TORONTO AIR QUALITY INDEX HEALTH LINKS ANALYSIS

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EXECUTIVE SUMMARY

In May 2000, Toronto Public Health released the report *Air Pollution Burden of Illness in Toronto.* Using 1995 as its base year, this study estimated that each year about 1,000 Toronto residents die prematurely and another 5,500 are admitted to hospitals because of six smog-related air pollutants. In addition to these severe effects, air pollutants are associated with thousands of preventable visits to hospital emergency rooms, and increased symptoms of chronic bronchitis and asthma. Air pollution is also adding significant cost to the health care system. The Ontario Medical Association has estimated that air pollution costs Ontario residents more than one billion dollars each year in hospital admissions, emergency room visits and absenteeism.

Toronto Public Health seeks to increase awareness of the adverse impacts of air pollution on health so as to support and accelerate local air quality improvement initiatives, as well as influence federal and provincial policies and regulations that govern air emissions. Raising public awareness is the first step of a long-term strategy to encourage the community to adopt behaviours to improve the air.

In interactions with the community, it is apparent that a dichotomy exists regarding messaging to the public. On the one hand, studies by air quality experts across North America provide increasing evidence that communities with the greatest air pollution levels also experience the greatest rates of adverse health effects. On the other hand, communications tools such as the provincial Air Quality Index suggest that air quality is "Good" or "Very good" most of the time, implying that no known health effects are to be expected. Air quality is described as "Poor" only on those rare days when there is a severe air pollution episode that results in a "smog alert". In Toronto in 1995, there were only five "smog alert" episodes (or eight "smog alert" days, based on the City of Toronto definitions), and hence eight days with "Poor" air quality, yet this was the same year for which Toronto Public Health determined that air pollution was contributing to an estimated 1,000 premature deaths and 5,500 hospitalizations.

The purpose of this study is to examine whether the air quality classifications of the Ontario Air Quality Index (AQI) values appropriately reflect the state of air quality and associated burden of illness in Toronto. The AQI categories are "Very good" (AQI<16), "Good" (AQI=16-31), "Moderate" (AQI=32-49), "Poor" (AQI=50-99) and "Very poor" (AQI=100+).

The study demonstrates (see Tables S1, S2, S3 and S4) that, for the City of Toronto as a whole, more than an estimated 92% of the premature mortality and hospitalization occurs when the Air Quality Index is in the "Very good" or "Good" range. An estimated 8% of the burden of adverse health outcomes measured occurs when the air quality is in the "Moderate" or "Poor-Very poor" range. This does not mean that "Poor" air quality has little adverse health outcome, but rather that the breakpoints (which indicate the concentration range of a pollutant) used to classify the "Good" and "Very good" AQI categories do not always correspond with pollutant levels that do not cause adverse health impact. This study demonstrates that the air quality that is currently characterized by the AQI as "Very good" or "Good" is responsible for the major burden of adverse health effects in Toronto. The air pollution concentrations associated with the AQI values less than 32 ("Very good" or "Good" range) are all lower than their respective Ontario provincial criteria.

There are many more days of "regular" pollution than days of "smog alert" or pollution episodes. It is the many days, which have somewhat lower pollution levels but still impact human health that steadily create the large burden of ill health and premature mortality. In large urban areas transportation and electrical power generation from fuel combustion are the major sources of these pollutants. The current AQI system cannot always communicate air quality conditions that may have an impact on health.

The system needs to be modified to reflect more accurately our current understanding of the health and environmental impacts of air pollution.

Burden of air pollution-related illness in Toronto - 1995

The burden of air pollution-related illness (premature mortality, respiratory hospital admissions and cardiac hospital admissions) in Toronto in 1995 was classified according to year quarter, AQI category, and pollutant. The results from all six monitoring sites were summed to give the "Toronto" result shown here (the values may not add up exactly due to rounding).

The categories of **AQI** values are: ***Very good*** (<16); ***Good*** (16-31); ***Moderate*** (32-49); ***Poor*** (50-99); and ***Very poor*** (100+). ***"Poor"*** and ***"Very poor"*** categories have been included together (50+), as in 1995 there were no instances of the AQI exceeding 99.

<u>Abbreviations:</u>

CO	=	carbon monoxide	NO_2	=	nitrogen dioxide
O_3	=	ozone	PM_{10}	=	fine particulates smaller than 10 microns
SO_2	=	sulphur dioxide	SO_4	=	sulphate

Table S1. Premature Mortality Estimated for Each AQI Category

	January to March				April to June				July to September				October to December				January to December				
AQI	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	Total
O_3	1	2	0	0	4	18	1	0	5	24	2	0	0	1	0	0	10	45	3	0	59
NO_2	102	27	3	0	55	40	5	0	72	42	8	1	110	20	1	0	338	129	16	1	485
CO	83	29	5	0	56	47	5	1	45	28	6	1	107	18	1	0	291	122	17	1	431
SO_2	24	8	1	0	9	8	2	0	14	13	4	1	26	6	0	0	73	36	7	1	117
PM_{10}																	132	94	0	0	226
SO_4																	66	53	0	0	120
All pol[1]	210	66	9	0	124	113	13	1	135	107	20	2	244	45	2	0	845	425	44	3	1317

[1] Includes PM_{10} but not SO_4.

Table S2. Respiratory Hospital Admissions Estimated for Each AQI Category

	January to March				April to June				July to September				October to December				January to December				
AQI	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	Total
O_3	4	6	0	0	14	61	5	0	15	80	7	0	2	5	0	0	34	151	12	0	198
NO_2	244	67	7	0	128	92	12	1	170	100	20	2	268	48	2	0	810	307	41	3	1161
CO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SO_2	34	12	2	0	15	13	3	0	19	18	5	1	38	8	1	0	106	50	11	1	169
PM_{10}																	321	235	0	0	556
SO_4																	93	78	0	0	171
All pol[1]	282	85	9	0	156	165	20	1	203	198	32	3	308	61	3	0	1271	744	65	5	2083

[1] Includes PM_{10} but not SO_4.

Table S3. Cardiac Hospital Admissions Estimated for Each AQI Category

	January to March				April to June				July to September				October to December				January to December				
AQI	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	Total
$O_{3(ave)}$ [1]	19	30	0	0	62	269	23	0	65	355	30	0	7	21	0	0	153	674	53	0	880
$O_{3(max)}$ [2]	0	32	16	0	0	147	151	55	0	107	247	96	1	14	14	0	1	300	428	151	880
NO_2	455	129	14	0	246	172	22	2	316	188	37	4	500	94	4	0	1518	582	78	6	2184
$CO_{(ave)}$ [1]	123	34	0	0	58	65	2	0	51	69	2	0	133	14	0	0	365	182	5	0	552
$CO_{(max)}$ [2]	35	97	26	0	2	89	28	6	7	61	46	8	54	79	13	0	98	326	113	14	552
SO_2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM_{10}																	464	346	0	0	81
SO_4																	92	79	0	0	171
All pol (ave) [1, 3]	597	192	15	0	365	506	48	2	432	612	69	4	641	129	4	0	2500	1784	136	6	4426
All pol (max) [1, 3]	490	258	56	0	248	408	201	63	323	355	330	108	555	188	31	0	2082	1554	619	171	4426

1 The ozone and carbon monoxide values were classified into specific AQI categories based on the daily average AQI values.
2 The ozone and carbon monoxide values were classified into specific AQI categories based on the daily maximum AQI values.
3 Includes PM_{10} but not SO_4.

Table S4. Summary of Burden of Air Pollution-Related Illness as Related to AQI Category in Toronto in 1995

	Estimated Number of Premature Mortality/Illness (%)				
AQI	<16	16-31	32-49	50+	Total
Premature Mortality	845 (64)	425 (32)	44 (3)	3 (<1)	1317 (100)
Respiratory Hospital Admission	1271 (61)	744 (36)	65 (3)	5 (<1)	2083 (100)
Cardiac Hospital Admission (ave) [1]	2500 (57)	1784 (40)	136 (3)	6 (<1)	4426 (100)
Cardiac Hospital Admission (max) [2]	2082 (47)	1554 (35)	619 (14)	171 (4)	4426 (100)

1 The ozone and carbon monoxide values were classified into specific AQI categories based on the daily average AQI values.
2 The ozone and carbon monoxide values were classified into specific AQI categories based on the daily maximum AQI values.

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1.0 INTRODUCTION

1.1 Background

In May 2000, Toronto Public Health released the report *Air Pollution Burden of Illness in Toronto* "APBIT" (APBIT 2000). Using 1995 as its base year, this study estimated that each year about 1,000 Toronto residents die prematurely and another 5,500 are admitted to hospital because of six smog-related air pollutants. In addition to these severe effects, air pollutants are associated with thousands of preventable visits to hospital emergency rooms, and increased symptoms of chronic bronchitis and asthma. Air pollution is also adding significant cost to the health care system. The Ontario Medical Association has estimated that air pollution costs Ontario residents more than one billion dollars each year in hospital admissions, emergency room visits and absenteeism (OMA 2000).

The six air pollutants examined in the *Air Pollution Burden of Illness in Toronto* study (APBIT, 2000) all have one thing in common. They are emitted when fossil energy sources such as coal, oil, natural gas, gasoline and diesel fuel are burned in cars, trucks, furnaces, electrical power generating stations and industrial processes (Environment Canada 1995, OMOE 1995). Within Toronto, the transportation sector is the largest contributor of air pollutants, however significant pollution levels also come from sources beyond Toronto, including power plants in Ontario and the United States.

Toronto Public Health seeks to increase awareness of the adverse impacts of air pollution on health so as to support and accelerate local air quality improvement initiatives, as well as influence federal and provincial policies and regulations that govern air emissions. Raising public awareness is the first step of a long-term strategy to encourage the community to adopt behaviours to improve the air. To this end, Toronto Public Health is developing a major social marketing campaign *20/20: The Way to Clean Air*. The goal of the campaign is to promote and enable the attainment of an individual and collective goal for reducing vehicle use and energy consumption by 20%. The campaign will act as a hub for collaboration and joint promotion by supporting existing air-related efforts in the Greater Toronto Area. It also aims to fill in programming gaps where needed with new tools and approaches to help the community shift to less-polluting practices.

1.2 Contradictory Messages

In interactions with the community, it is apparent that a dichotomy exists regarding messaging to the public. On the one hand, studies by air quality experts across North America provide increasing evidence that communities with the greatest air pollution levels also experience the greatest rates of air pollution-related adverse health effects. Furthermore, most major urban centres, such as Toronto, are known to have levels of air pollutants high enough to affect even healthy people, not just vulnerable individuals such as seniors, children and those with pre-existing respiratory and cardiac problems. On the other hand, communications tools such as the provincial Air Quality Index (AQI) (OMOE 2001, p. 25) suggest that air quality is "Good" or "Very good" most of the time, implying that no known health effects are to be expected (see Appendix 1 for provincial description of health impacts associated with AQI category). Air quality is described as "Poor" only on those rare days when there is a severe air pollution episode that results in what the province calls a "smog advisory" and the City of Toronto terms a "smog alert". In Toronto, there were only eight days in 1995 designated as "smog alert" days, and hence eight days with "Poor" air quality, yet this was the same year for which Toronto Public Health determined that air pollution was contributing to an estimated 1,000 premature deaths and 5,500 hospitalizations.

Shifting individual behaviour regarding vehicle use ("on the road") and energy use ("at home") is a very difficult undertaking. However, a key motivator for shifting individual behaviour is concern for one's health and that of others. The 20/20 campaign seeks to engage the public in activities that will reduce pollution emissions, improve air quality and thereby improve health for all. The AQI is an excellent vehicle for communicating the need for members of the public to take steps to protect their health during extreme pollution events, such as smog alerts, for example by staying indoors and not exercising vigorously outdoors. However, the current AQI system may have mislabelled pollution levels known to adversely affect health (particularly in vulnerable populations) as "Moderate" and "Good". As a result, it could actually hinder an otherwise engaged public from shifting its behaviour to less polluting practices all year long.

2.0 STUDY DESIGN

2.1 Objective

The purpose of this study is to examine whether the air quality classifications of the Ontario Air Quality Index (AQI) values appropriately reflect the state of air quality and associated burden of illness in Toronto.

2.2 Summary of Method

Our approach involves the calculation of the burden of illness for the total time when the AQI was in each of the following categories: "Very good", "Good", "Moderate", "Poor" and "Very poor". The calculation was conducted for each quarter of the year.

This project builds on the air quality and health effects data compiled for the base year 1995 used to conduct the *Air Pollution Burden of Illness in Toronto* study (APBIT 2000). The purpose of APBIT was to estimate the mortality and hospitalization (the "burden of illness") associated with common air pollutants in Toronto. In that study mortality and hospitalization estimates were calculated using data for four of the six criteria pollutants in the AQI: ozone (O_3), nitrogen dioxide (NO_2), carbon monoxide (CO) and sulphur dioxide (SO_2); as well as for the particulate pollutants represented by particles less than 10 microns in diameter (PM_{10}) and sulphate (SO_4). These pollutant species were selected because of their known adverse effects on community health, and because their unit incremental health risk (**Δ**H%) values were available from the literature. **Δ**H% describes the percentage of people with a given health outcome who experience that outcome because of exposure to one unit of an air pollutant. For example, the **Δ**H% for cardiac disease hospitalizations due to carbon monoxide is 1.69% per ppm CO. This means that every ppm of CO accounts for 1.69% of the total cardiac disease hospitalizations. Details of the data and the "burden of illness" method of calculation are given in APBIT and explained in Appendices 2 and 3 of this study.

Using atmospheric concentration data provided by the Ontario Ministry of the Environment (OMOE), an "effective daily concentration" (EDC) was calculated for individual pollutants for each AQI category. The health burden in Toronto was then estimated for each AQI category. These estimates were then used to evaluate the appropriateness of the AQI categories in reflecting the state of air quality and the associated burden of illness in Toronto, and their usefulness as a communication tool.

For the six monitoring sites used in APBIT, in addition to 1995 atmospheric concentration data for the individual pollutants, we obtained from the OMOE hourly data for the numeric value of the AQI, and the pollutant which has determined the AQI for that hour (we have referred to this as the "driver" pollutant). There are 8760 hours in a year. Since AQI is reported on an hourly basis, we have used all of the available hourly data from the 6 sites in the analysis. In the current study, calculations are based on the AQI break points which determine the categories used in the AQI (AQI<16, Very good; 16-31, Good; 32-49, Moderate; 50-99, Poor; and 100+, Very poor).

Three different methods of categorization and analysis have been used for three sets of pollutants: (i) the three gaseous pollutants NO_2, CO (for premature mortality) and SO_2; (ii) O_3 and CO (for cardiac hospital admissions); and (iii) PM_{10} and SO_4. This was necessary because the **Δ**H% for the three gaseous pollutants are based on daily (24-hr) average values; the **Δ**H% for ozone and CO-related cardiac hospital admissions are based on the daily 1-hr maximum; and the data for PM_{10} and SO_4 are available only on the basis of a 6-day rotation of daily 24-hour values.

