

Technical Memorandum

Aamjiwnaang First Nation Community Air Monitoring Station

Results for 2013



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Executive Summary

The Aamjiwnaang First Nation community air monitoring station was established in late 2008 in partnership between the provincial and federal governments and the Aamjiwnaang First Nation (AFN). The station is equipped to monitor a range of air contaminants. Some are sampled on an hourly basis, while others are sampled for twenty-four hours either once every six days or once every twelve days depending upon the monitoring program. The data produced from the monitoring may be used for long-term air quality studies and to assist in community health assessments.

Monitoring began at the station in September of 2008. A report summarising the first year of operation was released in January of 2011. This report, the fifth, covers the calendar year 2013. Data from most monitors are summarised either in two or four pages so the sections may be easily extracted should the reader wish. These summaries are designed to make the important information quickly available. Insofar as is possible, they follow a consistent format. Further elaboration of any the information is available upon request.

Hourly data are presented for:

- Sulphur dioxide (SO₂)
- Total reduced sulphur compounds (TRS)
- Nitrogen dioxide (NO₂)
- Ground-level ozone (O₃)
- Fine particulate matter (PM_{2.5})
- Specific volatile organic compounds (VOC)

Data from non-continuous sampling results are presented for:

- Suspended particulate (SP) and certain SP constituents – primarily metals
- A broader range of VOC
- Polycyclic aromatic hydrocarbons (PAH)

Monitoring results were compared with Ontario's Ambient Air Quality Criteria (AAQC) where such existed. The results were also compared to the Air Quality Index (AQI) classifications for SO₂, TRS, NO₂, O₃, and PM_{2.5}, the parameters on which the AQI is based. Measurements were made of the other AQI constituent, carbon monoxide (CO), but as they remained below the detection limit all year, no results are presented. Wherever possible, these monitoring results were compared to other ministry stations in Southwestern Ontario. Comparison sites were chosen at which most of the same substances were monitored and which reflected a similar urban environment.

Results are reported in two different concentration units. Particulate, metals, PAH, and canister VOC results are reported in micrograms per cubic metre (µg/m³), while most of the hourly results are reported in parts per billion (ppb). This is done for two reasons. The reporting results are given in the units in which they are reported by either the measuring instrument or the analysing laboratory. As well, these units are consistent with those used in the previous report and the ministry's annual *Air Quality in Ontario Report* allowing for easier comparison. Where results are reported in ppb and are to be compared to ministry standards and AAQC (both of which are published in µg/m³), the ministry's values are converted to ppb assuming a temperature of 20° C and an atmospheric pressure of 101.3 kPa.

A small but important point in the results is that there were some differences in how calculations were made for some of the substances compared to the method used for others. These differences are discussed briefly in the "Data Averaging" appendix. These methods have been used in each of the previous reports and so year to year values may be compared.

Another significant point which was also noted in last year's annual report is the adoption of several new air standards by the ministry in July of 2011. It is the ministry's practice to announce standards but give a five-year phase-in period to allow industry to adjust processes and acquire new technology, where necessary. However, the standards are based upon AAQC which, as target values, are available immediately for comparisons. Several of these are relevant to these measurements. These are for benzene, benzo[a]pyrene (as a surrogate for all PAH), 1,3-butadiene, chromium, manganese, and nickel.

The AAQC for each substance is based upon the lowest concentration at which effects are demonstrable – whether this be on human health or some other environmental endpoint. Since scientific studies of carcinogens generally result in risk estimates based upon lifetime exposures, their AAQC are usually stated as annual averages. This is the case for the first three substances on the new list: benzene, benzo[a]pyrene, and 1,3-butadiene. Other substances are believed to cause effects after shorter exposures and so their AAQC are based upon a shorter averaging period. The chromium AAQC is an example of this.

Results for this report are comparable to those in the previous reports. AQI parameters showed lower average concentrations for O₃ and PM_{2.5}, but a slightly higher average TRS when the concentrations are compared to those of 2012. The SO₂ and NO₂ averages were unchanged from the previous year. The ministry measured three exceedances for PM_{2.5} (down from ten in 2012) and twelve O₃ exceedances (versus fifty in 2012).

The average SP concentration increased but still included no exceedances of the AAQC. Average and maximum metal concentrations varied both up and down from the previous year, depending upon species but were all well below their respective AAQC.

The target list for hourly VOC monitoring was again updated from the previous year. Of the eleven compounds that were detected in both years, average values increased for seven and decreased for the other four. Maxima showed the opposite trend as seven were lower than the previous year. Both benzene (twenty two times) and 1,3-butadiene (once) showed exceedances of the 24-hour AAQC. Neither exceeded of their annual AAQC.

The ministry, in cooperation with Environment Canada (EC) takes 24-hour VOC samples every twelfth day using specially prepared evacuated canisters. Thirty-one samples were taken during 2012. Of the 161 species for which the canister samples were analysed, forty six have 24-hour AAQC and forty five of these were detected. Only benzene exceeded its 24-hour AAQC (three times). Six of the substances also have annual AAQC and, of these, only benzene exceeded this level.

The ministry also monitors PAH on the same schedule as the EC VOC. PAH concentrations were higher than those recorded in the previous year. In addition, benzo[a]pyrene, the only PAH with an AAQC, exceeded its twenty-four-hour AAQC ten times and its annual AAQC as well.

Sulphur Dioxide

Sulphur dioxide (SO₂) is colourless gas often emitted from industrial facilities and sources that burn sulphur-containing fuels. It contributes to acid rain, and can have human health impacts including eye and respiratory tract irritation as well as lung damage at higher concentrations. Like some other gases it can travel a considerable distance downwind from its source, in favourable conditions. The ministry has a half-hour standard of 310 ppb (for a particular source) and a 1-hour AAQC of 250 ppb. This report uses the AAQC for comparisons as they have been developed for use in assessing air quality whereas standards are meant to assess the contribution of any single source emissions.

Report Values	Average (ppb)	Maximum (ppb)	AAQC Exceedances
<i>AFN Station</i>			
2013	2.4	75	0
2012	2.4	105	0
<i>Other Stations, Current Report Period</i>			
Sarnia AQI	3.8	144	0
Windsor West AQI	2.6	52	0

No exceedances of the AAQC were recorded during this monitoring period. The average sulphur dioxide concentration was unchanged from the previous year and the maximum concentration was noticeably lower. Both values were lower than those measured at the Sarnia AQI station and the average is lower than that seen at the Windsor West AQI station though the maximum was higher than Windsor's. Both the highest monthly average and single hour concentration occurred in June.

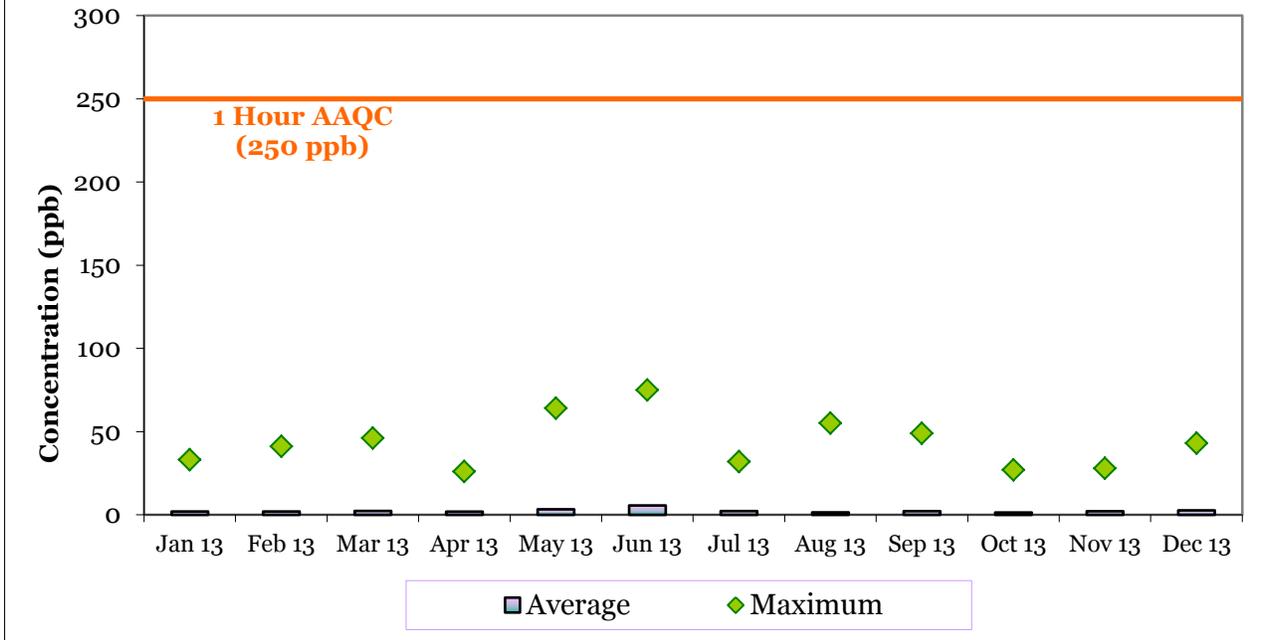
This year, all the SO₂ measurements led to a *Very Good* SO₂ AQI sub-index. The month by month results are given in the table below and shown in the graph on the next page.

The pollution rose shown on the next page illustrates how SO₂ concentration varies with wind direction. There are small differences between this wind pattern and results from previously years but the sources to the north of the station again appear to be the strongest influence on the Aamjiwnaang station.

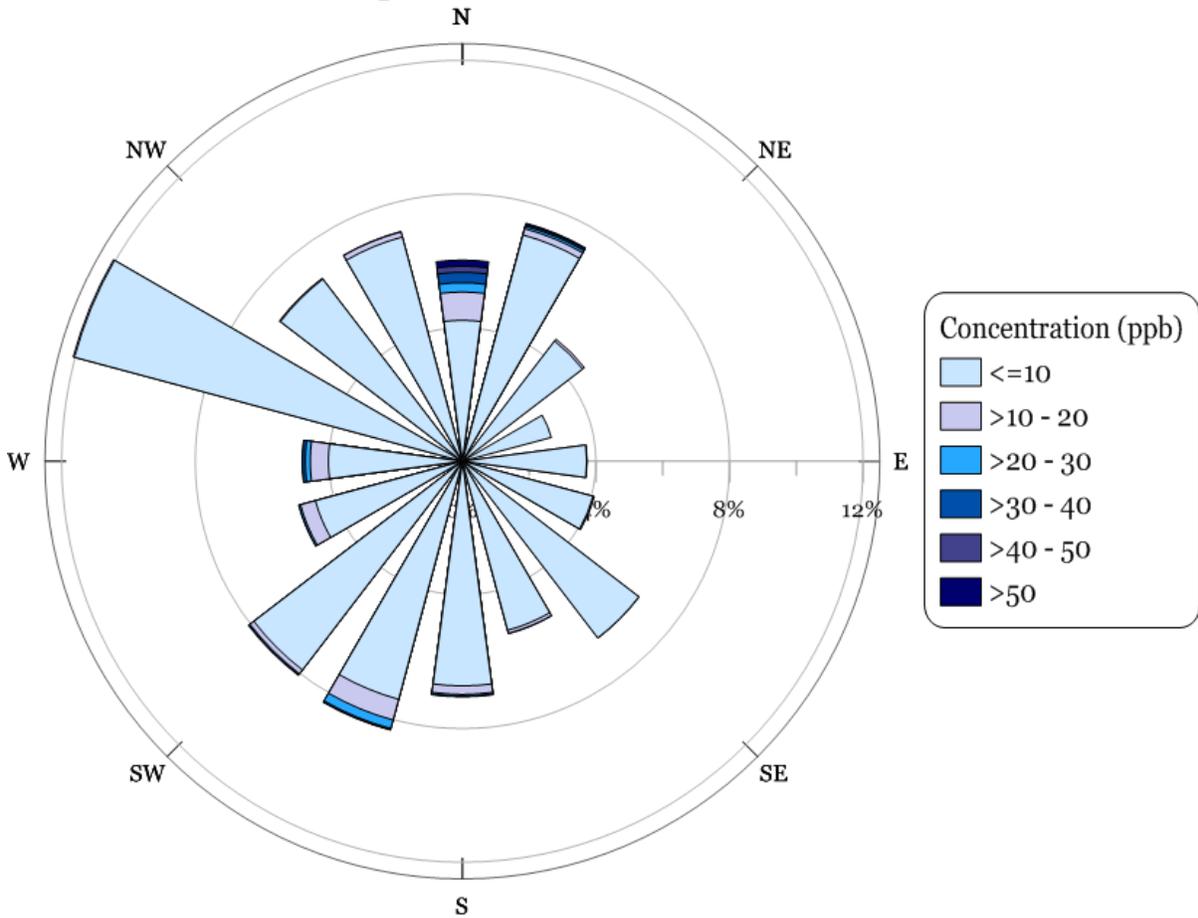
Month by Month Statistics - 2013								
	Concentration		AAQC Exceedances	AQI Sub-index				
	Average (ppb)	Maximum (ppb)		Very Good	Good	Moderate	Poor	Very Poor
Jan	2.0	33	0	100.0%	0.0%	0.0%	0.0%	0.0%
Feb	2.0	41	0	100.0%	0.0%	0.0%	0.0%	0.0%
Mar	2.3	46	0	100.0%	0.0%	0.0%	0.0%	0.0%
Apr	1.9	26	0	100.0%	0.0%	0.0%	0.0%	0.0%
May	3.3	64	0	100.0%	0.0%	0.0%	0.0%	0.0%
Jun	5.6	75	0	100.0%	0.0%	0.0%	0.0%	0.0%
Jul	2.3	32	0	100.0%	0.0%	0.0%	0.0%	0.0%
Aug	1.5	55	0	100.0%	0.0%	0.0%	0.0%	0.0%
Sep	2.2	49	0	100.0%	0.0%	0.0%	0.0%	0.0%
Oct	1.4	27	0	100.0%	0.0%	0.0%	0.0%	0.0%
Nov	2.2	28	0	100.0%	0.0%	0.0%	0.0%	0.0%
Dec	2.7	43	0	100.0%	0.0%	0.0%	0.0%	0.0%

The federal and provincial governments are currently reassessing SO₂ effects and may make recommendations that result in a new SO₂ AAQC.

