react in the presence of sunlight, with volatile organic compounds (VOC) that can be released from paints, degreasers, dry-cleaners and pesticides (MOEE, 1996). In Toronto, smog episodes are most frequently triggered by the high concentrations of ground-level ozone that can develop over most of southern Ontario in the summer season. About one half of this ozone originates in the United States, with a large share coming from coal-fired plants that operate in the midwestern United States (MOEE, 1996).

Ground-level ozone has been clearly linked with reduced lung capacity in healthy children, with an increased rate of respiratory infections such as pneumonia and bronchitis, and increased hospitalizations for asthma and chronic lung disease (MOEE, 1996). The current 1-hour provincial air quality criteria for ground-level ozone of 80 parts per billion (ppb) is currently being reviewed by a process established by the federal and provincial ministers of environment and health.

Recent studies have demonstrated health effects well below the current 80 ppb standard (Burnett, 1994; Thurston, 1994). For example, statistically significant increases in hospital admissions have been observed at hourly ozone readings as low as 25 ppb (CEPA, 1999). A number of studies suggest that there may be no level of exposure to ozone that is without health effects (MOEE, 1996; Steib et al., 1995; TPH, 1996; Bates, 1995).
In 1997, the 1-hour provincial standard of 80 ppb was exceeded between 3 and 39 times at the six sampling stations in Toronto. The lowest number of exceedances occurred at the downtown Toronto sampling site while the highest number occurred at the Etobicoke south sampling station (see Figure 1)(MOE, Data, April 1999). Ozone readings at the downtown Toronto site are lower than in other parts of the City because ozone reacts with nitrogen dioxide (NO_2) which is present in high levels in downtown Toronto due to high traffic density (MOE, 1998). This can give the appearance that air quality in downtown Toronto is better than in other areas of the City when that is not necessarily the case.

Figure 1



The 80 ppm standard is exceeded more frequently in the southwestern part of Ontario than in the City of Toronto because of transboundary pollution. Estimates indicate that about 50% of the ozone that affects southern Ontario comes from the United States, much of which comes from coal-fired plants in the Ohio Valley.

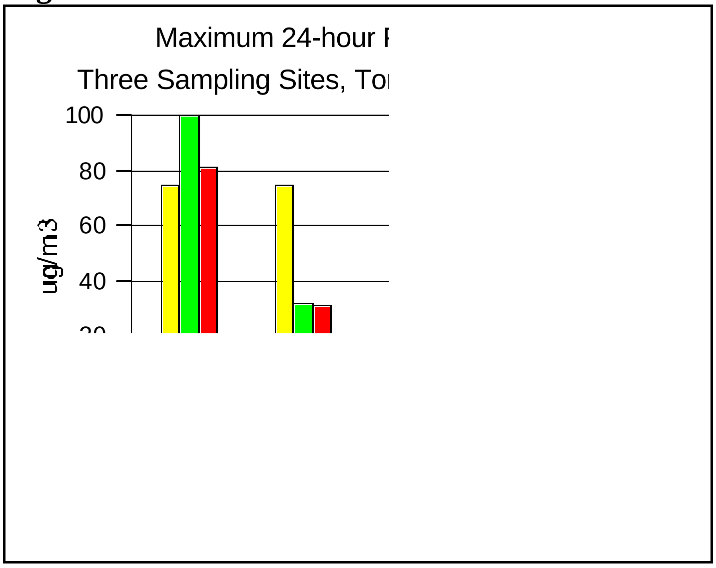
Trends in ozone levels can be difficult to identify because year to year levels are strongly influenced by weather. However, when the Ministry of Environment examined composite annual means for the 22 long-term ground-level ozone sites across Ontario from 1979 to 1996, it concluded that ozone levels are increasing. There was only one year between 1979 and 1987 which exceeded the 18-year average of 21.8 ppb, while all nine years from 1988 to 1996 had an annual average which exceeded 21.8 ppb (MOE, 1998).

2.1.2 Inhalable Particulates (PM_{10})

Inhalable particulates (PM_{10}) are particles that are small enough to be inhaled into the lungs. They can include fine acid mists, metal fumes and road dust. A large portion of PM_{10} is sulphates (about 25%) that are formed in the atmosphere from sulphur dioxide (MOEE, 1996). A large percentage of sulphur dioxide in Ontario (22%) and the United States (63%) is released from coal-fired electrical generating stations (TPH, 1999).

PM_{10} has been linked with increased rates of premature mortality and hospital admissions for heart diseases and respiratory diseases such as asthma, chronic obstructive pulmonary disease and infections. The provincial government has estimated that approximately 1,800 people in Ontario die prematurely each year because of the levels of PM_{10} in Ontario's air (MOEE, 1996). Significant increases in death rates and hospital admissions have been observed at daily PM_{10} levels as low as 20 and 25 micrograms per cubic meter of air (ug/m^3) respectively (CEPA, 1996; TPH, 1996).

Figure 1



In 1997, the maximum 24-hour reading in Toronto was 59 ug/m^3 while the annual mean of the 24-hour reading was 24.5 ug/m^3 (see Figure 2) (MOE, Data, April 1999).

2.1.3 Nitrogen Dioxide

A new study published in 1998 by researchers at Health Canada suggests that air pollution has a more profound effect on human health than previously believed (Burnett, 1998). This study suggests that the number of people who die each year because of air pollution may be twelve times greater than estimates based on PM_{10} alone. It focused on the contribution of the gaseous air pollutants, nitrogen dioxide (NO_2), sulphur dioxide (SO_2), ozone (O_3) and carbon monoxide (CO), on premature mortality in 11 Canadian cities from 1980 to 1991. It demonstrated that the three gaseous air pollutants, NO_2, SO_2 and O_3, combined increased the risk of death by 7.7%, and could be responsible for approximately 5,000 deaths per year in the 11 Canadian cities studied. The gas with the greatest impact on risk alone was NO_2, which increased the risk of death by an average of 4.6% (Burnett, 1998).