The analysis as outlined above has been further subdivided into quarter years. However, for particulate pollutants, the data were insufficient to allow classification by both AQI category and quarter, and thus the particulate burden of illness was determined for the whole year, classified into AQI categories. "Quarter years" refers to Quarter 1 (January to March), Quarter 2 (April to June), Quarter 3 (July to September) and Quarter 4 (October to December).

3.0 METHOD

The methodology used in the study involves the estimation of air pollution burden of illness for the total time when the AQI value was in each category for one year in Toronto. The categories of AQI values are: “Very good” (<16), “Good” (16-31), “Moderate” (32-49), “Poor” (50-99) and “Very poor” (100+). Atmospheric concentration data were used to calculate an effective daily concentration (EDC) for each pollutant in each AQI category. Finally, the burden of illness (mortality and hospitalization) was estimated using Equation 1 for each AQI category.

Equation 1 $O = B \times \Delta H/100 \times P$

where
O = yearly number of outcomes due to the pollutant of interest only;
B = base outcome rate (per year, or per 365 days);
ΔH = change in percent health outcome, per unit of pollutant;
P = yearly average of daily (or 1-hr max.) pollutant concentration (APBIT 2000, p. 38).

3.1 Air Quality Index Categorization

3.1.1 Data Sources and Validity

There were six former municipalities that now make up the City of Toronto: Etobicoke, York, Toronto, East York, North York, and Scarborough. Data for the AQI and individual pollutant concentrations relevant to the 6 former municipalities were available from 6 sites: downtown Toronto (OMOE monitoring site # 31103), Scarborough (33003), North York (34020), Etobicoke west (35003), Etobicoke south (35033) and York (36030). In addition, particulate data (PM_{10} and SO_2) from “hi-vol” samplers running on the 6-day North American synoptic cycle were available from Toronto (31127), Scarborough (33127) and Etobicoke south (35127).

For gases in 1995, there were 2 air quality monitoring sites in Etobicoke, and 1 each in York, Toronto, North York and Scarborough. The data were used as follows:

Etobicoke; average of 2 Etobicoke sites
York; York site
Toronto; Toronto site
East York; York site
North York; North York site
Scarborough; Scarborough site.

For particles in 1995 there were air quality monitoring sites in Etobicoke, Toronto and Scarborough. The data were used as follows:

Etobicoke; Etobicoke site
York; Toronto site
Toronto; Toronto site
East York; Toronto site
North York; Scarborough site
Scarborough; Scarborough site

With these choices, we were able to assign populations to the closest available monitoring sites. This was most important for the gaseous pollutants CO, NO_2 and SO_2. For ozone and fine particles the assignments were still on the basis of the closest available site, but examination of the spatial distribution would suggest that this refinement was less necessary.

3.1.2 AQI and its Determinants

Table 1 shows the number of hours with valid AQI data at each AQI site. In a complete year, there are 2160 hours in the first quarter of the year, and 2184, 2208, and 2208 hours in the second, third and fourth quarters, respectively. For the most part, the data are complete. At the Scarborough site, in the second quarter, there were only 844 hours of valid data for NO_2.

Table 2 shows, for each of the 6 sites, by quarter, the number of hours each of the pollutant species was the "driver" pollutant responsible for determining the AQI, category: "Very good" (AQI<16), "Good" (AQI=16-31), "Moderate" (AQI=32-49), and "Poor" (AQI=50-99). The "Very poor" (AQI=100+) range was not encountered, and for the purposes of this report the "Poor" and "Very poor" ranges (AQI=50+) have been combined. It is important to recognize that a separate AQI is determined hourly for each site, so that there is no "City of Toronto" AQI. Thus the burden of illness related to AQI must be calculated on a site-specific basis. The calculations related to the six former municipalities was done in the same way as described in the APBIT report. Table 3 shows, for each of the 6 sites, by quarter, the proportion of the time that AQI values indicated "Very good", "Good" and "Moderate, Poor or Very poor" air quality. Table 2 also includes API, CO8 and COH data. These sub-indices are described in Section 4.1.1.

3.2 Calculating Average Effective Daily Concentration

3.2.1 Overview of EDC Calculation

The air quality burden of illness as determined in the "APBIT" Report of May 2000 was calculated from the base mortality or morbidity rate for the geographical area of interest (associated with each monitoring site), the "unit incremental health risk" (**Δ**H%) for each pollutant, and the "average effective daily concentration" (EDC) of each pollutant (APBIT 2000, p. 40).

In APBIT 2000, for all pollutants where the **Δ**H% was based on the 24-hr average concentration (with no threshold), the EDC was calculated by summing all daily 24-hr average concentrations for each of the 365 days in the year, and then dividing by 365 (with suitable adjustments for missing data). In this report, however, since the AQI is determined on an hourly basis, and since the "driver" pollutant for the AQI can change throughout a 24-hour day, on the whole (where data are available) it is not appropriate to categorize the EDC on a 24-hr basis, but rather on an hourly basis.

Since for a given area (say the former City of Toronto) the base health outcome rate for 1995 is known, and the unit incremental health risks have already been determined, all that is necessary is to determine the average effective daily concentration for a given circumstance, e.g., for a given pollutant, in a given quarter, when the AQI is within a certain category, say "Good".

3.2.2 Details of Data Management

Samples of the data file supplied by Ontario Ministry of the Environment (OMOE) are given in Tables 4 and 5. Table 4 shows AQI data for the first 7 days of 1995 at the downtown Toronto site. Table 5 shows the corresponding O_3 concentration data. Note that the files contain hourly data as columns in a line, or row, with each line or row representing a day's data. Two rows are used for a single day's AQI data.

The first task was to arrange the data for each site in columns, so that there were 8760 rows, each representing information for one hour at the site, each column indicating respectively the hour number (i.e., 1-8760), month, day and hour, AQI, driver pollutant, and then each pollutant (O_3, NO_2, SO_2, CO, COH). A variable was created to classify the AQI into the four categories, and was inserted into another column. These data were then broken into files corresponding to the 4 quarters of the year. For each site, for each quarter, data were selected according to the AQI category. The average concentration of a pollutant for the hours in a category was calculated, as well as the number of hours data were available in that category. The product of these two numbers is the pollutant "dose" (in "unit-hrs", e.g., ppb-hr). In order to express population exposure in terms of pollutant concentration on a 24-hour basis and averaged over one year, this number was divided by 24, and again by 365 to give the effective daily concentration for that quarter, for that category. The sum of the EDC values so obtained, for all categories and all quarters, for a given pollutant at a given site should be equal (if no data were missing) to the corresponding EDC value given in APBIT Table 6.1.

Table 6 lists these values. The far right column "Total" is the sum of the EDC values for all quarters, for all categories, for a given pollutant at a given site. This should be in fairly close agreement with the values given in APBIT Table 6.1 for CO 24-hr average, NO_2 24-hr average, SO_2 24-hr average, and O_3 24-hr average. The extent to which they differ depends on the amount of missing data, and the criteria OMOE uses for calculating daily averages when data are missing. All available data were used in the present calculations. If no data were missing, the two numbers should be in agreement. APBIT EDC values were based on OMOE daily averages, where 24-hr averages were used. Note that in Table 6, EDC values have been determined for ozone and coefficient of haze 24-hour averages, although neither of these were used for burden of illness calculations. Table 7 gives the final EDC table for the 6 pollutants used, including ozone.

For ozone, the unit incremental health risk coefficients used in the literature have been largely based on the daily maximum value. As in APBIT, to be conservative, a "background" level of 30 ppb was subtracted from each daily maximum O_3 value used to aggregate to the EDC (the "O_3 1-hr max thresh=30" value; see APBIT Section 6.2 for explanation.) Thus the O_3 24-hr average levels were not used to calculate the burden of illness. The actual EDC used was the "O_3 1-hr max thresh =30" value and is provided in Table 7.

In this study, *we initially decided to use the average of the daily AQI values to classify the ozone values into categories*. Since the maximum concentration is used to represent the whole day, for the sake of comparison, we have also used the *daily maximum of the hourly values of AQI* to classify the ozone data. Table 8 provides the EDC for ozone classified using both approaches. The total EDC value (labeled "all category - all year") based on the average daily AQI value is comparable to the "O_3 1 hr max thresh=30" value in APBIT (2000) Table 6.1. When data were aggregated using the daily maximum AQI values, a "shift" in the distribution of the estimated EDC towards higher AQI categories was observed.

The same problem arose when estimating the burden of illness represented by cardiac hospital admissions on the basis of exposure to carbon monoxide (CO). The dose metric required from the referenced study in the literature was the daily 1-hr maximum CO level. Table 9 provides the daily 1-hr maximum CO data classified by the two methods, similar to that in Table 8. Unlike O_3, no background concentration was subtracted from the CO data. Again the estimated EDC generally shifted towards higher AQI categories when data were aggregated using the daily maximum AQI values.

For particulates, as indicated above, data were only available at 3 sites, and represented 24-hr averages collected every 6 days. In 1995 there were 61 sampling days: data were available from Toronto for 55 days, and from Etobicoke and Scarborough for 58 days. In APBIT we assumed that the 24-hr values for PM_{10} (less the 5 $\mu g/m^3$ "threshold" or "background" level) and the SO_4 value represented the average value for the 6-day period, and calculated an EDC based on that assumption. In this report, we use the same method, but obtain the EDC by classifying the particulate measurement according to the *average AQI on the day of particulate measurement* (Table 10). For comparison purposes, we also carried out classification according to the *maximum AQI on the day of particulate measurement*, as shown in Table 10. As indicated above, the limited data allowed us only to classify the particulate-related burden of illness for the year as a whole, rather than for each quarter.

An explanation of the burden of illness estimation is provided in Appendix 2.

3.3 Burden of Illness Links to Air Quality Index

As has been indicated above, and described in APBIT (pp. 38-42), the three elements necessary to calculate the burden of illness for a geographically defined population are: (i) the base rate of the health outcome of interest (e.g., non-traumatic mortality per year); (ii) the unit incremental health risk (**Δ**H%) for the same health outcome associated with the pollutant (e.g., 0.08% increase in non-traumatic mortality per $\mu g/m^3$ PM_{10}); and (iii) the average Effective Daily Concentration (EDC) of the pollutant (e.g., of PM_{10}) for the area of interest. Since the base outcome rate and **Δ**H% are independent of the Air Quality Index, to link the burden of illness to the AQI it is sufficient to categorize the EDC for each geographic area based on the AQI values. Tables 7, 8 and 9 present the EDC values for each AQI category, and thus form the core of this report. For the gaseous pollutants O_3, NO_2, CO and SO_2, there were sufficient data to allow segregation by AQI category for each quarter year; for PM_{10} and SO_4, limited data permitted only classification by AQI category for the entire year.

Since the available unit incremental health risk (ΔH%) for cardiac hospitalizations associated with CO and O_3 are based on the daily 1-hr maximum concentration, it was necessary to use the same dose metric in the calculations. This need gave rise to a problem in deciding the best way to categorize the CO and O_3 daily 1-hr maximum data. In the summer, the daily 1-hr maximum O_3 concentration frequently coincides with the daily maximum AQI value. In the winter, however, this is less often the case as COH or API is frequently the driver of the AQI. In the case of CO, in the summer, the daily 1-hr maximum concentration is unrelated to the daily maximum AQI value. This is because CO concentrations are strongly correlated with nitrogen oxide (NO) concentrations as both pollutants are associated with emissions from the transportation sector in the urban environment. As CO concentration increases, so does NO concentration, and since NO scavenges O_3, one often sees a simultaneous reduction in O_3 concentration at the same location.

To estimate the number of cardiac hospital admissions in 1995 for each of the AQI categories, we have decided to classify O_3 and CO data using 2 methods. One approach classified the data using the daily average AQI values, and the other using the daily maximum AQI values.

Although the available unit incremental health risk (ΔH%) for O_3-related premature mortality and respiratory hospitalization are also based on the daily 1-hr maximum O_3 concentration, we have aggregated the O_3 data based on the daily AQI values only. Aggregation using the daily maximum AQI values would likely shift the distribution of ozone related burden from lower to higher AQI categories.

However, when compared to other air pollutants, O_3 contributes little (< 10%) to the total burden of premature mortality and respiratory hospitalization in Toronto (APBIT, 2000). As a result, one does not expect a significant shift in the distribution of the total burden when all pollutants are considered.

From the data given in Tables 7, 8 and 9, it was possible to determine the burden of premature mortality and illness for each AQI category for each former municipality for each quarter of the year. Following this, it was then possible to sum the burdens within each AQI category for all the geographical areas. It is important to recognize that since different air quality index values are applicable in the six different geographical areas, categorization had to be undertaken in each geographical area separately, and the burdens calculated. The burdens from the six localities within each AQI category were then summed in order to arrive at an overall classification of burden for the whole City of Toronto.

The detailed results for each locality are presented in Table 11 for premature mortality, Table 12 for respiratory hospitalization and Tables 13-14 for cardiac hospitalization. The summed burdens (by pollutant) for the whole City of Toronto, by AQI category and quarter year are given in Tables 15-18. These tables represent the "final results" of the study. It should be noted that the burden of illness associated with PM_{10}, but not SO_4, was considered in calculating the total burden for all pollutants since SO_4 is a significant component of PM_{10}.

4.0 RESULTS AND DISCUSSION

4.1 AQI Categorization

4.1.1 AQI Driver Pollutants and Sub-indices

Table 2 presents, for all 6 AQI monitoring sites in 1995, for each quarter year, the number of hours registered for each of the 4 categories: Very good (AQI<16), Good (AQI = 16-31), Moderate (AQI = 32-50), and Poor or Very poor (AQI = 50+). In 1995, no sites reported AQI values of 100 or greater (Very poor). In addition, the data are categorized further by the "driver" pollutant or sub-index, i.e., the pollutant or sub-index that determined the AQI for that hour.

Three sub-indices deserve comment: API, CO8 and COH. API represents the Air Pollution Index, a combination of data from the Coefficient of Haze (COH) measurement and SO_2. COH is used as a surrogate for Total Suspended Particulate (TSP), because it is available by telemetry on an hourly basis. Unfortunately COH bears a different relationship to TSP at different locations and must be locally "calibrated". API is important because it has regulatory force, and can lead to mandatory reductions in emissions from some specific industrial sources. The range of AQI values is numerically equal to the API.

The sub-index CO8 refers to the 8-hour running average of the hourly carbon monoxide (CO) concentrations. This has likely arisen because the biological half-life of CO in the body is approximately 8 hours, but recent studies of congestive heart failure in the elderly have not used this metric.

Coefficient of haze (COH) was selected as a measuring tool for particulate matter by Ontario provincial air pollution scientists when developing the Air Pollution Index in the late 1960s. It bears some resemblance to a British Standard Smoke measurement used at that time, and until very recently in the U.K. There is very little air pollution epidemiology that has used the COH as a measure, in part because it is very much influenced by the optical characteristics of the particles measured in a given locality. When measuring COH, the sample of air is drawn at low velocity through a strip of filter paper held stationary for a period of time (usually 1 hour), and a small blot of particles collects on the surface. The paper is advanced by a standard amount such that the degree to which the blot obscures the passage of light can be measured, and again the paper remains stationary for an hour. It should be obvious from this description that a given mass of black, "sooty" particles will register higher than the same mass of essentially transparent or whitish particles. SO_4, for example, consists usually of small, light-coloured particles, whereas diesel exhaust has darker carbonaceous particles. There is a renewed interest in COH, however, as an indicator of urban, transportation-related particles, and some epidemiological data may be forthcoming.

