TORONTO

STAFF REPORT
ACTION REQUIRED

Local Air Quality Study of Ward 5 and Ward 6

Date:	February 14, 2014
To:	Parks and Environment Committee
From:	Josie Scioli, Chief Corporate Officer
Wards:	Wards 5 and 6
Reference Number:	P:\2014\Internal Services\E&E\Pe14001ee – (AFS17006)

SUMMARY

On January 15th, 2014 the results of a City-initiated study of local air quality in Wards 5 and 6 (Etobicoke-Lakeshore) were presented to local residents at a public open house. Using established air quality models approved by the Ontario Ministry of Environment and verified against monitored data from the Ministry's four monitoring stations located in Toronto, the study identified expected concentrations of 30 contaminants using average and worst case 24-hour conditions. Analysis was also conducted to estimate the relative contributions of contaminants from sources in northeastern United States, southern Ontario and Toronto and by source type, including industrial, vehicular, residential and commercial sources.

Assessment of the 30 contaminants showed four substances to be of concern when compared to ambient air benchmarks from the Ministry of Environment and other similar benchmarks. The four contaminants of most concern are : oxides of nitrogen, benzene, particulate matter less than 10 microns, and particulate matter less than 2.5 microns. A fifth contaminant, benzo(a)pyrene may also be of concern, but further research is still required and being undertaken.

All five of these contaminants are produced from a variety of sources, but in Wards 5 and 6, the most significant source of concern is that of motor vehicles, in particular the emissions tied to the volume and type of motor vehicle traffic travelling Highway 427 and the Gardiner Expressway.

Utilizing the results of the local air quality study, Toronto Public Health assessed the cumulative health impacts of three sub groups of the 30 contaminants. These three groups are:

- non-carcinogens (toxic, non-cancerous contaminants);
- carcinogens (cancerous contaminants); and
- criteria air contaminants.

Based on the findings of the air quality study, Toronto Public Health prepared a health assessment estimating the cumulative health impacts of air pollution in the area. The health assessment (as summarized in Appendix A) found that most of the 30 air contaminants selected for this study, mainly the non-carcinogenic ones, occur below levels of concern to health in Wards 5 and 6 even when the combined exposure is taken into account. However, it is possible that some carcinogens are present at levels above the one in one million excess cancer risk benchmark. Other pollutants such as nitrogen dioxide and particulate matter are also found at levels that are known to have an adverse impact on health. These findings suggest that further actions are needed to reduce local air pollution and improve health for Torontonians.

RECOMMENDATIONS

The Chief Corporate Officer recommends that:

1. City Council direct the Director of the Environment and Energy Division in collaboration with the Medical Officer of Health, to investigate and undertake appropriate actions to encourage a reduction in truck emissions, such as seeking federal support for improved truck emissions standards across North America.

2. City Council direct the Chief Corporate Officer to report to City Council in 2015 on the results of additional local air quality studies and such report discuss the initiatives of appropriate City Divisions, Agencies and Corporations taken to support local residents in improving their local air quality and natural environment.

3. City Council request the Ontario Ministry of the Environment to:

    a. further measure, assess, verify and address the findings of the study especially for the compounds identified to exceed the Ministry's Ambient Air Quality Criteria; and

    b. install and locate air monitors in proximity to major highways in Toronto and publish all such relevant data.

4. City Council forward this report to the Board of Health for information purposes.

Financial Impact

The local air quality study of Wards 5 and 6 (Etobicoke-Lakeshore) was conducted by City staff. During 2013, a total of $0.050 million was spent, funded by the Environmental Reserve Funds, on professional services to create the required base information in preparation for the future studies.

Six additional local air quality studies, involving 12 to 15 City wards, will be carried out over 2014 and 2015. Funding in the amount of $0.255 million gross and $0 net, funded from the Environmental Reserve Funds, is available in the 2014 Council Approved Operating Budget for the Environment and Energy Office within Facilities Management and Real Estate and continuous funding will be requested through an annual budget process in the 2015 Operating Budget Submission.

The Chief Financial Officer and Deputy City Manager has reviewed this report and agrees with the financial impact information.

DECISION HISTORY

On April 12, 2005 the Board of Health in its consideration of the Air Emissions and Health Status studies undertaken for the South Riverdale and The Beaches communities as part of the Ashbridges Bay Treatment Plant Environmental Assessment recommended that a study be conducted to examine the air quality impact of emissions of sources for these communities (http://www.toronto.ca/health/hphe/pdf/abtp_board_of_health.pdf).

On January 27, 2012, the Parks and Environment Committee considered the report, *Local Air Quality Study of Ward 30 and Ward 32*), and referred it to the Board of Health (http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2012.PE10.2).

At its meeting of February 27, 2012, the Board of Health considered the report from the Medical Officer of Health on the *Cumulative Health Impact Assessment of Air Quality in Wards 30 and 32* and requested the Medical Officer of Health to report back to the Board of Health as to the process on prioritizing which Wards will be selected for the Health Impact Assessment of Air Quality (http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2012.HL11.2).

On April 10 and 11, 2012 City Council adopted the report *Cumulative Health Impact Assessment of Air Quality in s 30 and 32.* When considering that report, City Council directed that a similar study of local air quality be conducted for Ward 5 and Ward 6 (Etobicoke-Lakeshore) and that the findings be presented to the Parks and Environment Committee upon completion of the study (http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2012.HL11.2).

This report has been prepared in collaboration with the Medical Officer of Health.

ISSUE BACKGROUND

Local air quality in Wards 5 and 6 has been an issue in the community for many years. Initial community concerns focused on the emissions coming from the former coal-powered Lakeview Generating Station in south eastern Mississauga, as well as the emissions from several large industries. Community concern currently focuses on concrete batching plants and large trucking and delivery companies in the area.

