

TORONTO STAFF REPORT

July 3, 2001

To: Board of Health

From: Dr. Sheela V. Basrur, Medical Officer of Health

Subject: Leaf Blowers and other Lawn/Garden Equipment: Noise, Air Pollution and Regulation

Purpose:

To report from a public health perspective on noise and air pollutant emissions from leaf blowers; an acceptable noise level for leaf blowers and other lawn/garden equipment; whether a leaf blower by-law or ban is justified based on health concerns; and by-laws and bans in major cities in North America that restrict leaf blower use.

Financial Implications and Impact Statement:

There are no financial implications resulting from the adoption of this report.

Recommendations:

It is recommended that:

- (1) the Board of Health request the City Solicitor to report on the extent to which the City has the authority to regulate and prohibit the operation of gas-powered leaf blowers within the City of Toronto;
- (2) the Board of Health request the General Manager of the Parks and Recreation Division, the Commissioner of Works & Emergency Services, and the Canadian Union of Public Employees (Local 416) to report back on:
 - (a) the implications on City operations and budget of a by-law to prohibit the operation of gas-powered leaf blowers; and
 - (b) suggested parameters for such a by-law (e.g., exemptions for use during specified times of the year), if deemed necessary to mitigate adverse impacts on operations;

- (3) the Board of Health request the Ontario Ministry of the Environment to convene a multi-stakeholder task group to develop health-protective standards for noise, exhaust and evaporative emissions to be met by manufacturers of lawn/garden equipment;
- (4) the Board of Health forward this report to the Planning and Transportation Committee and the Works Committee for their consideration;
- (5) the Planning and Transportation Committee seek public input on this report at Community Councils (at the same time that Community Councils give consideration to the Urban Development Services report on a harmonized Noise By-law for Toronto);
- (6) the Medical Officer of Health forward a copy of this report for information to: the Occupational Health and Safety Coordinating Committee of the City of Toronto; Toronto Cancer Prevention Coalition; City Agencies, Boards and Commissions; Environment Canada; Ontario Public Health Association; Ontario Ministry of Health; Health Canada; Ontario Ministry of Labour; Ontario Federation of Labour; Workplace Safety and Insurance Board; The Occupational Health Clinics for Ontario Workers Inc.; Landscape Ontario; Ontario Parks Association; Canadian Hearing Society; Canadian Centre for Occupational Health and Safety; NoiseWatch; the League for the Hard of Hearing; Industry Canada; the Canadian Standards Association; and the Noise Pollution Clearinghouse; and
- (7) the appropriate city officials be authorized and directed to take the necessary action to give effect thereto.

Background:

At its meeting on May 1, 2000, the Board of Health considered the Toronto Public Health staff report, "Health Effects of Noise" (March 2000) and requested that "leaf blowers and other garden equipment be considered in the analysis and strategies of noise control". At its meeting on June 12, 2000, the Planning and Transportation Committee considered the "Health Effects of Noise" report and the Board of Health's recommendations regarding this report. The Committee requested appropriate officials to identify as soon as possible, an acceptable noise level for the operation of leaf blowers and other garden equipment and to report back to the appropriate Board/Committee. This report responds to the requests of the Board of Health and the Planning and Transportation Committee.

The Environmental Plan adopted by City Council in 2000, recommended that the City monitor future and emerging issues (including noise) that relate to sustainability and the natural environment.

Staff within Toronto Corporate Services (Legal Division; Occupational Health, Safety, & Workers' Compensation; Fleet Management Division; Facilities & Real Estate Division); Economic Development, Culture and Tourism (Parks & Recreation Division, Economic Research & Business Information); Works & Emergency Services (Transportation Services Division, Solid Waste Management Services Division, Environmental Services);

Finance Department (Purchasing & Materials Management Division); Urban Development Services (Municipal Licensing & Standards Division); Canadian Union of Public Employees (Local 416); Ontario Ministry of the Environment; Environment Canada; and Health Canada were consulted in the preparation of this report.

Comments:

This report focuses on leaf blowers and presents a summary of a larger Technical Report prepared by Toronto Public Health staff (see Attachment 1).

Corporate Context:

As illustrated by reports to the Board of Health and standing committees in the former City of Toronto, there have been ongoing concerns regarding the noise, air pollutants and fugitive dust emissions from leaf blowers (Commissioner of Public Works, 1990a,b; City Solicitor and the Commissioner of Public Works and the Environment, 1994; Medical Officer of Health, 1994; City Solicitor, 1995a,b, 1996; Acting Commissioner of Public Works and the Environment, 1996). Standing committees have previously recommended greater regulation of leaf blower use in Toronto, reductions in their use in City operations and continuing efforts by the Commissioner of Public Works and the Environment to work with manufacturers, suppliers and users of leaf blowers to develop more effective controls on the use of leaf blowers through better education and the phasing in of more advanced silencing technology.

The City of Toronto has addressed some of these concerns through actions such as Noise By-law restrictions on the hours of operation and the sound level of leaf blowers; development and distribution of a brochure, "Keep the Noise Down-What Every Leaf Blower Operator Should Know"; and corporate cessation of leaf blowers on Smog Alert days when air pollution levels are especially high. As discussed below, the use of additional action is needed in view of the adverse impacts of leaf blowers on human health and the environment. Leaf blowers can increase community noise levels and contribute to noise pollution, particularly in high-density urban environments such as Toronto. Leaf blowers can also emit air pollutants and fugitive dust that can contribute to poor air quality and smog episodes in Toronto.

The draft harmonized Noise By-law for the City of Toronto is proposing that "the operation of a device that blows or vacuums leaves, grass clippings or debris" be prohibited at all times in quiet zones and that their use be restricted in residential zones (i.e., use prohibited from 7:00 p.m. to 9:00 a.m. the next day, all day Sundays and statutory holidays). The Noise By-law can only address the noise aspects of leaf blower operations. It is equally important that the Corporation take action to address the air pollutants and fugitive dust emissions from leaf blowers in order to achieve clean air by reducing reliance on these kinds of equipment.

Use of Leaf Blowers:

The main types of leaf blowers are backpack units and hand-held units (gasoline-powered or electric). Leaf blowers are used on private and public properties to remove leaves, dirt and other debris off sidewalks, driveways, lawns, yards, gutters and other surfaces. Various parts of the

Corporation of the City of Toronto use leaf blowers for clean-up purposes (e.g., removal of grass clippings from sidewalks, garbage in picnic shelters). The Parks & Recreation Division reports that backpack blowers are rarely used for more than 5 minutes at a time and are mostly used in the fall for leaves. They are also exploring less polluting alternatives, such as four-stroke engine models which do not use a gas/oil mixture.

Works & Emergency Services (WES) Transportation Services report that gas powered leaf blowers, trimmers and lawn mowing equipment are currently used by City and contracted staff to carry out routine maintenance and cleaning of the public right of way (roads, sidewalks and boulevards) within the City. Leaf blowers are used during fall clean up operations to remove leaves from public sidewalks and the underside of parked vehicles within the curb lane. Leaf blowers are used to form leaf piles for removal from the streets by mechanical equipment (i.e. sweepers and front-end loaders). Leaf blowers are also used by contractors to clean up the work site after grass cutting. Trimmers are used to trim weeds in response to complaints and to cut grass in areas that cannot be serviced by lawn mowing equipment. Lawn mowers are used to cut grass on boulevards and various roadside areas.

Health and Environmental Impacts of Leaf Blowers:

(a) Air Pollutants and Fugitive Dust Emissions

The majority of gasoline-powered leaf blowers utilize small two-stroke engines. These engines emit very high levels of air pollutants in their exhaust and evaporative emissions such as: hydrocarbons from both burned and unburned fuel (hydrocarbons combine with other gases in the atmosphere to form ozone, a key component of smog); carbon monoxide; fine particulate matter; and other toxic air contaminants in the unburned fuel, including benzene, 1-3 butadiene, acetaldehyde and formaldehyde. Leaf blowers can be more polluting than cars. Compared to a new car (1999 or 2000 model), one hour of operation of commercial gasoline-powered leaf blowers emits 498 times as much hydrocarbons, 49 times as much particulate matter and 26 times as much carbon monoxide.

While everyone in the immediate vicinity is exposed to a small degree to air pollution that results from exhaust and dust emissions from leaf blowers, the operators of leaf blowers are likely to be exposed the most to these air pollutants. The relatively large amount of carbon monoxide emitted directly into the air space surrounding the operator is of particular concern. Carbon monoxide is an air pollutant closely associated with adverse effects on the heart. Carbon monoxide binds with haemoglobin (the blood), reducing the ability of the blood to carry oxygen. Concentrations of other types of air pollutants such as benzene and 1,3-butadiene can be high enough to raise health concerns regarding the exposure of commercial leaf blower operators to these toxic air contaminants. Benzene is classified as carcinogenic to humans with no safe threshold for exposure. 1,3-butadiene has also been classified as a known human carcinogen.

In addition to the air pollutants emitted in the exhaust, fugitive dust (blown dust) emissions from leaf blowers are of concern. Fugitive dust is a subset of particulate matter. The high wind speed and volume of leaf blowers can result in small particles being blown into the air. Substances such as fecal material, fertilizers, fungal spores, pesticides, herbicides, pollen and other biological

substances are believed to be contained in the dust that is re-suspended by leaf blowers. These fugitive dust emissions can also include fine particulate matter deposited by other sources such as cars. Of particular concern are the fine particulate matter (PM₁₀) contained in dust that is re-suspended by leaf blowers. Fugitive dust emissions can adversely impact people, depending on proximity to the source, the size of the particles, and the amount of time since the source re-suspended the particles.

Air emissions such as those from leaf blowers can adversely affect the health of people in Toronto. For example, Toronto Public Health has found that existing carbon monoxide levels could be responsible for about one-third of early-deaths in Toronto due to air pollution; PM₁₀ levels in Toronto's air are estimated to result in excess asthma symptom days among 90,000 people, chronic bronchitis amongst 16,500 people (the majority (15,000) of whom were children), emergency room visits by 7,500 people, hospitalizations for heart disease amongst 800 people, hospitalizations for lung disease amongst 500 people, and 200 premature deaths.

(b) Noise Emissions

From a public health perspective, noise emissions from leaf blowers are of concern. Noise emissions can vary, depending on the model, emissions controls such as mufflers, and whether they are gasoline-powered or electric. For backpack and hand-held leaf blowers, ambient sound levels range from 62 dB(A) to 75 dB(A) at 50 feet. Operators' exposure to noise from leaf blowers can range from 88.6 to 106 dB(A).

In comparison to leaf blowers, the sound level of rustling leaves is 20 dB(A), normal conversation is 50-65 dB(A), a vacuum cleaner is 70 dB(A), city traffic is 80 dB(A), a chain saw is 100 dB(A), and a jet takeoff (at 100-200 feet) is 130 dB(A).