The Burnett study is meaningful for Toronto because it has the highest NO_2 readings in Ontario. In 1996, the highest annual mean of 33.9 ppb, the highest 1-hour reading of 171 ppb, and the highest 24-hour reading of 100.4 ppb were recorded in the City of Toronto. The current 1-hour air quality criterion for NO_2 is 200 ppb, while the 24-hour air quality criterion is 100 ppb. However these criteria do not reflect the recent studies. For example, nitrogen dioxide readings in the 11 Canadian cities examined in Burnett's 1998 study ranged from a low of 14.1 ppb to a high of 27.5 ppb. The elevated levels of NO_2 in Toronto and other major urban centers are attributed primarily to motor vehicle emissions (MOE, 1998).

2.2 Outdoor Air – Toxics

An air quality study conducted for the former City of Toronto in 1993 indicated that approximately 160 toxic compounds are routinely detected in Toronto's air. Of those detected, four are known human carcinogens, 27 are suspected human carcinogens, and 36 have been shown to cause adverse reproductive effects. Fourteen compounds were identified as priorities because of the levels at which they were present (see Figure 3)(TPH, Air, 1993).

Figure 2: Priority Air Toxics, 1992

Benzene
Chromium (VI)
Nickel
1,3-Butadiene
1,1,2-Trichloroethane
1,2,-Dichloroethane
Dichloromethane
Trichloromethane
Chloromethane
Trichloroethene
Styrene
Cadmium
Tetrachloroethene
1,1,2-Trichloroethane

2.2.1 Benzene

Benzene, a known human carcinogen, is emitted as a vapour from gasoline and in the exhaust of motor vehicles. In urban centres across Canada, benzene is detected at average levels of 1.8 to 3.6 ug/m^3. The U.S. Environmental Protection Agency estimates that in a population of 1 million people, between 2.2 - 7.8 cases of cancer may result from a life time exposure to benzene levels of 1 ug/m^3 in outdoor air (U.S. EPA, 1999). Samples collected between 1989 and 1998 indicate that 24-hour benzene levels average from 1.3 to 2.8 ug/m^3 in Toronto, while the 24-hour maximum ranges from 4.3 to 77 ug/m^3 (Environment Canada, 1999). There is no air quality standard for benzene in Canada.

2.2.2 Formaldehyde

Formaldehyde, identified as a probable human carcinogen, is commonly detected in outdoor air in large urban centres. Motor vehicle emissions are one source of formaldehyde in urban environments. While formaldehyde levels of 0.14 to 0.96 ug/m^3 are common in rural areas, large urban centres such as Toronto commonly have formaldehyde levels ranging from 2 to 4 ug/m^3. The existing provincial air quality criterion for formaldehyde is 65 ug/m^3 for a 1-hour period (MOE, 1998a).

2.2.3 1,3-Butadiene

1,3-Butadiene is a toxic substance emitted in the exhaust from vehicles. Considered a probable human carcinogen for many years, the U.S. Environmental Protection Agency is considering upgrading 1,3-butadiene to a "known human carcinogen" on the basis of new scientific evidence (IARC, 1986, 1992; US EPA, 1998; Health Canada, 1999). 1,3-Butadiene is detected at much higher levels in urban centres with high traffic density. Unpublished data from the National Air Pollution Surveillance program indicate that the annual average of the 24-hour readings for 1,3-butadiene ranged from 0.21 to 0.46 ug/m^3 in Toronto between 1989 and 1996, while the maximum readings ranged from 1.2 to 2.2 ug/m^3 (Health Canada, 1999). An air quality standard for 1,3-Butadiene is currently being developed as part of the Canada wide standard setting process.

2.2.4 Manganese

Manganese was identified as a substance of concern in 1993 because its presence was increasing in Toronto's air. Manganese is emitted from motor vehicles that use gasoline which contains the additive MMT. Occupational studies have demonstrated that manganese may be toxic to the nervous system, hence there are concerns that increased levels in the ambient air could lead to long-term health problems for the general population (TPH, 1993).

2.3 Outdoor Air – Global Climate Change

Global climate change, affected by the release of carbon dioxide (CO_2) and other greenhouse gases into the atmosphere, could change weather patterns, food supplies, tree growth, water levels, and patterns of disease around the world. In Ontario, global climate change is expected to increase the frequency and severity of extreme weather events such as tornados, heat waves and flash floods.

It has been estimated that 166 million tonnes of CO_2 were emitted from human activities in Ontario in 1990. About 90% of those emissions were released from the burning of fossil fuels such as coal, gasoline, oil and natural gas. About 20% were released from coal-fired generating stations that produce electricity in this province (MOEE, 1992).

Carbon dioxide (CO_2) is present at a concentration of 355 parts per million (ppm) in the earth's atmosphere. The CO_2 concentration appears to be increasing at approximately 0.5 % per year, an increase that has been attributed to the burning of fossil fuels (TPH, 1996).

Global climate change is expected to increase the number of people who die each year from heat waves in Toronto from 20 in the 1980s to 290 by the year 2020 (TNRS, 1996). An even larger number of Toronto residents are expected to be affected by increased rates of allergic lung disease, chronic lung disease and heart disease because of the increased levels of allergens, ground-level ozone, and inhalable particulates (PM_{10}) (TPH, 1997; David Suzuki Foundation, 1999). Increases in death and disease could also result from extreme weather events such as tornados and flash floods that are difficult to predict.

2.4 Outdoor Air – Depletion of the Ozone Layer

The global ecosystem is also threatened by the depletion of the ozone layer in the upper atmosphere. The ozone layer protects humans, animals and plants from the harmful ultraviolet (UV) fraction of sunlight. It has been estimated that for every 1% decrease in the ozone layer, there is a 1% increase in the UV index, and 1% to 3% increase in the number of non-melanoma skin cancer cases (TDHC, 1999).