The purpose of the local air quality study in Wards 5 and 6 was to:

a. identify the sources and concentration of 30 substances that have the most potential to impact on local air quality;
b. determine which, if any, of the air contaminants are exceeding desirable air quality standards;
c. assess what, if any, might be the cumulative human health impacts of all 30 substances; and
d. identify strategies with the community to help reduce exposure and improve the health of residents in this community.

The study of Wards 5 and 6 is the second in a series of local air quality studies that are being undertaken in neighbourhoods across the city. The first local air quality study took place in 2011 in Wards 30 and 32 (South Riverdale, Leslieville and Beaches).

The local air quality study of the Wards 5 and 6 uses a simulated air quality model to produce data and maps of average and daily maximum concentrations of thirty air pollutants from all emission sources such as industrial, commercial, residential, transportation-related, agricultural and natural sources, that when combined may have an impact at the neighbourhood level.

In addition, the study included information about pollutants emitted from local sources, as well as, pollutants emitted in other parts of Ontario and Northeastern United States. This information was combined with information about local weather patterns so that the model could predict the total local concentrations of each pollutant across Wards 5 and 6.

The estimated concentrations of pollutants were then compared against air quality standards or health benchmarks to identify if releases could result in levels of concern in a specific area. The air quality standards used were:

- Ambient Air Quality Criteria (AAQC), established by the Ontario Ministry of the Environment; and

- Canada Wide Standards (CWS), adopted by the Canadian Council of Ministers of the Environment.

COMMENTS

In 2009, the City contracted Golder Associates to complete a report called "*An All Sources Cumulative Air Quality Impact Study of South Riverdale-Leslieville-Beaches*" which can be found on the City's website at: http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=95cf9bc4a5991410VgnVCM10000071d60f89RCRD. This report details the data sources and the other inputs that went into the air quality computer model as well as their analysis and conclusions respecting Wards 30 and 32.

Following the completion of the work by Golder Associates, the Environment and Energy Division re-ran the model to extract contaminant concentrations specific to Wards 5 and 6. The results of the study were provided to Toronto Public Health for their cumulative health impact assessment of three groups of pollutants: carcinogens, non-carcinogens, and criteria air contaminants which are included in Appendix A of this report.

Citizen Liaison Committee and Public Meetings

To ensure that the concerns of local residents were considered in the study, the City engaged the public through a Community Liaison Committee comprised of community residents, Councillor's representatives and staff of the Ministry of the Environment. An Industry Liaison Committee comprised of representatives of local industry was also established. Both committees formally met twice with City staff to discuss the study and review preliminary results.

A public evening meeting was held on January 15, 2014 at the Assembly Hall (Lakeshore and Kipling) to provide the public with study findings and next steps. Approximately 60 people attended and expressed their concern regarding the health impacts related to local air quality. Participants stressed the need for regulatory action to reduce pollution from industrial sources.

Participants were informed that ChemTRAC data (obtained through Toronto's Environmental Reporting and Disclosure Bylaw) would be used to improve future estimates of the cumulative exposure in these and other Toronto neighbourhoods and that updated results would be communicated to the community when available.

Study's Main Findings

The air quality issues in Ward 5 and 6 of most concern are those that are related to exposure to traffic emissions from specific highways. The main contaminants of concern from traffic emissions are oxides of nitrogen, benzene, particulate matter less than 10 microns (PM_{10}), and particulate matter less than 2.5 microns ($PM_{2.5}$). Exposures to site-specific industrial emissions as well as exposure to emissions from residential and commercial areas are generally lower. Key points and findings are discussed below.

Traffic Related Emissions

Traffic related emissions include tailpipe emissions, as well as, the fine particles that come from the wearing down of vehicle tires and road surfaces. The areas of Wards 5 and 6 that are adjacent to the Highway 427 and the Gardiner Expressway / Queen Elisabeth Way are the areas of most concern.

Vehicle emission concentrations relate directly to the volume and types of vehicle that use each road. As such the higher volume of traffic and the associated greater emissions from Highway 427 and the Gardiner Expressway are cause for greater concern than the transportation emissions concentrations seen in other parts of Wards 5 and 6. It should be noted that the elevated contaminant concentrations adjacent to Highway 427 and the Gardiner are greater than those adjacent to the Don Valley Parkway, as studied previously in Wards 30 and 32.

Traffic- related emissions from vehicles using all highways in Toronto (i.e. Hwy 401, Hwy 400, Hwy 427, the Gardiner-QEW and the Don Valley Parkway) appears likely to cause elevated air quality concentrations of concern for residents and business in all areas of Toronto that are adjacent to these highways. Further study and reporting is expected to confirm this.

Site Specific Industrial Emissions

Industrial emissions from within and upwind of Wards 5 and 6 have long been a focus of public interest for Etobicoke-Lakeshore residents. The recent air quality modelling study of Wards 5 and 6, in combination with information and assessment of data subsequent to the study year, shows that industrial emissions and their resultant local concentrations are declining from previous levels and are less of an exposure source than transportation emissions.

Industrial emissions reported through federal and provincial regulations (e.g. the National Pollution Release Inventory (NPRI)) have declined in Wards 5 and 6. The three main reasons are:

- industries have closed and/or moved away;
- industries have reduced their processing lines (but these could be re-activated); and
- industries have improved their processes and reduced air emissions.

Because the industrial emissions data used in the model was from 2006, the study identified some areas of elevated pollution concentrations. Examination of more recent data (2011) from NPRI and discussions with the Ontario Ministry of Environment and members of the Industrial Liaison Committee identified that the industries in the areas of elevated pollution concentrations have, since 2006, reduced their emissions by between 75% and 80% or identified that an industry has since closed.