Leaf blowers can increase community noise levels, particularly in high-density urban environments where separation distances between homes can be small, well less than the 50 feet used to regulate leaf blower noise. Given that sound levels increase by 6 dB(A) as the distance to the noise source is decreased by half, a leaf blower that emits 70 dB(A) at 50 feet, emits 76 dB(A) at 25 feet, 82 dB(A) at 12.5 feet and 88 dB(A) at about 6 feet. Regular use of leaf blowers in dense urban centres does raise concerns regarding potential health impacts, especially in sensitive populations such as children.

Leaf blowers have a unique tonality which can be very annoying. Leaf blowers emit both high intensity and high frequency sound. In a quiet residential neighbourhood, there are few or no natural sources of sound at these high frequencies. The sound emissions of gasoline-powered leaf blowers are not only more intense than the ambient sound levels but also markedly different. The high frequency emissions are therefore not masked by other sounds and are more noticeable.

There is a risk of hearing loss for commercial leaf blower operators due to the high sound levels and the likelihood that few (less than 10%) wear hearing protection. Bystanders exposed to leaf blower noise on an irregular basis have a lower likelihood of hearing loss. The potential health impacts that are likely more important include interference with communication, sleep interruption, and annoyance. In outdoor living areas during daytime and evening, noise of 55

dB(A) can result in serious annoyance. Therefore, the sound levels of leaf blowers can result in serious annoyance amongst bystanders. Depending on the insulation of dwellings, noise from lawn/gardening equipment such as leaf blowers can travel indoors and impact on residents' quality of life. For a good night's sleep, the equivalent sound level should not exceed 30 dB(A) for continuous background noise, and individual noise events exceeding 45 dB(A) should be avoided (World Health Organization, 1999). Uninterrupted sleep is known to be a prerequisite for good physiological and mental functioning of healthy persons. Sleep disturbance is a major effect of environmental noise (World Health Organization, 1999). The sound levels of leaf blowers can result in sleep disturbance.

Public Policy Responses to Leaf Blowers and Other Lawn/Garden Equipment:

Leaf blowers contribute to noise and air pollution that can adversely affect human health and the environment. In addressing these concerns, some municipalities in North America have enacted outright bans that prohibit the use of electrical or gasoline-powered leaf blowers. For example, twenty cities in the State of California have banned the use of leaf blowers, sometimes only within residential neighbourhoods and usually targeting gasoline-powered equipment (California Air Resources Board, 2000). Other municipalities in Canada and the United States have restricted leaf blower use through Noise By-laws or Municipal Codes.

Other types of lawn/garden equipment such as lawn mowers can contribute to noise and air pollution and can be more polluting than cars even though they are used for considerably shorter periods of time. The potential adverse health and environmental impacts of lawn/garden equipment underscore the need for concerted public policy development. A multi-pronged public policy strategy is therefore necessary in the City of Toronto to minimize noise, exhaust and evaporative emissions from lawn/garden equipment and protect public health.

This strategy could consist of:

- (A) improved provincial regulatory standards (established by the Ontario Ministry of the Environment) for noise, air pollutant, and fugitive dust emissions that must be met by manufacturers of lawn/garden equipment;
- (B) restrictions on leaf blower use in Toronto through:
 - (i) the harmonized Noise By-law (e.g., restrictions on the days and hours of operation, a maximum sound level limit);
 - (ii) more comprehensive restrictions/operational guidelines in a leaf blower by-law (e.g., restrictions on use within residential neighbourhoods, requirements for operators); and
- (C) public awareness on the health and environmental impacts of lawn/garden equipment and actions to minimize exposure to noise and air pollutant emissions (e.g., wearing face masks and hearing protection as appropriate, alternatives to the use of gas-powered lawn/garden equipment).

These options are mutually supportive. Implementation of any one option does not preclude implementation of the others.

Greater Regulation of Leaf Blower Use:

Greater regulation of leaf blower use within the City of Toronto is warranted for the following reasons:

- (a) Noise, air pollutants and fugitive dust emissions from leaf blowers can adversely impact on quality of life, human health and the environment. These emissions continue to be of public health concern. For example, the air pollutants and noise emitted by leaf blowers can contribute to poor air quality and noise pollution;
- (b) The recommendations in the Toronto Public Health 1994 staff report, "Health and Environmental Impacts of Leaf Blowers" have largely not been acted upon; and
- (c) Toronto residents continue to express concerns about excessive noise levels from leaf blowers and resulting impairment of quality of life in residential neighbourhoods, and contribution of emissions to poor air quality in Toronto and adverse health impacts, particularly for people with respiratory problems such as asthma, emphysema and chronic bronchitis.

The harmonized Noise By-law proposed for Toronto can address only the noise aspects of leaf blower operations. There is sufficient health and environmental justification to merit exploration of enhanced regulation of leaf blower use. There is a need for an opinion from the City Solicitor on a leaf blower by-law. It is recommended that the Board of Health request the City Solicitor to report on whether the City has the authority to regulate and prohibit the operation of gas-powered leaf blowers within the City of Toronto. This report should also consider the findings of the ongoing policy and legal study related to air quality strategies being carried out by Works & Emergency Services.

Given the use of gas-powered leaf blowers by various parts of the Corporation, there is a need for consultation with the General Manager, Parks and Recreation Division; the Commissioner of Works & Emergency Services; and the President of the Canadian Union of Public Employees (Local 416) regarding the potential impacts of a leaf blower by-law on the City's operations and suggested modifications to such a by-law.

The General Manager of the Parks and Recreation Division has provided preliminary input on the implications of a leaf blower by-law on the Division's operations (including budget impacts). The Parks & Recreation Division has indicated that there would be a significant cost in labour associated with the use of rakes and brooms instead of leaf blowers. The Parks & Recreation Division has also indicated that the use of electric leaf blowers is not possible in a park scenario without the use of a generator which would defeat the purpose (Tucker-Reid, 2001).

The General Manager of Transportation Services has indicated that although his staff already strive to comply with the noise control provisions contained within the various by-laws of the former municipalities, he would be willing to explore other options to reduce public exposure to air pollutants and dust emissions. Concern was expressed, however, as to whether less polluting and quieter power equipment was commercially available. Regarding the option of use of manual equipment, concern was expressed about reduced efficiency and increased cost. Occupational health and safety issues were also raised, especially with manual leaf removal in the fall because staff would need to frequently bend under and around parked vehicles, putting them in close proximity to traffic and therefore increasing the likelihood of accidents. The General Manager of Transportation Services has indicated that the removal of leaves from City streets is an essential part of maintaining the efficiency of the sewer system and preparing the streets for winter services.

The Canadian Union of Public Employees (Local 416) has indicated that it is "... in agreement with a by-law to reduce noise levels and air pollution of leaf blowers and lawn mowers. Our members are exposed to the high levels of noise and harmful emissions from the exhaust fumes. Local 416 does have concerns of the subsequent effects the by-laws may have on our members. In the event of a "smog alert day" and the cessation of the use of gasoline powered equipment, there must be alternate work for those workers who would normally be assigned to use the equipment. An alternate on these occasions would be the use of rakes and brooms. We also feel strongly that enforcement of by-laws should apply to contractors. This would ensure that city workers would not be at a disadvantage with respect to work performance and of productivity and efficiency measures." (Ouellette, 2001).

It is recommended that the Board of Health forward this report to the Planning and Transportation Committee and the Works Committee for consideration. It is also important that the Planning and Transportation Committee seek public input on this report at Community Councils.

Conclusions:

Leaf blowers can contribute to community noise and promote hearing loss amongst equipment operators, and annoyance amongst residents. There is evidence that leaf blowers can contribute to poor air quality and that the health of Toronto residents is already adversely affected by current air pollution levels. The achievement of clean air in Toronto requires reductions in pollutants from many sources including leaf blowers and other lawn and garden equipment. The harmonized Noise By-law proposed for Toronto can address only the noise aspects of leaf blower operations. There is sufficient health and environmental justification to merit exploration of enhanced regulation of leaf blower use such as a leaf blower by-law in Toronto to minimize exposure to noise, air pollutants, and fugitive dust emissions. In the interim, alternatives to leaf blowers (e.g., rakes, brooms) should be used where reasonable to minimize these emissions. Public input on this report should be obtained at Community Councils at the same time as public consultation on the draft harmonized Noise By-law.

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List of Attachments:

- (1) Toronto Public Health Technical Report: Leaf Blowers and other Lawn/Garden Equipment: Noise, Air Pollution and Regulation (June 2001)

References:

Acting Commissioner of Public Works and the Environment. (January 10, 1996). Regulation of Leaf Blowers (All Wards). Report to City Services Committee, City of Toronto.

Anonymous. (1997). The world's quietest power blower? Consumer Reports April, p. 8.

California Environmental Protection Agency Air Resources Board. (2000). A Report to the California Legislature on the Potential Health and Environmental Impacts of Leaf Blowers. State of California Air Resources Board Mobile Sources Control Division.

City Solicitor. (January 8, 1996). Further Authority to Regulate or Prohibit the Use of Leaf Blowers – All Wards.

City Solicitor. (May 30, 1995a). Regulation of Leaf Blowers. City of Toronto: Report to City Council.

City Solicitor. (May 30, 1995b). Use of Leaf Blowers. City of Toronto: Report to City Services Committee.

City Solicitor and the Commissioner of Public Works and the Environment. (January 6, 1994). Regulation of Leaf Blowers – Application for Special Legislation. City of Toronto: Report to City Services Committee.

Commissioner of Public Works. (June 1, 1990a). Regulation of Noise from Leaf Blowers. City of Toronto: Report to City Services Committee.

Commissioner of Public Works. (September 4, 1990b). Time Restrictions on the Use of Leaf Blowers. City of Toronto: Report to City Services Committee.

Commissioner of Public Works and the Environment. (1994). City of Toronto Noise Control Programme Progress Report No. 3.

Dill, P., Basrur, S.V., Gutteridge, B. (2000). Harmonization of the Noise By-law. City of Toronto: Report of Commissioner of Urban Development Services, Medical Officer of Health, Commissioner of Works & Emergency Services to the Toronto Board of Health.

Environmental Task Force. (February 2000). Environmental Plan, Clean, Green and Healthy, A Plan for an Environmentally Sustainable Toronto. City of Toronto.

Government of Canada, Environment Canada, and Health and Welfare Canada. (1993). Benzene. Canadian Environmental Protection Act Priority Substances List Assessment Report.

Medical Officer of Health. (May 18, 2000a). Air Pollution Burden of Illness in Toronto – Summary Report. Report to Board of Health, City of Toronto.

Medical Officer of Health. (March 23, 2000b). Health Effects of Noise. Report to Board of Health, City of Toronto.

Medical Officer of Health. (1994). Health and Environmental Impacts of Leaf Blowers. City of Toronto: Report to Board of Health.

National Toxicology Program. (2000). Report on Carcinogens. U.S. Department of Health and Human Services.