The UV index, used to indicate the intensity of the sun, ranges from 0 to 10, with precautions recommended at 4, and sunburns occurring within 20 minutes at 7 (TDHC, 1999). In Toronto, the incidence of high (7-9) and extreme (>9) UV index values climbed from 30-40 days in 1989 to approximately 60 days per year in 1995 and 1996 (Environment Canada, 1997).

The ozone layer is being depleted by the release into the atmosphere of chemicals such as chlorofluorocarbons (CFCs), halons, 1,1,1-trichloroethane and methyl bromide. The Montreal Protocol, an international agreement on the phase-out of ozone depleting substances, called for elimination of production of: halons by the end of 1993; CFCs by the end of 1995; carbon tetrachloride by 2000; and 1,1,1-trichloroethane by 2005. Hydrochloroflourocarbons (HCFCs), which have been allowed as temporary substitutes for CFCs, are supposed to be phased out from use and production between 2004 and 2030 (MOEE, 1992).

2.5 Indoor Air

Indoor air can have a significant impact on human health in northern climates where people spend most of their time indoors. The quality of indoor air is dependent upon the quality of the outdoor air, the consumer products, construction materials, and equipment that may be present indoors, and on the biological organisms such as bacteria and moulds that may be present in indoor environments.

2.5.1 Chemical Contaminants

All outdoor contaminants can be present indoors because of the continuous exchange of air between the interior and exterior of buildings, although outdoor contaminants vary in their ability to penetrate the indoor environment. A number of studies have demonstrated that the concentration of some air contaminants such as carbon monoxide, formaldehyde and phthalates can be higher in indoor air than in outdoor environments because of indoor sources (TPH, 1994). For example, in conventional homes, air levels of formaldehyde can range from 25 to 60 ug/m^3, while levels in Toronto's outdoor air range from 2 to 4 ug/m^3. (The provincial 1-hour air quality criterion for formaldehyde, which has been identified as a probable human carcinogen, is 65 ug/m^3) (MOE, 1998a).

In many cases, these contaminants are “off-gassing” from construction materials and furnishings such as plywood, carpets and flooring. In other situations, they are released from equipment such as photocopiers or gas stoves, activities such as cleaning or smoking, or consumer products such as air fresheners. Exposure to these indoor contaminants can produce a variety of acute health effects including eye, skin and nose irritation, headaches, and nausea. Exposure to some of these contaminants can increase the risk of chronic health effects such as cancer, liver and kidney disease (TPH, 1994).

2.5.2 Biological Contaminants

Asthma, allergies, skin irritation and respiratory infections and a variety of other health effects have been linked to biological organisms in indoor environments such as moulds that can grow on damp construction materials (eg. drywall), dust mites that can breed in household furnishings (eg. carpets and mattresses), bacteria that can grow in humidifiers, insects such as cockroaches that can multiply in a variety of conditions, and furry pets (Raizenne, 1998).

While the causes of asthma are still poorly understood, there is a growing body of literature which demonstrates that the indoor air environment, like outdoor air, can enhance the development of asthma in susceptible children (Infante-Rivard, 1993). There is also growing evidence that viral infections, that can be caused by biological agents in the indoor environment, may condition the lungs for adverse reactions to air pollutants in children with or without asthma (Raizenne, 1998). Passive smoking, dust mites, furry pets, cockroaches, water damage (which could increase exposure to moulds or fungi) have all been associated with increased rates of asthma and/or allergies in children (Raizenne, 1998).

Asthma’s relationship to indoor air quality is of particular concern because estimates indicate that the percentage of children under 15 years of age suffering from asthma may have increased from 2.5% in 1978 to 11.2% in 1994. Health Canada estimates that more than half a million children under 19 years of age suffer from asthma in this country today, and that more than 60% of these children will be admitted to hospitals because of asthma at some point in their lives (Health Canada, 1998; Statistics Canada, 1998).

Studies have demonstrated that children living in damp homes or homes with mould growth are more likely to develop respiratory problems, fatigue, headaches and central nervous symptoms (Etzel, 1999). A specific fungus, *Stachybotrys chartarum*, can produce very potent toxins that produce bleeding in the nose and windpipes of adults and bleeding in the deep lungs of infants. The fungus was implicated in an alarming outbreak of pulmonary hemorrhage (bleeding in the lungs) among 37 infants in Cleveland, Ohio, between 1993 and 1998 (Dorr, 1999). This fungus has been found in school portables in a number of cities in Ontario.

Diseases related to biological contaminants are responsible for a significant proportion of morbidity and mortality in North America. The United States Environmental Protection Agency (EPA) has estimated that more than 20,000 deaths and over 500,000 hospital visits per year result from biological contaminants of indoor air (EPA, 1992). One of the most studied biological contaminants is the bacteria, *Legionella pneumophilia*, responsible for Legionnaire's disease, which can be found in humidifiers and air conditioning units (TPH, 1994a).

2.5.3 Regulatory Framework

In Canada, there are currently no legal standards regulating the levels of indoor air pollutants for non-industrial workplaces or in residential and institutional buildings. A 1989 report prepared by Health Canada entitled *The Exposure Guidelines for Residential Indoor Air Quality,* provides a benchmark for evaluating residential indoor air quality with respect to 18 chemical air contaminants. The American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) has developed guidelines for ventilation requirements for residential, office, and institutional buildings. The current guidelines referred to as ASHRAE Standards are considered to be a reasonable protection by the Ontario Ministry of Labour and the Ministry of Housing.

Over 500 indoor air quality complaints were received by Toronto Public Health in 1998. This number represents a small fraction of the total number of indoor air quality concerns in Toronto because many go unreported or are reported to other government agencies.

3.0 WATER

3.1 Drinking Water – Biological Safety

Toronto's drinking water, which is drawn entirely from Lake Ontario, is treated in four water treatment plants run by the City, to ensure that it is free of biological contaminants. In 1995, the provincial government revised the Ontario Drinking Water Objectives (ODWOs) for biological quality to indicate that total coliform bacteria should not be present in consecutive samples, and that fecal coliform bacteria and/or E. coli should not be detected at all. In 1998, 100% of the 6,765 water samples collected from Toronto's drinking water complied with the province's ODWOs for biological quality (Works, 1999; TDHC, 1999).