Since 2006, there have been new industries locating in the community and there are concerns among local residents about the emissions to air associated with activities located adjacent to residential areas. Of particular local concern are emissions from concrete batching plants which combine the ingredients required to make concrete. The operation of concrete batching plants include activities that lead to air emissions as dust associated with both the combining of the ingredients as well fine particulate matter ($PM_{2.5}$) emissions associated with the trucks coming and going from the facilities and idling while waiting to enter the facility.

These emissions are not currently included in the air quality model. The emissions associated with the mixing process are not, and cannot be, included in the air quality model as no data exists from any known source to reflect such dust emissions appropriately. Further work will be undertaken in order to determine if data improvements can be established and modelled appropriately.

Area-Wide Multiple Small Source Emissions

Area-wide multiple small source emissions include emissions from residential and commercial natural gas burning furnaces and boilers (used for space and water heating), gas powered lawnmowers and barbeques, as well as emissions associated with vehicles along arterial roads and local roads.

The pollutants that are emitted by vehicles on highways and by vehicles on local roads are the same, but they also differ considerably because of the varying traffic volumes and the varying proportion of heavy trucks on highways versus local residential streets. Consequently, although the emissions are the similar, the exposure level to air emissions is locally different. Along, and adjacent to, the major highways, such as Highway 427 and the Gardiner Expressway, the elevated exposure of traffic related contaminants is pronounced. However, within residential areas and along less travelled arterial and local roads, the exposures to traffic emissions are much less pronounced.

Typically, small source emissions do not result in geographic areas of high concentration that exceed current standards. Equally typically, they create more uniform background concentrations across neighbourhoods rather than locally elevated concentrations as along highways. However, such background concentrations are significant enough to warrant local improvement actions be undertaken.

Overview of the Local Air Quality Modelling Approach

The report by Golder Associates incorporated emissions from all different types of sources: industrial, commercial, residential, agricultural, natural, and transportation-related. Information about air pollutants emitted from sources in Ontario (aside from Toronto) and the United States were included with local sources within Toronto and dove-tailed with information about distant and local weather patterns to predict the total ground level concentrations of 30 selected air contaminants of concern.

The air quality model incorporated the weather patterns (meteorology) and air emissions that affect local air quality and calculated ground level pollutant concentrations at 1048 receptor points (or "virtual air monitoring stations") that were spaced equally throughout the study area.

Additional receptor points were used to provide comparisons between the modelled ground level concentrations with actual air monitoring station concentrations. The comparison between predicted modelling results (virtual stations) and monitored data (physical stations) are very good for the air contaminants that are monitored (only 11 of the 30 substances modelled in this study are monitored by the Ministry of the Environment or Environment Canada).

Data Sources

The air quality model developed for the Wards 5 and 6 study area included sources from as far away as Indiana and Sudbury to sources as local as vehicle tailpipes and small auto-body shops. The air emissions data used in the model consisted of three study specific sub-areas covering: (i) the Great Lakes states and provinces (including in whole or in part – Michigan, Illinois, Indiana, Ohio, Kentucky, West Virginia, Virginia, North Carolina, Maryland, Pennsylvania, and New York - as well as northern Ontario and southern Quebec); (ii) southern Ontario; and (iii) Toronto. The Great Lakes states and provinces were modeled using a 36 km x 36 km grid size; southern Ontario was modeled using a 12 km x 12 km grid size; and Toronto was modeled using a 1 km x 1 km grid size.

Standard detailed emission estimation techniques were used to quantify the emissions from all these geographic areas. In addition, the model varied the emissions from all three areas (United States, Ontario and Toronto) and from all sources (residential, commercial, industrial, transport, agricultural and biogenic) temporally to more closely resemble expected timing of when the emissions would typically occur.

Substances Modelled

The 30 Priority Air Contaminants (listed in Table 1 below) identified and modelled as part of the study include the City's Environmental Reporting and Disclosure priority substances as well as Criteria Air Contaminants identified by the Ontario Ministry of the Environment and by Environment Canada.

Table 1 – Contaminants of Concern Modelled in the Local Air Quality Study

Acetaldehyde	1,2-Dichloroethane	$PM_{2.5}$ * [2]
Acrolein	Dichloromethane	Tetrachloroethylene
Benzene	Ethylene dibromide	Toluene
1,3-Butadiene	Formaldehyde	Trichloroethylene
Cadmium	Lead	Vinyl Chloride
Carbon tetrachloride	Manganese	Carbon Monoxide *
Chloroform	Mercury	PM_{10} * [2]
Chloromethane	Nickel Compounds	Sulphur Dioxide *
Chromium	Nitrogen Oxides *	VOC (Anthropogenic & Biogenic) * [3]
1,4-Dichlorobenzene	PAHs (as B[a]Ps) [1]	Ozone *

* Criteria Air Contaminants (CACs)

Notes: 1. PAH (as B[a]Ps) refers to "Polycyclic-aromatic hydrocarbons as Benzo[a]pyrene"; B[a]P is used as a surrogate for the whole PAH family of compounds

2. PM_{10} and $PM_{2.5}$ are two separate components of PM (Particulate Matter) where PM_{10} is particulate matter less than 10 microns and $PM_{2.5}$ is particulate matter less than 2.5 microns

3. VOC are volatile organic compounds

Modelling System

Three key factors combine to influence air quality: air emissions, weather patterns, and the physical environment. The model used in this study works to mimic these three factors, using modelling systems to simulate local source of air pollution and pollutants from the Northeastern United States, Ontario and Toronto.