Sulphur Dioxide - Hourly Statistics by Month



Sulphur Dioxide



Total Reduced Sulphur

Total reduced sulphur (TRS) is a group of sulphur-based compounds including hydrogen sulphide and various mercaptans. The ministry does not have a 1-hour AAQC so values were compared to 27 ppb, the highest concentration which would cause a *Moderate* AQI. This level is equivalent to the values used to evaluate the other AQI parameters. As a mixture, TRS may have a variety of sources. Some of these are natural such as swamps and bogs, others are industrial from sectors where sulphur-containing substances are common such as petrochemical refineries and sewage treatment plants.

Report Values	Average (ppb)	Maximum (ppb)	AAQC Exceedances
<i>AFN Station</i>			
2013	0.6	8	0
2012	0.5	6	0
<i>Other Stations, Current Report Period</i>			
Sarnia AQI	0.1	15	0
Windsor West AQI	0.3	16	0

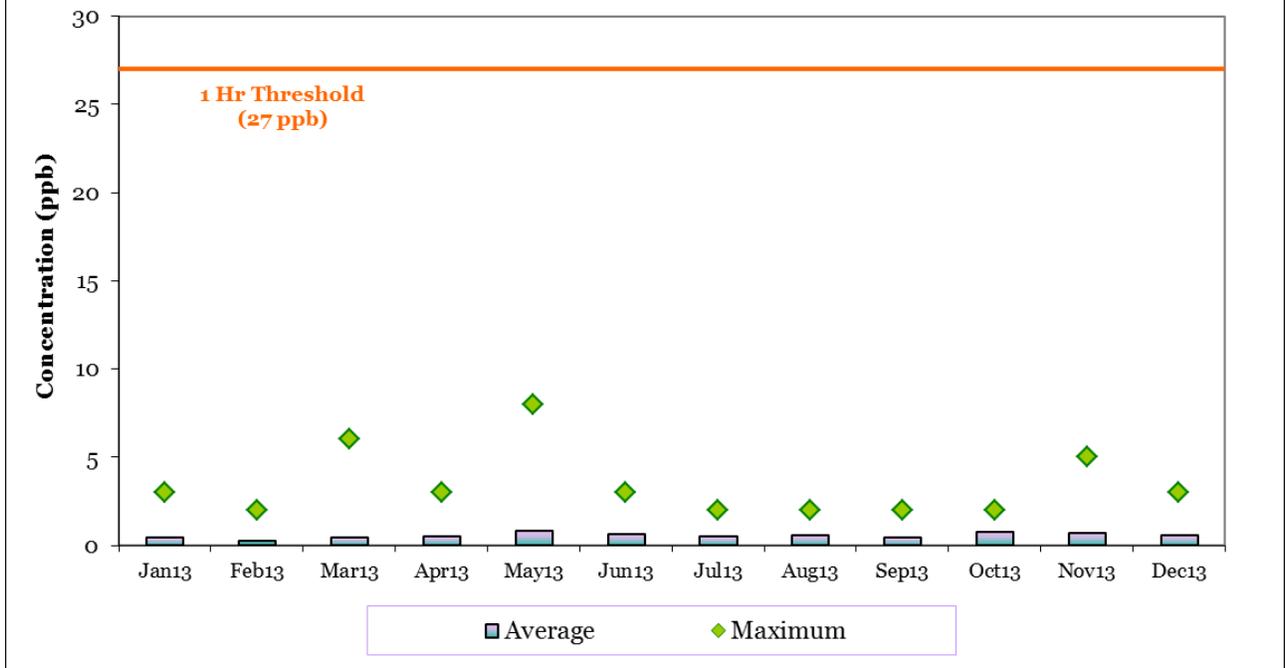
No exceedance of the comparison value was measured in 2012. The maximum value was lower than the previous year though the average was higher. The average was also higher than those at the comparison stations while the maximum was about half the values seen at each of the other two sites. Monthly results are given in the second table and illustrated on the next page. Two months, March and May, each had one hour during which the TRS AQI sub-index was *Good*, while the rest of the year remained in the *Very Good* range. Average levels appeared to increase over the year, though the peak was seen April.

A pollution rose for values greater than 1 ppb is shown on the next page. The lowest values (1 ppb) were omitted so that they did not overwhelm the few higher values. The figure suggests that there is not a dominant source of TRS but rather there may be a number of smaller sources in the area.

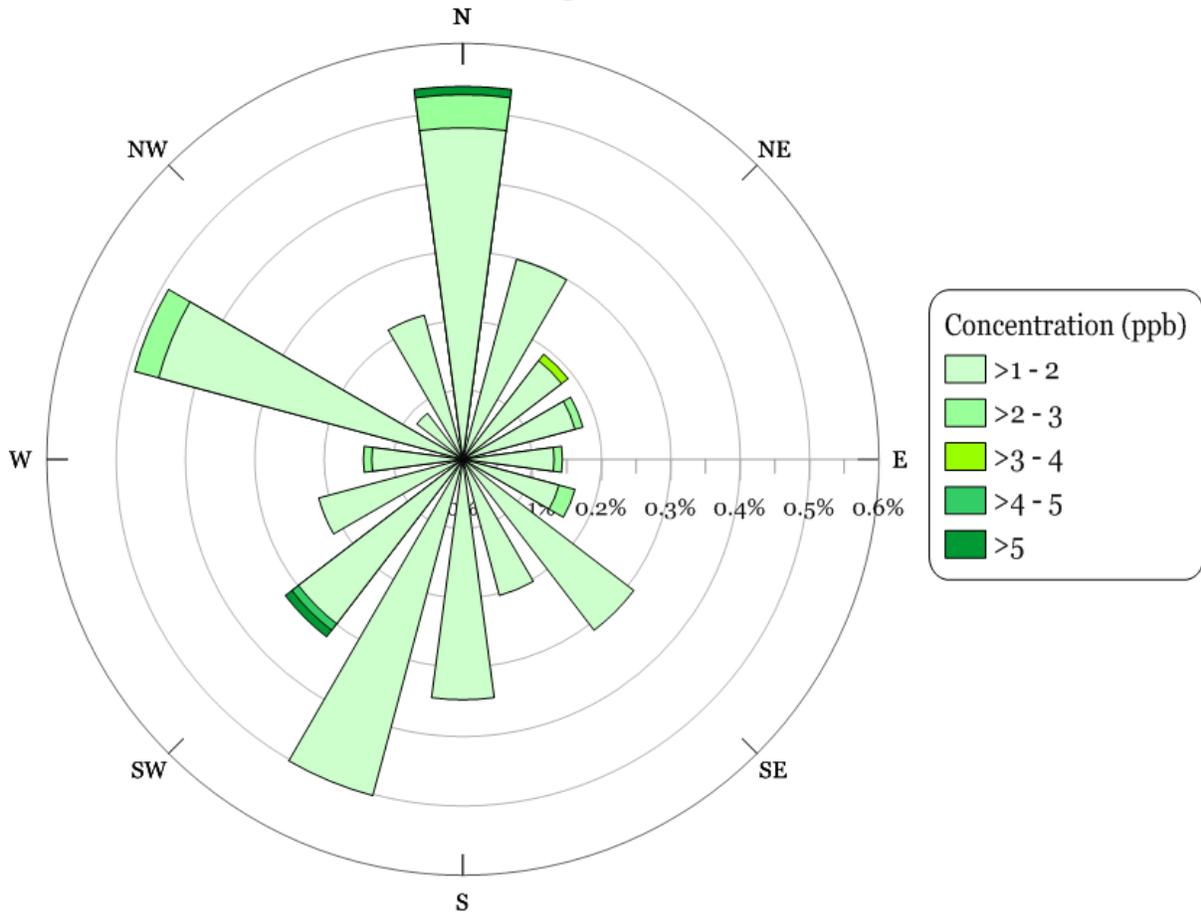
Month by Month Statistics - 2013								
	Concentration		AAQC Exceedances	AQI Sub-index				
	Average (ppb)	Maximum (ppb)		Very Good	Good	Moderate	Poor	Very Poor
Jan	0.5	3	0	100.0%	0.0%	0.0%	0.0%	0.0%
Feb	0.3	2	0	100.0%	0.0%	0.0%	0.0%	0.0%
Mar	0.4	6	0	99.9%	0.1%	0.0%	0.0%	0.0%
Apr	0.5	3	0	100.0%	0.0%	0.0%	0.0%	0.0%
May	0.8	8	0	99.9%	0.1%	0.0%	0.0%	0.0%
Jun	0.7	3	0	100.0%	0.0%	0.0%	0.0%	0.0%
Jul	0.5	2	0	100.0%	0.0%	0.0%	0.0%	0.0%
Aug	0.6	2	0	100.0%	0.0%	0.0%	0.0%	0.0%
Sep	0.4	2	0	100.0%	0.0%	0.0%	0.0%	0.0%
Oct	0.8	2	0	100.0%	0.0%	0.0%	0.0%	0.0%
Nov	0.7	5	0	100.0%	0.0%	0.0%	0.0%	0.0%
Dec	0.6	3	0	100.0%	0.0%	0.0%	0.0%	0.0%

As of February, 2013, the ministry has a 10-minute odour-based standard for TRS of 13 µg/m³ (approximately 9.1 ppb if the TRS is just composed of hydrogen sulphide). As a result, successive 10-minute averages of the 1-minute data were calculated for 2013. No exceedances of the standard were seen. By comparison, had the standard been in place during the previous year, six exceedances spread over four different days would have occurred.

Total Reduced Sulphur - Hourly Statistics by Month



Total Reduced Sulphur



Nitrogen Dioxide

Nitrogen dioxide (NO₂) is a common combustion product. It occurs as a consequence of the large amount of nitrogen in the atmosphere. The main sources are motor vehicles and large combustions sources such as electric utilities and industrial boilers. NO₂ reacts in the atmosphere to form a number of compounds, some of which have adverse health or environmental effects. It is an ozone precursor, a component of smog, and one of the causes of acid rain. The 1-hour AAQC for NO₂ is 200 ppb. This level is used here for evaluation.