On examination of the data, because SO_2 levels in Toronto are much lower than the Ontario Ambient Air Quality Criterion (250 ppb 1-hr average), the sub-index based on SO_2 is always very low. Thus the API reflects primarily the COH. In Toronto, for example, in the first and fourth quarters, the API and COH taken together account for at least half of the hours; in the second and third quarters, ozone is predominant. This pattern is repeated to a greater or lesser degree at all other sites.

It should also be noted that NO_2, CO and SO_2 account for very few hours, and the AQI values for almost all of these hours are at the lowest (Very good) level. The provincial criteria for these pollutants rest on decades-old studies, the scientific basis of which is out-dated. For example, the SO_2 criterion has not been changed since its initial determination, based on a single scientific study from Holland in 1965. The NO_2 criterion has remained where it was, because new data on the direct health effects of NO_2, (distinct from its role as an ozone precursor) have not been taken into account.

4.1.2 1995 AQI Distribution

Table 3 shows the distribution among the AQI categories in 1995 at each monitoring site. The pattern is similar across the sites in each quarter. The distribution in the first quarter (January to March) is similar to that of the fourth quarter (October to December). Likewise, the second and third quarters have similar distributions. In the first and fourth quarters, the AQI is less than 16 approximately 80% of the time and between 16 and 31 close to 20% of the time. In the first and fourth quarters, the AQI rarely goes beyond 32 (up to 2% of the time). In the second and third quarters the distribution is different. The number of hours that the AQI reaches above 32 is substantially higher in the second and third quarters, but is still minimal (4% to 12%) compared to the number of hours that the AQI is less than 32. During the second and third quarters, the AQI is approximately equally distributed between AQI values of “less than 16” and “16 to 31”.

4.2 Average Effective Daily Concentration

Tables 6, 8, 9 and 10 give the results of the calculation and classification of the data from the 6 AQI sites and the 3 particle monitoring sites: the final results used for burden of illness calculations are given in Tables 7, 8 and 9. As was described in Section 3, the aggregated results, labelled “Total” in Tables 6 and 7, “all category-all year” in Tables 8 and 9 should be in general agreement with those given in Tables 6.1 and 6.2 of APBIT (p. 41). If there were no missing data, the two would be in perfect agreement. In APBIT, for the most part (except for O_3, CO and particles) EDC was calculated using the daily average values given by OMOE (e.g. Table 5 of this report, second column from the right). In the current report, EDC values were obtained from all hours within a given AQI category and quarter, and may include data from partial days.

Table 6 provides some information that is not ultimately used in the burden of illness calculations, in particular the EDC values of COH and non-threshold average O_3 data.

In this study, although the EDC of COH remains similar in all quarters, and among sites, the burden of COH is distributed mostly in the “Very good” category in the first and fourth quarters, but more equally between “Very good” and “Good” in the middle two quarters. There is very little EDC of COH in the “Poor” and “Very poor” categories. As described in Section 4.1.1, COH is not a good indicator of particulate matter. Also, no corresponding **Δ**H% value has been identified. Consequently the COH data were not used in the burden of illness calculations in this report.

There are two distinctions between the ozone EDC data in Table 6 and Table 7. In Table 6 the ozone data are derived from the *average of all hours in a given category*, categorized according to the AQI index value of the same hour of the measurement. In Table 7, the EDC is based on the *daily maximum* value for ozone, less a threshold value of 30 ppb, but categorized according to the *average AQI* for that day. The hourly AQI has a much larger distribution (range of values) than the daily average AQI, and thus there is a tendency for the daily average AQI to be biased to lower categories. Thus for ozone, in Table 7 there are no instances where the EDC is greater than zero in the “Poor” category, whereas in Table 6 at all sites, in the second and third quarters, there are significant values of EDC. The effect of this is to bias the ozone burden of illness towards the lower categories. However, since the threshold value of 30 ppb is subtracted from those values which otherwise might appear in the higher category, and the number of days in that category are so few, the quantitative effect on the distribution of burden of illness is likely to be small. The issue of how to deal with a "daily maximum hourly value" of ozone and how to relate it to the AQI is not so difficult in the middle two quarters, but becomes difficult in the first and last quarter. There is no "right answer".

A similar problem exists for the 6-day particulate data, which has been referred to above. The EDC was calculated from the data after having subtracted the 5 $\mu g/m^3$ background concentration from the observed values. As shown in Table 10, the distribution of EDC was determined on two bases: the maximum AQI on the day of measurement, and the average AQI on the day of measurement. The results are similar to those obtained for ozone, in that no values of EDC were observed greater than zero in the two higher categories of AQI when the 24-hr average AQI was used, but when the maximum daily AQI was the basis for classification, there were in all cases significant EDC values in the "Poor" category. Again, there is no "right" answer, but it is important to draw attention to the existence of this problem.

4.3 Burden of Illness Links to Air Quality Index

4.3.1 Comparability of Burden of Mortality and Hospitalization

Tables 11-14 provide, for each monitoring site, a detailed estimation of the burden of premature mortality, hospital admission for respiratory disease, and hospital admission for cardiac disease. The total burdens for the whole City of Toronto (sum of all monitoring sites) are given in Tables 15-18.

As for EDC, there should be a reasonable agreement between the aggregate values of burden of mortality and hospital admission as shown in Tables 15-18, and the estimates shown in APBIT (Table 7.1). For mortality (Table 15), the correspondence is almost exact for O_3, PM_{10} and SO_4. For NO_2, CO and SO_2 the numbers are within 5% of each other. In the case of NO_2 and CO, the aggregate number of outcomes in the present study is slightly smaller than that found previously, and we believe that this reflects the impact of missing data. From Table 1 we can see that the greatest number of missing data occurs for NO_2.

Since the EDC values are common to all calculations, the same observations can be made for both respiratory and cardiac hospital admissions as for non-traumatic mortality, with the exception of ozone-related cardiac hospital admissions. In APBIT (p. 44) we expressed considerable reservations about the high number of ozone-related cardiac hospital admissions. Part of the reason for this number was the ozone metric itself, which was a 12-hr "day" average with no threshold subtracted. This gave rise to a much higher EDC than the maximum daily value with a 30 ppb threshold. For example, for the former municipality of Toronto, the EDC was 6.9 ppb O_3 (this study, Table 7), compared with 19.9 ppb O_3 (APBIT, Table 6.1). In this study we chose to use the same ozone dose metric for cardiac hospital admission as for the other outcomes, yielding a lower figure for Toronto-wide ozone-related cardiac hospital admissions (i.e., 880 admissions [this study, Tables 17, 18] compared with 2155 [APBIT, Table 7.1]).

In the APBIT (2000) study, the 24-hr daily average CO concentration was mistakenly used in the calculation of CO-related cardiac hospital admissions. This error resulted in an underestimation of CO-related cardiac hospital admissions (274 admissions were estimated for the overall City of Toronto, while the correct figure should have been 552). The correct dose metric (daily 1-hr maximum) was used in the current report.

4.3.2 Choice of Unit Incremental Health Risk (ΔH%)

In the APBIT (2000) study, two approaches were taken, referred to as "The HAQI Approach", and "The Pollutant Mix Approach". The first approach is similar to that used in a previous estimation of burden of illness in Hamilton, Ontario (HAQI 1997) which uses **Δ**H% values from many studies, some, but not all of which are derived from limited multi-pollutant models. The second approach is based on a single paper by Burnett *et al.* (1999) which describes a multi-year study carried out in the same areas of Toronto as APBIT, and which used a comprehensive multi-pollutant statistical model. In general, the second approach yielded a smaller number of outcomes than the first, and the APBIT (2000) study concluded that these two might be regarded as higher and lower bounds of the estimates. For the purposes of the present study, we have used the first approach, with the understanding that the distribution of outcomes by AQI category would be the same for both, but the absolute numbers would be different.

4.4 Distribution of Burden of Mortality and Hospitalization

In the APBIT study (except for ozone-related cardiac hospital admissions), it was noted that the greatest burden of mortality and hospital admissions was related to NO_2, CO, PM_{10} and SO_2, all of which are associated with fossil-fuel combustion. Ozone, although important, was associated with a smaller burden. In the present study, as in APBIT (2000), it is apparent that the same general statement is true for all former municipalities of the City of Toronto, although some areas (such as downtown Toronto and Etobicoke south) have somewhat lower levels of ozone and somewhat greater levels of transportation-related short-range pollutants.

The distribution of burden of illness by AQI category is remarkably similar when comparing non-traumatic mortality and respiratory hospital admissions. For either of these health outcomes, (see Table 19), more than 95% of the burden of illness occurs when the AQI is less than 32. For cardiac hospital admissions, when ozone and CO daily 1-hr maximum data are categorized using the average AQI value on the day of measurement, again more than 95% of the burden of illness occurs when the AQI is less than 32. However, when these pollutants are categorized using the maximum AQI value on the day of measurement, the percentage of cardiac hospital admissions when AQI is less than 32 becomes 82%. When we used these estimates to calculate the overall percentage for the 3 health outcomes we found that 97% (in the first case) or 92% (in the second case) of the Toronto air pollution burden of illness occurs when the AQI is less than 32.

It can be argued that using the daily average AQI value to classify daily 1-hr maximum O_3 and CO data inappropriately assigns a lower AQI value to the data. However, it can also be argued that categorizing the data based on daily maximum AQI value inappropriately assigns a higher AQI value to the data than is likely to be representative. The most correct value would be the actual hourly AQI at the time the ozone or CO 1-hr maximum was observed in the 24-hour period. Although this kind of calculation is possible with the available data, it must be done separately for each site and for each pollutant, taking into account all of the hourly data. Since resources did not permit this level of detailed calculation, it would appear that categorization based on the daily average AQI value provides an estimate of the upper-bound of the percentage burden occurring at AQI below 32. Categorization using the daily maximum AQI value, on the other hand, provides an estimate of the lower-bound. In any event, it is clear that the largest burden of illness in Toronto occurs when the AQI value is less than 32, i.e., in the "Very Good" or "Good" range.

This study has demonstrated that, for the City of Toronto as a whole, more than 92% of the estimated premature non-traumatic mortality and hospitalization occurs when the Air Quality Index is in the "Very good" or "Good" range (see Table 19). The remaining 8% occurs when the air quality is in the "Moderate" or "Poor-Very poor" range. This does not mean that "Poor" air quality has little adverse health outcome, but rather that the breakpoints (which indicate the concentration range of a pollutant) used to classify the "Good" and "Very good" AQI categories do not always correspond with pollutant levels that do not cause adverse health impact. As a result, the AQI system was unable to communicate more than 90% of the time (see Table 3) air quality conditions associated with adverse health effects in 1995. It is these many days of somewhat lower pollution levels that steadily create the large burden of ill health and premature mortality that we observe. In large urban areas transportation and electric power generation from fuel combustion are the major sources of these pollutants.

When we calculated the average daily health outcome within each AQI category for 1995 (see Appendix 2 for details), we found no correlation between the AQI categories and the average daily individual health outcome (i.e. premature mortality, respiratory hospitalization and cardiac hospitalization). This lack of correlation suggests that the AQI system does not depict accurately the health risk associated with air quality. There are several possible reasons for this observation. The AQI is driven by a single pollutant, whereas we are calculating the burden of illness based on all six pollutants. The individual pollutant concentrations related to AQI values less than 32 ("Good-Very Good" range) are lower than their respective Ontario Ambient Air Quality criteria and the criteria for a number of the air pollutants were established more than a decade ago. More recent scientific findings have indicated that health effects occur at levels much lower than were recognized previously and below the current air quality criteria for these pollutants. As some important breakpoints in the AQI system are determined using the existing Ontario Ambient Air Quality Criteria (see Appendix 1), the AQI categories do not reflect current health information. A review of the provincial criteria needs to be conducted and any revision must take into consideration recent data on direct health effects of the pollutants. To make the system a better communication tool for the state of air quality, the AQI system needs to be modified to reflect more accurately our current understanding of the health and environmental impacts of air pollution.

5.0 CONCLUSIONS

5.1 The Air Quality Index (AQI) as reported at the 6 sites in Toronto shows only minor qualitative or quantitative differences between sites, on a yearly average basis.

5.2 For the AQI, there are much greater differences between quarters of the year at a given site than there are between sites; however the first and last ("winter") quarters are similar to each other, and the second and third ("summer") quarters are similar to each other. There are substantial differences between the "winter" and "summer" quarters.

5.3 In the first and last quarters, Coefficient of Haze (COH) either directly or as a component of the Air Pollution Index (API), is the major determinant of the AQI. In the second and third quarters, ozone is the dominant determinant, followed by COH and API. "Moderate" or "Poor" AQI category is more common in these quarters, but rare in the first and last quarters.

5.4 In the City of Toronto (all sites) the greatest burden of premature mortality and hospitalization is associated with directly emitted fossil fuel combustion products (NO_2, CO and SO_2, as well as some PM_{10}). Additional burden is associated with ozone and secondary particulates (particles such as SO_4 that are formed from substances released to the atmosphere).

5.5 For the City of Toronto as a whole, more than an estimated 92% of the premature mortality and hospitalization occurs when the Air Quality Index is in the "Very good" or "Good" range. An estimated 8% of the burden of adverse health outcomes estimated occur when the air quality is in the "Moderate" or "Poor-Very poor" range.

5.6 There are many more days of "regular" pollution than days of "smog alert" or pollution episodes. It is the many days which have lower pollution levels but still have an impact on health that steadily create the large burden of ill health and premature mortality. In large urban areas transportation and electric power generation from fuel combustion are the major sources of these pollutants.

5.7 Air pollution concentrations related to the AQI values less than 32 ("Very good" or "Good" range) are all lower than their respective Ontario provincial criteria. This indicates that over 92% of the air pollution-related burden of illness in Toronto takes place when air pollution levels are below the criterion (regulatory) level.

5.8 The current AQI system is not a very good indicator for the health impact of air quality.

6.0 RECOMMENDATIONS

6.1 A review of the provincial criteria for a number of the air pollutants needs to be conducted. Any revision must take into consideration recent data on direct health effects of the pollutants.

6.2 The current AQI system needs to be modified to reflect more accurately our current understanding of the health and environmental impacts of air pollution. For some pollutants, recent studies suggest the non-existence of a threshold for adverse effects and their occurrence at lower levels.