The turbidity or cloudiness of water can reflect the presence of biological organisms such as plankton, as well as clay and silt. Highly turbid or cloudy water has been associated with the outbreak of illness such as Cryptosporidiosis in other locations (Works, 1999). For this reason, the turbidity of Toronto's drinking water is closely monitored. In 1997, the turbidity of Toronto's drinking water was maintained at 0.07 Nephelometric Turbidity Units (NTU), which is more than ten times lower than the provincial standard of 1 NTU (Works, 1999).

3.2 Drinking Water – Chemical Safety

Toronto's drinking water is tested by the City for 165 organic chemicals, including 17 by-products of disinfection, 36 inorganic chemicals, and 107 pesticides. According to Works & Emergency Services, with the exception of 12 of the disinfection by-products, none of the 165 organic chemicals were detected at levels exceeding the detection limit of the sampling method. Of the 36 inorganic chemicals tested at the plant, only one, aluminum, was measured at levels approaching the standard set. Of the 107 pesticides tested, only one, atrazine, was detected, and it was measured at levels (0.0001 mg/L) 50 times less than the provincial standard of 0.005 mg/L (Works, 1999).

3.2.1 Disinfection By-products

A number of disinfection by-products are produced when chlorine, which is used to kill potentially harmful biological organisms, reacts with organic material in water. Among the chemicals produced are a family called trihalomethanes (THMs) and a family called haloacetic acids (HCAs). While the City tests 17 chlorinated disinfection by-products, provincial standards have been set for only four of the THMs. In 1993, the Canadian drinking water quality guideline for total THMs was reduced from 350 parts per billion (ppb) to 100 ppb. A study released by Health Canada in 1995 suggested that 10 to 13% of all bladder and colon cancers in Ontario may be attributed to long-term exposure to chlorinated drinking water drawn from lakes and rivers. The increased cancer rates were observed where people were exposed to THM concentrations greater than 50 ppb for more than 35 years (Health Canada, 1995). THM levels in Toronto's water have been maintained consistently below 20 ppb for the last 10 years. In 1997, they averaged 13 ppb, well below the level at which cancer cases have been demonstrated (Works, 1999).

3.2.2 Aluminum

Aluminum is used in the water treatment process to help remove harmful biological organisms. Its use also reduces the formation of disinfection by-products such as THMs. While research findings to date are inconsistent, several studies have demonstrated a slight increase in the risk of Alzheimer's disease and dementia in communities where drinking water contains high concentrations of aluminum (Health Canada, 1999). While the Federal-Provincial Subcommittee on Drinking Water has not yet recommended a health-based guideline for aluminum, it has recommended that water treatment plants maintain residual aluminum levels below an Operational Guideline of 0.1 milligrams of aluminum per litre of water (mg/L) (Health Canada, 1999). Aluminum levels in Toronto's water have been reduced from an annual average of 0.108 mg/L in 1988 to an annual average of 0.077 mg/L in 1997 (Works, 1999).

3.2.3 Fluoride

Fluoride is added to drinking water to reduce the risk of dental cavities. Currently, fluoride levels are maintained at approximately 1.0 parts per million (ppm) (Works, 1999). The incidence of dental fluorosis (mottling of teeth) in children has increased in recent years, signaling an increase in excessive fluoride exposure (Brothwell, 1999). Given that fluoride has now been added to most toothpastes and that children inevitably swallow small amounts of toothpaste, Public Health is monitoring the situation to determine whether the level of fluoride in drinking water should be lowered in the future. The object is to maximize dental health benefits of water fluoridation while minimizing concerns regarding possible over-exposure (Basrur, 1998).

3.2.4 Lead

Drinking water can be contaminated with high levels of lead from lead supply lines or lead soldered pipes within homes and throughout the water distribution system. Lead based solder was used until 1989 to join copper pipes and can still be purchased for use by individuals today. In a survey of Toronto homes serviced by lead supply lines or using lead soldered pipes, lead levels averaged 28 ppb for water that had been standing in the pipes for more than eight hours. Lead levels in flushed water that had been in pipes for less than five hours were well below the 10 ppb guideline established by the provincial government (MTTU/SRCHC, 1995). One survey of Toronto residents suggests that approximately 40% do not flush their taps before drinking water (Campbell, 1996).

3.2.5 Radioactivity

Given the proximity of Ontario Hydro's nuclear plant in Pickering, it is possible that Toronto's drinking water could be affected by the accidental release of radioactive water (tritium) into Lake Ontario. Tritium is a cancer-causing agent that cannot be removed from water with conventional water treatment systems. In 1994, a water guideline of 7,000 becquerels per litre (Bq/L) was adopted for tritium on an interim basis by the provincial government as an annual average. However, in 1994, the Advisory Committee for Environmental Standards (ACES), a scientific body that reported to the Ontario Minister of Environment and Energy, indicated that the government proposed standard would allow 340 excess fatal cancers per million people exposed over a lifetime, and proposed instead an interim guideline of 100 Bq/L and the phasing in of a guideline of 20 Bq/L (ACES, 1994).

Generally, tritium levels in Toronto's drinking water are maintained between 8 and 12 Bq/L (Works, Data). Samples are collected every shift and reported as a weekly average. There have been occasional unintentional releases of tritium from the nuclear plant in Pickering. The last unintentional release was in 1992 when tritium levels peaked at 605 Bq/L at the F.J. Horgan water treatment plant in Scarborough and at 624 Bq/L at the R.C. Harris plant in the former City of Toronto (Metro Works, 1992).