Report Values	Average (ppb)	Maximum (ppb)	AAQC Exceedances
<i>AFN Station</i>			
2013	11.5	38	0
2012	11.5	36	0
<i>Other Stations, Current Report Period</i>			
Sarnia AQI	8.1	46	0
Windsor West AQI	11.5	65	0
London AQI	6.4	38	0

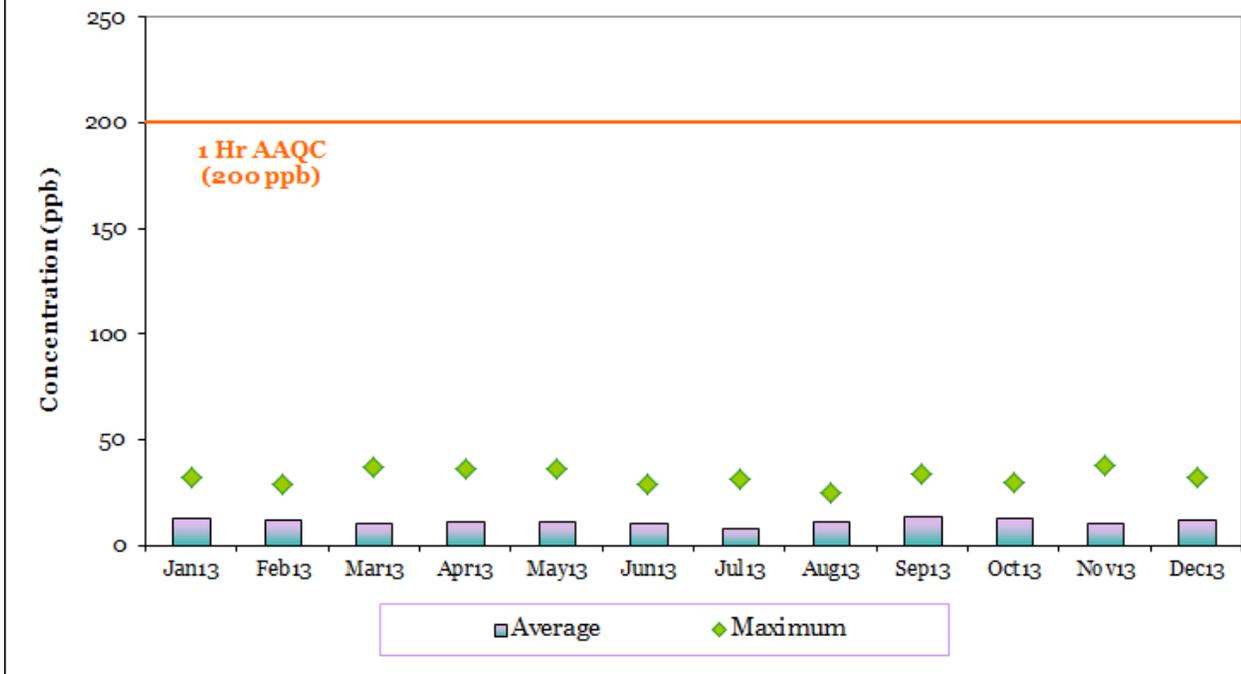
No exceedance of the AAQC was measured during 2012. The average was unchanged from 2012, while the maximum concentration was slightly higher than in the previous year. The average was higher than those seen in London or at the Sarnia AQI stations but the same as that in Windsor. The maximum was lower than the Sarnia and Windsor West AQI stations and was identical to the London AQI comparison station.

A month by month summary of the NO₂ concentrations is given in the table below. No strong seasonal influence is apparent. The NO₂ AQI subindex was always in the *Very Good* range – an improvement over the previous year.

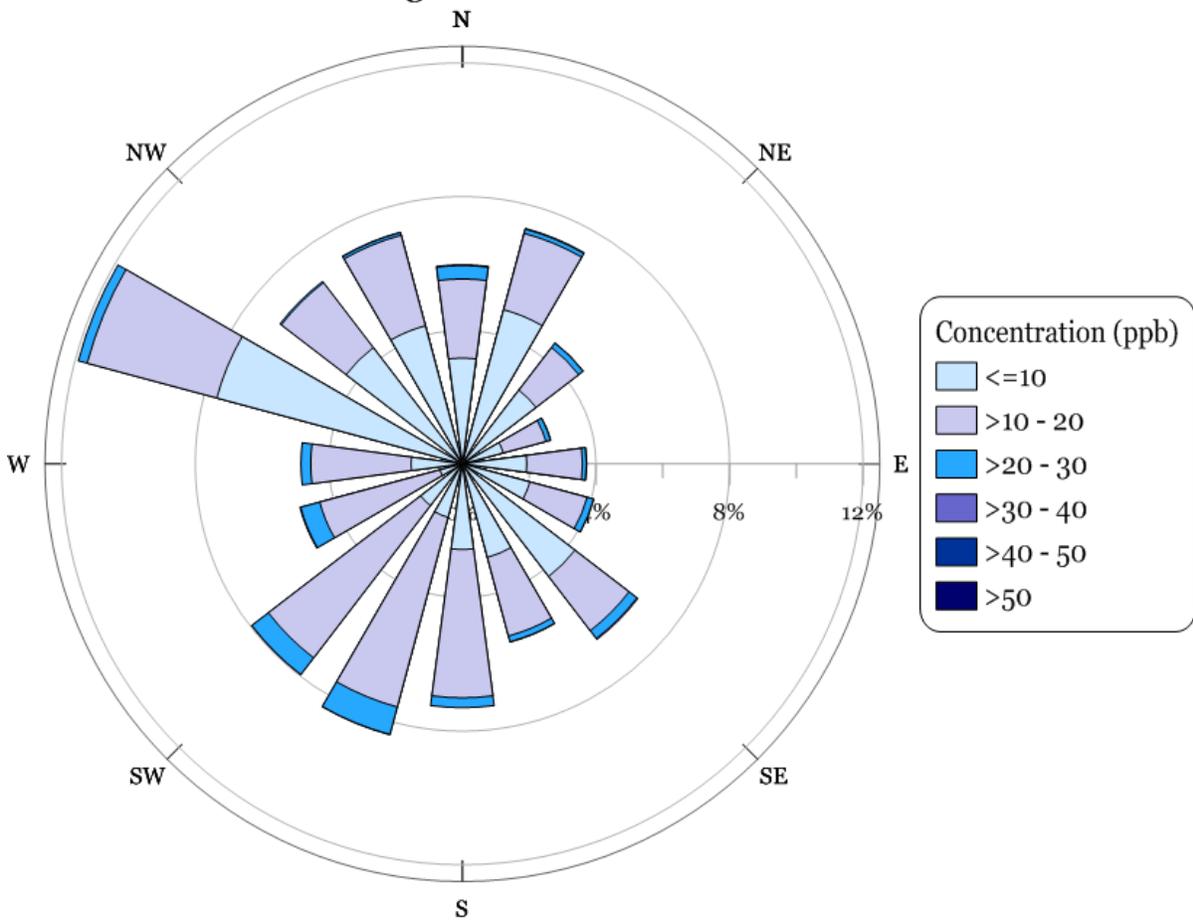
The pollution rose on the next page illustrates how the NO₂ concentration varied with wind direction. The station's highest concentrations are not restricted to particular directions although, as in previous years, they are more frequent when the wind is coming from the south. In addition to local sources, long range atmospheric transport may also contribute to local concentrations.

Month by Month Statistics - 2013								
	Concentration		AAQC Exceedances	AQI Sub-index				
	Average (ppb)	Maximum (ppb)		Very Good	Good	Moderate	Poor	Very Poor
Jan	12.8	32	0	100.0%	0.0%	0.0%	0.0%	0.0%
Feb	11.8	29	0	100.0%	0.0%	0.0%	0.0%	0.0%
Mar	10.9	37	0	100.0%	0.0%	0.0%	0.0%	0.0%
Apr	11.3	36	0	100.0%	0.0%	0.0%	0.0%	0.0%
May	11.4	36	0	100.0%	0.0%	0.0%	0.0%	0.0%
Jun	10.3	29	0	100.0%	0.0%	0.0%	0.0%	0.0%
Jul	8.3	31	0	100.0%	0.0%	0.0%	0.0%	0.0%
Aug	11.1	25	0	100.0%	0.0%	0.0%	0.0%	0.0%
Sep	13.8	34	0	100.0%	0.0%	0.0%	0.0%	0.0%
Oct	12.9	30	0	100.0%	0.0%	0.0%	0.0%	0.0%
Nov	10.9	38	0	100.0%	0.0%	0.0%	0.0%	0.0%
Dec	12.4	32	0	100.0%	0.0%	0.0%	0.0%	0.0%

Nitrogen Dioxide - Hourly Statistics by Month



Nitrogen Dioxide



Ground-level Ozone

Ozone (O₃) is a reactive, inorganic gas with a distinctive pungent odour. Unlike many other air contaminants, ozone is not emitted to the atmosphere. Instead, it is formed in the presence of sunlight in reactions between nitrogen oxides and volatile organic compounds. This is a relatively slow process and some of the gases that form ground level ozone may have first travelled hundreds of kilometres. Strong sunlight and warm conditions speed up production and thus the highest levels usually occur in the summer. This formation process also causes concentrations to rise during the day and fall at night. However year to year variation for ozone is greatly dependant on weather patterns.

Report Values	Average (ppb)	Maximum (ppb)	AAQC Exceedances
<i>AFN Station</i>			
2013	28.4	96	12
2012	29.4	108	50
<i>Other Stations, Current Report Period</i>			
Sarnia AQI	28.6	83	4
Windsor West AQI	26.7	87	3
London AQI	28.7	82	2

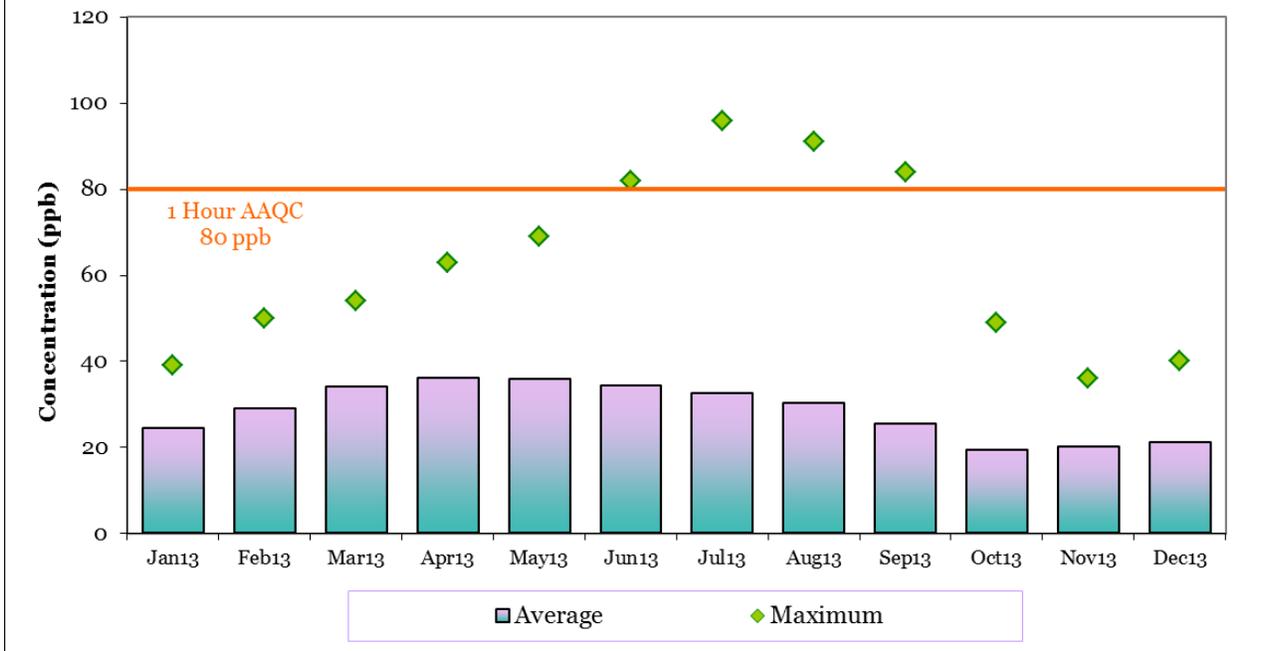
Ground-level ozone is a major component of smog and can have human health impacts, particularly respiratory tract irritation. It may also adversely affects certain plants. The ministry's 1-hour AAQC for O₃ is 80 ppb. This level is used for evaluation in this report.