Table 1. Number of Hours with Valid AQI Data at AQI Sites in Toronto - 1995

	O_3	NO_2	SO_2	CO	COH	AQI
Toronto (Site #31103) (Hours valid data)						
January to March	2152	2151	2154	2144	2131	2160
April to June	2088	2051	2052	2052	2064	2102
July to September	2199	2201	2185	2186	2200	2208
October to December	2189	2185	2184	2166	2136	2018
Scarborough (Site #33003) (Hours valid data)						
January to March	2026	2084	2145	2144	2144	2160
April to June	2011	844	2003	2026	2037	2072
July to September	2168	2188	2158	2151	2186	2208
October to December	2137	2173	2153	2108	2175	2208
North York (Site #34020) (Hours valid data)						
January to March	2152	2154	2160	2153	2153	2160
April to June	2142	2156	2184	2145	2078	2184
July to September	2196	2201	2207	2204	2202	2208
October to December	2197	2201	2207	2206	2205	2208
Etobicoke West (Site #35003) (Hours valid data)						
January to March	2141	2137	2129	2143	2107	2160
April to June	2094	2115	2102	2106	2116	2184
July to September	2185	2193	2184	2187	2130	2208
October to December	2184	2182	2177	2178	2196	2208
Etobicoke South (Site #35033) (Hours valid data)						
January to March	2140	2137	2137	2138	2120	2160
April to June	1985	2009	2123	1993	1910	2184
July to September	2165	2183	2149	2139	2190	2208
October to December	2156	2161	2148	1925	2188	2208
York (Site #36030) (Hours valid data)						
January to March	2140	2143	2141	2144	2143	2160
April to June	2136	1828	2155	1979	2145	2184
July to September	2160	2144	2180	2182	1951	2208
October to December	1928	2101	2188	2186	2191	2208

Table 2. Number of Hours for which Each Pollutant was the "Driver" Pollutant Responsible for Determining AQI - 1995

AQI	January to March (Hours)					April to June (Hours)					July to September (Hours)					October to December (Hours)				
	<16	16-31	32-49	50+	Total	<16	16-31	32-49	50+	Total	<16	16-31	32-49	50+	Total	<16	16-31	32-49	50+	Total
Toronto (31103)																				
API	788	79	0	0	867	203	22	0	0	225	413	28	0	0	441	911	64	0	0	975
COH	246	71	8	0	325	151	46	0	0	197	157	48	9	0	214	302	73	0	0	375
CO8	0	0	0	0	0	1	0	0	0	1	14	0	0	0	14	2	0	0	0	2
NO_2	47	0	0	0	47	24	0	0	0	24	116	0	0	0	116	64	0	0	0	64
O_3	702	218	0	0	920	637	944	71	2	1654	571	720	123	8	1422	476	107	0	0	583
SO_2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					2159					2101					2207					1999
Scarborough (33003)																				
API	620	58	0	0	678	179	7	0	0	186	336	27	0	0	363	657	32	0	0	689
COH	260	49	11	0	320	172	32	2	0	206	243	54	6	0	303	241	26	3	0	270
CO8	5	0	0	0	5	13	0	0	0	13	6	0	0	0	6	114	0	0	0	114
NO_2	27	0	0	0	27	16	0	0	0	16	49	0	0	0	49	57	0	0	0	57
O_3	806	320	3	0	1129	443	996	182	22	1643	510	752	195	30	1487	845	200	7	0	1052
SO_2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					2159					2064					2208					2182
North York (34020)																				
API	550	113	0	0	663	228	5	0	0	233	359	68	0	0	427	680	145	0	0	825
COH	237	84	24	0	345	200	41	0	0	241	267	93	5	0	365	336	113	9	0	458
CO8	1	0	0	0	1	2	0	0	0	2	1	0	0	0	1	3	0	0	0	3
NO_2	4	0	0	0	4	26	0	0	0	26	5	0	0	0	5	5	0	0	0	5
O_3	552	585	10	0	1147	542	1017	110	13	1682	521	722	151	15	1409	567	348	2	0	917
SO_2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					2160					2184					2207					2208
Etobicoke West (35003)																				
API	519	78	0	0	597	285	10	0	0	295	428	29	0	0	457	684	41	0	0	725
COH	251	78	16	0	345	229	42	6	0	277	261	71	6	0	338	277	38	6	0	321
CO8	2	0	0	0	2	6	0	0	0	6	1	0	0	0	1	2	0	0	0	2
NO_2	80	0	0	0	80	71	0	0	0	71	61	0	0	0	61	70	0	0	0	70
O_3	758	370	5	0	1133	601	821	82	3	1507	545	677	110	14	1346	804	278	7	0	1089
SO_2	0	0	0	0	0	1	0	0	0	1	4	1	0	0	5	0	0	0	0	0
					2157					2157					2208					2207
Etobicoke South (35033)																				
API	803	71	5	0	879	313	17	0	0	330	496	49	0	0	545	1129	57	0	0	1186
COH	287	87	34	4	412	189	89	5	0	283	229	140	13	0	382	270	68	10	0	348
CO8	8	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO_2	28	0	0	0	28	74	0	0	0	74	31	0	0	0	31	26	0	0	0	26
O_3	630	199	4	0	833	461	743	144	13	1361	336	670	211	32	1249	533	102	12	0	647
SO_2	0	0	0	0	0	123	0	0	0	123	0	0	0	0	0	0	0	0	0	0
					2160					2171					2207					2207
York (36030)																				
API	619	89	0	0	708	234	20	0	0	254	338	43	0	0	381	796	67	0	0	863
COH	215	87	29	0	331	193	48	4	0	245	198	88	15	0	301	135	37	13	0	185
CO8	1	0	0	0	1	0	0	0	0	0	15	0	0	0	15	8	0	0	0	8
NO_2	66	0	0	0	66	102	11	0	0	113	135	0	0	0	135	314	12	0	0	326
O_3	700	352	1	0	1053	531	887	136	15	1569	465	694	187	26	1372	622	197	4	0	823
SO_2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					2159					2181					2204					2205

API Air Pollution Index.
COH Coefficient of Haze .
CO8 8-hour running average of hourly CO concentrations.

Table 3. Percentage of Total Hours in Each Quarter within Specific AQI Ranges - 1995

AQI	January to March (% of total hours)			April to June (% of total hours)			July to September (% of total hours)			October to December (% of total hours)		
	<16	16-31	>32	<16	16-31	>32	<16	16-31	>32	<16	16-31	>32
Toronto (31103)	83	17	0.4	48	48	3.5	58	36	6.3	88	12	0
Scarborough (33003)	81	20	0.6	40	50	10	52	38	10	88	12	0.5
North York (34020)	62	36	1.6	46	49	5.6	52	40	7.7	72	27	0.5
Etobicoke West (35003)	75	24	1	55	40	4.2	59	35	5.9	83	16	0.6
Etobicoke South (35033)	81	17	2	53	39	7.5	49	40	11.6	89	10	1
York (36030)	74	24	1.4	49	44	7.1	52	37	10.3	85	14	0.8

Tables 4 and 5: Samples of the Air Quality Data File Provided by OMOE

Table 4. Hourly AQI Data for First Seven Days in 1995 for Downtown Toronto Site

POLL	STN	YEAR	MON	DAY	HR1	HR2	HR3	HR4	HR5	HR6	HR7	HR8	HR9	HR10	HR11	HR12	HR13	HR14	HR15	HR16	HR17	HR18	HR19	HR20	HR21	HR22	HR23	HR24
250	31103	1995	1	1	12	12	12	13	13	13	14	15	15	15	15	15	15	14	14	13	13	13	13	13	12	12	12	11
251	31103	1995	1	1	API	API	API	API	API	API	API	COH	API	API	API	API	API	API	API	API	API	API	API	API	API	API	API	API
250	31103	1995	1	2	11	12	12	13	12	11	9	8	8	8	7	8	10	12	12	10	8	9	6	5	6	7	7	8
251	31103	1995	1	2	O_3	O_3	O_3	O_3	O_3	O_3	O_3	O_3	O_3	O_3	O_3	O_3	O_3	O_3	O_3	O_3	O_3	O_3	O_3	NO_2	O_3	O_3	O_3	O_3
250	31103	1995	1	3	10	9	8	7	8	7	7	6	6	6	5	7	7	7	7	6	8	6	7	8	7	7	7	7
251	31103	1995	1	3	O_3	O_3	O_3	O_3	O_3	O_3	O_3	COH	COH	COH	COH	O_3	O_3	O_3	O_3	API	COH	COH	O_3	O_3	O_3	API	API	API
250	31103	1995	1	4	10	7	8	8	12	14	13	8	7	8	10	14	14	6	19	6	8	6	6	6	8	6	7	8
251	31103	1995	1	4	O_3	O_3	O_3	O_3	O_3	O_3	O_3	O_3	API	O_3	O_3	O_3	O_3	API	O_3	API	O_3	COH	API	API	O_3	O_3	O_3	O_3
250	31103	1995	1	5	7	8	10	13	16	12	7	6	9	6	6	6	7	7	7	8	8	8	8	8	8	8	8	8
251	31103	1995	1	5	O_3	O_3	O_3	O_3	O_3	O_3	O_3	COH	COH	COH	COH	COH	O_3	O_3	API	API	API	API	API	API	API	API	API	API
250	31103	1995	1	6	9	8	8	9	9	9	9	9	9	9	9	10	10	10	10	9	12	12	11	14	11	11	12	12
251	31103	1995	1	6	O_3	O_3	API	API	API	API	API	API	API	API	API	API	API	API	API	API	COH	COH	COH	COH	COH	API	API	API
250	31103	1995	1	7	12	12	12	13	13	13	13	13	13	12	12	12	13	14	14	12	10	10	9	9	8	8	8	14
251	31103	1995	1	7	API	API	API	API	API	API	API	API	API	API	API	API	O_3	O_3	O_3	O_3	API	API	API	API	API	API	COH	COH

Table 5. Corresponding Hourly Ozone Data Provided by the OMOE (First Seven Days in 1995 for Downtown Toronto)

POLL	STN	YEAR	MON	DAY	HR1	HR2	HR3	HR4	HR5	HR6	HR7	HR8	HR9	HR10	HR11	HR12	HR13	HR14	HR15	HR16	HR17	HR18	HR19	HR20	HR21	HR22	HR23	HR24	DHRCNT	DAILY AVG	DAILY MAX
122	31103	1995	1	1	0	1	0	1	1	0	1	1	1	1	1	1	2	2	2	1	1	0	0	0	0	1	6	9	24	1.4	9
122	31103	1995	1	2	17	18	19	20	18	17	14	13	12	12	11	13	16	19	19	16	13	14	9	6	9	10	11	12	24	14.1	20
122	31103	1995	1	3	15	14	12	10	13	11	10	7	5	6	5	10	11	10	10	7	6	8	10	12	11	6	5	5	24	9.1	15
122	31103	1995	1	4	15	11	12	12	19	22	20	13	8	13	16	22	21		29		12	8	8	8	12	9	11	12	22	14.2	29
122	31103	1995	1	5	11	13	16	20	24	18	10	4	5	6	7	8	10	11	6	4	9	6	5	5	10	10	10	11	24	10.0	24
122	31103	1995	1	6	14	13	10	8	9	5	6	6	7	6	7	7	9	7	5	5	4	3	4	1	0	1	0	0	24	5.7	14
122	31103	1995	1	7	0	1	1	1	1	2	1	1	3	6	13	1	20	21	21	18	14	7	6	4	5	4	3	2	24	7.1	21

Table 6. Summary of "Effective Daily Concentrations"[1] for Each Pollutant at Each AQI Site

	Effective Daily Concentration[2] (based on average of total hours/quarter/category)																
	January to March				April to June				July to September				October to December				Total
AQI	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	
Toronto (31103)																	
O_3	1.98	0.78	0.00	0.00	1.60	3.63	0.50	0.02	1.63	2.84	0.86	0.09	1.82	0.39	0.00	0.00	16.14
COH	0.07	0.02	0.00	0.00	0.04	0.04	0.00	0.00	0.05	0.04	0.01	0.00	0.08	0.02	0.00	0.00	0.37
NO_2	6.08	1.45	0.08	0.00	3.58	2.86	0.23	0.00	4.45	2.61	0.52	0.02	6.20	1.00	0.00	0.00	29.08
CO	0.09	0.03	0.00	0.00	0.09	0.09	0.01	0.00	0.08	0.05	0.01	0.00	0.20	0.03	0.00	0.00	0.68
SO_2	0.61	0.19	0.01	0.00	0.11	0.20	0.02	0.00	0.50	0.46	0.12	0.01	0.65	0.18	0.00	0.00	3.06
Scarborough (33003)																	
O_3	1.96	1.13	0.02	0.00	1.12	3.92	1.26	0.22	1.35	3.00	1.37	0.31	1.97	0.73	0.04	0.00	18.39
COH	0.06	0.02	0.00	0.00	0.03	0.03	0.01	0.00	0.04	0.03	0.01	0.00	0.06	0.01	0.00	0.00	0.31
NO_2	4.92	1.22	0.13	0.00	1.02	1.13	0.27	0.05	3.34	1.83	0.40	0.07	5.44	0.66	0.04	0.00	20.50
CO	0.21	0.06	0.01	0.00	0.12	0.12	0.02	0.00	0.10	0.07	0.02	0.00	0.23	0.02	0.00	0.00	0.98
SO_2	0.68	0.19	0.03	0.00	0.43	0.36	0.10	0.02	0.28	0.27	0.11	0.03	0.78	0.11	0.01	0.00	3.38
North York (34020)																	
O_3	1.47	2.12	0.07	0.00	1.39	3.95	0.75	0.13	1.44	2.94	1.07	0.15	1.67	1.27	0.01	0.00	18.43
COH	0.06	0.03	0.01	0.00	0.04	0.03	0.00	0.00	0.05	0.05	0.01	0.00	0.07	0.03	0.00	0.00	0.38
NO_2	3.33	1.33	0.16	0.00	2.15	1.12	0.14	0.01	2.24	1.48	0.25	0.02	3.80	1.37	0.05	0.00	17.46
CO	0.11	0.05	0.01	0.00	0.07	0.04	0.00	0.00	0.05	0.04	0.01	0.00	0.11	0.04	0.00	0.00	0.53
SO_2	0.61	0.29	0.05	0.00	0.22	0.13	0.04	0.01	0.24	0.24	0.07	0.01	0.34	0.17	0.01	0.00	2.42
Etobicoke West (35003)																	
O_3	1.73	1.28	0.03	0.00	1.47	3.11	0.58	0.03	1.38	2.69	0.76	0.14	1.80	0.96	0.05	0.00	16.01
COH	0.06	0.03	0.00	0.00	0.04	0.03	0.01	0.00	0.05	0.03	0.01	0.00	0.06	0.01	0.00	0.00	0.32
NO_2	5.16	1.47	0.13	0.00	3.91	1.88	0.18	0.00	3.80	1.83	0.23	0.02	5.03	0.77	0.05	0.00	24.47
CO	0.18	0.07	0.01	0.00	0.12	0.07	0.00	0.00	0.07	0.03	0.00	0.00	0.19	0.03	0.00	0.00	0.78
SO_2	0.54	0.18	0.02	0.00	0.26	0.17	0.03	0.00	0.43	0.34	0.06	0.01	0.74	0.11	0.01	0.00	2.91
Etobicoke South (35033)																	
O_3	1.81	0.72	0.04	0.00	1.27	3.00	1.00	0.13	1.14	2.79	1.46	0.33	1.76	0.41	0.08	0.00	15.95
COH	0.07	0.02	0.01	0.00	0.04	0.04	0.01	0.00	0.05	0.05	0.01	0.00	0.08	0.02	0.00	0.00	0.41
NO_2	6.15	1.35	0.36	0.05	3.81	2.51	0.39	0.03	3.57	2.57	0.55	0.07	6.37	0.82	0.10	0.00	28.69
CO	0.24	0.06	0.01	0.00	0.12	0.10	0.02	0.00	0.06	0.04	0.01	0.00	0.14	0.02	0.00	0.00	0.81
SO_2	0.92	0.23	0.08	0.01	0.48	0.28	0.06	0.01	0.60	0.44	0.14	0.02	1.59	0.20	0.04	0.00	5.10
York (36030)																	
O_3	1.82	1.23	0.01	0.00	1.31	3.46	0.94	0.15	1.20	2.79	1.30	0.26	1.75	0.73	0.03	0.00	16.99
COH	0.06	0.03	0.01	0.00	0.04	0.03	0.01	0.00	0.04	0.03	0.01	0.00	0.06	0.02	0.00	0.00	0.33
NO_2	5.30	1.67	0.26	0.00	3.37	2.35	0.39	0.03	3.76	2.19	0.53	0.06	7.11	1.09	0.14	0.00	28.24
CO	0.21	0.09	0.02	0.00	0.10	0.07	0.02	0.00	0.11	0.07	0.02	0.00	0.23	0.04	0.01	0.00	0.99
SO_2	0.56	0.22	0.04	0.00	0.33	0.26	0.11	0.01	0.19	0.26	0.10	0.01	0.93	0.16	0.02	0.00	3.21

1 The EDC is expressed in terms of ppb for O_3, NO_2 and SO_2; ppm for CO; $(1000\ ft)^{-1}$ for COH.
2 The values may not add up exactly due to rounding.