The modelling systems used are CALPUFF and Penn State MM5. CALPUFF provides simulations of atmospheric pollution dispersion and is used by the United States Environmental Protection Agency. The MM5 model provides detailed simulations of the actively changing state of weather across our three large geographic areas for the selected year. A full year (2006) of detailed hourly meteorological data was used to drive the model and to ensure better consistency across the three study areas and between the interacting weather systems within the model.

Validation of Results

Physical air quality monitoring stations remain the standard benchmark against which modelled concentrations are judged and compared. The air quality model employed in this study created approximately (1048 virtual air monitoring stations in Wards 5 and 6 to display the same data as four physical monitoring stations located in Toronto.

The average monitoring (physical stations) to modelling (virtual stations) ratio was 1:1.03, which identifies high validity in the conclusions drawn from the modelled results.

Sources of Air Pollution

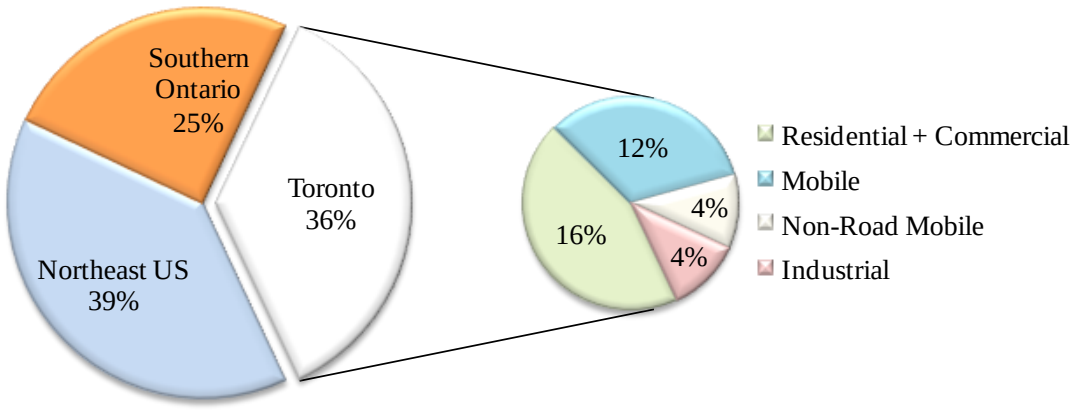
The influence of upwind air emissions from the United States and Ontario on Toronto's air quality has long been recognized. More than 95% of all of the emissions modelled in this study originate the USA, and a further 4% of all of the emissions modelled originate in Ontario (excluding Toronto). The influence of such upwind sources at ground level ("nose level") is diminished as they travel towards and over Toronto. Effectively, by the time those emissions cross over Toronto, the bulk of them pass too far overhead to significantly impact local air quality at ground level.

However, sufficient pollution from the northeast USA and Ontario does impact ground level exposure in Toronto to be a concern. Almost 40% of the air pollution at ground level across Toronto originates in the US and a further 25 % originates in Ontario beyond Toronto.

Distant upwind sources create background pollution levels that are largely uniformly mixed such that they cause uniform concentration contribution levels within distant downwind areas. Less distant upwind sources such as those that come from elsewhere within the GTA, or more specifically those that come from sources immediately adjacent to Ward 5 and 6 such as from Mississauga, will have a less uniform impact, but still do not contribute significantly to Ward 5 and 6.

The relative percentages of the sources of air pollution found across Toronto are shown in the following pie chart, which also shows the sources of air pollution generated within Toronto.

Pie Chart 1: Source Area **Contributions from Upwind Source Areas Compared to Toronto's Contribution and Toronto Category Type Contributions**



However, the pie chart shows both the relative contributions from the three modelled source areas as northeast USA (39%), southern Ontario (25%) and Toronto (36%) as well as the contribution by category type for Toronto as residential and commercial (16%), mobile (i.e., cars and trucks)(12%), non road mobile (i.e., planes, trains, boats and off road vehicles(4%) and industry (4%). The small amounts of biogenic and agricultural emissions that occur are too small to identify at this scale of comparison.

The residential and commercial sources of air pollution in Toronto directly cause about 16% of the total ground-level concentrations, while the transportation sector contributes about 12%. However, the 12% caused by local transportation creates localized areas along highways of exposure whereas the 16% caused by local residential and commercial releases, does not. Small residential and commercial source emissions create more geographically uniform background concentrations across neighbourhoods rather than locally elevated concentrations as along highways. However, such background concentrations do warrant that local improvement actions be undertaken

The amount of emissions varies with traffic volume and the mix of traffic types (cars, vans and trucks by size). Unlike industrial emissions, tail pipes are effectively at ground level, and though emissions rise with exhaust heat and vehicle created turbulence, the pollution concentrations in areas adjacent to roads, such as Highway 427, can be significant.

Air Contaminant Concentration Issues

The Ontario Ministry of the Environment has developed Ambient Air Quality Criteria (AAQC) values as a component of their air quality standard setting and assessment process. AAQC define acceptable contaminant concentration levels that are "effect-based" and associated with specific averaging times (e.g., annual, 24 hour, 1 hour, or 10 minutes). AAQC are set at levels below which adverse health and/or environmental effects are not expected. AAQC are used in this study as the benchmark in this study.

Four of the 30 modelled substances exceed Ambient Air Quality Criteria benchmarks in Wards 5 and 6. These are:

- oxides of nitrogen (key source: vehicle tailpipe emissions);
- benzene (key source: vehicle tailpipe emissions);
- particulate matter < 10µm (PM_{10}) (key source: road, tire and break pad wear); and
- particulate matter < 2.5µm ($PM_{2.5}$) (key source: vehicle tailpipe emissions).