Both the average and the maximum concentrations were lower than during the previous year and there were only 12 AAQC exceedances - a sharp drop from the previous year. The average concentration was slightly less than two of three comparison stations, only Windsor was lower, but the maximum was higher than any of the comparison stations

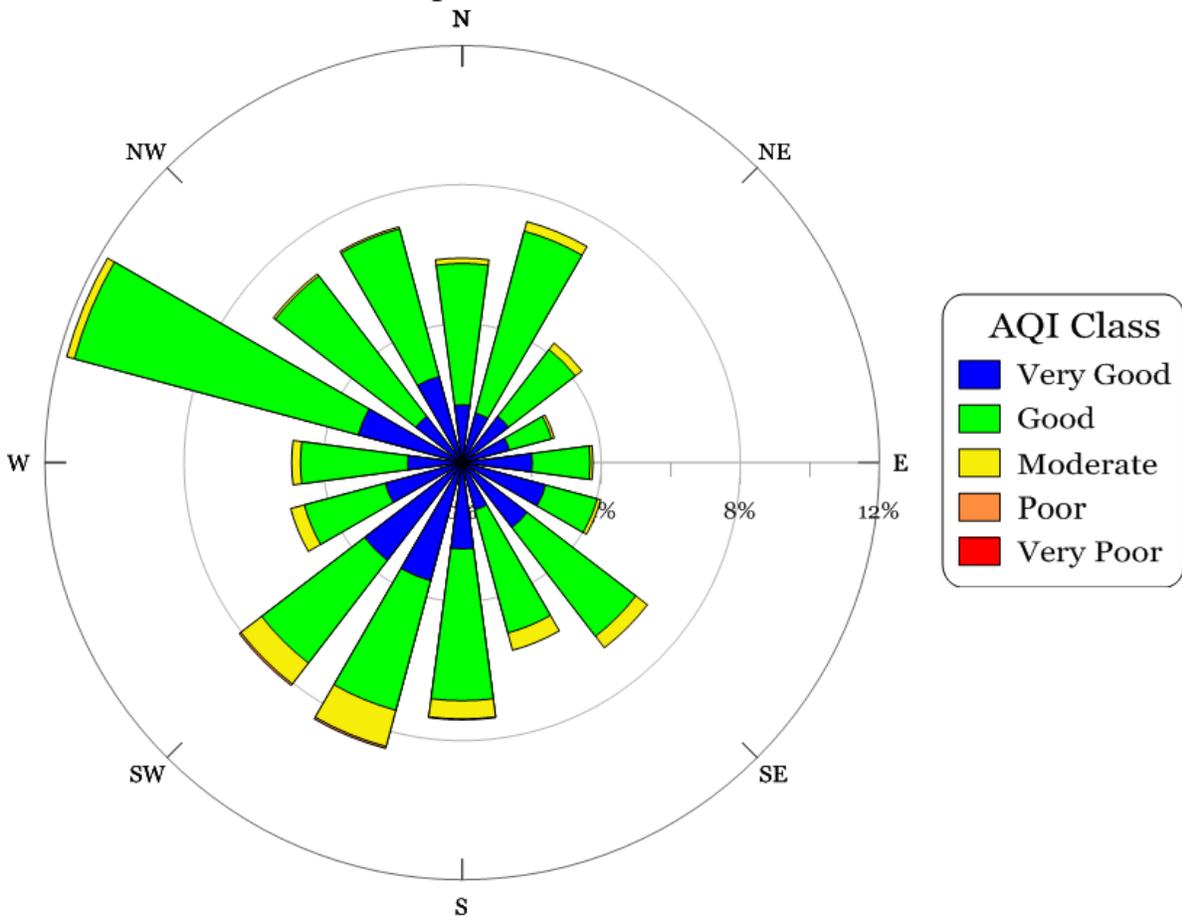
In general, southerly winds bring more of the chemicals that form ozone (precursors) to the region. These compounds originate in industrial and developed areas and so concentrations are influenced by the prevailing winds. This is reflected in the pollution rose where higher frequencies of *Moderate* (yellow) and *Poor* (orange) air quality are more strongly associated with southerly winds.

Month by Month Statistics – 2013								
	Concentration		AAQC Exceedances	AQI Sub-index				
	Average (ppb)	Maximum (ppb)		Very Good	Good	Moderate	Poor	Very Poor
Jan	24.5	39	0	41.7%	58.3%	0.0%	0.0%	0.0%
Feb	28.9	50	0	22.0%	78.0%	0.0%	0.0%	0.0%
Mar	34.0	54	0	7.3%	91.8%	1.0%	0.0%	0.0%
Apr	36.1	63	0	5.4%	89.8%	4.8%	0.0%	0.0%
May	35.8	69	0	15.7%	69.3%	15.0%	0.0%	0.0%
Jun	34.3	82	1	20.4%	69.1%	10.4%	0.2%	0.0%
Jul	32.6	96	6	29.6%	55.5%	14.2%	0.8%	0.0%
Aug	30.2	91	4	36.2%	50.4%	12.9%	0.5%	0.0%
Sep	25.4	84	1	46.0%	50.1%	3.8%	0.1%	0.0%
Oct	19.5	49	0	67.4%	32.6%	0.0%	0.0%	0.0%
Nov	20.1	36	0	70.3%	29.7%	0.0%	0.0%	0.0%
Dec	21.2	40	0	57.6%	42.4%	0.0%	0.0%	0.0%

Ozone - Hourly Statistics by Month



Ozone AQI Sub-index



Fine Particulate Matter

Fine particulate matter, sometimes called respirable particulate or PM_{2.5}, is the fraction of atmospheric particulate that is smaller than 2½ µm in aerodynamic diameter. These particles are important because their small size enables them to bypass many of the body's natural defences and reach the deepest parts of the lung. There, they can pass contaminants into the blood stream which will carry these substances through the body.

PM_{2.5} often forms in the atmosphere and acts much like a gas due to its small size. As a result, it may be found hundreds of kilometres from its source. The ministry does not have a 1-hour AAQC or standard for PM_{2.5}. "Exceedances" for PM_{2.5} were determined relative to the top of the *Moderate* AQI range, 45 µg/m³ although, unlike many of the other AQI parameters, the PM_{2.5} AQI sub-index is based upon a 3-hour running average. This comparison is consistent with that used for the other AQI pollutants and so gives an equivalent measure of the number of undesirable periods. For consistency, other values were also calculated for 3-hour averages.

The average and maximum 3-hour concentration were both lower than the previous year. There were three (consecutive) one hour periods where the fine particulate concentration fell in the *Poor* AQI range. In 2013, the ministry installed new monitors at its Air Quality Index stations that are expected to provide a more accurate measurement of fine particulate matter. A more in-depth discussion of this may be found in the ministry's Air Quality in Ontario 2013 Report. The new monitors reported higher annual means for London and Windsor West stations than had been seen in the previous year, but the maximum for the Sarnia AQI station was lower. While part of these differences may be due to the new

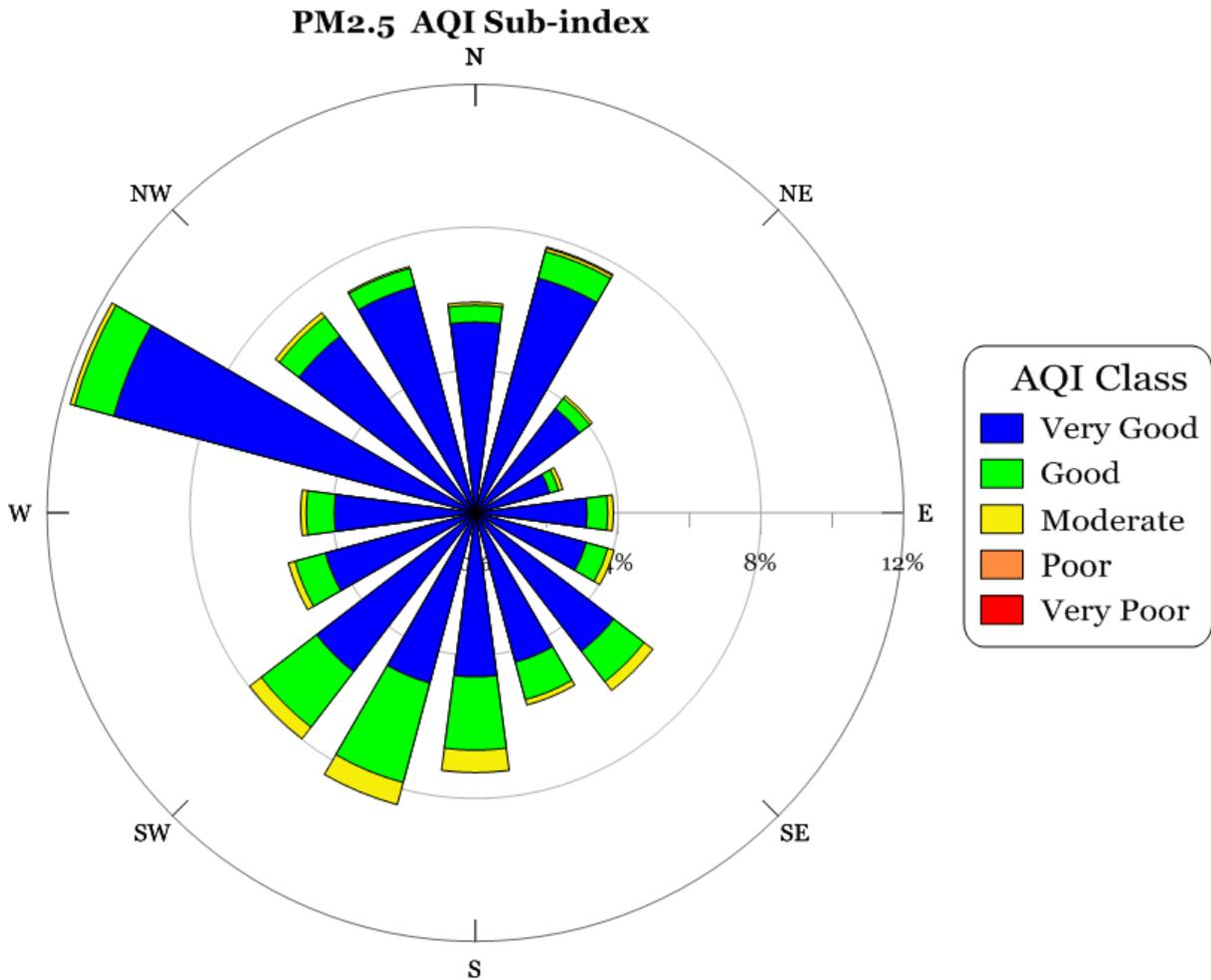
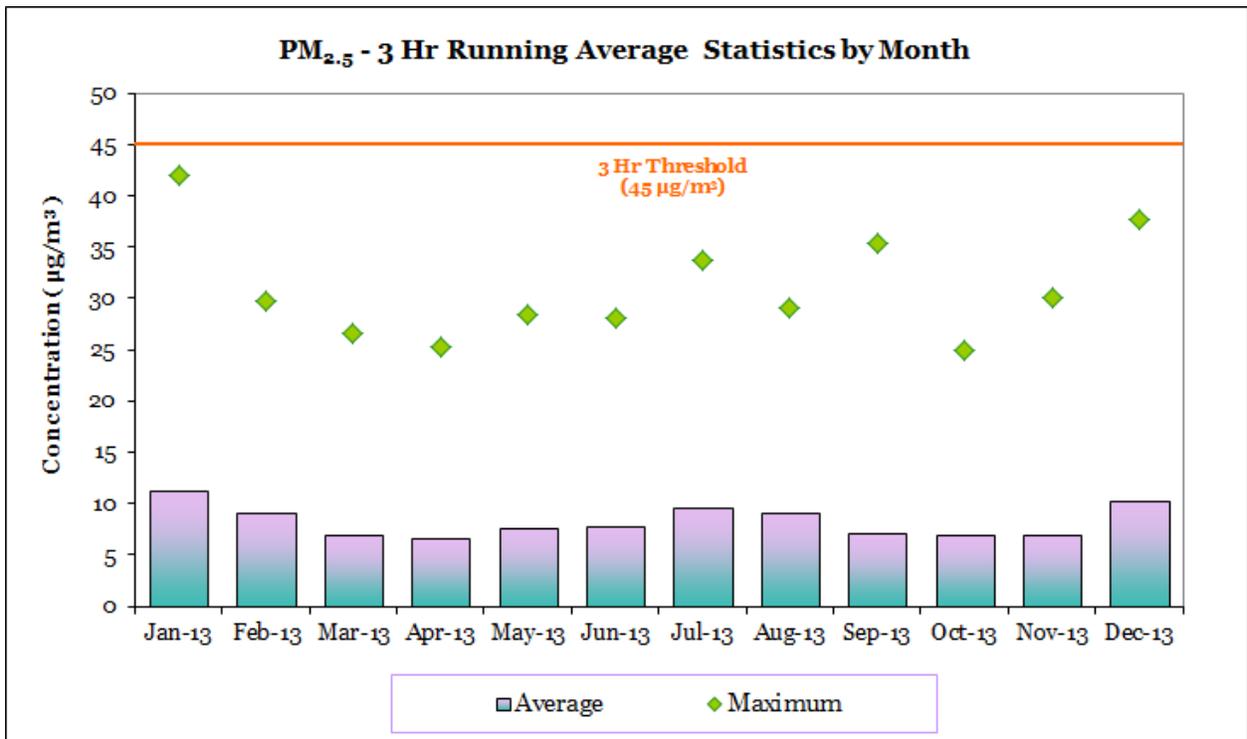
Annual Values (3-hr)	Average (µg/m ³)	Maximum (µg/m ³)	Exceedances
<i>AFN Station</i>			
2013	8.4	54.7	3
2012	9.1	63.7	10
<i>Other Stations, Current Report Period</i>			
Sarnia AQI	8.5	42.0	0
Windsor West AQI	10.0	45.3	1
London AQI	9.1	45.3	1

monitors, it is not uncommon to see changes from year to year.