Table 7. "Effective Daily Concentration"[1] as Determined for Each Pollutant for Each AQI Category at Each Monitoring Site

Effective Daily Concentration[2] (based on average of total hours/quarter/category)

AQI	January to March				April to June				July to September				October to December				All Year				Total
	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	
Toronto																					
O_3	0.1	0.0	0.0	0.0	0.6	2.3	0.0	0.0	0.7	2.8	0.2	0.0	0.0	0.1	0.0	0.0	1.4	5.2	0.2	0.0	6.84
NO_2	6.1	1.4	0.1	0.0	3.6	2.9	0.2	0.0	4.5	2.6	0.5	0.0	6.2	1.0	0.0	0.0	20.3	7.9	0.8	0.0	29.1
CO	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.7
SO_2	0.6	0.2	0.0	0.0	0.1	0.2	0.0	0.0	0.5	0.5	0.1	0.0	0.7	0.2	0.0	0.0	1.9	1.0	0.2	0.0	3.1
PM_{10}																	12.0	6.4			18.5
SO_4																	2.2	1.2			3.5
Scarborough																					
O_3	0.2	0.3	0.0	0.0	0.7	3.4	0.5	0.0	0.6	4.2	0.7	0.0	0.1	0.3	0.0	0.0	1.6	8.2	1.2	0.0	11.0
NO_2	4.9	1.2	0.1	0.0	1.0	1.1	0.3	0.0	3.3	1.8	0.4	0.1	5.4	0.7	0.0	0.0	14.7	4.8	0.8	0.1	20.5
CO	0.2	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.7	0.3	0.0	0.0	1.0
SO_2	0.7	0.2	0.0	0.0	0.4	0.4	0.1	0.0	0.3	0.3	0.1	0.0	0.8	0.1	0.0	0.0	2.2	0.9	0.2	0.1	3.4
PM_{10}																	7.4	7.3			14.7
SO_4																	1.4	1.7			3.0
North York																					
O_3	0.3	0.6	0.0	0.0	0.7	3.1	0.2	0.0	0.5	3.8	0.2	0.0	0.1	0.3	0.0	0.0	1.6	7.8	0.4	0.0	9.8
NO_2	3.3	1.3	0.2	0.0	2.2	1.1	0.1	0.0	2.2	1.5	0.2	0.0	3.8	1.4	0.0	0.0	11.5	5.3	0.6	0.0	17.5
CO	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.5
SO_2	0.6	0.3	0.0	0.0	0.2	0.1	0.0	0.0	0.2	0.2	0.1	0.0	0.3	0.2	0.0	0.0	1.4	0.8	0.2	0.0	2.4
PM_{10}																	7.4	7.3			14.7
SO_4																	1.4	1.7			3.0
Etobicoke West																					
O_3	0.3	0.4	0.0	0.0	0.7	2.2	0.1	0.0	1.1	3.3	0.0	0.0	0.2	0.3	0.0	0.0	2.3	6.2	0.1	0.0	8.6
NO_2	5.2	1.5	0.1	0.0	3.9	1.9	0.2	0.0	3.8	1.8	0.2	0.0	5.0	0.8	0.1	0.0	17.9	5.9	0.6	0.0	24.5
CO	0.2	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.6	0.2	0.0	0.0	0.8
SO_2	0.5	0.2	0.0	0.0	0.3	0.2	0.0	0.0	0.4	0.3	0.1	0.0	0.7	0.1	0.0	0.0	2.0	0.8	0.1	0.0	2.9
PM_{10}																					
SO_4																					
Etobicoke South																					
O_3	0.2	0.1	0.0	0.0	0.8	2.6	0.5	0.0	0.6	4.5	0.6	0.0	0.1	0.2	0.0	0.0	1.7	7.5	1.1	0.0	10.3
NO_2	6.1	1.3	0.4	0.0	3.8	2.5	0.4	0.0	3.6	2.6	0.5	0.1	6.4	0.8	0.1	0.0	19.9	7.3	1.4	0.1	28.7
CO	0.2	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.6	0.2	0.0	0.0	0.8
SO_2	0.9	0.2	0.1	0.0	0.5	0.3	0.1	0.0	0.6	0.4	0.1	0.0	1.6	0.2	0.0	0.0	3.6	1.2	0.3	0.0	5.1
PM_{10}																					
SO_4																					
Etobicoke																					
O_3	0.2	0.2	0.0	0.0	0.7	2.4	0.3	0.0	0.8	3.9	0.3	0.0	0.1	0.3	0.0	0.0	2.0	6.9	0.6	0.0	9.4
NO_2	5.7	1.4	0.2	0.0	3.9	2.2	0.3	0.0	3.7	2.2	0.4	0.0	5.7	0.8	0.1	0.0	18.9	6.6	1.0	0.1	26.6
CO	0.2	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.6	0.2	0.0	0.0	0.8
SO_2	0.7	0.2	0.1	0.0	0.4	0.2	0.0	0.0	0.5	0.4	0.1	0.0	1.2	0.2	0.0	0.0	2.8	1.0	0.2	0.0	4.0
PM_{10}																	10.6	8.3			18.9
SO_4																	1.9	1.6			3.5
York																					
O_3	0.2	0.2	0.0	0.0	0.6	2.9	0.3	0.0	0.8	4.3	0.2	0.0	0.1	0.2	0.0	0.0	1.7	7.7	0.5	0.0	9.9
NO_2	5.3	1.7	0.3	0.0	3.4	2.3	0.4	0.0	3.8	2.2	0.5	0.1	7.1	1.1	0.1	0.0	19.5	7.3	1.3	0.1	28.2
CO	0.2	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.6	0.3	0.1	0.0	1.0
SO_2	0.6	0.2	0.0	0.0	0.3	0.3	0.1	0.0	0.2	0.3	0.1	0.0	0.9	0.2	0.0	0.0	2.0	0.9	0.3	0.0	3.2
PM_{10}																	12.0	6.4			18.5
SO_4																	2.2	1.2			3.5
East York																					
O_3	0.2	0.2	0.0	0.0	0.6	2.9	0.3	0.0	0.8	4.3	0.2	0.0	0.1	0.2	0.0	0.0	1.7	7.7	0.5	0.0	9.9
NO_2	5.3	1.7	0.3	0.0	3.4	2.3	0.4	0.0	3.8	2.2	0.5	0.1	7.1	1.1	0.1	0.0	19.5	7.3	1.3	0.1	28.2
CO	0.2	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.6	0.3	0.1	0.0	1.0
SO_2	0.6	0.2	0.0	0.0	0.3	0.3	0.1	0.0	0.2	0.3	0.1	0.0	0.9	0.2	0.0	0.0	2.0	0.9	0.3	0.0	3.2
PM_{10}																	12.0	6.4			18.5
SO_4																	2.2	1.2			3.5

[1] The EDC is expressed in terms of ppb for O_3, NO_2 and SO_2; ppm for CO; µg/m³ for PM_{10} and SO_4.
For O_3, the EDC is based on daily maximum value, less the background level of 30 ppb.
For PM_{10} the EDC is based on the measured data, less the background level of 5 µg/m3.

[2] The values may not add up exactly due to rounding.

Table 8. Summary of "Effective Daily Concentrations" for Ozone Burden Above Background Levels[1]

Effective Daily Concentration[2] (ppb) Total Ozone Burden (30 ppb threshold)										
	Based on Daily Average AQI[3]					Based on Daily Maximum AQI[4]				
AQI	<16	16-31	32-49	50+	All Category	<16	16-31	32-49	50+	All Category
Toronto (31103)										
January to March	0.09	0.03	0.00	0.00	0.12	0.00	0.12	0.00	0.00	0.12
April to June	0.55	2.29	0.00	0.00	2.85	0.00	1.50	1.20	0.15	2.85
July to September	0.72	2.85	0.21	0.00	3.77	0.00	1.22	2.19	0.36	3.77
October to December	0.04	0.09	0.00	0.00	0.13	0.02	0.10	0.00	0.00	0.13
All Year	1.40	5.26	0.21	0.00	6.88	0.02	2.95	3.39	0.51	6.88
Scarborough (33003)										
January to March	0.17	0.31	0.00	0.00	0.48	0.00	0.33	0.15	0.00	0.48
April to June	0.68	3.46	0.52	0.00	4.67	0.00	1.38	2.11	1.18	4.67
July to September	0.66	4.34	0.69	0.00	5.69	0.00	1.03	2.88	1.78	5.69
October to December	0.09	0.30	0.00	0.00	0.39	0.00	0.15	0.24	0.00	0.39
All Year	1.61	8.41	1.22	0.00	11.24	0.00	2.89	5.39	2.96	11.24
North York (34020)										
January to March	0.29	0.64	0.00	0.00	0.93	0.00	0.61	0.33	0.00	0.93
April to June	0.68	3.06	0.18	0.00	3.92	0.00	1.97	1.41	0.55	3.92
July to September	0.55	3.85	0.21	0.00	4.61	0.00	1.22	2.58	0.81	4.61
October to December	0.06	0.27	0.00	0.00	0.33	0.00	0.16	0.17	0.00	0.33
All Year	1.58	7.82	0.39	0.00	9.78	0.00	3.95	4.48	1.35	9.78
Etobicoke West (35003)										
January to March	0.29	0.31	0.00	0.00	0.60	0.00	0.39	0.21	0.00	0.60
April to June	0.73	1.98	0.14	0.00	2.85	0.00	1.13	1.42	0.29	2.85
July to September	1.06	2.93	0.00	0.00	3.99	0.00	1.15	2.18	0.66	3.99
October to December	0.19	0.27	0.00	0.00	0.46	0.00	0.24	0.21	0.00	0.46
All Year	2.27	5.48	0.14	0.00	7.89	0.00	2.91	4.03	0.95	7.89
Etobicoke South (35033)										
January to March	0.20	0.12	0.04	0.00	0.37	0.00	0.09	0.23	0.04	0.37
April to June	0.78	2.63	0.52	0.00	3.93	0.00	1.16	2.10	0.67	3.93
July to September	0.65	4.58	0.56	0.00	5.79	0.00	0.85	3.38	1.56	5.79
October to December	0.08	0.24	0.00	0.00	0.32	0.00	0.08	0.24	0.00	0.32
All Year	1.71	7.58	1.12	0.00	10.41	0.00	2.18	5.95	2.28	10.41
Etobicoke (average)										
January to March	0.24	0.22	0.02	0.00	0.48	0.00	0.24	0.22	0.02	0.48
April to June	0.76	2.30	0.33	0.00	3.39	0.00	1.15	1.76	0.48	3.39
July to September	0.86	3.75	0.28	0.00	4.89	0.00	1.00	2.78	1.11	4.89
October to December	0.13	0.26	0.00	0.00	0.39	0.00	0.16	0.23	0.00	0.39
All Year	1.99	6.53	0.63	0.00	9.15	0.00	2.54	4.99	1.61	9.15
York (36030)										
January to March	0.18	0.23	0.00	0.00	0.41	0.00	0.27	0.14	0.00	0.41
April to June	0.60	2.94	0.33	0.00	3.86	0.00	1.42	1.77	0.67	3.86
July to September	0.80	4.34	0.16	0.00	5.31	0.00	1.02	2.90	1.39	5.31
October to December	0.13	0.21	0.00	0.00	0.33	0.00	0.23	0.11	0.00	0.33
All Year	1.71	7.72	0.48	0.00	9.91	0.00	2.94	4.92	2.06	9.91

1 The EDC was calculated based on the "0_3 1-hr max thresh=30" value.
2 The values may not add up exactly due to rounding.
3 The data are categorized using the daily average AQI values.
4 The data are categorized using the daily maximum AQI values.