A fifth substance benzo(a)pyrene was also identified as being of concern and it also originates from vehicle tailpipe emissions. Further investigation is still required and will be undertaken because unlike the four other modelled results, its monitored data does not verify well with its modelled data results. This may be because of inaccurate data obtained from the northeast USA.

Table 2 shows the maximum concentration and an average concentration for each substance of concern. Concentration levels are measured against a 24-hour timeframe. The four substances of concern (excluding benzo[a]pyrene) originate from a variety of sources, but in Wards 5 and 6, it is clear that these contaminants come primarily from Highway 427 and the Gardiner Expressway.

Table 2: Air Pollutants Determined to be at Concentration Levels of Concern

Individual Air Pollutant	ID	24-hr AAQC[1] ug/m^3	24-hr Maximum Concentration ug/m^3	24-hr Neighbourhood Average ug/m^3
Oxides of nitrogen (NOx)[2]	CAC[4]	200	808.6	573.5
PM_{10} [3]	CAC[4]	50	173.7	122.0
$PM_{2.5}$ [3]	CAC[4]	30	65.1	43.8
Benzene[2]	Mobile Toxic	2.3	7.1	5.4

Notes: 1. Ambient Air Quality Criteria (AAQC)
2. AAQC standard
3. Canada Wide Standard used in absence of AAQC standard
4. Criteria Air Contaminants

The relative contribution from the three emission source areas (northeast USA, Ontario, and Toronto) to the concentrations of concern in Wards5 and 6 are shown in Table 3 based on a contributory analysis for all of Toronto and not just for Wards 5 and 6.

Table 3: Sources of Principal Air Pollution in Toronto

Individual Air Pollutant	NE USA[1]	Southern Ontario	Toronto				
			Industrial	Residential & Commercial	On Road Vehicles	Non Road Vehicles	Biogenic & Agriculture
Oxides of nitrogen (NOx)	22%	21%	5.2%	11.30%	**32.6%**	7.9%	0%
$PM_{2.5}$ [2]	32%	20%	10.9%	16.00%	16.0%	5.1%	0%
PM_{10} [2]	30%	20%	5.1%	6.40%	**36.3%**	2.2%	0%
Benzene	26%	19%	**8.7%**	0%	**39%**	8.3%	0%

Notes: 1. Northeastern United States source area, as identified here, includes, in whole or in part – Michigan, Illinois, Indiana, Ohio, Kentucky, West Virginia, Virginia, North Carolina, Maryland, Pennsylvania, and New York - as well as parts of northern Ontario and western Quebec.
2. PM_{10} and $PM_{2.5}$ are components of PM (Particulate Matter) where PM_{10} is particulate matter less than 10 microns and $PM_{2.5}$ is particulate matter less than 2.5 microns

Background Concentrations and Locally Significant Concentrations

Background concentrations are those that emanate from distant sources. This is true in both the natural "reality" and in the "modelling" of air emissions to determine resultant air quality.

All emissions to air move physically with the movement of the air it is emitted into (technically this is known as "advection"). Emissions also move within the wind it is emitted into – as all air is varyingly turbulent and winds are a varying mix of both vertical and horizontal movements, emissions are physically mixed within that air. Emissions also move randomly in all directions within that air (technically this is known as "diffusion") and may also move uniformly, as with settling velocities of particles (technically this is known as "dispersion"). Collectively, emissions to air generally move downwind, sideways, upwards and downwards and in so doing are diluted with distance from their sources. With greater distance comes greater mixing such that though the movements of emissions within moving air began as a random distribution, it very largely becomes a more uniform and weaker concentration downwind. This apparent "reduction" is not however a true reduction, as the emissions that started at or near ground levels in the northeast USA, and in southern Ontario, all pass overhead (rather than at ground elevation or "nose-level".

The data in Table 3 show that the predominant source of the pollution concentrations of concern in Toronto as in Wards 5 and 6, by emission sources, is from car and truck emissions. Though not included in this table, the greatest proportion of the emissions from the geographic areas of north-east USA and southern Ontario follow the same contribution pattern, that is, are they are also dominated by car and truck emissions.

What these figures do not show, but which can be clearly seen on the associated maps of pollutant concentrations in Wards 5 and 6, is that whereas the contributions from the United States and southern Ontario provide a uniform "background" across the Ward 5 and 6 study area, the Toronto emissions, and especially the emissions from the roads and highways within and adjacent to Wards 5 and 6 have a significantly pronounced localized and linear impact. The closer a location is to a high volume vehicle carrying road or major highway, the greater is the localized impact.

In order to address local air pollution problems, and in particular the pollutants that exceed acceptable levels, it is also important to verify the modelled estimates further through the deployment of mobile air monitoring stations as are operated by the Ministry of the Environment.

Compliance Mapping

All 30 substances were mapped to show their individual degree of compliance when measured against the AAQC and augmented with benchmarks from the Canada Wide Standards (CWS) as for particulate matter < 2.5µm ($PM_{2.5}$).