Month by Month Statistics - 2013

	Concentration (3-hr)		Exceedances	AQI Sub-index				
	Average (µg/m ³)	Maximum (µg/m ³)		Very Good	Good	Moderate	Poor	Very Poor
Jan	11.2	42	0	65.9%	23.0%	11.2%	0.0%	0.0%
Feb	9.1	30	0	76.9%	19.0%	4.0%	0.0%	0.0%
Mar	6.9	27	0	88.0%	10.2%	1.7%	0.0%	0.0%
Apr	6.7	25	0	91.1%	7.9%	1.1%	0.0%	0.0%
May	8.1	55	3	82.8%	14.4%	2.3%	0.4%	0.0%
Jun	7.8	28	0	86.0%	12.8%	1.2%	0.0%	0.0%
Jul	9.6	34	0	73.0%	23.5%	3.5%	0.0%	0.0%
Aug	9.2	29	0	78.5%	16.4%	5.1%	0.0%	0.0%
Sep	7.1	35	0	82.5%	11.7%	5.8%	0.0%	0.0%
Oct	7.0	25	0	85.2%	14.4%	0.4%	0.0%	0.0%
Nov	6.9	30	0	81.6%	17.9%	0.5%	0.0%	0.0%
Dec	10.4	38	0	69.7%	23.6%	6.6%	0.0%	0.0%

A month by month summary is given in the second table and illustrated in the graph on the next page. The data shows the *Poor* conditions only occurred in May. The highest average occurred during January. *Moderate* levels were more frequent when the wind was from the south, but were occasionally seen for all wind directions.



Suspended Particulate & Metals

The atmosphere contains a wide assortment of particles, both solid and liquid. They range in size from not much bigger than a molecule to well over the diameter of a human hair and have a vast diversity of composition and shape. These differences give particulate a huge array of environmental and health effects, some of which we are still discovering.

The ministry has a 24-hour AAQC for suspended particulate less than 44 microns (μm) in aerodynamic diameter (SP) as well as certain common constituents of particulate that are believed to have either health or environmental effects at higher concentrations. So in addition to hourly measurements of respirable particulate, twenty-four hour samples of suspended particulate are taken every 6th day following the same schedule used by Environment Canada and most other sampling network in Ontario. In addition to determining particulate mass concentrations, this method permits analysis for a variety of particulate constituents such as metals. Samples are taken midnight to midnight EST.

The table below includes the number of values for each test that are greater than the detection limit. Averages are not reported when more than half the samples in the reporting period are below this level. The reason for this is discussed in the appendix

	2013			2012		
	Ave	Max	No > mdl	Ave	Max	No > mdl
Suspended Particulate	12.22	30.90	53	10.69	40.00	57
Silicon	0.32	1.60	51	0.29	2.40	57
Calcium	0.52	2.00	53	0.47	2.10	58
Vanadium	-	0.011	14	-	0.056	19
Chromium	-	0.003	2	-	0.001	0
Manganese	-	0.012	18	-	0.015	12
Iron	0.131	0.470	53	0.119	0.730	58
Nickel	-	0.007	10	-	0.005	6
Copper	-	0.016	14	-	0.006	14
Zinc	0.006	0.014	40	0.007	0.040	43
Cadmium	-	0.006	8	-	0.004	18
Lead	-	0.009	5	-	0.006	9

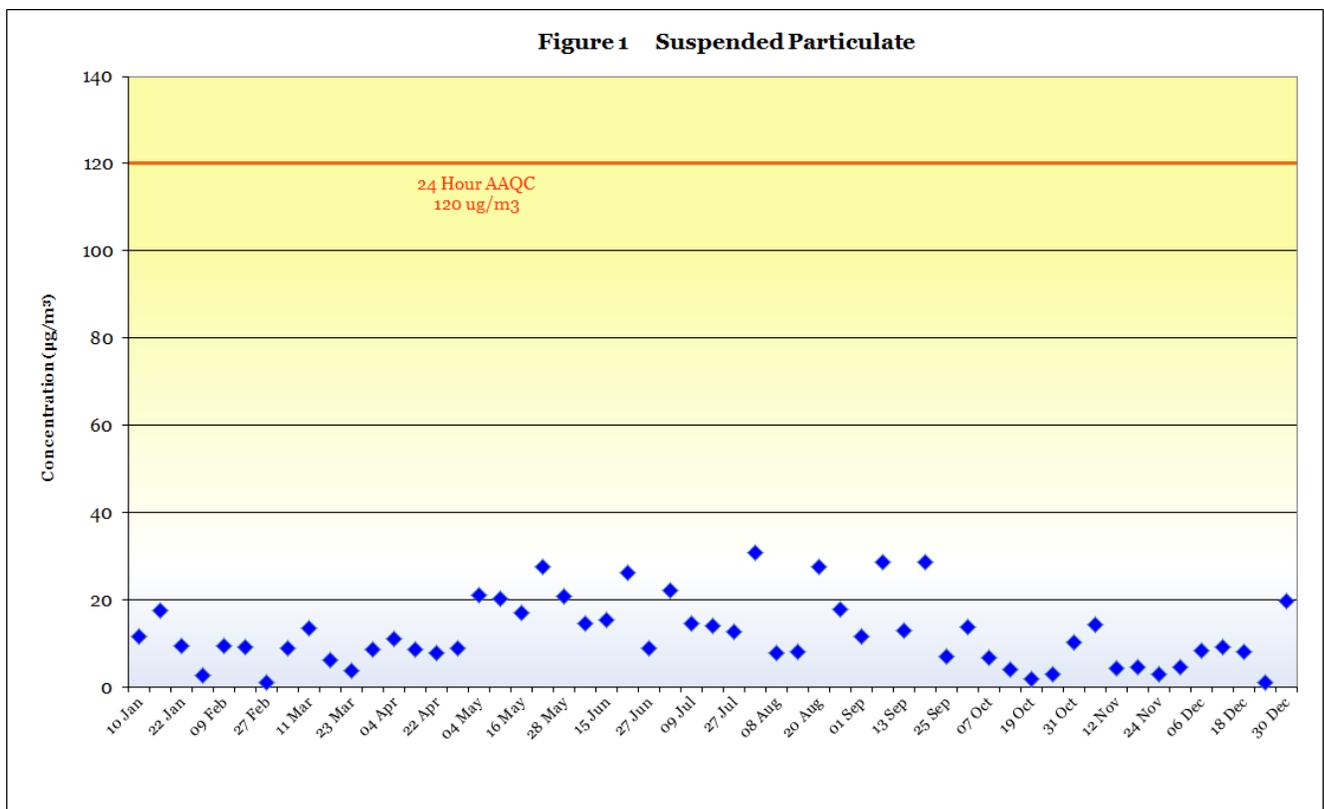
The maximum suspended particulate concentration was lower than seen in the previous year, the average was somewhat higher. The other species measured on the filters were generally the same as the previous years although calcium, iron, vanadium, and zinc all showed noticeably lower maxima.

Table 2 lists the 24-hour AAQC for SP all of determined particulate constituents for which an AAQC exists. None of the AAQC were exceeded.

Table 2 Maximum Concentrations Compared to AAQC		
Test	AAQC ($\mu\text{g}/\text{m}^3$)	% of AAQC
TSP	120	25.75%
Silicon	-	-
Calcium	-	-
Vanadium	2	0.55%
Chromium	0.5	0.60%
Manganese	0.4	0.48%
Iron	4	11.75%
Nickel	0.2	0.35%
Copper	50	0.03%
Zinc	120	0.01%
Cadmium	0.025	24.00%
Lead	0.5	1.80%

Directional information is normally of limited use for 24-hour samples as the wind variation may allow sources in different directions to contribute to a single sample and it is not possible to separate their contribution.

Particulate levels did not vary greatly from month to month. Levels were somewhat higher in the summer. Larger particulate loading may be related in part to influences of agriculture and changes in precipitation and snow cover. The individual results can be seen in Figure 1.



Volatile Organic Compounds – Hourly Measurements

Volatile organic compounds (VOC) are organic (carbon containing) chemicals with a high vapour pressure at typical atmospheric conditions. VOC arise from a variety of sources, both natural and anthropogenic. These two facts mean that VOC are usually present in the atmosphere. Their concentrations are usually enhanced in built up or urbanised areas.

VOC may often be odourous and some are linked to various health or environmental concerns. Most VOC are not encountered in levels that are immediately toxic although they may cause effects on long exposure. For these reasons, the ministry regulates the atmospheric release of a wide variety of VOC.

Hourly levels of several volatile organic compounds (VOC) have been measured at the AFN station since its inception, using a gas chromatograph/mass spectrometer (GC/MS). The initial list of target compounds was chosen based upon the ministry's expectations of what might be detected in the area. It has subsequently been updated to reflect sampling results, dropping some substances that weren't detected, in favour of new ones. Carbon tetrachloride and trichloroethylene were included as target compounds but never detected. Table 1 summarises the 2013 results and compares them to the results from previous years.

Table 1 Summary of Hourly VOC Measurements						
	2013			2012		
	Average (ppb)	Max (ppb)	% > mdl	Average (ppb)	Max (ppb)	% > mdl
Propylene	2.96	255.48	19.94%	1.04	141.90	7.04%
Chloromethane	0.22	63.23	2.30%	0.26	47.17	2.11%
1,3-Butadiene	0.04	82.12	0.17%	0.01	26.97	0.23%
Hexane	0.52	125.78	4.92%	0.40	91.61	4.00%
Cyclohexane	0.33	46.90	7.35%	0.25	60.91	3.80%
Benzene	0.12	15.70	10.91%	0.11	16.48	4.07%
Toluene	0.09	15.06	10.91%	0.12	52.06	6.09%
Tetrachloroethylene	0.00	1.95	0.11%	-	-	-
Ethyl Benzene	0.01	2.80	2.39%	0.03	13.80	2.84%
m & p-Xylene	0.02	4.80	2.38%	0.03	6.56	2.64%
o-Xylene	0.02	2.55	2.50%	0.02	3.35	2.40%
Styrene	0.00	0.89	0.36%	0.00	1.55	0.11%

Propylene and toluene were both seen more than 10% of the time - a significant increase from the previous year. Similarly benzene and cyclohexane were detected more than 5% of the time and hexane, o-xylene, and styrene were detected more frequently. While some of this may have been due to continuing improvement in the instrument, variations in the wind direction or changes in processes at the local plants are probably more significant contributors. Most average concentrations were slightly lower than those of 2012.

24-hour averages were compared with the respective AAQC. These comparisons are summarised in Table 2. Only benzene (twenty two times) and 1,3-butadiene (once) exceeded their 24-hour AAQC. Since the ministry publishes its standards in micrograms per cubic metre ($\mu\text{g}/\text{m}^3$) but the instrument reports values in parts per billion (ppb), the published values are converted to ppb and the equivalent values are included in the table.

The measurements should be compared to the AAQC values given in ppb on the second (purple) line.

Only two compounds have annual AAQC, benzene (AAQC=0.134 ppb) and 1,3-butadiene (AAQC=0.859 ppb). Neither were exceeded.

	Propylene	Chloromethane	1,3-Butadiene	Hexane	Cyclohexane	Benzene	Toluene	Tetrachloroethylene	Ethyl Benzene	M & p-Xylene	o-Xylene	Styrene
24-hour AAQC (µg/m³)	4000	320	10	2500	6100	2.3	2000	360	1000	730	730	400
24-hour AAQC (ppb)	2287	152	4.4	698	1744	0.7	522	52	227	165	165	92
# > AAQC	0	0	1	0	0	22	0	0	0	0	0	0
Max 24-hour Value (ppb)	27.05	8.99	9.93	45.13	8.65	2.38	1.43	0.43	0.47	0.95	0.46	0.15

Table 3 summarises the month to month variation in all species that were detected. There did not seem to be any strong patterns over the year. These are illustrated in Figure 1.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Propylene	2.18	2.07	2.87	2.28	2.65	0.98	4.59	4.15	3.88	2.15	2.42	4.74
Chloromethane	0.03	0.02	0.29	0.23	0.69	0.07	0.17	0.54	0.24	0.17	0.01	0.23
1,3-Butadiene	0.06	0.00	0.33	0.04	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.02
Hexane	0.05	0.04	0.32	0.26	2.19	0.36	0.35	1.91	0.25	0.10	0.06	0.39
Cyclohexane	0.46	0.29	0.35	0.14	0.16	0.06	0.40	0.33	0.24	0.41	0.34	0.72
Benzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Toluene	0.16	0.17	0.23	0.14	0.27	0.02	0.05	0.13	0.02	0.01	0.15	0.15
Tetrachloroethylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethyl benzene	0.11	0.05	0.10	0.10	0.24	0.05	0.05	0.13	0.04	0.04	0.06	0.11
m- & p-Xylene	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
o-Xylene	0.00	0.00	0.01	0.01	0.04	0.01	0.03	0.02	0.00	0.00	0.01	0.01
Styrene	0.00	0.01	0.02	0.01	0.04	0.02	0.06	0.04	0.00	0.00	0.02	0.02

Figure 2 shows the pollution roses for the five most frequently seen VOC (other than benzene). They are scaled the same to illustrate the difference in frequency. However the roses also illustrate diversity in strength and directionality underlying the variety of sources in the area. Figure 3 is a similar comparison for five other compounds (note the different frequency scale). It suggests a strong relationship between ethyl benzene and xylene but no clear relationship between these and either styrene or tetrachloroethylene. Figure shows benzene and 1,3-butadiene (note that scales are different) – these are the only hourly VOC measurements to indicated exceedances in the study period. They do not appear related to each other nor do they bear a strong relationship to any of the other species.