Orange County Grand Jury. (1999). Leaf Blower Pollution Hazards in Orange County. Orange County Council of Governments.

Orpin, R. (2001). Works & Emergency Services Transportation Services. Personal Communication.

Ouellette, P. (2001). Canadian Union of Public Employees (Local 416). Personal Communication.

Toronto Public Health. (December 2000). Toronto's Air: Let's Make it Healthy.

Tucker-Reid, C. (2001). City of Toronto Parks & Recreation Division. Personal Communication.

Vescio, G. (2001). City of Toronto Urban Development Services. Personal Communication.

Zwerling, E. (1999). Electronic Communications with Dr. Nancy Steele, California Air Resources Board.

**City of Toronto
Community & Neighbourhood Services
Toronto Public Health
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TECHNICAL REPORT

**LEAF BLOWERS AND OTHER LAWN/GARDEN EQUIPMENT:
NOISE, AIR POLLUTION, AND REGULATION**

**Dr. Sheela V. Basrur
Medical Officer of Health**

June 8, 2001

Reference: Toronto Public Health, *Leaf Blowers and other Lawn/Garden Equipment Noise, Air Pollution, and Regulation*, Toronto: City of Toronto, June 2001.

This report is a companion document to a Toronto Public Health staff report to the Board of Health, “Leaf Blowers and other Lawn/Garden Equipment: Noise, Air Pollution, and Regulation” dated June 1, 2001.

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Background:

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The Environmental Plan adopted by City Council in 2000, recommended that the City monitor future and emerging issues (including noise) that relate to sustainability and the natural environment.

Staff within Toronto Corporate Services (Legal Division; Occupational Health, Safety, & Workers' Compensation; Fleet Management Division; Facilities & Real Estate Division); Economic Development, Culture and Tourism (Parks & Recreation Division, Economic Research & Business Information); Works & Emergency Services (Transportation Services Division, Solid Waste Management Services Division, Environmental Services); Finance Department (Purchasing & Materials Management Division); Urban Development Services (Municipal Licensing & Standards Division); Canadian Union of Public Employees (Local 416); Ontario Ministry of the Environment; Environment Canada; and Health Canada were consulted in the preparation of this report.

Comments:

This report focuses on leaf blowers. In response to the requests from the Planning and Transportation Committee, and the Board of Health, reference is made where possible, to other types of lawn/garden equipment such as lawn mowers.

Lawn/garden equipment is used for residential and commercial purposes. The commercial users include grounds keepers for nonresidential, large apartment complexes, and some single-family homes. Commercial equipment has significantly different usage than residential equipment in terms of hours per year, weekday and weekend day (United States Environmental Protection Agency (U.S. EPA, 1998)).

While estimates have been published on the annual hours of use of lawn/garden equipment (e.g., U.S. EPA, 1998), there are few data sources on their health and environmental impacts. Much of the information presented in this report is based on the following reports:

- "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling" (U.S. EPA, 1998);
- "A Report to the California Legislature on the Potential Health and Environmental Impacts of Leaf Blowers" (California Air Resources Board, 2000); and
- "Lawn Mower Use and Emissions in Canada" (Environment Canada, 1994).

In this report, noise is defined as ‘unwanted sound’ (a definition used by the World Health Organization (1999) that is also common to many noise by-laws). While the terms “noise” and “sound” are used interchangeably throughout the report, use of the term “sound” is usually more technically correct.

Corporate Context:

As illustrated by reports to the Board of Health and standing committees in the former City of Toronto, there have been ongoing concerns regarding the noise, air pollutants and fugitive dust emissions from leaf blowers (Commissioner of Public Works, 1990a,b; City Solicitor and the Commissioner of Public Works and the Environment, 1994; Medical Officer of Health, 1994; City Solicitor, 1995, 1996; Acting Commissioner of Public Works and the Environment, 1996). Standing committees have previously recommended greater regulation of leaf blower use in Toronto, reductions in their use in City operations and continuing efforts by the Commissioner of Public Works and the Environment to work with manufacturers, suppliers and users of leaf blowers to develop more effective controls on the use of leaf blowers through better education and the phasing in of more advanced silencing technology.

The City of Toronto has taken actions such as the following to address the aforementioned concerns regarding leaf blowers and other lawn/garden equipment:

- an occupational noise exposure study of City staff in the early 1990s. Leaf blower operators were found to be exposed to noise levels averaging 95 decibels (dB(A)). The mandatory use of hearing protection was introduced for City staff (Greer, 1995);
- the development of a product specification for Corporate purchases of leaf blowers that requires for example, a noise controlled muffler and the noise level at 15 metres not to exceed 70 dB(A). (This product specification is available from the Finance Department Purchasing & Materials Management Division.);
- prohibition in the former City of Toronto Noise By-law on the operation of lawn mowers, “weed-eaters”, leaf blowers in the outside environment that is audible at any residential point of reception between the hours of 9:00 p.m. and 7:30 a.m. of the following day (unless the following day is a Sunday or a holiday in which case the time is 9:00 a.m.);
- specification in the former City of Toronto Noise By-law, of a maximum permissible sound level limit for leaf blowers of 70 dB(A) when measured from 15 metres away;
- information provided to landscapers/contractors regarding the Noise By-law when the leaf blower provisions are contravened and a requirement for the use of a quieter, low tone unit (Commissioner of Public Works and the Environment, 1994);
- development and distribution to property owners of a brochure, “Keep the Noise Down What Every Leaf Blower Operator Should Know”;

- cessation of Corporate use of gasoline-powered equipment such as leaf blowers and lawn mowers on Smog Alert days when air pollution levels are especially high (carried out as part of implementation of the Corporate Smog Alert Plan adopted by Toronto City Council on June 5, 1998);
- public awareness materials that encourage residents to avoid use of gasoline-powered equipment such as leaf blowers and lawn mowers on Smog Alert days (carried out as part of activities to promote public participation in the achievement of clean air); and
- a review of by-laws, policies and programs in other jurisdictions to determine how best to address lawn and garden equipment (completed as part of development of Toronto's harmonized Noise By-law).

Use of Leaf Blowers:

The main types of leaf blowers are gasoline-powered backpack units, gasoline-powered hand-held units, electric-powered backpack units, and electric-powered hand-held units. Leaf blowers are used on private and public properties to remove leaves, dirt and other debris off sidewalks, driveways, lawns, yards, gutters and other surfaces. Some estimates have been published on the use of leaf blowers. In California, homeowners are more likely to use electric rather than gasoline-powered leaf blowers. Homeowners' use of electric leaf blowers is estimated to be 10 hours per year per unit. Virtually all professional gardeners use gas engine-powered leaf blowers, with use per unit estimated to be 275 hours per year (California Air Resources Board, 2000). According to the U.S. EPA (1998), leaf blowers are used for 10 hours per year for residential purposes and 282 hours per year for commercial purposes. While estimates are not available for Canada, it is reasonable to expect that leaf blowers are used less often in Canada in view of the climate and shorter growing season. It is not known to what extent leaf blowers are used by landscape services, commercial gardeners, or householders in Toronto.

The Corporation of the City of Toronto uses leaf blowers for various purposes. For example, the Parks & Recreation Division uses leaf blowers to remove grass clippings from sidewalks, sand and dirt from spray pads, garbage in picnic shelters, garbage under bleachers, sawdust from forestry operations, debris out of flower beds, leaves and snow. Backpack blowers are rarely used for more than 5 minutes at a time and most use is in the fall for leaves. The Parks & Recreation Division reports that instead of using the present small two-stroke engine leaf blowers, the Division is testing 4-stroke models, which do not use the gas/oil mixture (Tucker-Reid, 2001). Leaf blowers are used by other parts of the Corporation (e.g., Works and Emergency Services (WES) Transportation Services).

Works & Emergency Services (WES) Transportation Services report that gas powered leaf blowers, trimmers and lawn mowing equipment are currently used by City and contracted staff to carry out routine maintenance and cleaning of the public right of way (roads, sidewalks and boulevards) within the City. Leaf blowers are used during the fall clean up operations to remove leaves from public sidewalks and the underside of parked vehicles within the curb lane. Leaf blowers are used to form leaf piles for removal from the streets by mechanical equipment (i.e. sweepers and front end loaders). Leaf blowers are also used by contractors to clean up the work site after grass cutting. Trimmers are used to trim weeds in response to complaints and to cut

grass in areas that cannot be serviced by lawn mowing equipment. Lawn mowers are used to cut grass on boulevards and various roadside areas.

The Need for Greater Regulation of Leaf Blowers:

The Board of Health adopted the recommendations of the Toronto Public Health 1994 staff report, “Health and Environmental Impacts of Leaf Blowers” (see Appendix A). However, these recommendations have largely not been acted upon. For example, the federal government has not developed a standard labelling protocol for noise emissions from leaf blowers. Meanwhile, Toronto residents continue to express concerns about excessive noise levels from leaf blowers and resulting impairment of quality of life in residential neighbourhoods, and contribution of emissions to poor air quality in Toronto and adverse health impacts, particularly for people with respiratory problems such as asthma, emphysema and chronic bronchitis.

Noise, air pollutants and fugitive dust emissions from leaf blowers can adversely impact on quality of life, human health and the environment. As discussed below, these emissions continue to be of public health concern.

Health Impacts of Leaf Blowers:

i) Air Pollutants and Fugitive Dust Emissions

The majority of gasoline-powered leaf blowers utilize small two-stroke engines. These engines emit very high levels of air pollutants in their exhaust and evaporative emissions such as: hydrocarbons from both burned and unburned fuel (hydrocarbons combine with other gases in the atmosphere to form ozone, a key component of smog); carbon monoxide; fine particulate matter; and other toxic air contaminants in the unburned fuel, including benzene, 1-3 butadiene, acetaldehyde, and formaldehyde (California Air Resources Board, 2000). Agencies such as the California Air Resources Board have prepared estimates on air pollutant emissions from leaf blowers. For example, evaporative fuel emissions from leaf blowers are estimated to be 2.5 grams/day (Wong, 2001).

According to the California Air Resources Board (2000), the types of air pollutants emitted when using a gasoline-powered leaf blower for half an hour are equivalent to those emitted from 440 miles of automobile travel at 30 miles (or 48 kilometres) per hour average speed. For example, hydrocarbon emissions from half an hour of leaf blower operation are equivalent to those from 7,700 miles of driving, at 48 km/h average speed. As indicated in Table 1 below, one hour of leaf blower operation emits considerably more hydrocarbons, carbon monoxide, and particulate matter than a year old car (1999 or 2000 model) driven for one hour at 48 km/h. Compared to a new car, one hour of operation of commercial gasoline-powered leaf blowers emits 498 times as much hydrocarbons, 49 times as much particulate matter and 26 times as much carbon monoxide.