3.3 Water — Persistent Toxics

The presence of toxic contaminants in the Great Lakes is a significant public health concern. Despite their great depth and size, the Great Lakes are vulnerable to toxic contaminants because they can remain in the system for many years. Many of these contaminants pose a serious threat because they are persistent and bioaccumulative, becoming more concentrated as they move up the food chain from plants to wildlife to people. More than 360 chemicals, about half of them organochlorine compounds, have been detected in the Great Lakes Basin. While this fact often raises concerns among residents about the quality of Toronto's drinking water, the route of greatest exposure to these chemicals is through the fish and other animals that inhabit the water.

3.3.1 Route of Exposure

For contaminants that are persistent and capable of accumulating in the food chain such as PCBs, DDT and mercury, food is the most significant route of exposure for humans. It has been estimated that 80-90% of human exposures to organochlorine compounds such as PCBs and DDT come from foods such as fish, while 36% of total mercury intake is from methyl mercury
which originates wholly from fish that assimilate inorganic mercury from the environment (Health Canada, 1997).
Consumption restrictions, based on the levels of chemical contaminants, apply to 9 out of 13 species of fish caught on Toronto's waterfront and to 4 out of 6 species of fish caught offshore from Toronto. In Lake Ontario, PCBs, mirex, mercury and dioxins are responsible for 50%, 27%, 22% and 1% respectively of restrictions placed on the consumption of fish by the provincial government (Ontario, 1997).

3.3.2 Health Effects

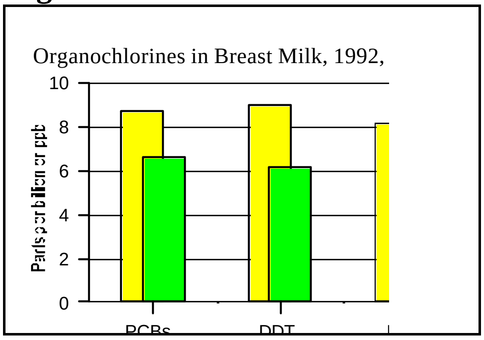
Current research indicates that organochlorine compounds such as PCBs, DDT and dioxins, and heavy metals such as mercury, cadmium and lead, can affect the immune system resulting in decreased resistance to infections and chronic diseases such as cancer, or in an increase in allergic reactions. For example, one study of women who ate fish from the Great Lakes demonstrated that maternal PCB levels were associated with an increased incidence of infectious diseases in their infants (Health Canada, State, 1997; Environment Canada, SOLEC, 1994).

Studies also indicate that a number of these persistent substances can produce neurobehavioural effects in children exposed to low levels during pregnancy. A number of studies conducted on the children of women who have eaten fish from the Great Lakes suggest that low levels of chemicals such as DDT and PCBs can have a measurable effect on the intellectual ability, memory and behaviour of children exposed in the womb (Health Canada, 1997).

Toxicological studies have also demonstrated that a number of environmental pollutants including organochlorine compounds, pesticides, phthalates and alkyl phenol compounds, have the ability to mimic the female hormone estrogen. Wildlife research suggests that environmental contaminants that are capable of mimicing hormones such as estrogen could be responsible for the elevated levels of birth defects, reproductive disorders, behavioural abnormalities, thyroid disorders, and compromised immune systems observed in fish and wildlife around the world (Health Canada, 1997). Many of these health effects have now been reproduced in laboratory test animals using the suspected environmental contaminants (U.S. EPA 1997).

The estrogenic properties of organochlorine compounds have led to suggestions that hormone mediated cancers such as breast cancer may be linked to environmental exposures. Several human studies have compared the levels of organochlorine compounds in the bodies of women with breast cancer to the levels in women who do not have breast cancer. To date, the results of these studies have been contradictory; a few have demonstrated a positive association between breast cancer and organochlorine compounds, while others have not (TPH, 1996).

Figure 4



3.3.3 Indicator of Exposure

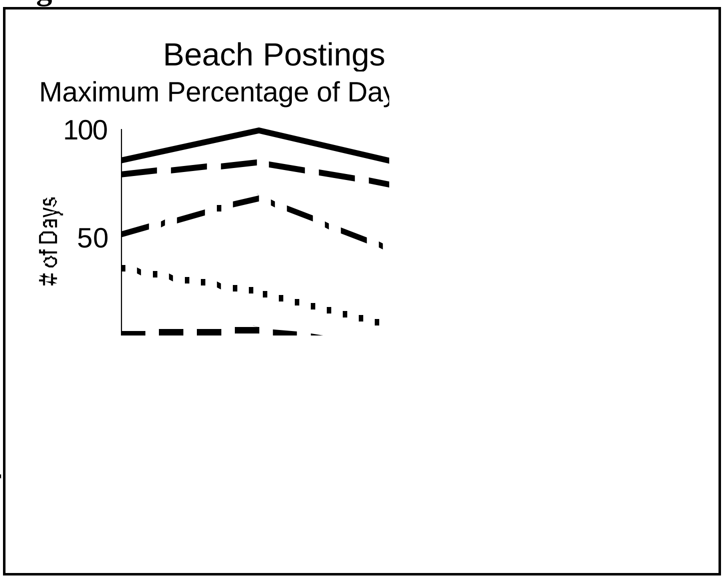
Human breast milk can be used as an indicator of exposure for those persistent substances that

are fat-soluble. Toronto residents, like others living around the Great Lakes, have on average slightly higher levels of organochlorine compounds in their bodies, than do other Ontario residents. This likely reflects greater fish consumption among many who live around the Great Lakes (see Figure 4).

In a City with food banks working beyond capacity, it is ironic that a high quality protein source that is available for free, must be eaten in limited quantities because the Great Lakes has become a sink for persistent toxics that have been released into the air, sprayed on agricultural lands, disposed improperly, or dumped into the Lake or sewer systems.