Figure 1 Hourly Maxima by Month

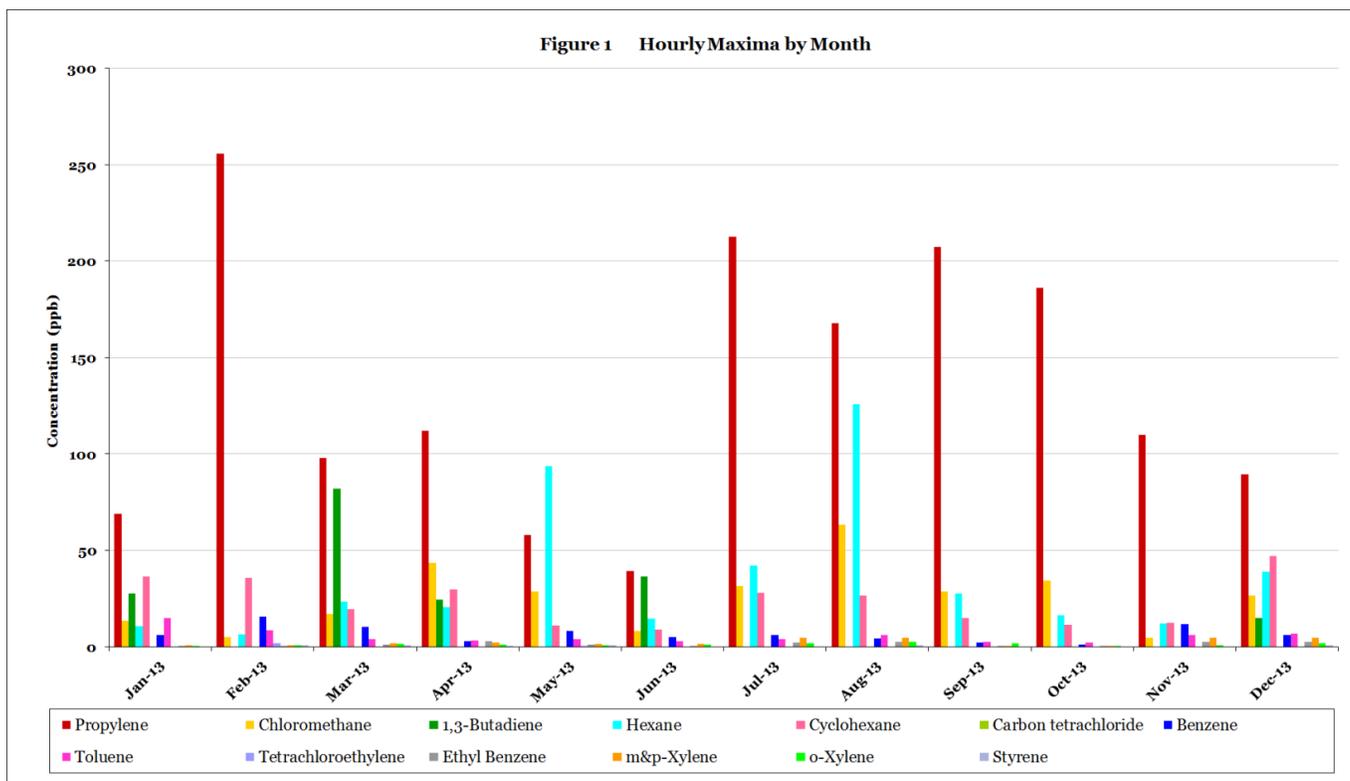
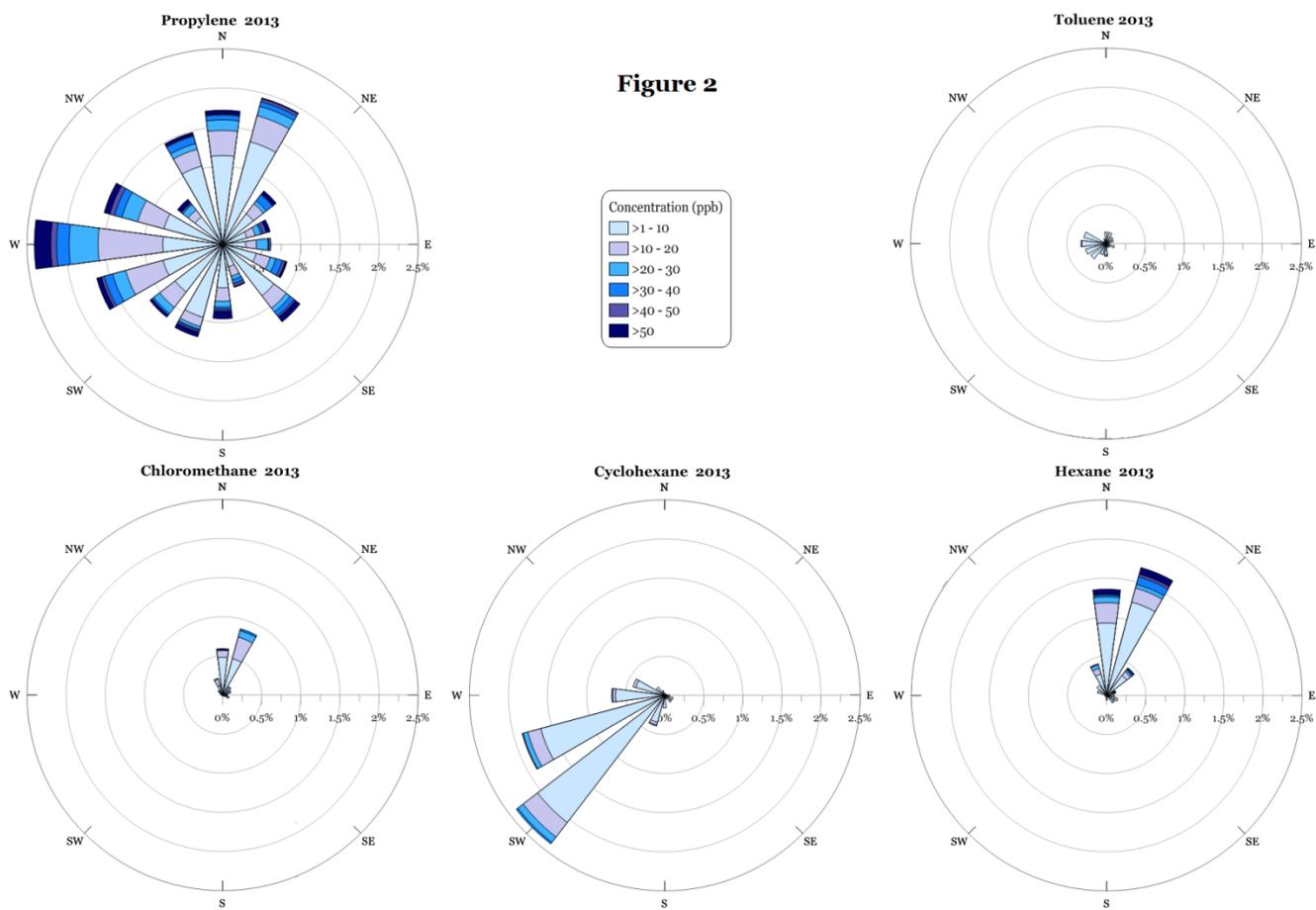


Figure 2



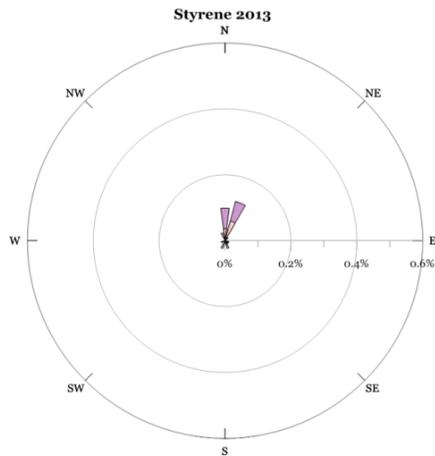


Figure 3

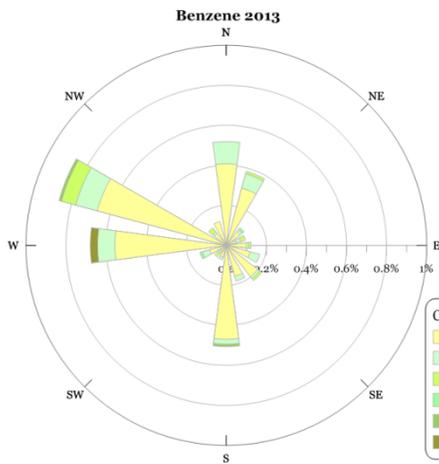
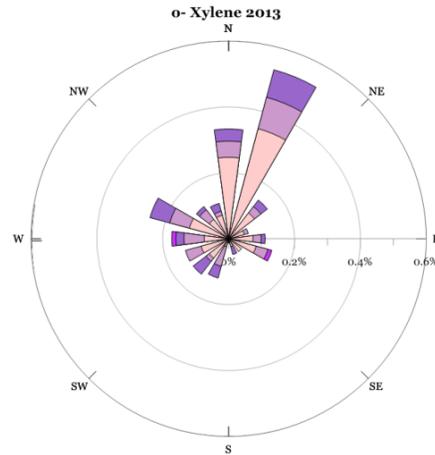
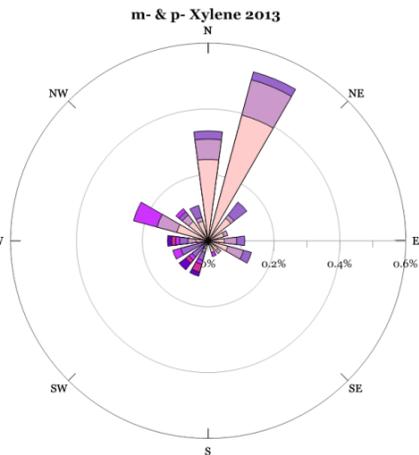
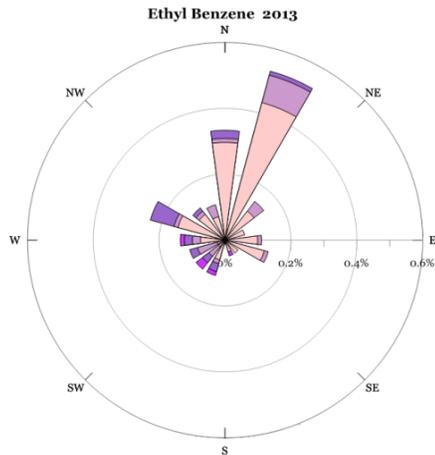
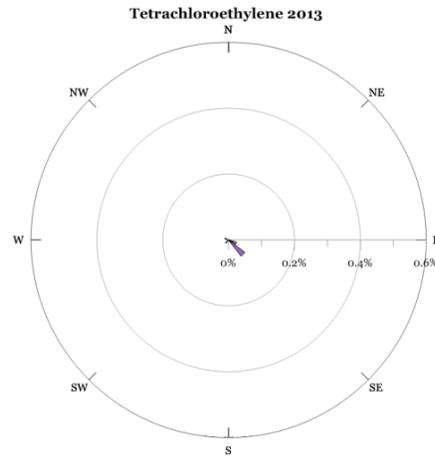
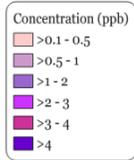
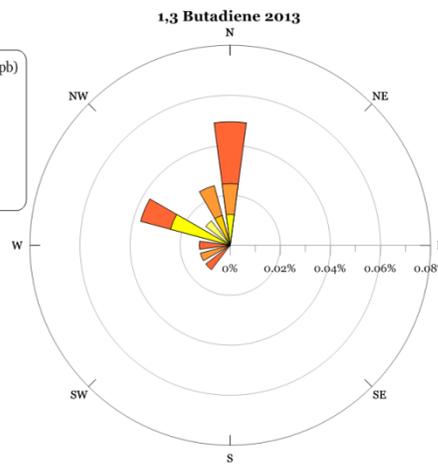
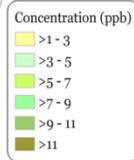
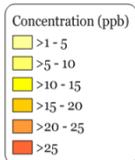


Figure 4



Non-continuous Volatile Organic Compounds

In addition to the hourly VOC monitoring conducted by the ministry at AFN station, Environment Canada (EC) collected 24-hour VOC samples every twelfth day. This is conducted in conjunction with EC's National Air Pollution Surveillance (NAPS) sampling network. This network spans Canada and samples the same 161 compounds across a broad range of conditions. As a result, EC chose a sampling method which detects all of these species at very low concentrations. EC collected samples using specially prepared evacuated canisters and analysed these samples at their laboratory in Ottawa.