Table 1: 1999 Emissions Data for Commercial Gasoline-Powered Leaf Blower Emissions Compared to Car Emissions

	Exhaust Emissions of Leaf Blowers, grams per hour (g/hr)	Exhaust Emissions of New Car (g/hr) ^a	Exhaust Emissions of Older Car (g/hr) ^b
Carbon Monoxide	424	16	1310
Hydrocarbons	199	0.4	202
Fugitive Dust ^c	49-1031	N/A	N/A
Particulate Matter	6.4	0.13	0.78

- (a) one year old, 1999 or 2000 model year car, driven for one hour at 30 mph (48 km/h)
 (b) 1975 model year and older car, pre-catalytic car, driven for one hour at 30 mph (48 km/h)
 (c) Fugitive dust can be defined as “dust particles that are introduced into the air through certain activities such as soil cultivation, or vehicles operating on open fields or dirt roadways” (California Air Resources Board website).

Source: California Air Resources Board (2000)

The lighter-duty models of leaf blowers used by homeowners can be just as polluting as the heavier-duty models used in commercial operations. As with the heavier-duty commercial leaf blower, emissions from the lighter-duty leaf blower are many times higher than emissions of the same pollutants from cars. Table 2 provides figures on exhaust emissions for leaf blowers and cars. Compared to a new car (1999 or 2000 model) driven for one hour at 30 mph (48 km/h), leaf blowers used by homeowners emit 143 times as much hydrocarbons, 11 times as much particulate matter, and 7.4 times as much carbon monoxide.

Table 2: 1999 Emissions Data for Homeowner Leaf Blower Emissions Compared to Car Emissions

	Exhaust Emissions of Leaf Blowers, grams per hour (g/hr)	Exhaust Emissions of New Car (g/hr) ^a	Exhaust Emissions of Older Car (g/hr) ^b
Carbon Monoxide	119	16	1310
Hydrocarbons	57	0.4	202
Fugitive Dust	49-1031	N/A	N/A
Particulate Matter	1.44	0.13	0.78

- (a) one year old, 1999 or 2000 model year car, driven for one hour at 30 mph (48 km/h)
 (b) 1975 model year and older car, pre-catalytic car, driven for one hour at 30 mph (48 km/h)
 Source: California Air Resources Board (2000)

In addition to the air pollutants emitted in the exhaust, fugitive dust (blown dust) emissions are of concern. Fugitive dust is a subset of particulate matter. The high wind speed and volume of leaf blowers can result in small particles being blown into the air. Substances such as fecal material, fertilizers, fungal spores, pesticides, herbicides, pollen and other biological substances are believed to be contained in the dust that is re-suspended by leaf blowers (Orange County Grand Jury, 1999 as cited in California Air Resources Board, 2000). These fugitive dust emissions can also include fine particulate matter deposited by other sources such as cars. Of particular concern are the fine particulate matter (PM₁₀) contained in dust that is re-suspended or re-entrained by leaf blowers. Fugitive dust emissions can adversely impact people, depending on

proximity to the source, the size of the particles, and the amount of time since the source re-suspended the particles (California Air Resources Board, 2000). Additional study is required to provide a definitive estimate of fugitive dust emissions from leaf blowers. Fugitive dust can be emitted by both gas-powered and electric leaf blowers (Maillette, 2001).

While the volume of fine particulate matter emissions is small, they are significant in terms of health impacts. Short-term exposures of one to two days to high levels of particulate matter can lead to coughing and minor throat irritation (California Air Resources Board, 2000). There have been very few studies that have focused on the long-term effects of particulate matter. Data from North America shows that particulate matter can result in an increase in bronchitis and decreases in lung function, capacity, growth and development in children (Agency for Toxic Substances and Disease Registry, 1997; Ontario Medical Association, 1998; U.S. EPA, 1996a). When these children grow up, they are more susceptible to various lung diseases. Finally, some studies have suggested that particulate matter may cause cancer (Health Canada & Environment Canada, 1999; National Toxicology Program, 2000). It is important that leaf blower operators wear a face mask that is effective at filtering particulate matter from the air (California Air Resources Board, 2000).

While everyone in the immediate vicinity is exposed to a small degree to air pollution that results from exhaust and dust emissions from leaf blowers, the operators of leaf blowers are likely to be exposed the most to these air pollutants. The relatively large amount of carbon monoxide emitted directly into the air space surrounding the operator is of particular concern. In the case of commercial leaf blowers, the carbon monoxide contained in exhaust emissions is 424 g/hr. In the case of homeowner leaf blowers, the carbon monoxide contained in exhaust emissions is 119 g/hr. However, these figures do not imply that the operator will inhale this amount of carbon monoxide. Nonetheless, leaf blower operators can be exposed to a substantial volume of carbon monoxide depending on the amount of use of leaf blowers. The use of leaf blowers can range from 15 minutes per day to a full work day. Carbon monoxide is an air pollutant closely associated with adverse effects on the heart. Carbon monoxide binds with haemoglobin (the blood), reducing the ability of the blood to carry oxygen (Toronto Public Health, 2000).

Concentrations of other types of air pollutants such as benzene and 1,3-butadiene can be high enough as to reinforce concern regarding the exposure of commercial leaf blower operators to these toxic air contaminants (California Air Resources Board, 2000). Benzene is classified as carcinogenic to humans (Government of Canada, Environment Canada, Health and Welfare Canada, 1993). 1,3-butadiene has been classified as a known human carcinogen (National Toxicology Program, 2000).

Air pollutant emissions such as those from leaf blowers can adversely affect the health of people in Toronto by adding to existing levels of key pollutants linked with negative health impacts. For example, Toronto Public Health (2000) has found:

- PM₁₀ levels in Toronto resulted in asthma symptom days among 90,000 people, chronic bronchitis amongst 16,500 people (the majority (15,000) of whom were children), emergency room visits by 7,500 people, hospitalizations for heart disease amongst 800 people, hospitalizations for lung disease amongst 500 people, and 200 deaths.
- Carbon monoxide levels in Toronto could be responsible for about one-third of early-deaths in the City due to air pollution. At daily average concentrations of 0.5 to 1 parts per million, carbon monoxide was also linked to 5 per cent of pollution-related hospital admissions for heart problems.
- Ground-level ozone levels (the principal constituent of smog) in Toronto are increasing (Health Canada & Environment Canada, 1999; Ontario Ministry of the Environment, 1998). Ozone accounts for 39 per cent of admissions to hospital for air pollution-related heart problems, 9 per cent of admissions to hospitals for air pollution-related lung problems and 4 per cent of air pollution-related early-deaths in Toronto.

ii) Noise Emissions

Noise is typically defined as “unwanted sound”. Sound is typically described in terms of sound pressure which rate the pressure fluctuations that stimulate the sense of hearing. Sound pressure fluctuations are described in terms of decibels which are based on a logarithmic scale, similar to that of a Richter scale. The ear also responds to changes in pitch (or frequency). This variation in response has been utilized to program the filtering systems found in most sound measuring equipment. Decibels that have been filtered in this way account for human sensitivity to the frequency of the sound. This measurement is known as A-weighted decibels and is denoted dB(A). Typical dB(A) levels that are encountered range from 0 dB(A), at which sound can barely be heard, to 120 dB(A), at which sound can cause pain from excessive exposure (Cowan, 1994). Since sound levels are logarithmic in scale, a small increase in decibels represents a large increase in sound energy (Talbot & Thompson, 1995). Each increase of 10 dB means that the sound energy or sound pressure level has increased by 10 times, however, the subjective response is a doubling of loudness. Therefore, a 70 dB(A) sound source would sound twice as loud as a 60 dB(A) sound source (Cowan, 1994). Doubling the distance between noise from a point source and the person listening drops the level of the sound by approximately 6 dB(A) (California Air Resources Board, 2000). A person who is in close proximity to a noise source will tend to experience the noise as much louder than someone who is further away.

From a public health perspective, noise emissions from leaf blowers are of concern. Noise emissions from leaf blowers can vary, depending on the model, emissions controls such as mufflers and whether they are gasoline-powered or electric. For backpack and hand-held leaf blowers, sound levels range from 62 dB(A) to 75 dB(A) at 15 meters (50 feet). As indicated in Table 3 below, gasoline-powered leaf blowers can emit varying noise levels, with the majority emitting noise of 69-70 dB(A) at 15 meters.

Table 3: Noise Emissions from Gasoline-Powered Leaf Blowers

Reported Noise Emissions At 50 Feet (15 m)	Percent of Models (55 Models in Total)
>70 dB(A)	18
69-70 dB(A)	> 50
<69 dB(A)	27

Source: California Air Resources Board (2000)

The quietest gasoline-powered models (all backpack), ranged from 62 to 65 dB(A) at 50 feet. Bearing in mind the way perceived loudness varies with decibel level, the 13 dB(A) difference between a leaf blower of 62 dB(A) and one of 75 dB(A) would be perceived by a listener as two to three times as loud. Electric leaf blowers can be marginally quieter than gasoline-powered models, with the quietest models (all hand-held) emitting 63 dB(A) (California Air Resources Board, 2000). In comparison, the sound level of rustling leaves is 20 dB(A), normal conversation is 50-65 dB(A), a vacuum cleaner is 70 dB(A), city traffic is 80 dB(A), a chainsaw is 100 dB(A), and a jet takeoff (at 100-200 feet) is 130 dB(A) (Medical Officer of Health, 2000b).

Leaf blowers have a unique tonality which can be very annoying (Commissioner of Public Works and the Environment, 1994). Leaf blowers emit both high intensity and high frequency sound. In a quiet residential neighbourhood, there are few or no natural sources of sound at these high frequencies. The sound emissions of gasoline-powered leaf blowers are not only more intense than the ambient sound levels but also markedly different. The high frequency emissions are therefore, not masked by other sounds and are more noticeable (unpublished study by Zwerling, 1999 cited in California Air Resources Board, 2000).

As discussed below, leaf blowers can also contribute to exposure to excessive noise. While studies have not focused on the health impacts of exposure to noise from leaf blowers per se, studies have shown that noise affects both mental and physical well-being (California Air Resources Board, 2000; World Health Organization, 1995; Medical Officer of Health, 2000b). Leaf blowers can increase community noise levels and contribute to noise pollution, particularly in high-density urban environments where separation distances between homes can be small, well less than the 50 feet typically used to regulate leaf blower noise. Given that sound levels increase by 6 dB(A) as the distance to the noise source is decreased by half, a leaf blower that emits 70 dB(A) at 50 feet, emits 76 dB(A) at 25 feet, 82 dB(A) at 12.5 feet and 88 dB(A) at about 6 feet. Regular use of leaf blowers in dense urban centres does raise health concerns regarding potential impacts on hearing in sensitive subpopulations such as children.

a) Operators' Exposure to Leaf Blower Noise and Health Impacts

According to the California Air Resources Board (2000), homeowners who choose to use a leaf blower likely experience relatively low-level exposures to noise which they control. Commercial leaf blower operators and gardening crews have the greatest exposure to noise from leaf blowers. Operators' exposure to noise from leaf blowers can range from 88.6 to 106 dB(A) (California Air Resources Board, 2000; Consumer Reports, 1997).