3.4 Water – For Recreation

Figure 5



Toronto's 20 beaches are commonly posted with signs indicating that people should not swim in the summer months when the water becomes contaminated with bacteria from run-off, over-flowing storm sewers, or sanitary sewers that have been historically connected to storm sewers. *E. coli*, a bacteria found in the excrement of both humans and animals, is used as an indicator of contamination. When *E.coli* is found in water samples at concentrations greater than 100 *E.coli* per 100 millilitres (ml) of water, the beaches are posted because swimming could lead to health effects such as skin rashes or gastro-intestinal illnesses.

Recreational water in Toronto is monitored jointly by Toronto Public Health and Works and Emergency Services from the end of May to Labour Day in September. Figure 5 indicates the maximum percentage of days that each group of beaches was posted with signs indicating that people should not swim, from 1994 to 1998. There are five groups of beaches; three in Etobicoke, four in the western part of the former City of Toronto, four in the eastern part of the former City of Toronto, seven in central Toronto, and two beaches in Scarborough (TPH, data; TDHC, 1999).

A storage tunnel is being built by the City to capture and treat the sewer over-flow that is considered responsible for much of the contamination in the west end of the former City of Toronto and the former City of Etobicoke. However, that tunnel will not be completed until the summer of 2000. Contamination at the eastern beaches has been greatly reduced since retention tanks were built in 1995 to handle sewer over-flow in the east end.

4.0 LAND

4.1 Contaminated Soil

Because Toronto has been industrialized for more than a hundred years, past industrial activities have contributed to soil pollution in some neighbourhoods. Historically, industrial processing, toxic storage, and waste handling were conducted in a way that air, soil and groundwater could become contaminated. Toxics such as benzene, toluene, xylene, gasoline, PCBs, polyaromatic hydrocarbons (PAHs) and lead can still be found in the ground today. These toxics can present a hazard to people who live, work or play at or around the contaminated site. Vapours from volatile toxics such as gasoline can travel through the soil and accumulate in buildings on or beside the contaminated site. Toxics such as lead can be ingested directly by children playing on the ground or indirectly by people eating food grown in contaminated soil.

Historical activities commonly associated with soil contamination include battery recycling, waste storage, electroplating, petroleum refining, gas stations, foundries, smelters, power plants, railway depots, electrical equipment manufacturing, tanneries and landfill sites (Campbell, 1996).

4.1.1 Lead

For toxics such as lead, soil can be a major source of exposure. Approximately half of the lead that enters a child's body is ingested from soil and dust (MOE, 1992). Soil has become contaminated with lead from three principle sources: emissions from vehicles operated on leaded fuel; emissions from local lead smelters; and dust from weathering leaded paint. An Ontario soil survey indicated that lead levels in soil averaged 500 ppm in old urban areas, 123 ppm in urban areas, 73 ppm in small towns, and 35 ppm in rural areas (MTTU/SRCHC, 1995)

The Ministries of Health and Environment have conducted a number of blood-lead surveys of school aged children in two Toronto neighbourhoods surrounding secondary lead smelters. Between 1984 and 1990, the average blood-lead levels declined from 12 micrograms per decilitre (ug/dL) to 3.6 ug/dL (MTTU/SRCHC, 1995). This decline likely reflects a combination of factors including the elimination of leaded gasoline, a substantial reduction in production at the nearby lead smelters, and removal of contaminated soil from properties in one of the areas. Despite these declines, lead remains a public health concern because recent studies demonstrate adverse intellectual and behavioural effects in children with blood-lead levels ranging between 2 and 15 ug/dL (Health Canada, 1997).

The Ministry of Environment estimates that about 18,000 children or 4% of children 1 to 4 years of age in Ontario have blood lead levels at or above the reference level of 10 ug/dl (OMOEE, 1994). These children are being exposed to lead that is distributed in the home and community environment from past practices (Campbell, 1996). The age of housing is considered the single most important environmental marker of lead poisoning today. The interior and exterior surfaces of dwellings built before the 1950s were likely to be painted with lead based paints which can be released into and around the home in paint chips and dust (Bailey, 1994). It has been estimated that about 22% of the homes in Toronto were built before 1946, with a higher percentage in the former cities of Toronto (46%), East York (31%) and York (34%), and a lower percentage in the former cities of Etobicoke (10%), North York (5%), and Scarborough (4.5%) (Campbell, 1996).

4.1.2 PCBs

While PCBs have not been produced in Ontario for many years, they continue to present a public health concern today because of their persistence in the environment, ability to accumulate in the food chain, and demonstrated health effects (see Water section). Until recently, storage of PCBs in government approved sites, was the only option available for high level PCB wastes. Now that a number of destruction options are available, the provincial and federal governments are encouraging people to destroy PCB waste to minimize further release to the environment through accidental spills, leaks or fires. In 1997, there were approximately 23,000 tonnes of PCB waste stored in sites spread throughout Toronto (MOE, 1997).

4.2 Physical Agents

Some environmental exposures of concern to the community involve physical agents such as noise, electromagnetic fields (EMFs) associated with electrical power lines and appliances, radio towers, microwaves and cellular phones, and ionizing radiation emitted from radioactive materials such as radon.

4.2.1 Extra Low Frequency EMFs

For two decades, scientists have been conducting studies to determine if there is link between cancer and the extra low frequency range (ELF) of the electromagnetic field (EMF) that is associated with electrical power lines, wiring and appliances. Laboratory studies have demonstrated that the ELF EMF is capable of affecting cell proliferation, melatonin production, RNA transcription and other physiological changes, suggesting that it may be biological plausible for this range of the EMF to have carcinogenic properties. Many studies have been conducted on people exposed to the ELF EMF, particularly on electrical workers and people who live close to power lines, to determine if there is an

increased risk of cancer, particularly of childhood leukemia and brain cancer. The results of these studies have been inconsistent and contradictory; a number have demonstrated a link while many have not (TPH, 1993; NIH, 1998)
This field of research has been complicated by difficulties related to the measurement of the ELF EMF. Some of the inconsistencies in findings may be related to the fact that different studies are actually examining different kinds of exposures. In June 1998, the National Institute of Health in the United States released a report that concluded that the EMF surrounding power lines "should be regarded as a 'possible carcinogen' because a role in cancer could not be ruled out". In light of this scientific uncertainty, many jurisdictions, including the former City of Toronto, have adopted prudent avoidance policies. In Toronto, that policy was interpreted as advocating that exposure to electromagnetic fields be limited "where practical and feasible at little or no cost". (NIH, 1998; Toronto, 1993; Toronto, 1992).