Table 9. Summary of "Effective Daily Concentrations" for Carbon Monoxide[1]

	Effective Daily Concentration[2] (ppm)									
	based on daily average AQI[3]					based on daily maximum AQI[4]				
AQI	<16	16-31	32-49	50+	All Category	<16	16-31	32-49	50+	All Category
Toronto (31103)										
January to March	0.26	0.06	0.00	0.00	0.32	0.10	0.19	0.03	0.00	0.32
April to June	0.17	0.18	0.00	0.00	0.35	0.01	0.26	0.07	0.01	0.35
July to September	0.17	0.17	0.00	0.00	0.34	0.04	0.19	0.10	0.01	0.34
October to December	0.38	0.02	0.00	0.00	0.40	0.21	0.20	0.00	0.00	0.40
All Year	0.99	0.43	0.00	0.00	1.42	0.36	0.84	0.20	0.01	1.42
Scarborough (33003)										
January to March	0.42	0.10	0.00	0.00	0.51	0.13	0.30	0.08	0.00	0.51
April to June	0.17	0.23	0.01	0.00	0.42	0.00	0.27	0.12	0.03	0.42
July to September	0.13	0.22	0.02	0.00	0.37	0.01	0.16	0.16	0.04	0.37
October to December	0.40	0.03	0.00	0.00	0.43	0.23	0.16	0.04	0.00	0.43
All Year	1.12	0.58	0.03	0.00	1.72	0.37	0.88	0.40	0.07	1.72
North York (34020)										
January to March	0.30	0.13	0.00	0.00	0.44	0.05	0.31	0.08	0.00	0.44
April to June	0.12	0.17	0.00	0.00	0.29	0.01	0.23	0.04	0.01	0.29
July to September	0.10	0.18	0.00	0.00	0.28	0.01	0.16	0.10	0.02	0.28
October to December	0.33	0.05	0.00	0.00	0.38	0.04	0.31	0.04	0.00	0.38
All Year	0.85	0.53	0.01	0.00	1.39	0.10	1.00	0.26	0.03	1.39
Etobicoke West (35003)										
January to March	0.34	0.09	0.00	0.00	0.42	0.10	0.25	0.07	0.00	0.42
April to June	0.21	0.12	0.00	0.00	0.34	0.01	0.25	0.07	0.01	0.34
July to September	0.17	0.15	0.00	0.00	0.32	0.02	0.18	0.12	0.01	0.32
October to December	0.35	0.04	0.00	0.00	0.39	0.13	0.21	0.06	0.00	0.40
All Year	1.08	0.40	0.00	0.00	1.48	0.25	0.88	0.32	0.02	1.48
Etobicoke South (35033)										
January to March	0.46	0.05	0.01	0.00	0.52	0.18	0.25	0.08	0.01	0.51
April to June	0.19	0.18	0.01	0.00	0.38	0.00	0.23	0.12	0.02	0.38
July to September	0.14	0.16	0.01	0.00	0.31	0.01	0.14	0.12	0.03	0.31
October to December	0.34	0.04	0.00	0.00	0.38	0.17	0.15	0.06	0.00	0.38
All Year	1.13	0.42	0.03	0.00	1.58	0.36	0.78	0.38	0.06	1.58
Etobicoke (average)										
January to March	0.40	0.07	0.01	0.00	0.47	0.14	0.25	0.08	0.01	0.47
April to June	0.20	0.15	0.01	0.00	0.36	0.01	0.24	0.10	0.01	0.36
July to September	0.15	0.16	0.01	0.00	0.32	0.01	0.16	0.12	0.02	0.32
October to December	0.35	0.04	0.00	0.00	0.39	0.15	0.18	0.06	0.00	0.39
All Year	1.10	0.41	0.02	0.00	1.53	0.31	0.83	0.35	0.04	1.53
York (36030)										
January to March	0.44	0.12	0.00	0.00	0.57	0.10	0.34	0.13	0.00	0.57
April to June	0.16	0.19	0.02	0.00	0.37	0.00	0.25	0.09	0.03	0.37
July to September	0.19	0.28	0.01	0.00	0.48	0.02	0.21	0.21	0.04	0.48
October to December	0.46	0.06	0.00	0.00	0.52	0.19	0.24	0.09	0.00	0.52
All Year	1.26	0.65	0.02	0.00	1.93	0.31	1.04	0.51	0.07	1.93

[1] The EDC was calculated based on the daily 1-hr maximum concentrations.
[2] The values may not add up exactly due to rounding.
[3] The data are categorized using the daily average AQI values.
[4] The data are categorized using the daily maximum AQI values.

Table 10. Summary of "Effective Daily Concentrations" for Particulate Burden Above Background Concentration - 1995

AQI	Toronto (31127) Average[1]	Toronto (31127) Maximum[2]	Scarborough (33127) Average[1]	Scarborough (33127) Maximum[2]	Etobicoke South (35127) Average[1]	Etobicoke South (35127) Maximum[2]
	Effective Daily Concentration ($\mu g/m^3$) for the Whole Year (not separated by quarter)					
<16						
Count	39	18	35	12	40	14
PM_{10}	12.0	5.2	7.4	2.3	10.6	4.0
SO_4	2.2	1.0	1.4	0.6	1.9	0.8
16-31						
Count	16	33	23	36	18	31
PM_{10}	6.4	10.6	7.3	8.0	8.3	9.0
SO_4	1.2	1.9	1.7	1.4	1.6	1.5
32-49						
Count	0	3	0	7	0	11
PM_{10}		2.1		2.8		5.0
SO_4		0.5		0.7		1.1
50+						
Count	0	1	0	3	0	2
PM_{10}		0.5		1.7		0.9
SO_4		0.1		0.4		0.1
All Categories						
Count	55	55	58	58	58	58
PM_{10}	18.5	18.5	14.7	14.7	18.9	18.9
SO_4	3.5	3.5	3.0	3.0	3.5	3.5

[1] Based on average AQI on day of particulate measurement.
[2] Based on maximum AQI on day of particulate measurement.

Table 11. Estimated Premature Mortality[1] for Each Former Municipality, Quarter, AQI Category and Pollutant - 1995

AQI	January to March				April to June				July to September				October to December				All Year				Total
	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	
Toronto																					
O_3	0.2	0.1	0.0	0.0	1.4	5.9	0.0	0.0	1.8	7.3	0.5	0.0	0.1	0.2	0.0	0.0	3.6	13.5	0.5	0.0	18
NO_2	46.7	11.1	0.6	0.0	27.5	22.0	1.8	0.0	34.2	20.1	4.0	0.2	47.6	7.7	0.0	0.0	156.0	60.9	6.3	0.2	223
CO	21.2	6.9	0.8	0.0	20.5	19.3	1.5	0.1	18.0	10.2	1.9	0.2	45.3	6.7	0.0	0.0	104.9	43.2	4.2	0.2	153
SO_2	8.9	2.8	0.2	0.0	1.5	3.0	0.3	0.0	7.2	6.7	1.7	0.1	9.4	2.6	0.0	0.0	27.1	15.0	2.2	0.1	44
PM_{10}																	62.2	33.2	0.0	0.0	95
SO_4																	31.5	17.5	0.0	0.0	49
Scarborough																					
O_3	0.2	0.4	0.0	0.0	0.9	4.5	0.7	0.0	0.9	5.7	0.9	0.0	0.1	0.4	0.0	0.0	2.1	11.0	1.6	0.0	15
NO_2	19.5	4.8	0.5	0.0	4.0	4.5	1.1	0.2	13.2	7.2	1.6	0.3	21.6	2.6	0.1	0.0	58.4	19.2	3.3	0.5	81
CO	24.3	7.4	0.9	0.0	13.9	13.5	1.9	0.3	11.8	7.6	2.0	0.4	27.1	2.8	0.2	0.0	77.1	31.4	5.0	0.6	114
SO_2	5.1	1.4	0.2	0.0	3.2	2.7	0.7	0.1	2.1	2.0	0.8	0.2	5.8	0.8	0.1	0.0	16.3	6.9	1.8	0.4	25
PM_{10}																	19.8	19.5	0.0	0.0	39
SO_4																	9.9	12.2	0.0	0.0	22
North York																					
O_3	0.4	0.9	0.0	0.0	0.9	4.3	0.2	0.0	0.8	5.3	0.3	0.0	0.1	0.4	0.0	0.0	2.2	10.8	0.5	0.0	14
NO_2	13.8	5.5	0.7	0.0	8.9	4.6	0.6	0.0	9.3	6.1	1.0	0.1	15.7	5.7	0.2	0.0	47.6	21.9	2.5	0.1	72
CO	12.9	6.3	1.5	0.0	8.5	4.5	0.4	0.1	5.5	4.3	0.7	0.1	13.1	5.1	0.3	0.0	40.1	20.2	3.0	0.1	63
SO_2	4.7	2.2	0.4	0.0	1.7	1.0	0.3	0.0	1.9	1.9	0.5	0.1	2.7	1.3	0.1	0.0	10.9	6.5	1.3	0.2	19
PM_{10}																	20.6	20.3	0.0	0.0	41
SO_4																	10.3	12.7	0.0	0.0	23
Etobicoke																					
O_3	0.2	0.2	0.0	0.0	0.7	2.2	0.3	0.0	0.8	3.5	0.2	0.0	0.1	0.3	0.0	0.0	1.8	6.2	0.6	0.0	8
NO_2	15.1	3.8	0.7	0.1	10.3	5.9	0.8	0.0	9.9	5.9	1.0	0.1	15.2	2.1	0.2	0.0	50.5	17.6	2.7	0.2	71
CO	16.4	4.8	0.7	0.0	9.1	6.5	0.8	0.1	5.1	2.9	0.6	0.1	12.9	1.9	0.2	0.0	43.5	16.0	2.4	0.2	62
SO_2	3.7	1.0	0.3	0.0	1.9	1.1	0.2	0.0	2.6	2.0	0.5	0.1	5.9	0.8	0.1	0.0	14.1	5.0	1.1	0.1	20
PM_{10}																	19.1	14.9	0.0	0.0	34
SO_4																	9.3	7.9	0.0	0.0	17
York																					
O_3	0.0	0.0	0.0	0.0	0.1	0.5	0.1	0.0	0.1	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.4	0.1	0.0	2
NO_2	2.9	0.9	0.1	0.0	1.9	1.3	0.2	0.0	2.1	1.2	0.3	0.0	3.9	0.6	0.1	0.0	10.8	4.0	0.7	0.0	16
CO	3.5	1.5	0.3	0.0	1.6	1.2	0.2	0.0	1.8	1.2	0.3	0.0	3.7	0.7	0.1	0.0	10.5	4.5	1.0	0.1	16
SO_2	0.6	0.2	0.0	0.0	0.3	0.3	0.1	0.0	0.2	0.3	0.1	0.0	1.0	0.2	0.0	0.0	2.1	0.9	0.3	0.0	3
PM_{10}																	4.5	2.4	0.0	0.0	7
SO_4																	2.3	1.3	0.0	0.0	4
East York																					
O_3	0.0	0.1	0.0	0.0	0.2	0.8	0.1	0.0	0.2	1.1	0.0	0.0	0.0	0.1	0.0	0.0	0.4	2.0	0.1	0.0	3
NO_2	4.1	1.3	0.2	0.0	2.6	1.8	0.3	0.0	2.9	1.7	0.4	0.0	5.5	0.8	0.1	0.0	15.0	5.6	1.0	0.1	22
CO	4.8	2.0	0.4	0.0	2.2	1.6	0.3	0.0	2.4	1.6	0.5	0.0	5.2	1.0	0.2	0.0	14.5	6.3	1.4	0.1	22
SO_2	0.8	0.3	0.1	0.0	0.5	0.4	0.2	0.0	0.3	0.4	0.1	0.0	1.4	0.2	0.0	0.0	2.9	1.3	0.4	0.0	5
PM_{10}																	6.2	3.3	0.0	0.0	10
SO_4																	3.2	1.7	0.0	0.0	5
All[2]	210	66	9	0	124	113	13	1	135	107	20	2	244	45	2		845	425	44	3	1317

[1] The values may not add up exactly due to rounding.
[2] Includes PM_{10} but not SO_4.

Table 12. Estimated Respiratory Hospital Admissions[1] for Each Former Municipality, Quarter, AQI Category and Pollutant - 1995

AQI	January to March				April to June				July to September				October to December				All Year				Total
	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	
Toronto																					
O_3	0.5	0.2	0.0	0.0	3.3	13.7	0.0	0.0	4.3	17.0	1.3	0.0	0.2	0.5	0.0	0.0	8.4	31.4	1.3	0.0	41.1
NO_2	82.6	19.7	1.1	0.0	48.6	38.9	3.1	0.1	60.5	35.5	7.0	0.3	84.2	13.6	0.0	0.0	276.0	107.7	11.2	0.4	395.3
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SO_2	9.2	2.9	0.2	0.0	1.6	3.1	0.3	0.0	7.5	6.9	1.7	0.1	9.8	2.6	0.0	0.0	28.1	15.6	2.3	0.1	46.1
PM_{10}																	111.7	59.7	0.0	0.0	171.4
SO_4																	32.7	18.1	0.0	0.0	50.9
Scarborough																					
O_3	0.9	1.6	0.0	0.0	3.5	17.8	2.7	0.0	3.4	22.2	3.5	0.0	0.4	1.6	0.0	0.0	8.2	43.1	6.2	0.0	57.6
NO_2	58.4	14.4	1.5	0.0	12.1	13.5	3.2	0.6	39.6	21.7	4.7	0.8	64.6	7.8	0.4	0.0	174.7	57.3	9.8	1.4	243.2
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SO_2	9.0	2.4	0.4	0.0	5.6	4.7	1.3	0.2	3.7	3.5	1.4	0.4	10.2	1.5	0.1	0.0	28.5	12.1	3.2	0.7	44.5
PM_{10}																	60.2	59.2	0.0	0.0	119.4
SO_4																	17.4	21.4	0.0	0.0	38.8
North York																					
O_3	1.4	3.1	0.0	0.0	3.3	14.8	0.9	0.0	2.7	18.6	1.0	0.0	0.3	1.3	0.0	0.0	7.6	37.8	1.9	0.0	47.3
NO_2	36.5	14.6	1.7	0.0	23.6	12.2	1.5	0.1	24.5	16.2	2.7	0.3	41.6	15.0	0.5	0.0	126.2	58.1	6.5	0.4	191.1
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SO_2	7.4	3.5	0.6	0.0	2.6	1.6	0.5	0.1	2.9	3.0	0.8	0.2	4.1	2.1	0.1	0.0	17.0	10.1	2.0	0.2	29.3
PM_{10}																	55.5	54.6	0.0	0.0	110.2
SO_4																	16.0	19.7	0.0	0.0	35.8
Etobicoke																					
O_3	0.7	0.7	0.1	0.0	2.1	6.7	0.9	0.0	2.4	10.9	0.8	0.0	0.4	0.8	0.0	0.0	5.5	19.0	1.7	0.0	26.3
NO_2	35.6	8.9	1.6	0.2	24.3	13.8	1.8	0.1	23.2	13.8	2.5	0.3	35.9	5.0	0.5	0.0	118.9	41.5	6.3	0.5	167.2
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SO_2	5.1	1.4	0.4	0.0	2.6	1.6	0.3	0.0	3.6	2.7	0.7	0.1	8.1	1.1	0.2	0.0	19.4	6.8	1.5	0.2	27.9
PM_{10}																	45.6	35.6	0.0	0.0	81.2
SO_4																	12.8	11.0	0.0	0.0	23.7
York																					
O_3	0.3	0.3	0.0	0.0	0.9	4.2	0.5	0.0	1.2	6.3	0.2	0.0	0.2	0.3	0.0	0.0	2.5	11.2	0.7	0.0	14.3
NO_2	17.4	5.5	0.9	0.0	11.1	7.7	1.3	0.1	12.4	7.2	1.7	0.2	23.4	3.6	0.4	0.0	64.3	24.0	4.3	0.3	92.9
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SO_2	2.1	0.8	0.2	0.0	1.2	0.9	0.4	0.1	0.7	0.9	0.4	0.0	3.4	0.6	0.1	0.0	7.4	3.2	1.0	0.1	11.7
PM_{10}																	27.1	14.5	0.0	0.0	41.5
SO_4																	7.9	4.4	0.0	0.0	12.3
East York																					
O_3	0.2	0.3	0.0	0.0	0.7	3.3	0.4	0.0	0.9	4.8	0.2	0.0	0.1	0.2	0.0	0	1.9	8.6	0.5	0.0	11.1
NO_2	13.5	4.2	0.7	0.0	8.5	6.0	1.0	0.1	9.6	5.6	1.3	0.1	18.1	2.8	0.3	0	49.6	18.5	3.3	0.2	71.7
CO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0
SO_2	1.6	0.6	0.1	0.0	0.9	0.7	0.3	0.0	0.5	0.7	0.3	0.0	2.6	0.4	0.1	0	5.7	2.5	0.8	0.1	9.0
PM_{10}																	20.9	11.2	0.0	0.0	32.0
SO_4																	6.1	3.4	0.0	0.0	9.5
All[2]	282.3	85	9	0	156	165	20	1	203	198	32	3	308	61	3	0	1271	744	65	5	2083

[1] The values may not add up exactly due to rounding.
[2] Includes PM_{10} but not SO_4.