Forty six of their target compounds have a 24-hour AAQC. One of these, 1,1-dichloroethane, was not detected. The monitoring results for the rest are compared to the existing 24-hour AAQC in Table 1.

Compound	24-hour AAQC (µg/m ³)	Maximum (% of AAQC)	Average (% of AAQC)	Compound	24-hour AAQC (µg/m ³)	Maximum (% of AAQC)	Average (% of AAQC)
Freon113	800000	0.0001%	0.0001%	1,2,4-Trichlorobenzene	400	0.0028%	0.0013%
Freon114	700000	0.0000%	0.0000%	Tetrachloroethylene	360	0.1131%	0.0181%
Freon12	500000	0.0006%	0.0005%	Chloromethane	320	6.1828%	0.6456%
Freon22	350000	0.0003%	0.0002%	1,3,5-Trimethyl benzene	220	0.0226%	0.0106%
1,1,1-Trichloroethane	115000	0.0000%	0.0000%	1,2,4-Trimethyl benzene	220	0.0844%	0.0394%
1-Decene	60000	0.0001%	0.0000%	1,2,3-Trimethyl benzene	220	0.0254%	0.0134%
Acetylene	56000	0.0017%	0.0008%	Dichloromethane	220	0.2309%	0.1322%
1-Octene	50000	0.0004%	0.0001%	trans-1,2-Dichloroethylene	105	0.8298%	
Heptane	11000	0.0041%	0.0016%	cis-1,2-Dichloroethylene	105	0.0023%	0.0003%
Hexane	7500	0.3120%	0.0188%	1,4-Dichlorobenzene	95	0.0441%	0.0142%
Methyl tertbutylether	7000	0.0002%	0.0000%	Bromoform	55	0.0411%	0.0235%
Cyclohexane	6100	0.2570%	0.0290%	Ethylene	40	36.2418%	10.9391%
Freon11	6000	0.0331%	0.0262%	Naphthalene	22.5	0.6631%	0.2903%
Chloroethane	5600	0.0008%	0.0005%	Trichloroethylene	12	0.3008%	0.1239%
Propylene	4000	0.2195%	0.0561%	1,3-Butadiene	10	36.3340%	1.9390%
1,2-Dichloropropane	2400	0.0013%	0.0007%	1,1-Dichloro ethylene	10	0.0150%	0.0015%
Toluene	2000	0.1579%	0.0581%	Ethylene dibromide	3	0.0367%	0.0038%
Bromomethane	1350	0.0082%	0.0040%	Carbon tetrachloride	2.4	28.6625%	21.6399%
Ethyl benzene	1000	0.0657%	0.0139%	Benzene	2.3	153.8826%	43.3277%
m and p-Xylene	730	0.0955%	0.0375%	1,2-Dichloroethane	2	5.2600%	3.4553%
o-Xylene	730	0.0377%	0.0150%	Vinyl chloride	1	0.6700%	0.2734%
Styrene	400	0.5698%	0.0363%	Chloroform	1	15.4800%	9.0097%
isoPropylbenzene	400	0.0129%	0.0030%				

Benzene is the only compound to exceed its 24-hour AAQC. It did this on 3 occasions.

Four other compounds have AAQC for other averaging periods. One, octane, has a 10-minute AAQC, while the other three, decane, 1,2-dichlorobenzene, and chlorobenzene, each have a 1-hour AAQC. In cases where AAQC do not exist for the appropriate time scale, the ministry uses a method outlined in O. Reg. 419/05 to calculate an equivalent concentration for comparison purposes. This benchmark level was determined for each of these four compounds and the monitoring results were compared to these (converted) values. This is summarised in Table 2.

Compound	AAQC (µg/m ³)	AAQC Averaging time	Equivalent 24 hour benchmark (µg/m ³)	Maximum (% of benchmark)	Average (% of benchmark)
Octane	61800	10 minutes	15000	0.0044%	0.0001%
Decane	60000	1 hour	25000	0.0016%	0.00003%
1,2-Dichlorobenzene	30500	1 hour	12500	0.00004%	0.00002%
Chlorobenzene	3500	1 hour	1400	0.0018%	0.0005%

In addition to the 24-hour AAQC listed above, six substances also have annual AAQC. These are listed in Table 3. The annual averages are recapped in the table for ease of comparison.

Substance	Annual AAQC (µg/m ³)	2013 (µg/m ³)	2012 (µg/m ³)
1,3-Butadiene	2.0	0.1939	0.0949
Benzene	0.45	0.9965	1.1219
Vinyl chloride	0.2	0.0027	0.0028
Dichloromethane	44.0	0.2907	0.2463
Chloroform	0.45	0.0901	0.0945
1,2-Dichloroethane	0.4	0.0691	0.0730

These values do not show a consistent trend: the annual averages for benzene, chloroform, and 1,2-dichloroethane are lower than those from the previous year; 1,3-butadiene and dichloromethane averages are higher; and vinyl chloride is essentially unchanged. This is behaviour that might be expected for species that have different sources.

Environment Canada also samples VOC across the country and there are three stations in southwestern Ontario which can be compared to these results to give them a context. Table 4 presents the results for 11 species: all those whose average exceeded 0.3% of their respective AAQC.

The table shows similar values for carbon tetrachloride, 1,2-dichloroethane, and vinyl chloride across the region. In most cases the Sarnia and Aamjiwnaang station show similar values. The most noticeable difference is the chloromethane maximum, although even this value was only about 6% of the 24-hour AAQC. Ethylene remains high in the Sarnia area as do benzene and 1,3-butadiene.

London most often has the lowest values though it exhibits slightly higher levels of trichloroethylene. Windsor values were usually intermediate, though higher for naphthalene and dichloromethane.

Table 4 Comparison of Selected Environment Canada VOC Results (µg/m³)					
Compounds		Aamjiwnaang	Sarnia AQI	London	Windsor
Benzene	Average	0.997	0.820	0.413	0.519
	Maximum	3.539	4.621	0.822	1.350
Carbon tetrachloride	Average	0.519	0.525	0.523	0.520
	Maximum	0.688	0.626	0.632	0.622
Ethylene	Average	4.376	3.059	0.720	1.052
	Maximum	14.497	15.309	1.990	3.497
Chloroform	Average	0.090	0.112	0.105	0.103
	Maximum	0.155	0.396	0.221	0.208
1,2-Dichloroethane	Average	0.069	0.071	0.066	0.069
	Maximum	0.105	0.109	0.115	0.103
1,3-Butadiene	Average	0.194	0.210	0.025	0.038
	Maximum	3.633	1.368	0.081	0.142
Chloromethane	Average	2.066	1.514	1.164	1.172
	Maximum	19.785	4.257	1.345	1.451
Naphthalene	Average	0.065	0.085	0.099	0.141
	Maximum	0.149	0.292	0.267	0.443
Vinyl chloride	Average	0.003	0.002	0.002	0.002
	Maximum	0.007	0.009	0.006	0.006
Dichloromethane	Average	0.291	0.303	0.324	0.355
	Maximum	0.508	0.562	0.650	1.379
Trichloroethylene	Average	0.015	0.023	0.036	0.022
	Maximum	0.036	0.091	0.149	0.074

Table 5 presents a comparison of maxima and averages between this year and the previous year. The 24-hour AAQC for each substance is included for ease of reference. The four substances with AAQC for periods other than 24 hours are included at the bottom of the table, in italics, with their 24-hour AAQC equivalent given in brackets.

Year to year variations are to be expected as they depend, in part, on wind direction and speed, and the variation in production cycles. Overall it appears that maximum values increased more than they decreased from the previous year but that overall averages remained about the same.

Table 5 Comparison of Canister VOC Results (All values in µg/m ³)					
Compounds	24-hour AAQC	2013		2012	
		Max	Average	Max	Average
Freon113	800000	0.7096	0.5870	0.7530	0.6066
Freon114	700000	0.1318	0.1112	0.1627	0.1178
Freon12	500000	3.1367	2.5072	3.0153	2.5236
Freon22	350000	0.9530	0.7489	1.3516	0.7691
1,1,1-Trichloroethane	115000	0.0351	0.0276	0.0570	0.0357
1-Decene	60000	0.0543	0.0126	0.0987	0.0124
Acetylene	56000	0.9722	0.4559	0.8665	0.4634
1-Octene	50000	0.1928	0.0483	0.1720	0.0438
Heptane	11000	0.4515	0.1724	0.9473	0.2424
Hexane	7500	23.3990	1.4080	17.6245	2.1419
Methyltertbutylether	7000	0.0154	0.0010	0.0079	0.0013
Cyclohexane	6100	15.6757	1.7668	12.0498	2.3203
Freon11	6000	1.9850	1.5722	1.8915	1.5908
Chloroethane	5600	0.0460	0.0262	0.0512	0.0239
Propylene	4000	8.7809	2.2421	8.6539	2.1780
1,2-Dichloropropane	2400	0.0301	0.0165	0.0288	0.0151
Toluene	2000	3.1589	1.1616	5.0885	1.3848
Bromomethane	1350	0.1102	0.0534	0.2167	0.0602
Ethylbenzene	1000	0.6574	0.1385	0.6795	0.1881
m- & p-Xylene	730	0.6972	0.2738	1.1320	0.3681
o-Xylene	730	0.2752	0.1091	0.3796	0.1357
Styrene	400	2.2793	0.1451	0.5835	0.0784
iso-Propylbenzene	400	0.0517	0.0119	0.0368	0.0129
1,2,4-Trichlorobenzene	400	0.0111	0.0053	0.0282	0.0088
Tetrachloroethylene	360	0.4073	0.0650	0.1586	0.0553
Chloromethane	320	19.7850	2.0659	16.3410	2.1146
1,3,5-Trimethylbenzene	220	0.0497	0.0234	0.0885	0.0336
1,2,4-Trimethylbenzene	220	0.1856	0.0866	0.3206	0.1238
1,2,3-Trimethylbenzene	220	0.0558	0.0295	0.1134	0.0435
Dichloromethane	220	0.5079	0.2908	0.3522	0.2463
trans-1,2-Dichloroethylene	105	0.8713	0.0480	0.0446	0.0074
cis-1,2-Dichloroethylene	105	0.0024	0.0003	0.0032	0.0008
1,4-Dichlorobenzene	95	0.0419	0.0135	0.0351	0.0147
Bromoform	55	0.0226	0.0129	0.0744	0.0166
Ethylene	40	14.4967	4.3757	28.5524	4.7038
Naphthalene	22.5	0.1492	0.0653	0.2185	0.0811
Trichloroethylene	12	0.0361	0.0149	0.0635	0.0208
1,3-Butadiene	10	3.6334	0.1939	0.6103	0.0949
1,1-Dichloroethylene	10	0.0015	0.0001	0.0021	0.0004
Ethylene dibromide	3	0.0011	0.0001	0.0041	0.0006
Carbon tetrachloride	2.4	0.6879	0.5194	0.7189	0.5503
Benzene	2.3	3.5393	0.9965	3.4581	1.1219
1,2-Dichloroethane	2	0.1052	0.0691	0.1468	0.0730
Vinyl chloride	1	0.0067	0.0027	0.0110	0.0028
Chloroform	1	0.1548	0.0901	0.1462	0.0945
<i>Octane</i>	<i>(15000)</i>	<i>0.6596</i>	<i>0.0972</i>	<i>0.5086</i>	<i>0.1225</i>
<i>Decane</i>	<i>(25000)</i>	<i>0.3990</i>	<i>0.0824</i>	<i>0.7039</i>	<i>0.1277</i>
<i>1,2-Dichlorobenzene</i>	<i>(12500)</i>	<i>0.0054</i>	<i>0.0026</i>	<i>0.0086</i>	<i>0.0033</i>
<i>Chlorobenzene</i>	<i>(1400)</i>	<i>0.0254</i>	<i>0.0125</i>	<i>0.03</i>	<i>0.0135</i>

Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons (PAH) are a group of complex hydrocarbons that may be formed by incomplete combustion of organic compounds. They are common products of industrial processes such as coking, combustion of organic materials such as coal or wood, and every day activities such as barbecuing and smoking. Some PAH are known to be carcinogenic.

The ministry samples for several PAH at the Aamjiwnaang station every twelfth day (following the National Air Pollution Surveillance [NAPS] schedule). PAH are sampled on a filter which is returned to the ministry's laboratory for analysis. Each sample is collected for twenty-four hours, from midnight to midnight, EST.