Sound levels at around 85 dB(A) with exposures of 8 hours per day will produce permanent hearing loss after many years (United States Institute of Health Consensus Statement on Noise and Hearing Loss, 1990). High intensity and high frequency sound can also adversely affect health. Physical ear discomfort of noise exposure starts from sound pressure levels of 80-100 dB(A) and up. Persons with some ear or sensorineural hearing disorders and hearing-aid users may experience pain in their ears when exposed to noise at even lower levels. Tinnitus (ringing in the ears) can accompany temporary or permanent hearing impairment (World Health Organization, 1995).

Leaf blower operators and gardening crews are at increased risk of hearing loss from leaf blower noise due to the high pressure sound levels at their ear and the likelihood that few of them (10% or less) regularly wear hearing protection (California Air Resources Board, 2000).

b) Bystanders' Exposure to Leaf Blower Noise and Health Impacts

Bystanders experience less exposure to leaf blower noise than leaf blower operators. Bystanders may experience low or high exposures, depending on how the leaf blower is used and its noise level. A bystander exposed to leaf blower noise on an irregular basis has a low likelihood of hearing loss. The potential health impacts that are likely more important include interference with communication, sleep interruption, and annoyance (California Air Resources Board, 2000).

In outdoor living areas during daytime and evening, noise of 55 dB(A) can result in serious annoyance. Depending on the insulation of dwellings, noise from lawn/gardening equipment can travel indoors and impact on residents' quality of life. In indoor living areas, noise of 35 dB(A) affects speech intelligibility (World Health Organization, 1999). Each of these impacts may in turn lead to stress responses, although research has not conclusively tied chronic exposures with any particular adverse health outcome (California Air Resources Board, 2000).

For a good night's sleep, the equivalent sound level should not exceed 30 dB(A) for continuous background noise, and individual noise events exceeding 45 dB(A) should be avoided (World Health Organization, 1999). Uninterrupted sleep is known to be a prerequisite for good physiological and mental functioning of healthy persons. Sleep disturbance is a major effect of environmental noise (World Health Organization, 1999).

Noise levels such as those emitted by leaf blowers can also affect behavior. For example, noise above 80 dB(A) is associated with increased aggressive behavior and reduced helping behavior (i.e., willingness to help others in need) (World Health Organization, 1999). Willingness to help has been suspected to be less during exposure to noise as well as during an undetermined time period after exposure (Korte, Ympa, & Toppen, 1975; Korte & Grant, 1980; Mathews & Canon, 1975; Page, 1977 as cited in World Health Organization, 1995). Noise exposure alone is not believed to be sufficient to produce aggression. However, in combination with provocation or pre-existing anger or hostility, it may trigger aggression (World Health Organization, 1999).

Noise and Air Pollution Emissions from Lawn Mowers:

Among various types of outdoor equipment, lawn mowers are an important contributor to community noise, with the blades contributing up to 50% of noise (Tauro & Mann III, 1997).

Lawn mowers can be just as loud as leaf blowers. According to the Canadian Hearing Society (1991), lawn mowers can emit 80-96 dB(A) when measured at a distance of three feet.

Like gas-powered leaf blowers, gas-powered lawn mowers emit air pollutants. As indicated in Table 4 below, these air pollutants include hydrocarbons, carbon monoxide, nitrogen oxides and particulate matter.

Table 4: Lawn Mower Emissions

Pollutant	Estimated Emissions (tonnes/year)
Carbon Monoxide	3294
Hydrocarbons	1411
Particulate Matter	52
Nitrogen Oxides	2.2

Source: Environment Canada (1994)

These emissions represent less than 5% of the total emissions of these individual pollutants in Canada, except for hydrocarbons, which are nearly 14% of total hydrocarbon emissions (Environment Canada, 1994).

Two-stroke lawn mowers tend to be more polluting than four-stroke models. For example, one study found that lawn mowers with two-stroke engines emit hydrocarbons at an average rate in excess of seven times the rate of emission from lawn mowers with four-stroke engines (Priest et al., 2000). Evaporative fuel emissions from lawn mowers are estimated to be 5.8 grams/day (Wong, 2001).

Lawn mowers can be more polluting than driving a car. One half-hour of lawn mowing with a typical walk-behind mower produces as much hydrocarbon emissions as driving a 1995 automobile for about 100 miles or 160 kilometres (California Air Resources Board, 2000). A Swedish study found that the emissions produced from a lawn mower engine during one hour of operation were around 4000 µg/h; this is comparable to driving more than 150 km in a car with a three-way catalytic converter (Christensen & Westerholm, 2001).

Both lawn mower users and bystanders can be exposed to noise and air pollutant emissions. Figures from Statistics Canada indicate that there were 5,850,000 lawn mowers in Canada in 1985, the majority of which were gas-powered (73.3%). There were comparatively fewer electric (23.9%) and push mowers (2.8%) (Environment Canada, 1994). Most lawn mowers that are available in the Canadian marketplace are imported (Maillette, 2001). According to information obtained from Statistics Canada, 126 walk-behind lawn mowers were imported into Canada during 1996-1999. Figures on domestic production of lawn mowers are not available from Industry Canada (Maillette, 2001).

A users' survey conducted by Environment Canada (1994) of a limited number of households found that two-stroke, walk-behind lawn mowers are used an average of 19 hours per year. Lawn care services use predominantly these types of lawn mowers.

Public Policy Responses to Leaf Blowers and other Lawn/Garden Equipment:

Leaf blowers and other lawn/garden equipment (e.g., lawn mowers) contribute to noise and air pollution that can adversely affect human health and the environment. A multi-pronged public policy strategy is therefore necessary in the City of Toronto to minimize noise, exhaust and evaporative emissions from lawn/garden equipment and protect public health.

This strategy could consist of:

- A. improved provincial regulatory standards for lawn/garden equipment;
- B. restrictions on leaf blower use in Toronto through:
 - i) the harmonized Noise By-law;
 - ii) more comprehensive restrictions/operational guidelines in a leaf blower by-law; and
- C. public awareness on the health and environmental impacts of lawn/garden equipment.

These options are mutually supportive. The potential adverse health and environmental impacts of leaf blowers and other lawn/garden equipment underscore the need for concerted public policy development. Implementation of any one option does not preclude implementation of the others. Each option is described below.

A. Improved Provincial Regulatory Standards for Lawn/Garden Equipment

Small lawn/garden equipment generally have a short median life (the point where 50% of engines are scrapped). For example, leaf blowers and lawn mowers used for residential purposes have a median life of 4.3 years and 5.8 years, respectively. Leaf blowers and lawn mowers used for commercial purposes have a median life of 2.3 years, and 2 years, respectively (U.S. EPA, 1998).

While lawn/garden equipment have relatively short median lives in comparison to cars, they can be very polluting (U.S. EPA, 1995). The majority of lawn/garden equipment is powered by two-stroke engines (Environment Canada, 1999). A major disadvantage of two-stroke engines is high exhaust emissions (California Air Resources Board, 2000). Two-stroke engines are approximately ten times more polluting than four-stroke engines (State of California Air Resources Board, 1998). Four-stroke engines such as those contained in “walk-behind” models of leaf blowers used to clean large parking lots and industrial facilities, emit significantly lower emissions than their two-stroke counterparts, with significantly lower levels of hydrocarbons and particulate matter (California Air Resources Board, 2000). The fuel used in two-stroke engines is not burned as completely or as efficiently as fuel in automobiles, resulting in noise and air pollutant emissions (Environment Canada, 1999).

In Canada, gasoline utility engine equipment such as leaf blowers, lawn mowers, weed trimmers, and chainsaws accounts for approximately 20 percent of the toxic emissions stemming from gasoline and diesel powered engines used in transportation and are significant and broad-based contributors to nitrogen oxides and carbon monoxide emissions (Environment Canada, 1999, 2000; Maillette, 2001). As indicated in Table 5, emissions from off-road gasoline engines such as those used in lawn/garden equipment account for 6% of carbon monoxide, 2.6% of volatile

organic compounds, and 1% of nitrogen oxides from all sources (including mobile sources such as transportation and stationary sources such as power plants). Leaf blowers and lawn mowers represent only a fraction of emissions from off-road engines (Maillette, 2001).

Table 5: Selected Air Contaminant Emissions for Canada in 1995

Air Contaminant	Emissions from Off Road Use of Gasoline in Metric Tons (% of all mobile sources)	Emissions from All Mobile Sources ^a (in Metric Tons)	Emissions from All Sources ^b (National Total, in Metric Tons)
Carbon Monoxide	1,027,393 (6.0)	6,707,715	17,127,836
Volatile Organic Compounds (VOC)	93,111 (2.6)	734,412	3,575,202
Nitrogen Oxides (NO _x)	25,395 (1.0)	1,290,214	2,463,971

(a) Includes sources such as transportation and lawn and garden equipment

(b) Includes mobile and stationary sources (e.g., power plants)

Source: Environment Canada (1995)

While specific estimates are not available for air pollutant emissions from lawn/garden equipment in Canada, Table 6 provides some information from the United States regarding emissions from small spark-ignition engines (mainly used in lawn/garden equipment) (Maillette, 2001). These figures indicate that small spark-ignition engines can be a significant source of carbon monoxide and hydrocarbon emissions.

Table 6: Distribution of Annual Emissions for Small Spark-Ignition Engines (15 kW) in the United States in 2000

	Emissions from Small Spark-Ignition Engines (% of Total Off-Road Emissions)	Total Off-Road Emissions (Metric Tons)
Carbon Monoxide	62.2	32,299,100
Hydrocarbons	40.8	4,022,300
Particulate Matter	10.6	508,400
Nitrogen Oxides	2.0	6,076,530

Source: Maillette (2001)

Health professionals have emphasized the need for reduced emissions from lawn/garden equipment. For example, the Ontario Task Force on the Primary Prevention of Cancer (1995) had recommended a decrease in emissions from two-stroke engines such as lawn mowers and chainsaws in order to address the health risks posed by motor fuel emissions.

As emissions controls on automobiles have become more effective, the relative contribution of emissions from small engines such as those found in lawn/garden equipment to overall air pollution has increased. The emissions from small engines are at a level comparable to the

passenger car engine from the 1960s (Rideout & Rostkowski, 1994). Small engines contribute more emissions per hour of use than cars which have complex emission control technology (U.S. EPA, 1995). Emissions from automobiles are 100 to 1000 times lower than those from small engines even though each automobile is typically operated between 100 and 1000 times longer than each small engine (Michigan State University, undated).