4.2.2 Radio Frequency EMFs

In recent years, the community has expressed concerns about the radio frequency (RF) range of the electromagnetic field (EMF). This is the range associated with radio transmitters and cellular phone transmission towers. While a good deal is known about the thermal or heating effects of this range of the EMF, there is relatively little known about how long-term exposure to this range of the EMF could affect human health.

A number of studies have suggested that the RF range of the EMF may be associated with neurobehavioural effects such as insomnia or chronic health effects such as cancer, but the results of these studies have been inconsistent and contradictory (Repacholi, 1998). Some of the inconsistencies may be related to the widely varying frequencies included in the RF EMF. It includes frequencies ranging from 10 kilohertz to 300 gigahertz (Hitchcock, 1995).

A small number of studies have been conducted on communities living around radio transmitters but, once again, the results have been inconsistent, and complicated by the many risk factors such as socioeconomic status, which could affect the results. Fewer studies have been conducted on cellular phone transmission towers than have been conducted on radio towers. While the frequencies used for cellular phone transmissions are in the RF range of the EMF spectrum like those used for radio towers, the power of the EMF is much less than that emitted from radio towers (Hitchcock, 1995; Health Canada, 1998).

4.2.3 Noise

Within an urban environment, noise can originate from many sources such as cars, trucks and construction equipment on nearby roads, overhead airplanes, pets on neighbouring properties, and stereos, air conditioners, lawn mowers, and leaf blowers being used by one's neighbours. Noise is often defined as an undesired sound and can be characterized by its frequency (ie. high or low tone), intensity (ie. loudness), continuity (ie. constant or intermittent), and duration. The cause and effect relationship between noise and hearing loss has been well recognized for many years. It is generally accepted that prolonged exposure to noise levels of 85 decibels or more can produce hearing loss in many individuals.

There is less consensus on the health effects associated with exposure to lower levels of noise that may be more commonly experienced in an urban environment. A working group struck to examine environmental noise, the Federal/Provincial Advisory Committee on Environmental and Occupational Health, has acknowledged that environmental noise is more than just a nuisance; that it can produce serious physical and psychological stress to which no one is immune. Noise-related health outcomes that may be induced or aggravated by stress include those on the cardiovascular system, immune system, sleep, task performance, behaviour, mental illness and psychiatric disorders (Health and Welfare Canada, 1989). Identifying the noise levels and patterns of exposure which represent a health risk to the community is a complicated task that must reflect individual variation in tolerance for noise and the psychological aspects that may be related to the source of noise.

In 1998, approximately 1300 noise complaints were investigated by the City of Toronto. The source of the complaints can be broken down into three broad categories; air conditioners, heating and ventilation; construction; and music (Andrew, 1999).

4.3 Pesticides

Pesticides are chemical products that are widely used to control pests that affect agricultural crops, homes, yards and gardens. These chemicals, which are classified for the kinds of pests they control include insecticides, herbicides, fungicides and rodenticides. Pesticides are one of the few toxic substances that we intentionally release into the environment. They are also one of the few toxic substances that are used in environments frequented by children.

4.3.1 Exposure

People can be exposed to pesticides used in homes, public buildings, gardens and public parks. People can also be exposed to pesticide residues on food products and in drinking water. (Some organochlorine pesticides, such as DDT, that were used historically in this country, and which continue to be used in other countries, are persistent in the environment and bioaccumulate in the food chain.)

Factory, farm and greenhouse workers involved in the manufacture and application of pesticides are at greatest risk for exposure. It is difficult to estimate exposure for the general population because of the many sources of exposure and the minute quantities involved. Children are uniquely vulnerable to the harmful effects of pesticides because of their physiological differences, developmental immaturity, and patterns of behaviour, including patterns of food and fluid intake. For example, one study demonstrated that children playing on the floor can inhale 4 to 6 times as much pesticide as an adult, and absorb through the skin, 30 times as much pesticide as an adult (Hoar Zahm, 1997).

Recent studies also suggest that pesticides can persist longer in the indoor environment than previously believed because there is no sunlight, rain or microbiological activity to speed their degradation. In one study, it was demonstrated that chlorpyrifos, an organophosphate pesticide used to treat cockroaches, continued to accumulate on children's toys and on hard surfaces for two weeks after apartments were sprayed with the pesticide (Davis & Ahmed, 1998). In another study, the phenoxy herbicide, 2,4-D, that is used to treat weeds, was found in carpets up to one year after the 2,4-D has been applied to the lawn (Nishioka, 1996).

4.3.2 Organophosphate Insecticides

The organophosphate pesticides are the class of pesticides most commonly used to kill pests such as cockroaches and grubs in homes, on lawns and in gardens. These pesticides can be acutely toxic with short-term exposures to high levels. These pesticides can affect a chemical messenger in the brain to produce health effects ranging from headaches and diarrhea to loss of consciousness and death. In the United States, 10,000 cases of organophosphate poisonings are reported each year. Most of these cases involve people occupationally exposed in the agricultural sector. A small number of cases involve children who have been exposed in homes that have been recently sprayed (Fenske, 1990).

Recent studies conducted on people occupationally exposed suggest that the organophosphate pesticides can produce measurable changes in motor skills, reflexes, memory, attention and behaviour. Animal studies suggest that these neuro-behavioural changes may be triggered at lower levels of exposure or worsened when pesticides are mixed with other chemicals and/or other pesticides (Echobichon, 1994; Keifer, 1997).