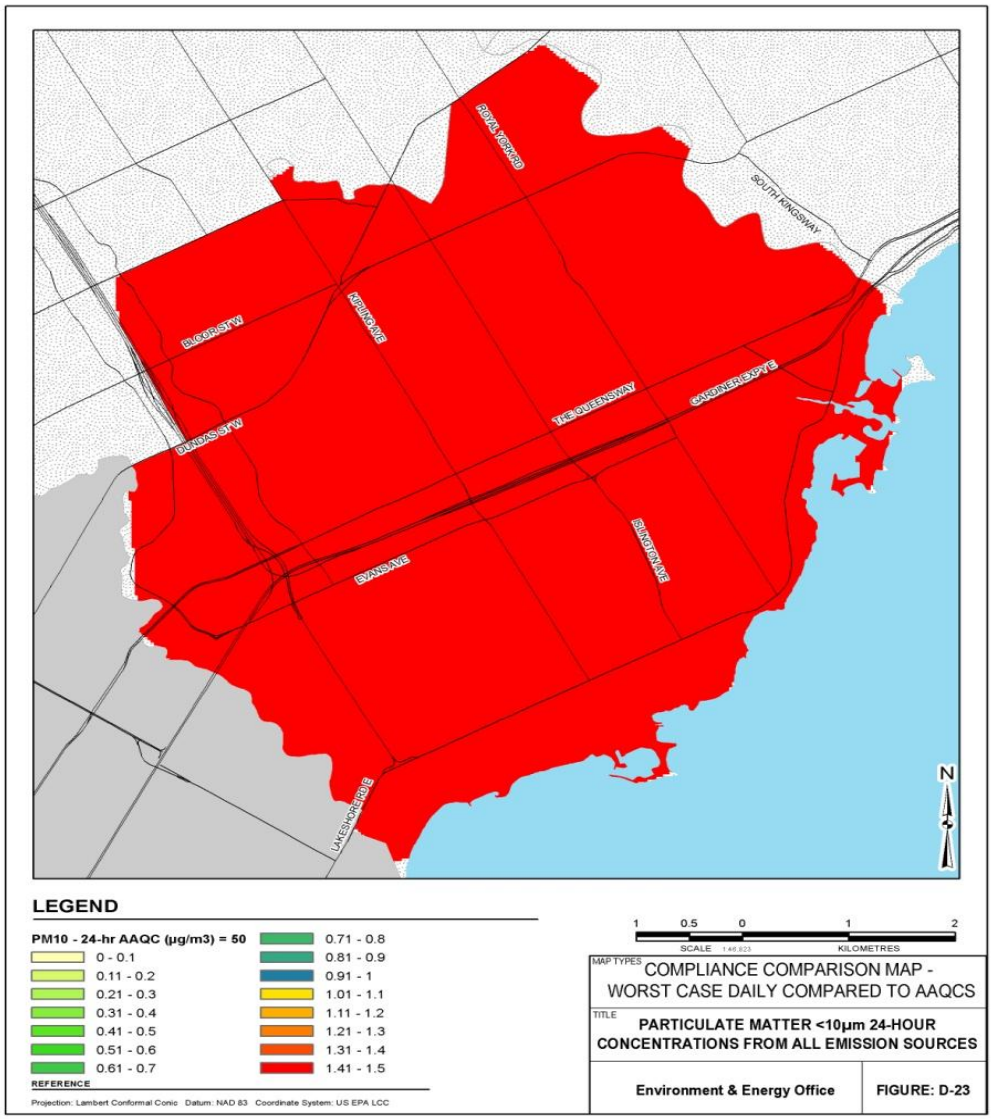
Of the 30 substances examined in this manner, two (2) substances had no established benchmarks that could be used (ozone and volatile organic carbons), three (3) substances were regarded as effectively not present in this neighbourhood, seventeen (17) substances were seen as having maximum concentrations of less than 10% of their appropriate standard benchmark, and three (3) substances attained compliance levels of between 10% below and 90% below their standard benchmark levels. But there were four (4) substances that were revealed to have worst case concentrations up to 140% of their respective standard benchmarks. One further substance is under further investigation and analysis.

Of the maps created and presented at the public meeting of January 15th, 2014, two substances best typify the conclusions to be reached – those of benzene (as originates from vehicle tailpipe emissions) and particulate matter < 10µm (PM10) which also comes from traffic but from the wearing down of tires, brake pads and discs, as well as road surface materials.

Map 1 below shows that the worst 24-hour concentration of particulate matter less than 10 microns is in excess of 141% of the established AAQC value in Wards 5 and 6.

Compliance mapping of the results of modeling for nitrogen oxides, benzene and particulate matter < 2.5 µm ($PM_{2.5}$) were found to appear effectively identical to Compliance Map 1,

MAP 1 - Compliance Comparison Map: Modelled results regarding Particulate Matter < 10µm (PM_{10}) Compared to Ambient Air Quality Criteria (i.e., the AAQC = 50 µg/m^3) as established by the Ontario Ministry of the Environment and here expressed as a percentage above or below that value.