The importance of exhaust emissions from small engines must not be underestimated, especially not during the months of the year when recreational activities and lawn manicuring peak (Christensen & Westerholm, 2001). Lawn/garden equipment tends to be used mostly during hot summer months, when ground-level ozone is the highest. When lawn/garden equipment is used, there is a potential for emissions from unburned fuel. The loss of unburned fuel is the primary cause of the high hydrocarbon emissions from two-stroke engines; nearly one-third of the fuel going into a conventional two-stroke engine exits the exhaust pipe unburned (State of California Air Resources Board, 1998). The exhaust emissions from leaf blowers are consistent with the exhaust emissions of other, similar off-road equipment powered by small, two-stroke engines, such as string trimmers (California Air Resources Board, 2000). While leaf blowers and other lawn/garden equipment appear to be relatively small sources of air pollutants, their cumulative impacts on air quality can be quite significant. For example, the U.S. EPA has estimated that one hour of operation of a chainsaw emits the same amount of hydrocarbons as driving a passenger car 320 kilometres respectively (Rideout & Rostkowski, 1994).

Emissions from lawn/garden equipment can be reduced through enhanced technology. For example, one study found that significant reductions in carbon monoxide, hydrocarbon, nitrogen oxide and particulate matter emissions from lawn mowers can be achieved through the installation of catalytic converters (American Chemical Society, 2001; Christensen & Westerholm, 2001)

Canada is acting to reduce air pollutant emissions from lawn/garden equipment. For example, Environment Canada intends to proceed with the development of emissions control programs for off-road engines, under Division 5 of the Canadian Environmental Protection Act, aligned with the corresponding U.S. federal emissions control programs. These programs include development of proposed Regulations corresponding to the U.S. EPA Phase 2 program for spark-ignition gasoline engines (e.g., those used in lawn/garden equipment) (Canada Gazette, 2001). Environment Canada is currently working at improving predicting and reporting emissions inventories. One goal is to refine how emissions from the off-road sector are reported so it would be possible to present, for example, emissions from lawn/garden equipment. A collaborative working group involving Environment Canada, some provincial departments (including Ontario), industries and environmental non-governmental organizations is currently active in this area (Maillette, 2001).

Environment Canada recently entered into voluntary agreements, Memorandums of Understanding (MOUs), with manufacturers of small hand-held and non-handheld utility engines (Environment Canada, 2001b). A MOU with the Portable Power Equipment Manufacturers Association, commits manufacturers to supply engines for leaf blowers, string trimmers, and chainsaws to the Canadian market that comply with the U.S. EPA Phase 1 federal emission standards for non-road spark-ignition engines emissions starting in year 2000 (Environment Canada, 2000). Leaf blower manufacturers are developing new designs to reduce noise and to

change the quality of sound to make it less irritating (Portable Power Equipment Manufacturers Association, undated).

According to the World Health Organization (1999), the introduction of sound labelling is a major tool for reducing the noise emission of products on the market. Within the European Community, “permissible sound levels” and “sound power levels” must be stated for machines such as lawn mowers. The federal government in Canada has no regulatory standard for declaring noise emissions from lawn/garden equipment (Bly, 2001). While noise is not addressed directly by the proposed small equipment engines regulations being developed by Environment Canada, these regulations will probably create some reduction of noise level as the use of four-stroke engines by equipment manufacturers will probably increase with time (Maillette, 2001).

To date, standards-setting organizations such as the Canadian Standards Association (CSA) have not defined noise or exhaust emissions standards for manufacturers of gas-powered lawn/garden equipment. Health Canada has been helping to develop a CSA voluntary national standard of Canada for declaring noise emissions from machinery, such as lawn/garden equipment (Bly, 2001). The CSA (1999) standard for electric motor-operated gardening appliances (which applies to equipment such as leaf blowers and lawn mowers) does not address noise emissions.

Research conducted to date indicates that leaf blowers can contribute to community noise and promote hearing loss amongst equipment operators, and annoyance amongst residents. Without greater characterization of exposure, it is not possible at this time to conclusively define other types of health impacts of leaf blowers and other lawn/garden equipment on equipment operators or bystanders. It is also not possible for Toronto Public Health to define acceptable noise levels for lawn/garden equipment. Nonetheless, it is important to define health-protective provincial regulatory standards for lawn/garden equipment emissions in view of the widespread use of this equipment, their contributions to noise and air pollution, and the potential hearing loss and annoyance impacts on operators and bystanders respectively. These health-protective standards should focus on exhaust, evaporative fuel and noise emissions levels to be met by manufacturers. Quieter leaf blowers would reduce worker exposures to excessive noise and protect hearing, and reduce negative impacts on bystanders (California Air Resources Board, 2000). Reduced exhaust and evaporative emissions from gas-powered leaf blowers would contribute to improved air quality.

It is important that province-wide standards be established in order to achieve clean air in Ontario. It has been suggested by the Parks and Recreation Division that the development of health-protective provincial regulatory standards for lawn/garden equipment emissions should also take into account the value of the health and recreation benefit of lawns, and recreational and athletic turf (Tucker-Reid, 2001). It is recommended that the Ontario Ministry of the Environment initiate a multi-stakeholder process to develop health-protective standards for noise, exhaust and evaporative emissions from lawn/garden equipment. The Ministry used a multi-stakeholder process (involving City staff) to develop provincial noise emission standards for air conditioners (Vescio, 2001). Provincial health-protective standards for lawn/garden equipment could complement the new regulations under the Canadian Environmental Protection Act for air pollutant emissions from small equipment engines, reduce the formation of ground-level ozone (the principal component of smog) and result in a decrease of air pollution-related health problems for Ontarians.

The Ontario Ministry of the Environment has provided some preliminary feedback regarding the proposal for improved provincial regulatory standards for lawn/garden equipment and advised that “(S)uch an initiative is possible only through a formation of an Advisory Committee composed of a broad cross-section of the interest groups including representatives of manufacturing industry, research institutes, consultants and regulatory agencies. A successful development of such standards may require establishment of separate sub-committees, each dealing with narrowly defined specific issues, development and implementation of attitudinal survey, preparation of the standard and it may take a number of years to complete such work. Considering time and resources required, the Ministry is not in a position to initiate such a process.” (Krajewski, 2001).

The MOE has indicated that the most effective way to reduce the noise impacts of leaf blowers is to implement the 1994 Toronto Public Health staff recommendation “That the Federal Minister of Consumer and Corporate Affairs, in consultation with the Canadian Standards Association and representatives of manufacturer and consumer groups, develop a standard labelling protocol for noise emissions from small lawn and garden equipment to facilitate informed choice.”. The MOE has indicated that it could play a consultative role, should this initiative be undertaken (Krajewski, 2001).

B. Restrictions on Use of Leaf Blowers in Toronto

i) Restrictions on use of leaf blowers through the harmonized Noise By-law

Given the noise impacts of leaf blowers and continuing concerns expressed by residents regarding their operation, it is important that the harmonized Noise By-law include at minimum, restrictions on their days and hours of operation, and a maximum permissible sound level limit (as defined by the Ontario Ministry of the Environment in the multi-stakeholder process proposed previously). Urban Development Services staff have advised that a sound level limit of 70 dB(A) at 15 metres away is likely to be unenforceable. In order to take a sound level reading, full co-operation would be needed from the user of the leaf blower and it is highly unlikely that such cooperation will take place (Weinstock, 2001). With respect to sound level limits for leaf blowers, the Ontario Ministry of the Environment has indicated that it supports 70 dB(A) measured at 15 metres in view of the increasing number of leaf blowers used on private and public properties, lack of any regulatory controls (sound emission standards at the manufacturing stage) in Canada and the inherent tonality aspect of leaf blower operations (Krajewski, 2001). It is also prudent from a public health perspective, to consider other types of restrictions such as those possible with a leaf blower by-law.

ii) More comprehensive restrictions/operational guidelines on the use of leaf blowers through a leaf blower by-law

There are sufficient health and environmental concerns associated with the use of leaf blowers to warrant enhanced regulation to minimize air pollution, fugitive dust, and noise emissions. Other municipalities have enacted municipal leaf blower regulations (Appendix B and C) that may serve as a useful model for consideration in Toronto. A leaf blower by-law may be an effective public policy instrument to reduce exposure to noise, air pollutants and fugitive dust emissions.

Lawn and landscape contractors and homeowners who use leaf blowers, and people in the immediate vicinity of a leaf blower during and shortly after operation, are exposed to potentially high exhaust, fugitive dust, and noise emissions from leaf blowers on a routine basis. While exposures to carbon monoxide, particulate matter and noise may not have immediate, acute health effects, long term exposures can lead to chronic health effects (California Air Resources Board, 2000). Toronto residents experience a substantial burden of illness because of the quality of Toronto air and are being harmed by air pollution year round. Air pollution can affect all members of society. Children, the elderly and those with heart failure are most vulnerable (Medical Officer of Health, 2000a). While the harmonized Noise By-law for the City of Toronto proposes to restrict the days and hours of operation of leaf blowers, it cannot address the air quality impacts of leaf blowers.

Alternatives to leaf blowers are readily available. For example, rakes and brooms do not emit noise, exhaust or evaporative fuel. Electric leaf blowers are an alternative to gas-powered models. Electric leaf blowers tend to be less expensive than gas-powered models, with comparable performance on residential products (California Air Resources Board, 2000). Generally, electric equipment is cleaner than equipment powered by gasoline engines. Electric lawn and garden tools produce essentially no pollution from exhaust emissions or through fuel evaporation (U.S. EPA, 1996b). However, electric leaf blowers are still noisy and can re-entrain fine particulate matter.

Some municipalities in North America have enacted outright bans that prohibit the use of electrical or gasoline-powered leaf blowers. For example, twenty cities in the State of California have banned the use of leaf blowers, sometimes only within residential neighbourhoods and usually targeting gasoline-powered equipment (California Air Resources Board, 2000).

Other municipalities in Canada and the United States have restricted leaf blower use through Noise By-laws or Municipal Codes (See Appendix B and C for examples). Based on a review by Toronto Public Health staff, legislation in other municipalities in North America have included provisions such as:

- a prohibition on the use of gas-powered leaf blowers;
- a prohibition on leaf blower use of any type on City-owned or maintained property;
- a prohibition on use of gasoline or diesel-powered leaf blowers within 300 feet of residential property between specified times of the year (e.g., between June 15 and Sept. 15);
- other types of restrictions on leaf blower use in residential areas (e.g., operation for no more than fifteen minutes per hour on any one parcel of land; prohibition against blowing of leaves or other debris into the street, sidewalk, or beyond the parcel property line);
- a maximum permissible sound limit;
- requirements for:
 - the use of the full blower nozzle extension for maximum efficiency and to minimize the spread of dust;
 - the use of a mister or for surfaces to be moistened prior to blowing when leaf blowers are used in dusty conditions;
 - the disposal of debris in trash receptacles after leaf blower use;

- the leaf blower to be in proper working order and all manufacturer's noise and dust control equipment to remain on the leaf blower and be in operating condition;
- the operation of the leaf blower with the least amount of noise and at the lowest speed possible and use to be kept for as short a time as possible;
- commercial leaf blower operators to have in their possession a business license available for inspection on site; and
- a penalty for violation (e.g., fine).