4.3.3 Phenoxy Herbicides

The phenoxy herbicides, such as 2,4-D and MCPA, are the pesticides most commonly used to control weeds on lawns. These herbicides are not very toxic with short-term exposure but long-term exposures have been associated with cancers, particularly non-Hodgkin's lymphoma, in a number of occupational studies. Because of the mixed exposures experienced by the people included in these studies, there is no consensus on the cancer-causing potential of individual herbicides such as 2,4-D and MCPA (Hoar Zahm, 1997; IOM, 1996; Kogevinas, 1997).

In 31 studies conducted on childhood cancer and pesticides between 1970 and 1996, childhood brain cancer and leukemia were the two cancers most frequently studied with fairly consistent and moderate increases in risk (Daniels, 1997). While these studies do not prove a relationship between childhood cancer and pesticides, they do suggest a link between parental exposure to pesticides before and during pregnancy with childhood cancer (Daniels, 1997). These findings are significant in light of the increasing incidence of childhood cancers, particularly leukemia and brain cancer, among Canadians. In children less than 15 years in age, childhood cancer has increased by about 25% in the last 25 years, with the highest rates among children who are less than 5 years of age (NCIC, 1995).

4.3.4 Quantities, Use and Environmental Impacts

It has been estimated that approximately 1.3 million kilograms of pesticides were applied by licensed applicators on lawns in urban areas in Ontario in 1993. This total does not include the amount applied personally by homeowners. The amount of pesticides used in urban areas represents about 25% or one quarter of all the pesticides used in Ontario for agricultural reasons (Struger, undated).

In 1998, the City of Toronto as a corporation used approximately: 1900 litres of herbicides on general parklands, sports fields, golf courses/bowling greens, and garden parks/horticulture; 1,690 litres of glyphosate in parks, sports fields and on roadsides; 567 litres of fungicides on golf courses/bowling greens; and about 60 kilograms of insecticides on trees, golf courses/bowling greens, and gardens. A strategy is being implemented to reduce pesticide use on City green spaces in 1999 in ways such as the following: herbicide application in general parklands, on sports fields and on road sides by 50%, 10% and 100% respectively; and glyphosate use in general parklands, on sports fields, and on roadsides by 50%, 10% and 10% respectively (Parks, 1999). The strategy also emphasizes the implementation of an Integrated Plant Health Care program which focuses on the use of alternative strategies to control pest populations to acceptable levels and the use of chemical intervention only as a last resort.

Sampling conducted in 1998 indicates that pesticides being used on lawns, gardens and agricultural crops in and around Toronto are entering the larger ecosystem. Six different pesticides were detected in either or both the Don and Humber Rivers in Toronto: atrazine, an herbicide commonly used with corn crops; metolachlor, an herbicide commonly used with soya crops; MCPP and 2,4-D, two herbicides used to control weeds on grass; cypermethrin, a synthetic pyrethrin insecticide used in gardens; and diazinon, an organophosphate insecticide used on lawns and gardens to controls pests such as grubs. While diazinon was detected at concentrations well below the Ontario Drinking Water Objectives established to protect human health, it was measured at levels (0.1 ug/L) which exceeded the Ontario Water Quality Objective (of 0.08 ug/litre) established to protect aquatic life. (Struger, 1999)

A 1990 survey of pesticide use in the former City of Toronto suggested that about one half of residents use some form of pest control in their homes. Of the 422 people interviewed, 21% and 18% respectively were having problems with cockroaches or ants. Cockroaches appeared to be a greater problem among those in apartments or rental situations while ants were largely associated with houses or owner-occupied dwellings. Mice were reported in 14% of apartments and 21% of houses, while rats were reported in 10% of townhouses, 5% of houses and 1% of apartments (Sly, 1991).

5.0 CONCLUSIONS

There is a substantial body of literature which suggests that a significant number of deaths, hospitalizations, and illnesses in Toronto can be attributed to poor air quality. The sources of Toronto’s air pollutants are many and varied. However, vehicles operating in the Greater Toronto Area and coal-fired generating stations operating in Ontario and in the United States are the most significant contributors. While the City must continue with the implementation of its Corporate Smog Reduction Strategy, it must work with, and advocate for, aggressive action from senior levels of government. Air emission caps for coal-fired plants in Ontario; provincial and federal funding for public transit and improved rail service in the Windsor-Montreal corridor; and international discussions on nitrogen oxide emissions from coal-fired plants in the United States; are all examples of the kind of action required.

While the human health links have not been so clearly documented for global climate change, we can predict that this environmental issue could have an even more profound effect on life on this planet than all the other environmental issue facing us. For this reason, it is essential that the City continue its ambitious campaign to reduce the release of greenhouse gases within the City of Toronto and that it continue to advocate for more aggressive actions from senior levels of government.

Indoor air quality is an area requiring greater attention from Public Health and the Corporation. Greater research needs to be directed at the risk factors in indoor environments, at the regulatory tools needed to respond to health concerns identified in the community, and at the policies needed to prevent future problems from developing.

There is a growing body of literature that demonstrates that human health can be affected by low level of exposure to persistent toxics which are accumulating in our food chain. As a city with food banks working beyond capacity, it is ironic that the fish in Lake Ontario, a high quality protein source that is readily available, must be eaten in limited quantities because they are contaminated with persistent toxics. The reclamation of this food source must be a priority in a strategy to move towards sustainable development. While it will take time to clear persistent toxics that have accumulated in Lake Ontario from historical practices, there are actions that can be taken to reduce and eliminate present and future releases of persistent pollutants. As a City, we have begun this process by incorporating a pollution prevention policy into the proposed Sewer Use By-law and by phasing out incineration at the Ashbridges Bay Sewage Treatment Plant.

While the causal relationship between pesticides and cancer remains uncertain, there is a growing body of health literature which suggests that there are reasons to reduce our use of, and reliance on, chemical pesticides. In recognition of this health concern, City Council has adopted a policy to phase out the use of pesticides on city-owned parks and green space, and has recognized the need for greater education of the public on both the hazards of, and alternatives to pesticides.

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