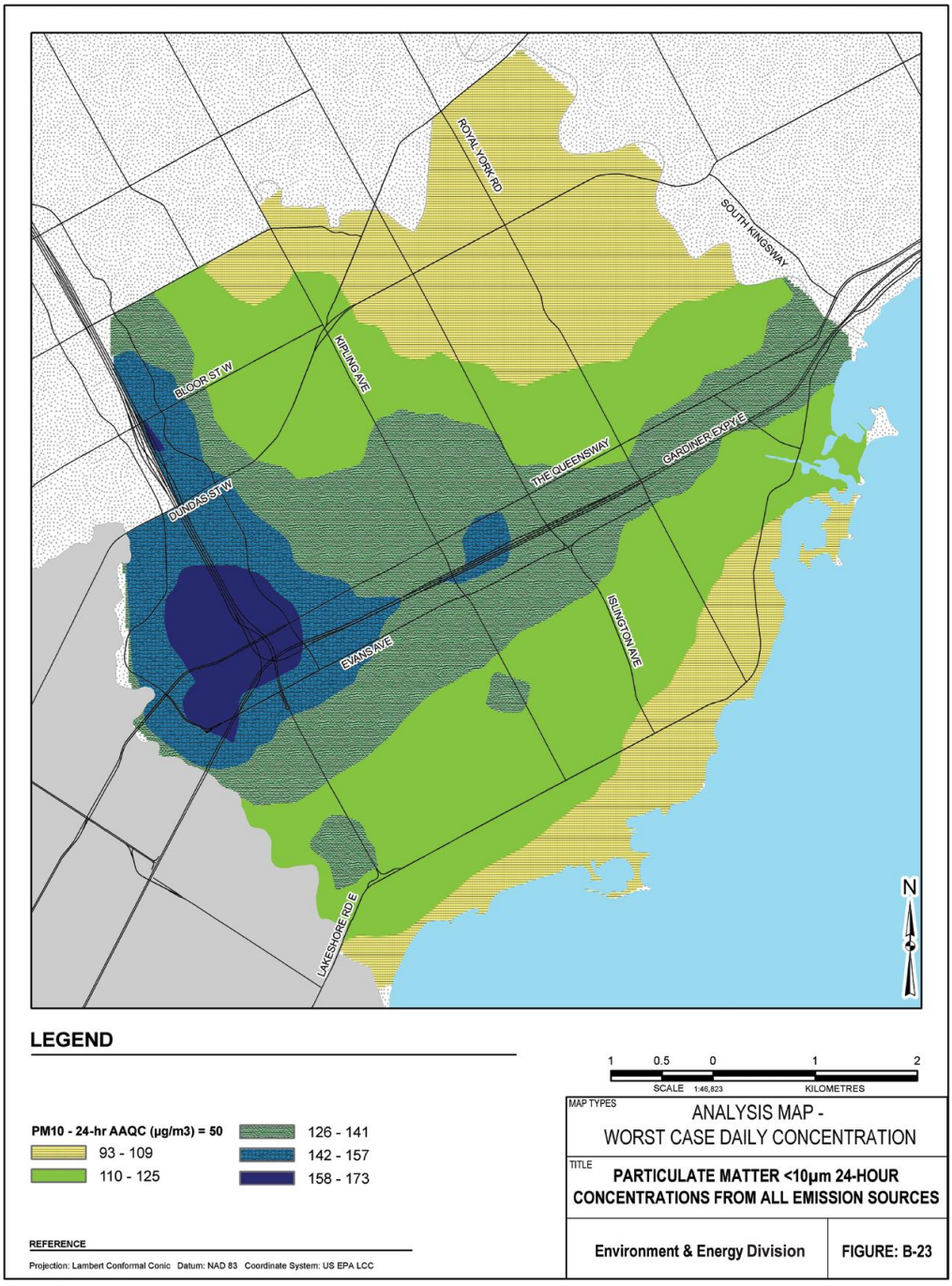


Whereas the "red map" above indicates concentrations in excess of standard desired levels of particulate matter < 10µm (PM_{10}**)** compared to ambient air quality criteria (i.e., the AAQC = 50 µg/m^3) as established by the Ontario Ministry of the Environment that is also duplicated in maps and AAQC comparisons of nitrogen oxides, benzene and particulate matter < 2.5µm ($PM_{2.5}$), these maps do not reveal the emission sources of the substances of concern. Unlike the "compliance map" above (Map1), the map below (Map 2) is a policy analysis map. Such maps are created to maximize source recognition. Map 2 permits exactly that.

The highest concentrations found in Map 2 which shows the same contaminant as does Map 1 clearly delineates it sources and clearly links the contaminant with car and truck emissions sources travelling on the 427 and the Gardiner Expressway. The variation of air concentration values along the corridors reflects the variation of volumes on individual road segments experienced. Highway 427 carries higher traffic volumes than does the Gardiner Expressway - but it is noticeable that at their confluence, as at the location of merging highway traffic, the model creates the highest concentrations of all, reflecting the greater combined vehicle volumes that occur at that highway intersection.

The equivalent policy analysis maps of nitrogen oxides and particulate matter < 2.5 µm ($PM_{2.5}$) reveal similar distributions and relate similarly to the same causal factors – cars and trucks along 427 and the Gardiner Expressway, and similarly greater concentrations in the areas of the merging highway traffic.

MAP 2 - Analysis Map: Modelled results regarding Particulate Matter < 10µm (PM_{10}) showing the range of locally significant concentrations under typical worst case 24 hour situations of between 93 and 173 µg/m^3 – or concentrations of approximately 2 to 3½ times the Ambient Air Quality Criteria established by the MOE (i.e., the AAQC = 50 µg/m^3).