There is a need for an opinion from the City Solicitor on a leaf blower by-law. It is recommended that the Board of Health request the City Solicitor to report on whether the City has authority to regulate and prohibit the operation of gas-powered leaf blowers within the City of Toronto. This report should also consider the findings of the ongoing air quality strategies policy and legal study being carried out by Works & Emergency Services.

Given the use of gas-powered leaf blowers by various parts of the Corporation, there is a need for consultation with the General Manager, Parks and Recreation Division; the Commissioner of Works & Emergency Services; and the Canadian Union of Public Employees (Local 416) regarding the potential impacts of a leaf blower by-law on the City's operations and suggested modifications to such a by-law.

The General Manager of the Parks and Recreation Division has provided preliminary input on the implications of a leaf blower by-law on the Division's operations (including budget impacts). The Parks & Recreation Division has indicated that there would be a significant cost in labour associated with the use of rakes and brooms instead of leaf blowers. The Parks & Recreation Division has also indicated that the use of electric leaf blowers is not possible in a park scenario without the use of a generator which would defeat the purpose (Tucker-Reid, 2001).

The General Manager of Transportation Services has indicated that although his staff already strive to comply with the noise control provisions contained within the various by-laws of the former municipalities, he would be willing to explore other options to reduce public exposure to air pollutants and dust emissions (Orpin, 2001). Concern was expressed, however, as to whether less polluting and quieter power equipment was commercially available. Regarding the option of use of manual equipment (e.g. rakes and brooms), concern was expressed about reduced efficiency and increased cost. Occupational health and safety issues were also raised, especially with manual leaf removal in the fall because staff would need to frequently bend under and around parked vehicles, putting them in close proximity to traffic and therefore increasing the likelihood of accidents. The General Manager of Transportation Services has indicated that the removal of leaves from City streets is an essential part of maintaining the efficiency of the sewer system and preparing the streets for winter services.

The Canadian Union of Public Employees (Local 416) has indicated that it is "...in agreement with a by-law to reduce noise levels and air pollution of leaf blowers and lawn mowers. Our members are exposed to the high levels of noise and harmful emissions from the exhaust fumes. Local 416 does have concerns of the subsequent effects the by-laws may have on our members. In the event of a "smog alert day" and the cessation of the use of gasoline powered equipment, there must be alternate work for those workers who would normally be assigned to use the

equipment. An alternate on these occasions would be the use of rakes and brooms. We also feel strongly that enforcement of by-laws should apply to contractors. This would ensure that city workers would not be at a disadvantage with respect to work performance and of productivity and efficiency measures.” (Ouellette, 2001).

C. Public Awareness on the Health and Environmental Impacts of Lawn/Garden Equipment

The City of Toronto should continue to include as part of public awareness on smog, information on the health and environmental impacts of two-stroke gasoline-powered lawn/garden equipment (e.g., noise, air pollutants, and fugitive dust emissions), the importance of wearing face masks and hearing protection as appropriate, and alternatives to their use (see Appendix D). It is recommended that the Board of Health forward this report to the Planning and Transportation Committee and the Works Committee for consideration. It is also important that the Planning and Transportation Committee seek public input on this report at Community Councils.

Conclusions:

Leaf blowers can contribute to community noise and promote hearing loss amongst equipment operators, and annoyance amongst residents. There is evidence that leaf blowers can contribute to poor air quality and that the health of Toronto residents is already adversely affected by current air pollution levels. The achievement of clean air in Toronto requires reductions in pollutants from many sources including leaf blowers. The harmonized Noise By-law proposed for Toronto can address only the noise aspects of leaf blower operations. There is sufficient health and environmental justification to merit exploration of enhanced regulation of leaf blower use such as a leaf blower by-law in Toronto to minimize exposure to noise, air pollutants, and fugitive dust emissions. In the interim, alternatives to leaf blowers (e.g., rakes, brooms) should be used where reasonable to minimize these emissions. Public input on this report should be obtained at Community Councils at the same time as public consultation on the draft harmonized Noise By-law.

References

Acting Commissioner of Public Works and the Environment. (January 10, 1996). Regulation of Leaf Blowers (All Wards). Report to City Services Committee, City of Toronto.

Agency for Toxic Substances and Disease Registry. (1997). Healthy Children, Toxic Environments: Report of the Child Health Workgroup. Atlanta: ATSDR.

American Chemical Society. (2001). One hour of grass cutting equals 100 miles worth of auto pollution. On-line: <http://center.acs.org/applications/news/story.cfm?story=577>

Anonymous. (1997). The world's quietest power blower? Consumer Reports April, p. 8.

Berglund, B., and Lindvall, T. (1995). Community Noise. Prepared for the World Health Organization. Archives of the Centre for Sensory Research, Vol. 2, Issue 1, 1995. Stockholm University and Karolinska Institute.

Bly, S. (2001). Health Canada. Personal Communication.

California Air Resources Board website: <http://arbis.arb.ca.gov/html/gloss.htm>

California Environmental Protection Agency Air Resources Board. (2000). A Report to the California Legislature on the Potential Health and Environmental Impacts of Leaf Blowers. State of California Air Resources Board Mobile Sources Control Division.

Canada Gazette. Vol. 135, No. 7. Part I. Ottawa, Saturday, February 17, 2001.

The Canadian Hearing Society. May 1991. Noise at Home. Fact Sheet.

Canadian Standards Association. (1999). Motor-Operated Gardening Appliances.

Christensen, A. and Westerholm, R. (2001). Measurement of regulated and unregulated exhaust emissions from a lawn mower with and without an oxidizing catalyst: A comparison of two different fuels. Environmental Science & Technology 35(11).

City Solicitor. (January 8, 1996). Further Authority to Regulate or Prohibit the Use of Leaf Blowers – All Wards.

City Solicitor. (May 30, 1995). Regulation of Leaf Blowers (Clause 45, City Services Committee Report No. 8). City of Toronto: Report to City Council.

City Solicitor. (May 30, 1995). Regulation of Leaf Blowers. City of Toronto: Report to City Council.

City Solicitor. (May 30, 1995). Use of Leaf Blowers. City of Toronto: Report to City Services Committee.

City Solicitor and the Commissioner of Public Works and the Environment. (January 6, 1994). Regulation of Leaf Blowers – Application for Special Legislation. City of Toronto: Report to City Services Committee.

City of Toronto Finance Department Purchasing and Materials Management. Specification #065-6039.

Commissioner of Public Works. (June 1, 1990a). Regulation of Noise from Leaf Blowers. City of Toronto: Report to City Services Committee.

Commissioner of Public Works. (September 4, 1990b). Time Restrictions on the Use of Leaf Blowers. City of Toronto: Report to City Services Committee.

Commissioner of Public Works and the Environment. (January 10, 1996). Regulation of Leaf Blowers.

Commissioner of Public Works and the Environment. (1994). City of Toronto Noise Control Programme Progress Report No. 3.

Commissioner of Public Works and the Environment. (1993). Report re: Noise By-law review and amendments. City of Toronto.

Cowan, J.P. (1994). Educating the public on environmental and recreational noise exposure, pp. 14-20. In Handbook of Environmental Acoustics. New York.

Dill, P., Basrur, S.V., Gutteridge, B. (2000). Harmonization of the Noise By-law. City of Toronto: Report of Commissioner of Urban Development Services, Medical Officer of Health, Commissioner of Works & Emergency Services to the Toronto Board of Health.

Environment Canada. (2001a). Speaking Notes for the Hon. David Anderson, P.C., M.P., Minister of the Environment at the News Conference on Securing Clean Air for Canadians: Update 2001. Ottawa, Ontario. February 19, 2001. Available on-line: http://www.ec.gc.ca/minister/speeches/2001/010219_s_e.htm

Environment Canada. (2001b). Support Document to the Notice of Intent on Cleaner Vehicles, Engines and Fuels.

Environment Canada. (2000). Government and Industry Working Together for Cleaner Engines in Canada. Available on-line: http://www2.ec.gc.ca/air/engines_e.htm

Environment Canada. (1999). The two-stroke solution. Science and the Environment Bulletin. Available on-line: http://www.ec.gc.ca/science/sandejuly99/PrintVersion/print3_e.html

Environment Canada. Natural Resources Canada. Transport Canada. Agriculture Agri-Food Canada. (May 1999). Phase 3 Federal Smog Management Plan Discussion Document for Stakeholder Consultations June, 1999.

Environment Canada. (1995). Criteria Air Pollutant Emissions (CAPE). Available on-line: http://www.ec.gc.ca/pdb/ape/ape_tables/canada95_e.cfm

Environment Canada. (1994). Lawn Mower Use and Emissions in Canada. Report EPS 5/AP/6.

Environmental Task Force. (February 2000). Environmental Plan, Clean, Green and Healthy, A Plan for an Environmentally Sustainable Toronto. City of Toronto.

Government of Canada, Environment Canada, and Health and Welfare Canada. (1993). Benzene. Canadian Environmental Protection Act Priority Substances List Assessment Report.

Greer, T. (January 19, 1995). Correspondence to Dr. Perry Kendall regarding employee health and safety impacts of leaf blower.

Health Canada and Environment Canada. (1999). National Ambient Air Quality Objectives for Ground-level Ozone, Science Assessment Document. Health Canada and Environment Canada, Ottawa.

Hiscocks, D., Detlor, T., Eberle, M., Hannigan, E., Jang, B., Kainer, S., Noble, M., Pichora-Fuller, K., Silverson, R., and Turax, B. (April 1997). City Noise. Report of the Urban Noise Task Force City of Vancouver.

Industry Canada Information Centre. (September 19, 2000). Personal Communication.

Krajewski, C. (2001). Ontario Ministry of the Environment. Personal Communication.

Korte, C. & Grant, R. (1980). Traffic noise, environmental awareness, and pedestrian behavior. Environment & Behavior, 12: 408-420.

Korte, C., Ypma, I., and Toppen, A. (1975). Helpfulness in Dutch society as a function of urbanization and environmental input level. Journal of Personality and Social Psychology, 32:996-1003.

Maillette, J. (2001). Environment Canada Regulatory Development. Personal Communication.

Mathews Jr., K.E., & Canon, L. (1975). Environmental noise level as a determinant of helping behavior. Journal of Personality and Social Psychology, 32:571-577.

Medical Officer of Health. (May 18, 2000a). Air Pollution Burden of Illness in Toronto – Summary Report. Report to Board of Health, City of Toronto.

Medical Officer of Health. (March 23, 2000b). Health Effects of Noise. Report to Board of Health, City of Toronto.

Medical Officer of Health. (1994). Health and Environmental Impacts of Leaf Blowers. City of Toronto: Report to Board of Health.