PAH are found in very low concentrations in the atmosphere. As a result, concentrations are given in nanograms per cubic metre (ng/m³), a unit that is one thousand times smaller than the unit used for most other measurements in this report.

During 2013, the ministry collected thirty samples. The results are summarised in the Table 1. Some of the concentrations were so low they could not be determined in these samples. Averages are not reported when more than half of the values during a reporting period are below the method detection limit (mdl), as the degree of uncertainty becomes too high.

Table 1 Polycyclic Aromatic Hydrocarbons Monitoring Results							
Compounds and Abbreviations		2013			2012		
		Ave ng/m³	Max ng/m³	>mdl	Ave ng/m³	Max ng/m³	>mdl
Benz[a]anthracene	B[a]A	0.043	0.444	70.0%	0.032	0.151	80.6%
Chrysene / Triphenylene	Chry / TPh	0.090	0.769	93.3%	0.078	0.378	93.5%
Benzo[b]fluoranthene	B[b]F	0.145	0.866	93.3%	0.126	0.485	93.5%
Benzo[k]fluoranthene	B[k]F	0.053	0.322	93.3%	0.046	0.170	93.5%
Benzo[a]pyrene	B[a]P	0.061	0.480	93.3%	0.043	0.163	90.3%
Indeno[1,2,3-cd]Pyrene	I[1,2,3]P	0.095	0.572	93.3%	0.076	0.278	93.5%
Dibenz[a,h]Anthracene Dibenz[a,b]Anthracene	D[a,b]A / D[a,h]A	0.018	0.098	63.3%	0.017	0.053	77.4%
Benzo[g,h,i]perylene	B[g,h,i]P	0.106	0.569	93.3%	0.080	0.300	93.5%

The sample by sample results are illustrated in Figure 1 on the following page. Average and maximum concentrations were lower during this reporting period than during to the previous one.

Table 2 presents a comparison of the Aamjiwnaang results with those obtained at two other stations in southwestern Ontario. These sites are not the same as those used for most other contaminants as there are not PAH monitors at these locations. In particular, the comparison site in Windsor for most other substances is the Windsor West AQI site (College Ave. and South St.) while the PAH data come from a monitor at the Lou Romano Water Reclamation Plant, about 2.5 km to the southwest.

The Aamjiwnaang results were much lower than levels measured at the ministry's monitoring station in West Windsor which is across the Detroit River from a steel mill. However, they are higher than those measured at the Wallaceburg site. This is reasonable as the latter site is located in an agricultural area with few local sources of PAH.

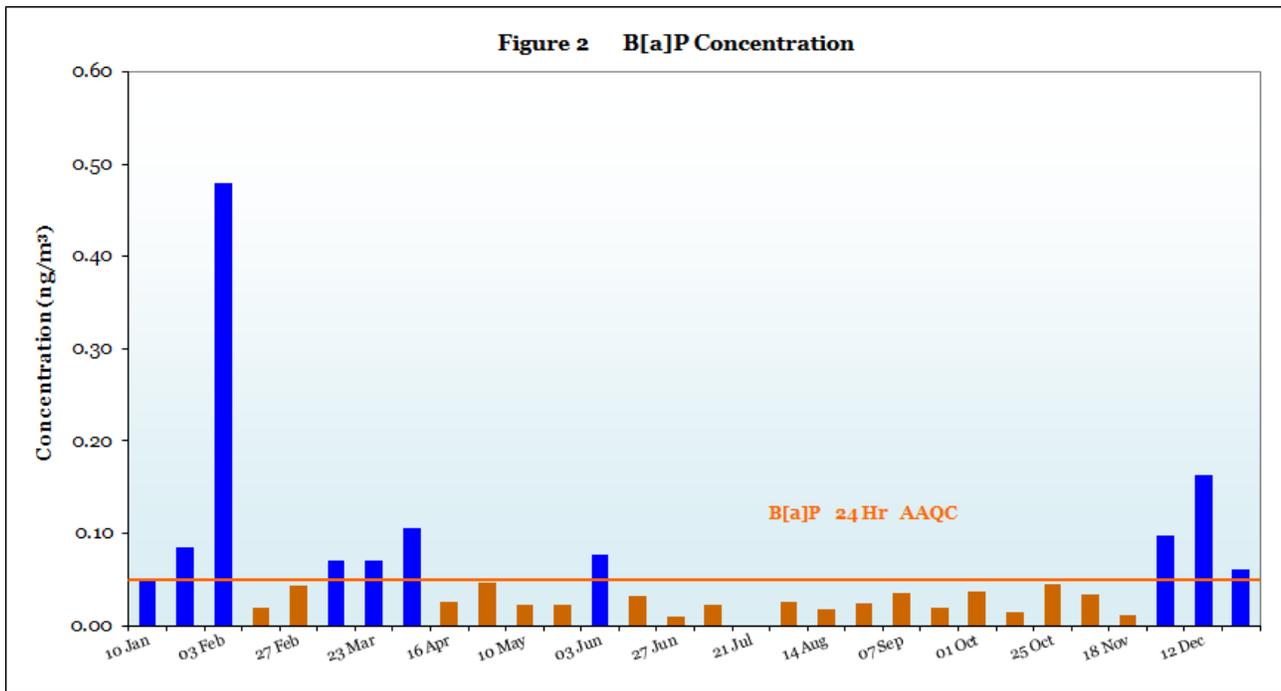


Table 2 Polycyclic Aromatic Hydrocarbons Comparison by Location

	Aamjiwnaang		West Windsor Industrial		Wallaceburg	
	Ave (ng/m ³)	Max (ng/m ³)	Ave (ng/m ³)	Max (ng/m ³)	Ave (ng/m ³)	Max (ng/m ³)
Benz[a]anthracene	0.043	0.444	0.077	0.301	0.021	0.068
Chrysene / Triphenylene	0.090	0.769	0.140	0.741	0.044	0.224
Benzo[b]fluoranthene	0.145	0.866	0.286	1.170	0.076	0.277
Benzo[k]fluoranthene	0.053	0.322	0.111	0.456	0.030	0.092
Benzo[a]pyrene	0.061	0.480	0.123	0.515	0.032	0.089
Indeno[1,2,3-cd]Pyrene	0.095	0.572	0.220	0.838	0.046	0.150
Dibenz[a,h]Anthracene Dibenz[a,b]Anthracene	0.018	0.098	0.042	0.132	0.013	0.030
Benzo[g,h,i]perylene	0.106	0.569	0.406	2.190	0.053	0.155

The ministry previously had a 24-hour AAQC for B[a]P of 1.1 ng/m³. None of the current samples approached this level. However the new 24-hour AAQC of 0.05 ng/m³ is much lower and ten of the 24-hour B[a]P concentrations exceeded this value. Only one of these exceedances occurred during the warmer months. These are illustrated in Figure 2 – the exceedances are highlighted in blue. For comparison, this occurred seven times in 2012.

In addition, the annual average in 2012 exceeded the new annual AAQC of 0.01 ng/m³.

As with other 24-hour samples, it is not possible to assign a direction to samples as the wind direction may vary considerably over the sample period.

Terminology

Ambient Air Quality Criteria (AAQC): Maximum-desirable average concentrations for specific atmospheric contaminants. AAQC are based upon the effects on the most sensitive endpoint: human health, plant or other environmental constituent, odours, or soiling. Where more than one significant effect occurs, the ministry may have multiple AAQC for the same substance. The AAQC is given for a particular averaging time which is initially set based on the underlying effect and is sometimes adjusted in order to allow for evaluation of air quality over different averaging periods.

Air Quality Index (AQI): An indicator of air quality, based on selected air pollutants that have adverse effects on human health and the environment. These pollutants are (ground level) ozone, fine particulate matter, nitrogen dioxide, carbon monoxide, sulphur dioxide and total reduced sulphur compounds. The air quality is reported as both a number (the index) and one of five classifications based upon the index: *Very Good, Good, Moderate, Poor, or Very Poor*.

More information may be found by following the links on the ministry's air quality web site <http://www.airqualityontario.com/>.

Air Quality Sub-index: A value related to the concentration of each AQI pollutant based upon their individual health and environmental effects. A sub-index is calculated every hour for each AQI pollutant measured at a station. The maximum is reported as the AQI for that station for that hour.

Detection Limit (DL): The smallest amount of a substance which an instrument can differentiate from 0. This is related to the Method Detection Limit (MDL) which is the lowest amount of a substance that an entire analysis method (media preparation, sampling, extraction, and instrumental analysis) can reliably determine.

Exceedance: A concentration of a pollutant that is higher than the standard or other benchmark for that substance.

Micrograms per Cubic Metre ($\mu\text{g}/\text{m}^3$): A concentration unit used to report pollutant concentrations in the atmosphere. One microgram is a millionth of a gram. PAH are reported in **nanograms per cubic metre (ng/m^3)**. A nanogram is a billionth of a gram. A nanogram per cubic metre would be the equivalent of a millilitre of water in a cubic kilometre of air.

Micron (μm): One millionth of a metre = one thousandth of a millimetre = about three millionths of a foot. Human hairs range from 40 to 120 μm thick.

NAPS: Environment Canada's *National Air Pollution Surveillance* program. It was established in 1969 to provide accurate and long-term air quality data of a uniform standard across Canada.

More information may be found at <http://www.ec.gc.ca/rnspa-naps> .

98th Percentile: The value in a set or series below which 98% of the measurements are found. This cannot be measured, only determined once measurements are complete.

Part per Billion (ppb): A concentration unit used by various instruments to report gas concentrations in the atmosphere. This is the approximate equivalent of 50 drops of water in an Olympic size swimming pool. Similarly "**ppm**" means "part per million" a unit which is 1000 times larger.

Point of Impingement Standard (POI): The maximum allowable average concentration of a particular pollutant which may be caused by a source or sources at one location. This level must exclude the background or contributions from other sources. Averaging periods are usually 1/2 hour or 24 hours but may be different in certain cases.

Polycyclic Aromatic Hydrocarbons (PAH): A class of molecules composed of fused six-sided carbon rings (looking a bit like honeycomb from the front). They form during most combustion processes when conditions do not allow all the carbon to be oxidised.

Volatile Organic Compounds (VOC): Organic (containing carbon) chemicals that exist as a gas (at least partially), at normal environmental temperatures and pressures.

Data Averaging and Unit Conversion

Averaging

The ministry has established procedures for dealing with air pollutant concentrations that are reported as “o”. In general if an instrument has a well-defined detection limit (*DL*) which is the lowest concentration at which it can say a substance is present, then anything below that will be recorded as o. However, the “real” value of that concentration could be anywhere below this level, the *DL*, and o. There is no way of knowing.

A standard practice in situations such as this is to use half of the *DL* when calculating averages. This usually offers a reasonably good estimate if the number of values below *DL* is relatively small. But since the uncertainty of the average grows with the number of these values, an average will not be reported if more than half of these values are below *DL*. This protocol is followed for the PAH, non-continuous VOC, and suspended particulate and metals.

However this is not the practice that is followed for the continuous monitors. The ministry has been reporting results from AQI monitors for years and including non-detects as o in average calculations. The same methodology is used in this report so that these results may be compared to those found in AQI reports. While most real-time instruments will record a “o” from time to time, this decision will only have a noticeable impact on SO₂, and TRS which usually exhibit very low levels.

This practice is also adopted for the real time VOC monitor but for very different reasons. Because of the experimental nature of the instrument, the ministry has not been able to determine a detection limit for each of the species involved. Therefore there is no value of which one can take half for use in performing calculations. In addition, since detectable levels are seen infrequently, averages could not be presented as they cannot be considered representative. This would greatly limit our ability to discuss the results.

Unit Conversion

Some of the ministry’s instruments report in parts per billion (ppb) or parts per million (ppm). Other results are expressed in micrograms per cubic metre ($\mu\text{g}/\text{m}^3$) or nanograms per cubic metre (ng/m^3). Most ministry air standards and AAQC are published in these latter units.

Comparisons require that the two things being compared be in the same units and so to write this report it was necessary to convert units for several measurements. These conversions depend on the temperature and pressure as well as the molecular weight and so vary with atmospheric conditions.

However since most measurements rely on samples taken over a period of time, it is possible for both the temperature and pressure to change. Since we do not have instantaneous measurements of all these parameter and the sample concentration, there is no practical way to correct for this. In addition since most instruments reside inside shelters, temperatures of the sample will be affected as they are drawn into the sampler.

As a result, assumptions about the parameter conversion have to be made. For the purposes of this document (and the previous reports) the temperature was assumed to be 20 ° C and the pressure to be 1 atmosphere (101.3 kilopascals [kPa]).

While changing these assumed parameters would change the converted values, the magnitude of the change would never have been large enough to alter any of the conclusions or change the number of exceedances.

Aamjiwnaang First Nation & Surrounding Area