Table 13. Estimated Cardiac Hospital Admissions[1] for Each Former Municipality, Quarter, AQI Category and Pollutant Using Average AQI Values - 1995

	January to March				April to June				July to September				October to December				All Year				
AQI	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	Total
Toronto																					
O_3	2.2	0.8	0.0	0.0	13.3	55.0	0.0	0.0	17.2	68.2	5.1	0.0	1.0	2.1	0.0	0.0	34	126	5	0	165
NO_2	142.5	33.9	1.8	0.0	83.9	67.1	5.4	0.1	104.4	61.3	12.1	0.6	145.3	23.4	0.0	0.0	476	186	19	1	682
CO	23.6	5.5	0.0	0.0	15.6	15.9	0.0	0.0	15.1	15.6	0.2	0.0	34.5	1.7	0.0	0.0	89	39	0	0	128
SO_2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0
PM_{10}																	147	79	0	0	226
SO_4																	30	16	0	0	46
Scarborough																					
O_3	3.4	6.2	0.0	0.0	13.5	68.6	10.4	0.0	13.1	85.8	13.7	0.0	1.7	6.0	0.0	0.0	32	166	24	0	222
NO_2	95.3	23.5	2.5	0.0	19.7	21.9	5.2	0.9	64.6	35.4	7.7	1.4	105.3	12.7	0.7	0.0	285	93	16	2	397
CO	30.9	7.2	0.0	0.0	12.8	17.1	1.0	0.0	9.9	16.3	1.2	0.0	29.4	2.3	0.0	0.0	83	43	2	0	128
SO_2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0
PM_{10}																	75	74	0	0	149
SO_4																	15	18	0	0	33
North York																					
O_3	7.9	17.2	0.0	0.0	18.2	82.3	4.8	0.0	14.7	103.4	5.7	0.0	1.6	7.2	0.0	0.0	42	210	10	0	263
NO_2	87.6	35.0	4.1	0.0	56.6	29.3	3.7	0.3	58.9	38.9	6.5	0.6	99.8	36.1	1.2	0.0	303	139	16	1	459
CO	30.7	13.3	0.0	0.0	12.4	16.9	0.3	0.0	10.0	18.2	0.3	0.0	33.2	5.3	0.0	0.0	86	54	1	0	140
SO_2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0
PM_{10}																	102	100	0	0	202
SO_4																	20	25	0	0	45
Etobicoke																					
O_3	3.2	2.9	0.3	0.0	10.1	30.8	4.4	0.0	11.4	50.1	3.7	0.0	1.8	3.4	0.0	0.0	27	87	8	0	122
NO_2	73.8	18.4	3.2	0.3	50.4	28.6	3.8	0.2	48.1	28.7	5.1	0.6	74.4	10.4	1.0	0.0	247	86	13	1	347
CO	19.9	3.3	0.3	0.0	10.1	7.4	0.4	0.0	7.7	7.8	0.3	0.0	17.4	2.0	0.0	0.0	55	21	1	0	77
SO_2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0
PM_{10}																	72	57	0	0	129
SO_4																	14	12	0	0	26
York																					
O_3	1.0	1.4	0.0	0.0	3.5	17.0	1.9	0.0	4.7	25.2	0.9	0.0	0.7	1.2	0.0	0.0	10	45	3	0	58
NO_2	30.1	9.5	1.5	0.0	19.1	13.3	2.2	0.2	21.4	12.5	3.0	0.3	40.3	6.2	0.8	0.0	111	41	7	0	160
CO	9.7	2.7	0.0	0.0	3.6	4.1	0.4	0.0	4.2	6.1	0.2	0.0	10.0	1.3	0.0	0.0	27	14	1	0	42
SO_2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0
PM_{10}																	36	19	0	0	55
SO_4																	7	4	0	0	11
E. York																					
O_3	0.9	1.2	0.0	0.0	3.0	14.9	1.7	0.0	4.1	22.0	0.8	0.0	0.6	1.0	0.0	0.0	9	39	2	0	50
NO_2	26.2	8.3	1.3	0.0	16.7	11.6	1.9	0.2	18.6	10.9	2.6	0.3	35.2	5.4	0.7	0.0	97	36	6	0	140
CO	8.4	2.4	0.0	0.0	3.1	3.6	0.3	0.0	3.6	5.3	0.2	0.0	8.7	1.1	0.0	0.0	24	12	0	0	37
SO_2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0
PM_{10}																	31	17	0	0	48
SO_4																	6	3	0	0	10
Sum of All former municipalities																					
O_3	19	30	0	0	62	269	23	0	65	355	30	0	7	21	0	0	153	674	53	0	880
NO_2	455	129	14	0	246	172	22	2	316	188	37	4	500	94	4	0	1518	582	78	6	2184
CO	123	34	0	0	58	65	2	0	51	69	2	0	133	14	0	0	365	182	5	0	552
SO_2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM_{10}																	464	346	0	0	810
SO_4																	92	79	0	0	171
All[2]	597	192	15	0	365	506	48	2	432	612	69	4	641	129	4	0	2500	1784	136	6	4426

[1] The values may not add up exactly due to rounding.
For NO_2 and SO_2 the EDC was calculated using the average hourly ambient concentrations.
For CO and O_3, EDC was calculated using daily maximum ambient concentrations.
[2] Includes PM_{10} but not SO_4.

Table 14. Estimated Cardiac Hospital Admissions[1] for Each Municipality, Quarter, AQI Category and Pollutant Using Daily Maximum AQI Values[2] - 1995

	January to March				April to June				July to September				October to December				All Year				
AQI	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	Total
Toronto																					
O_3	0.0	3.0	0.0	0.0	0.0	36.0	28.7	3.6	0.0	29.3	52.4	8.7	0.6	2.5	0.0	0.0	1	71	81	12	165
NO_2	142.5	33.9	1.8	0.0	83.9	67.1	5.4	0.1	104.4	61.3	12.1	0.6	145.3	23.4	0.0	0.0	476	186	19	1	682
CO	9.2	17.4	2.5	0.0	0.7	23.6	6.4	0.7	4.0	17.1	9.4	0.5	18.6	17.6	0.0	0.0	32	76	18	1	128
SO_2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0
PM_{10}																	147	79	0	0	226
SO_4																	30	16	0	0	46
Scarborough																					
O_3	0.0	6.5	3.0	0.0	0.0	27.3	41.8	23.3	0.0	20.3	57.0	35.3	0.0	2.9	4.8	0.0	0	57	107	59	222
NO_2	95.3	23.5	2.5	0.0	19.7	21.9	5.2	0.9	64.6	35.4	7.7	1.4	105.3	12.7	0.7	0.0	285	93	16	2	397
CO	9.7	22.4	6.0	0.0	0.0	19.8	8.9	2.3	1.0	11.5	11.9	2.9	16.9	11.7	3.1	0.0	28	65	30	5	128
SO_2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0
PM_{10}																	75	74	0	0	149
SO_4																	15	18	0	0	33
North York																					
O_3	0.0	16.3	8.8	0.0	0.0	52.9	37.8	14.7	0.0	32.7	69.4	21.6	0.0	4.3	4.6	0.0	0	106	121	36	263
NO_2	87.6	35.0	4.1	0.0	56.6	29.3	3.7	0.3	58.9	38.9	6.5	0.6	99.8	36.1	1.2	0.0	303	139	16	1	459
CO	5.0	31.0	8.0	0.0	0.8	23.2	4.4	1.1	0.6	16.0	10.0	1.9	3.6	31.0	3.9	0.0	10	101	26	3	140
SO_2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0
PM_{10}																	102	100	0	0	202
SO_4																	20	25	0	0	45
Etobicoke																					
O_3	0.0	3.2	2.9	0.3	0.0	15.3	23.5	6.4	0.0	13.3	37.1	14.8	0.0	2.2	3.0	0.0	0	34	67	22	122
NO_2	73.8	18.4	3.2	0.3	50.4	28.6	3.8	0.2	48.1	28.7	5.1	0.6	74.4	10.4	1.0	0.0	247	86	13	1	347
CO	6.9	12.5	3.8	0.3	0.3	12.1	4.8	0.7	0.7	7.9	6.1	1.1	7.5	9.1	2.9	0.0	15	42	17	2	77
SO_2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0
PM_{10}																	72	57	0	0	129
SO_4																	14	12	0	0	26
York																					
O_3	0.0	1.6	0.8	0.0	0.0	8.3	10.3	3.9	0.0	5.9	16.8	8.1	0.0	1.3	0.6	0.0	0	17	29	12	58
NO_2	30.1	9.5	1.5	0.0	19.1	13.3	2.2	0.2	21.4	12.5	3.0	0.3	40.3	6.2	0.8	0.0	111	41	7	0	160
CO	2.2	7.3	2.8	0.0	0.1	5.5	1.9	0.6	0.4	4.5	4.5	1.0	4.1	5.2	1.9	0.0	7	23	11	2	42
SO_2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0
PM_{10}																	36	19	0	0	55
SO_4																	7	4	0	0	11
E. York																					
O_3	0.0	1.4	0.7	0.0	0.0	7.2	9.0	3.4	0.0	5.2	14.7	7.0	0.0	1.1	0.5	0.0	0	15	25	10	50
NO_2	26.2	8.3	1.3	0.0	16.7	11.6	1.9	0.2	18.6	10.9	2.6	0.3	35.2	5.4	0.7	0.0	97	36	6	0	140
CO	2.0	6.4	2.5	0.0	0.1	4.8	1.6	0.5	0.4	4.0	3.9	0.8	3.6	4.5	1.7	0.0	6	20	10	1	37
SO_2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0
PM_{10}																	31	17	0	0	48
SO_4																	6	3	0	0	10
All former municipalities																					
O_3	0	32	16	0	0	147	151	55	0	107	247	96	1	14	14	0	1	300	428	151	880
NO_2	455	129	14	0	246	172	22	2	316	188	37	4	500	94	4	0	1518	582	78	6	2184
CO	35	97	26	0	2	89	28	6	7	61	46	8	54	79	13	0	98	326	113	14	552
SO_2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM_{10}																	464	346	0	0	810
SO_4																	92	79	0	0	171
All[3]	490	258	56	1	248	408	201	63	323	355	330	108	555	188	31	0	2082	1554	619	171	4426

[1] The values may not add up exactly due to rounding.
- For NO_2 and SO_2, EDC was calculated using the average hourly ambient concentrations.
- For CO and O_3, EDC was calculated using daily maximum ambient concentrations.

[2] Daily maximum AQI values were used to classify O_3 and CO data into specific AQI categories. Daily average AQI values were used in the classification of NO_2, SO_2, PM_{10} and SO_4 data.

[3] Includes PM_{10} but not SO_4.

Tables 15, 16, 17 and 18: Summary of Burden of Air Pollution-Related Illness in Toronto in 1995

Table 15. Estimated Premature Mortality[1] for Toronto (Sum of All Former Municipalities), for Each Quarter, AQI Category and Pollutant

AQI	January to March				April to June				July to September				October to December				All Year				Total
	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	
O_3	1	2	0	0	4	18	1	0	5	24	2	0	0	1	0	0	10	45	3	0	59
NO_2	102	27	3	0	55	40	5	0	72	42	8	1	110	20	1	0	338	129	16	1	485
CO	83	29	5	0	56	47	5	1	45	28	6	1	107	18	1	0	291	122	17	1	431
SO_2	24	8	1	0	9	8	2	0	14	13	4	1	26	6	0	0	73	36	7	1	117
PM_{10}																	132	94	0	0	226
SO_4																	66	53	0	0	120
All pol[2]	210	66	9	0	124	113	13	1	135	107	20	2	244	45	2	0	845	425	44	3	1317

[1] The values may not add up exactly due to rounding.
[2] Includes PM_{10} but not SO_4.

Table 16. Estimated Respiratory Hospital Admissions[1] for Toronto (Sum of All Former Municipalities), for Each Quarter, AQI Category and Pollutant

AQI	January to March				April to June				July to September				October to December				All Year				Total
	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	
O_3	4	6	0	0	14	61	5	0	15	80	7	0	2	5	0	0	34	151	12	0	198
NO_2	244	67	7	0	128	92	12	1	170	100	20	2	268	48	2	0	810	307	41	3	1161
CO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SO_2	34	12	2	0	15	13	3	0	19	18	5	1	38	8	1	0	106	50	11	1	169
PM_{10}																	321	235	0	0	556
SO_4																	93	78	0	0	171
All pol[2]	282	85	9	0	156	165	20	1	203	198	32	3	308	61	3	0	1271	744	65	5	2083

[1] The values may not add up exactly due to rounding.
[2] Includes PM_{10} but not SO_4.

Table 17. Estimated Cardiac Hospital Admissions[1] for Toronto (Sum of All Former Municipalities), for Each Quarter, AQI Category and Pollutant Using Average AQI Values

AQI	January to March				April to June				July to September				October to December				All Year				Total
	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	
O_3	19	30	0	0	62	269	23	0	65	355	30	0	7	21	0	0	153	674	53	0	880
NO_2	455	129	14	0	246	172	22	2	316	188	37	4	500	94	4	0	1518	582	78	6	2184
CO	123	34	0	0	58	65	2	0	51	69	2	0	133	14	0	0	365	182	5	0	552
SO_2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM_{10}																	464	346	0	0	810
SO_4																	92	79	0	0	171
All Pol[2]	597	192	15	0	365	506	48	2	432	612	69	4	641	129	4	0	2500	1784	136	6	4426

[1] The values may not add up exactly due to rounding.
[2] Includes PM_{10} but not SO_4.

Table 18. Estimated Cardiac Hospital Admissions[1] for Toronto (Sum of All Former Municipalities), for Each Quarter, AQI Category and Pollutant Using Daily Maximum AQI Values[2]

	January to March				April to June				July to September				October to December				All Year				
AQI	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	<16	16-31	32-49	50+	Total
O_3	0	32	16	0	0	147	151	55	0	107	247	96	1	14	14	0	1	300	428	151	880
NO_2	455	129	14	0	246	172	22	2	316	188	37	4	500	94	4	0	1518	582	78	6	2184
CO	35	97	26	0	2	89	28	6	7	61	46	8	54	79	13	0	98	326	113	14	552
SO_2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM_{10}																	464	346	0	0	810
SO_4																	92	79	0	0	171
All Pol[3]	490	258	56	1	248	408	201	63	323	355	330	108	555	188	31	0	2082	1554	619	171	4426

1 The values may not add up exactly due to rounding.
2 Daily maximum AQI values were used to classify O_3 and CO data into specific AQI categories. NO_2, SO_2, PM_{10} and SO_4 data were classified based on the daily average AQI values.
3 Includes PM_{10} but not SO_4.