Michigan State University. (undated). Small-Engine Emissions Research. Available on-line: <http://www.egr.msu.edu/ERL/emiss/emiss.htm>

Minutes of Toronto City Council. (July 14, 1997). Executive Committee Report No. 18 Clause 8 Catching Your Breath – A Corporate Model for Clean Air.

National Toxicology Program. (2000). Report on Carcinogens. U.S. Department of Health and Human Services.

Noise and Hearing Loss. NIH Consensus Statement Online 1990 January 22-24: 8(1):1-24.

Noise Pollution Clearinghouse. (1998). Personal Communication.

Ontario Medical Association. (1998). OMA Ground Level Ozone Position Paper. Toronto: OMA.

Ontario Ministry of the Environment. (1998). Air Quality in Ontario 1996. Ontario Ministry of the Environment: Toronto.

Ontario Task Force on the Primary Prevention of Cancer. (1995). Recommendations for the Primary Prevention of Cancer.

Orange County Grand Jury. (1999). Leaf Blower Pollution Hazards in Orange County. Orange County Council of Governments.

Orpin, R. (2001). Works & Emergency Services Transportation Services. Personal Communication.

Page, R.A. (1977). Noise and helping behavior. Environment & Behavior, 9:311-334.

Portable Power Equipment Manufacturers Association. (undated). Available on-line: <http://www.ppema.org>

Priest, M.W., Williams, D.J., and Bridgman, H.A. (2000). Emissions from in-use lawn-mowers in Australia. Atmospheric Environment 34, 657-664.

Rideout, G. and Rostkowski, J. (1994). Exhaust Emissions from Small Engines. MSED Report #94-11. Environment Canada: Environmental Technology Centre Mobile Sources Emissions Division. Unpublished report.

State of California Air Resources Board. (1998). Public Hearing to Consider Amendments to the 1999 Small Off-Road Engine Regulations. Staff Report.

Talbott, E., and Thompson, S.J. (1995). Health effects from environmental noise exposure. In Introduction to Environmental Epidemiology. pp. 209-219. New York: Lewis Publishers.

Tauro, D., and Mann III, J.A. (1997). Test rig for studying lawn mower blade noise. Noise Control Engineering Journal 45(2), 95-99.

Toronto Public Health. (December 2000). Toronto's Air: Let's Make it Healthy.

Tucker-Reid, C. (2001). City of Toronto Parks & Recreation Division. Personal Communication.

United States Environmental Protection Agency. (1998). Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling. EPA Office of Mobile Sources. Report No. NR-005A. Available on-line: <http://www.epa.gov/otaq/models/nonrdmdl/nr-005a.pdf>

United States Environmental Protection Agency. (1996a). Environmental Health Threats to Children. Washington, DC: US EPA.

United States Environmental Protection Agency. (1996b). Your Yard and Clean Air. EPA Environmental Fact Sheet. Available on-line: <http://www.epa.gov/otaq/19-yard.htm>

United States Environmental Protection Agency. (1995). Preventing Pollution in Your Backyard: Emissions from Lawn and Garden Equipment. Fact Sheet.

United States National Institutes of Health, National Institute on Deafness and other Communication Disorders. (2001). Protect Your Ears. Available on-line: http://www.nidcd.nih.gov/health/pubs_hb/ruler.htm

United States Institute of Health. (1990). Consensus Statement on Noise and Hearing Loss.

Vescio, G. (2001). Urban Development Services. Municipal Licensing and Standards. Personal Communication.

Weinstock, F. (2001). Urban Development Services. Municipal Licensing and Standards. Personal Communication.

Wong, W. (2001). California Air Resources Board. Personal Communication.

World Health Organization. (1999). Guidelines for Community Noise. Edited by Birgitta Berglund, Thomas Lindvall, Dietrich H. Schwela.

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Appendix A: Recommendations of Toronto Public Health Staff Report (1994), “Health and Environmental Impacts of Leaf Blowers”

Appendix B: Examples of Municipal Code Restrictions on Operation of Leaf Blowers in Cities In the State of California

Appendix C: Examples of Noise By-law/Ordinance Restrictions on Operation of Leaf Blowers In Canada and the United States

Appendix D: Alternatives to Gas-Powered Lawn and Garden Equipment

Appendix A: Recommendations of Toronto Public Health Staff Report (1994),
“Health and Environmental Impacts of Leaf Blowers”

1. That the Federal Minister of Consumer and Corporate Affairs, in consultation with the Canadian Standards Association and representatives of manufacturer and consumer groups, develop a standard labelling protocol for noise emissions from small lawn and garden equipment to facilitate informed choice.
2. That the Board of Health request the Federal Minister of the Environment, the Ontario Minister of the Environment and the Canadian Council of the Ministers of the Environment, to monitor and assess the United States Environmental Protection Agency’s proposed regulation of air emissions from small engines, including leaf blowers, with the view to adopting similar standards in Canada.
3. That in its undertaking of public awareness activities aimed at reducing vehicle use and mobile engine emissions, the Healthy City Office include information about emissions from small engine powered lawn and garden equipment. Such information may also extend to noise emissions since both vehicular traffic and small engines contribute significantly to urban background noise.
4. That the City of Toronto develop criteria for purchasing new lawn and garden equipment, and related contracting services, based on the best available technology to limit noise levels and air emissions.
5. That the Commissioner of Public Works and the Commissioner of Parks and Recreation ensure that City staff employing leaf blowers be made aware of appropriate practices concerning the safe and courteous use of the equipment to reduce public exposure to noise and dust.
6. That the Executive Director of Management Services ensure that all occupational health standard regarding exposure to noise and inhalation of dust and fumes are met for City employees using leaf blowers.
7. That the Commissioner of Public Works and the Environment and the Commissioner of Parks and Recreation report to the Board of Health on the feasibility of reducing their use of small engine powered lawn and garden equipment, including leaf blowers.
8. That the Board of Health express its concern that small combustion engines, including leaf blowers, are an environmental problem in the city and request the Commissioner of Public Works and the Environment and the Commissioner of Parks and Recreation to report to the Board of Health for its next meeting on December 15, 1994, on why they think the use of leaf blowers is necessary in the City.

9. That the Medical Officer of Health be requested to report to the Board of Health on the possibility of further study, either internally or by other sources, including health agencies such as The Lung Association, institutions of learning, and other levels of government.
10. That the Board of Health request the Commissioner of Public Works and the Environment to ensure adherence to the Noise By-law that leaf blowers are not exceeding 70 dB(A) when measured at 15 metres from the source.
11. That the Medical Officer of Health be requested to report to the Board of Health in early 1995 on the status of the above recommendations.

Appendix B: Examples of Municipal Code Restrictions on Operation of Leaf Blowers in Cities In the State of California

City	Municipal Code Provision
Beverly Hills	Prohibition against the use or operation of any portable machine powered with a gasoline engine to blow leaves, dirt, and other debris off sidewalks, driveways, lawns, or other surfaces
Hermosa Beach (located within the County of Los Angeles)	Prohibition against the use or operation or allowing the use or operation of any portable machine powered with a combustion or gasoline engine used to blow leaves, dirt and other debris off sidewalks, driveways, lawns and other surfaces
Los Angeles	Between the hours of 7:00 a.m. and 10:00 p.m., in any residential zone of the City or within 500 feet thereof, prohibition against the operation of a backpack blower that produces a maximum noise level exceeding 65 dB(A) at a distance of 50 feet
Malibu	Prohibition against the use of any portable machine powered with a combustion/gasoline engine used to blow leaves, dirt and other debris off sidewalks, driveways, lawns and other surfaces
Santa Monica	Prohibition against the operation of any motorized leaf blower within the City
West Hollywood	Prohibition against the use or operation or allowing the use or operation of any portable machine powered leaf blower with a combustion or gasoline engine used to blow leaves, dirt and other debris off sidewalks, driveways, lawns and other surfaces

Appendix C: Examples of Noise By-law/Ordinance Restrictions on Operation of Leaf Blowers
In Canada and the United States

JURISDICTION	
Canada	
City of Calgary Noise By-law #45M95	Prohibition against the operation of a motorized garden tool in a residential development (e.g., the site of a residential development) during the night-time (the period beginning at 10:00 p.m. and ending the following day at 7:00 a.m. if the following day is a weekday; or 9:00 a.m. if the following day is a weekend)
City of Ottawa Noise By-law 3-97	Maximum sound level of 78 dB(A)
City of Regina Noise Abatement By-law #6980	General prohibition against any noise that is a disturbance to others between 10:00 p.m. and 7:00 a.m. No maximum sound level specified
City of Vancouver Noise Control By-law # 6555	Maximum sound level of 77 dB(A) on an approved sound meter when received at 15.2 metres or a point of reception
United States	
City of Del Mar, California Noise Regulations	Prohibition against the use or operate within the City, any portable machine, powered with a gasoline engine or electric motor, to blow leaves, dirt and other debris off sidewalks, driveways, lawns, and other surfaces
City of Malibu, California Noise Ordinance	Prohibition against the use or operation of any portable machine powered with a combustion or gasoline engine used to blow leaves, dirt and other debris off sidewalks, driveways, lawns and other surfaces
New York City, State of New York Noise Code	Prohibition against the operation of leaf blowers: i) before 8:00 a.m. and after 7:00 p.m. or sunset, whichever occurs later; or ii) at any time in such a way as to create an unreasonable noise Exemption to paragraph (i) for department of parks and recreation who operate leaf blowers in any location more than 300 feet from any building that is lawfully occupied for residential use employees between 7:00 a.m. and 8:00 a.m

Appendix D: Alternatives to Gas-Powered Lawn and Garden Equipment

Type of Equipment	Alternative
Leaf Blowers	<p>Ignore the leaves (they return nutrients to the soil)</p> <p>Rake</p> <p>Corded electric leaf blower</p> <p>Cordless (battery) electric leaf blower</p>
Lawn Mowers	<p>Eliminate the lawn and replace it with garden or natural local flora.</p> <p>Plant native wildflowers and plants (these require little to no maintenance after planting).</p> <p>Low-maintenance turf grasses or grass/flower seed mixtures that grow slowly and require less mowing. (Check with your lawn and garden center about what is appropriate.)</p> <p>Decrease lawn area. Plant additional trees and shrubs to reduce the energy costs of heating and cooling your house and to provide landscaping for wildlife.</p> <p>Push reel mower</p> <p>Corded electric lawn mower</p> <p>Cordless (battery) electric mower</p> <p>Automatic cordless electric mower</p>
Weed-Whackers (Line-Trimmers)	<p>Corded electric line-trimmer</p> <p>Cordless (battery) electric line-trimmer</p>
Chainsaws	Corded electric chainsaws

Source: <http://www.ecogonics.com/en/smallpol.htm>
 U.S. EPA (1996b). Your Yard and Clean Air. EPA Environmental Fact Sheet.
 Available on-line: <http://www.epa.gov/otaq/19-yard.htm>