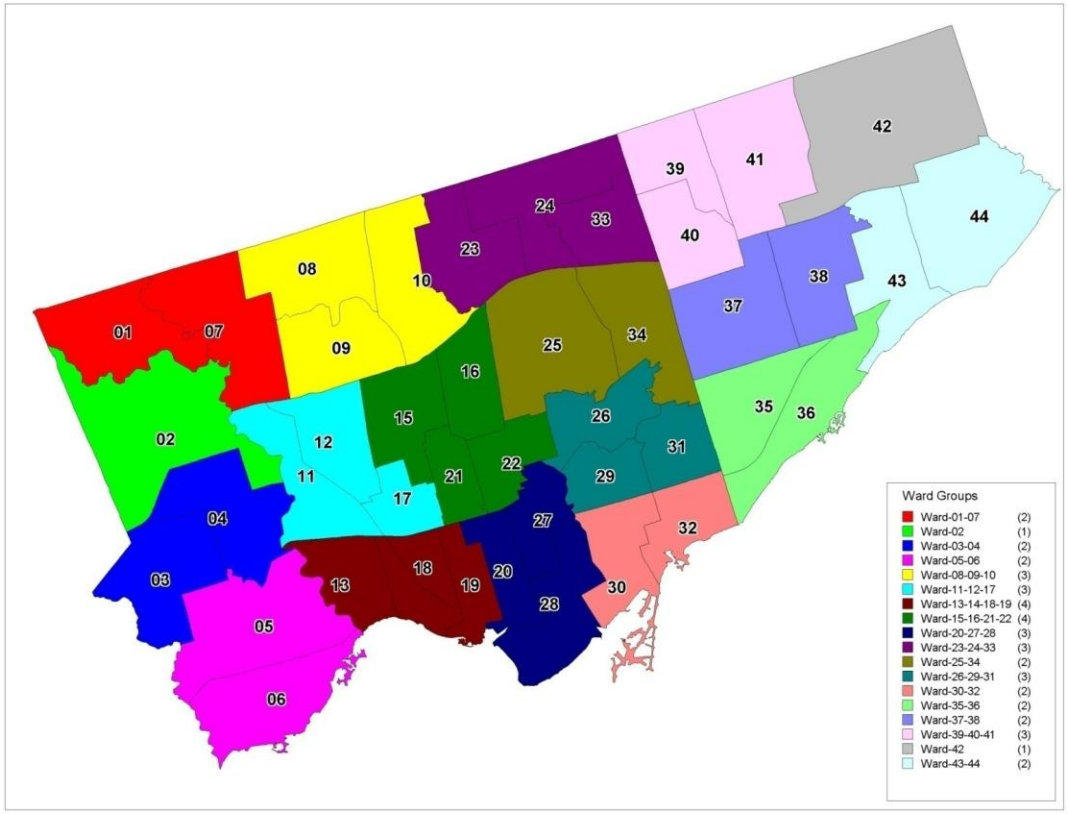


FUTURE WORK

The Environment and Energy Division will be conducting air quality studies in 6 additional areas using criteria adopted by the Board of Health in its report "*Criteria for Selection of Areas for Future Air Quality Modelling Study and Health Assessment*" (June 6, 2012). Specifically, the Board of Health directed that the priorities for selecting neighbourhoods for air emission modeling and health impact assessment studies be based on the following criteria:

- Cumulative toxicity of air emissions from point sources;
- Impact of major transportation sources as contributors of air pollutants; and
- Population vulnerability based on socioeconomic status.

Map 3: Map of 18 Local Air Quality Study Ward Grouping Areas



Following consultation with City Councillors and depending on the specifics of the final selection, approximately 12 to 15 wards will be included in this next phase of local air quality study.

CONCLUSIONS

The work undertaken in Wards 5 and 6 and in Wards 30 and 32 collectively demonstrates the benefit of the local air quality modelling approach for Toronto. Three areas of endeavour are contemplated:

- further model improvements and core emissions data updates
- collective advocacy regarding traffic emission improvements; and
- community engagement using facilitators to better promote local response and remedial actions.

Further Model Improvement & Core Data Updates

Local air quality modelling provides

- a much better representation of local situations;
- clearer analysis and recognition of issues; and
- greater engagement with residents at neighbourhood levels.

This suggests that further local air quality modelling can be beneficial everywhere in Toronto. Further improvements to the model can be made and in 2014 the following improvements will be considered and applied, if warranted:

- inclusion of all available ChemTRAC data to the model;
- updating the emissions data from the USA and Canada to 2012; and
- separation of the commercial and residential "areal" emissions related to burning natural gas.

The information provided to residents can be further improved by acquiring more accurate data of the percentages of vehicle types, especially of sub categories of heavy trucks along major highways in Toronto and on major and minor arterials throughout Toronto that clearly contribute disproportionately to local air quality concentrations.

Collective Advocacy Regarding Traffic Emission Improvements

The City of Toronto does not set fuel and engine standards, unlike Los Angeles via the California Air Resources Board (CARB) based on local air quality and health related needs, but Toronto can advocate for adoption of significant and timely improvements in vehicle fuels and engines. Such advocacy may well be more effective if undertaken in partnership with other major urban centres across Ontario (especially those with similar health issues related to similar traffic volumes and vehicle emissions in proximity to dense urban populations), other agencies that promote concern for our changing climate and the Province of Ontario in order to take a strong platform to Ottawa and beyond to the North American CAFÉ / CARB discussions.

The City can address transportation and land use factors over which it does have control and which were discussed in the following reports to City Council:

- "Towards a Sustainable Transportation Implementation Strategy - Update Report" http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2008.PG16.5

- "Sustainable Transportation Initiatives: Short-term Proposals" http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2007.PW9.2

Community Engagement and Improved Local Response and Remedial Actions

The original study undertaken in Wards 30 and 32, as well as the study in Wards 5 and 6, and all subsequent studies to be undertaken across Toronto will be augmented by engaging and helping the community to engage in finding local solutions to identified local air quality and other environmental concerns.

Community facilitators will engage residents, community groups, businesses and industry to identify and undertake actions in neighbourhoods to both improve air quality and create a more sustainable community. The facilitators will provide outreach on air quality issues at community meetings and assist with the development of community groups and business organizations. Such groups and organizations may be engaged in a variety of activities including but not limited to:

- the adoption of renewable energy and energy efficient retrofit technologies;

- the implementation of conservation initiatives and efficiency audits; and

- the development of community-organized alternative transportation activities.

The objectives for the Community Facilitators are to:

- increase the capacity of community groups, businesses and industry to identify, develop and implement actions that improve local air quality;

- provide guidance for community groups, businesses and industry on accessing financial support from both public and private sectors to sustain programs that improve local air quality;

- provide linkages between community groups, businesses, industry and expertise available at the City of Toronto, as well as other levels of government and private and non-profit sources; and

- help community groups, businesses and industry develop greater social and economic capacity and resilience.

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