Table 19. Summary of Burden of Air Pollution-Related Illness as Related to AQI Category in Toronto in 1995

	Estimated Number of Premature Mortality/Illness[1] (%)				
AQI	<16	16-31	32-49	50+	Total
Premature Mortality	845 (64)	425 (32)	44 (3)	3 (<1)	1317 (100)
Respiratory Hospital Admission	1271 (61)	744 (36)	65 (3)	5 (<1)	2083 (100)
Cardiac Hospital Admission (ave)[2]	2500 (57)	1784 (40)	136 (3)	6 (<1)	4426 (100)
Cardiac Hospital Admission (max)[3]	2082 (47)	1554 (35)	619 (14)	171 (4)	4426 (100)

1 The values may not add up exactly due to rounding.
2 The ozone and carbon monoxide values were allotted into specific AQI categories based on the daily average AQI values.
3 The ozone and carbon monoxide values were allotted into specific AQI categories based on the daily maximum AQI values.

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APPENDIX 1

ONTARIO AIR QUALITY INDEX

Table A-1. AQI Category and Breakpoints

AQI Category	Break Points Based on 1-Hour Pollutant Concentration (ppb)			
	CO	Ozone	SO_2	NO_2
Very good	< 12,000	< 23	< 164	< 104
Good	12,000 – 22,000	23 – 50	164 – 250	104 – 204
Moderate	23,000 – 30,000	51 – 80	251 – 340	205 – 254
Poor	31,000 – 49,000	81 – 149	341 – 1,999	255 – 524
Very poor	> 49,000	> 149	> 1,999	> 524

Source: OMOE, 2001 (shaded boxes show concentration ranges above the Ambient Air Quality Criteria).

Table A-2. Provincial Description of Health Impacts Associated with AQI Category

AQI Index	Category	CO	NO_2	O_3	SO_2	SP
0 – 15	Very Good	No known harmful effects.	No known harmful effects.	No known harmful effects.	No known harmful effects.	No known harmful effects.
16 – 31	Good	No known harmful effects.	Slight odour.	No known harmful effects.	Damages some vegetation in combination with ozone.	No known harmful effects.
32 – 49	Moderate	Blood chemistry changes but no noticeable impairment.	Odour.	Respiratory irritation in sensitive people during vigorous exercise; people with heart/lung disorders at some risk; damages very sensitive plants.	Damages some vegetation.	Some decrease in visibility.
50 – 99	Poor	Increased symptoms in smokers with heart disease.	Air smells and looks brown. Some increase in bronchial reactivity in people with asthma.	Sensitive people may experience irritation when breathing and possible lung damage when physically active; people with heart/lung disorders at greater risk; damage to some plants.	Odour; increasing vegetation damage.	Decreased visibility; soiling evident.

Source: OMOE, 2001.

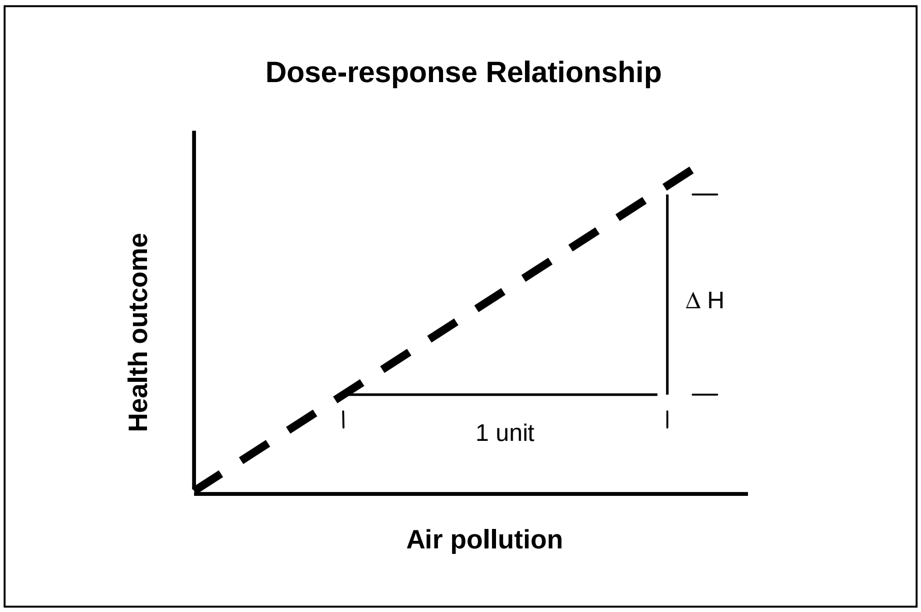
APPENDIX 2

BURDEN OF ILLNESS AND THE "EFFECTIVE DAILY CONCENTRATION"

Burden of Illness

Estimation of the burden of illness is a modelling exercise. Models may be used to analyze what has happened in the past, what is happening now, and what may happen in the future. The building or creation of a model involves observation of an object or event which exists or for which records exist from the past, and then constructing a model that consists of a mathematical function which best describes the original data. The model is then used in a predictive or analytic way to determine behaviour of the object or event in changed circumstances, making certain assumptions (the most usual being that the characteristics of the model itself remain unchanged, even if its environment has changed).

Figure A1



In air pollution epidemiology, observations are made about one or a number of health outcomes (mortality, hospital admissions, use of medications, etc.) and related to the level of air pollution, at the same time allowing for the effect of other variables which may influence the relationship (commonly referred to as "confounding variables"). The objective is usually to build a model in the form of a dose-response relationship. The simplest and most common form of such a relationship can be shown graphically (Figure A1) as a straight line: the greater the dose of pollution, the larger the outcome (more deaths, hospital admissions, doses of medication, etc.).

Examination of Figure A1 shows that there are three elements to the relationship: the *level of air pollution*, the *degree of health outcome*, and the *slope or steepness of the relationship*. The slope is the ratio of health outcome, represented by "ΔH", to air pollution levels. If ΔH represents 10 premature (non-traumatic or "medical") deaths per day, and 1 unit air pollution level represents 1 part per million (ppm) of CO averaged over 24 hours, then the slope would be 10 deaths per day per ppm CO (24-hr average). This would have been derived from a study which looked at a population of several million people, obtained mortality information from all the hospitals serving the population, and used air pollution information thought to be representative of air pollution to which the whole population was exposed. To make this information more relevant and useful, we would want to know the "average" or "base" level of non-traumatic deaths in this population per day, and express ΔH as a percent of the background level ($\Delta H\%$) and then the slope would be $\Delta H\%$ per unit of air pollution. In APBIT 2000 we referred to this as the "unit incremental health risk".

Application

It can be seen that if one knows any two of the three components of this relationship, one can calculate the third. In an epidemiological study, one knows the health outcomes; one knows the pollution levels, and thus one can determine the slope, using statistical techniques that may be quite complex.

To estimate the burden of illness from this model (in a sense, to "run the model backwards"), one needs to know the air pollution level, and the slope, and then one can calculate the percentage change in the health outcome (Equation 1). To make it applicable to a specific community, one then needs to know the base level of the health outcome, which, when multiplied by the percentage change gives an estimate of the actual number of outcomes attributed to air pollution (or burden of illness) in this community.

Equation 1 $O = B \times \Delta H/100 \times P$

where
- O = yearly number of outcomes due to the pollutant of interest only;
- B = base outcome rate (per year, or per 365 days);
- ΔH = change in percent health outcome, per unit of pollutant;
- P = yearly average of daily (or 1-hr max.) pollutant concentration (APBIT 2000, p. 38)

For burden of illness estimates, we thus need three pieces of information: the unit incremental health risk, the air pollution level, and the base outcome rate. The purpose of the APBIT study was to obtain the burden of illness for the period of one year, the year being 1995. Using the model as described above, one can estimate the burden of illness for each day of the year, and then add up the burdens for all 365 days to arrive at the yearly burden.

It should be understood that, once determined in an epidemiological study, the unit incremental health risk does not change from one day to the next. The base rate of health outcome (say, non-traumatic mortality) is determined on a yearly basis (16,615 deaths for Toronto in 1995, with a population of 2.37 million). Thus for the purposes of calculation the only variable which changes from one day to the next is the concentration of air pollution.

Effective Daily Concentration

For carbon monoxide, for example, the sum of all of the 24-hour (daily) average values for all 365 days, divided by 365 gives the average yearly concentration, or what we have referred to as the "Effective Daily Concentration" (EDC). This is complicated somewhat by the introduction of a threshold, and this is described in detail in APBIT (pp. 39-40) and will not be revisited here.

It would also be logical, if the data were available on an hourly basis, to determine the EDC by taking the sum of the 8760 hourly values, dividing by 24, and dividing by 365. If there were no missing data, this would give exactly the same result as the sum of the 365 24-hr average values divided by 365. Since the AQI is determined on an hourly basis, our first choice was to use the hourly summation in the present report.

Another way to view the EDC is as a "dose" of fixed concentration of air pollutant given over the whole year. As shown schematically in Figure A1, the greater the "dose", the greater the response. If one were to divide the year into quarters and if the air pollution remained constant throughout the whole year, 1/4 of the total air pollution dose would be delivered to the population in each quarter. However, examination of the data shows (especially for ozone) that a much greater dose of ozone is delivered in the middle quarters of the year than in the "end" quarters, and thus the burden of illness associated with ozone is greater in those quarters. The same observation is true if the EDC "dose" is divided according to the Air Quality Index. As described above, EDC was determined (except for ozone and particulates) using hourly data. The AQI value is known at each site on an hourly basis, so the EDC dose can be partitioned according to the AQI level at the hour of measurement.

Thus the sum of (for example) the hourly CO concentrations for all the hours when the AQI was less than 16 was determined at each site. This number, divided by 24 and by 365 gives the equivalent yearly dose of CO, when the AQI was less than 16. This same number, when multiplied by the unit incremental health risk and the base outcome rate gives the burden of illness (mortality) from CO during those hours when the AQI was less than 16.

To demonstrate the implications of this, let us take the example of carbon monoxide at the downtown Toronto site (see Table A-3). In the first quarter, there were 1769 hours when the AQI was below 16, but only 367 when the AQI was between 16 and 31. Although the average concentration of CO during the hours that AQI was below 16 was 0.47 ppm, the total dose was 831 ppm-hrs. When the AQI was between 16 and 31, the average CO concentration was much higher (0.74 ppm), but the total dose was much smaller (272 ppm-hrs) because there were far fewer hours when the highest CO levels occurred. It should be remembered, however, that the AQI is seldom driven by CO. This can be seen in the second quarter, where ozone is the dominant AQI determinant, and the average CO concentration when the AQI is less than 16 is actually greater than when the AQI lies between 16 and 31.

Thus the greatest portion of the total burden of illness (which depends on the dose of the pollutant) occurs when the AQI values are those commonly seen. There is no doubt that for a given pollutant the burden of illness increases with increasing dose or concentration. It must be remembered however, that the AQI represents only one pollutant at any given time, and does not reflect the true burden of illness from other pollutants that are also present.

Table A-3. Example Using CO To Illustrate How Total Dose Depends on Both Pollutant Level and Its Duration

AQI Category	<16	16-31	32-49	50+
January to March				
Average Concentration (ppm)	0.47	0.74	3.88	
Duration (hours)	1769	367	8	0
Total Dose (ppm-hours)	831	272	31	0
April to June				
Average Concentration (ppm)	0.81	0.76	0.81	1
Duration (hours)	988	992	70	2
Total Dose (ppm-hours)	800	754	57	2
July to September				
Average Concentration (ppm)	0.56	0.51	0.58	0.88
Duration (hours)	1259	789	130	8
Total Dose (ppm-hours)	705	402	75	7
October to December				
Average Concentration (ppm)	0.92	1.07		
Duration (hours)	1923	243	0	0
Total Dose (ppm-hours)	1769	260	0	0
All year – Total Dose (ppm-hours)	4106	1688	163	9

Association between AQI and Burden of Illness.

Table A-4 shows a lack of correlation between the weighted daily average burden of illness and the AQI categories. If the AQI accurately depicted the health risk associated with air quality, one would expect the AQI categories and the weighted daily average outcomes (mortality and hospital admissions) to be correlated. This correlation was not observed, and there are several possible reasons for this lack of correlation. The AQI is driven by a single pollutant, whereas all six air pollutants contributed significantly to the burden of illness. In addition, the breakpoints for the AQI categories are not set based on current health information. While this lack of correlation is expected given the factors listed above, these results again indicate that the AQI system should be adjusted to better reflect the true health impacts of air quality.

Table A-4. Estimated Burden of Illness for the Former City of Toronto

AQI Category	Air Pollution-related Premature Mortality	Respiratory Admissions	Cardiac Admissions	Duration (hours)	Duration (day-equivalents)	Weighted Average Daily Mortality (deaths/day)	Weighted Average Daily Respiratory Admissions	Weighted Average Daily Cardiac Admissions
<16	354	424	656	5825	242.7	1.46	1.75	2.70
16-31	166	214	412	2420	100.8	1.65	2.12	4.09
32-49	13	150	118	211	8.8	1.48	17.06	0.56
50+	1	0	14	10	0.4	2.40	0.00	1.40

APPENDIX 3

VALUES OF UNIT INCREMENTAL HEALTH RISK (ΔH%) USED IN THIS REPORT

Table A-5 is excerpted from APBIT (p. 17) and contains the ΔH% values used in this Health Links study. These values were compiled through a literature survey as part of the APBIT report.

Table A-5. Values of Unit Incremental Health Risk (ΔH%) Used in this Report

Pollutant	Non-traumatic Mortality	Respiratory Hospital Admissions	Cardiovascular Hospital Admissions
PM_{10} 24-hr average	0.08[1]	0.17[7]	0.23[12]
SO_4 24-hr average	0.22[2]	0.27[8]	0.25[13]
CO 1-hr maximum			1.69[14]
CO 24-hr average	3.48[3]		
NO_2 24-hr average	0.119[4]	0.249[9]	0.39[15]
SO_2 24-hr average	0.225[5]	0.276[10]	
O_3 1-hr maximum	0.04[6]	0.11[11]	0.452[16]

(1) NAAQO 1999a.
(2) Schwartz et al. 1996.
(3) See APBIT (2000), Section 4.1.1.
(4) See APBIT (2000), Section 4.2.1.
(5) See APBIT (2000), Section 4.3.2.
(6) NAAQO 1999b.
(7) NAAQO 1999a.
(8) NAAQO 1997.
(9) See APBIT (2000), Section 4.2.2.
(10) See APBIT (2000), Section 4.3.2.
(11) NAAQO 1999b.
(12) Burnett et al. 1997a.
(13) NAAQO 1997, Burnett et al. 1995.
(14) Schwartz 1997.
(15) Morgan et al. 1998.
(16) Burnett et al. 1997a.