Technical Memorandum

Aamjiwnaang First Nation Community Air Monitoring Station

Results for 2012

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Southwestern Region Technical Support Unit
Air Pesticides and Environmental Planning Section
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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 24 hours either once every 6 days or once every 12 days depending upon the monitor. The data 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, and a report summarising the first year of operation was released in January of 2011. This report, the fourth, covers the calendar year 2012. For most cases, the data is summarised in two pages. These summaries are designed to make the important information quickly available to readers. 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 (SO_2)
- Total reduced sulphur (TRS)
- Nitrogen dioxide (NO_2)
- Ground-level ozone (O_3)
- Fine particulate matter ($PM_{2.5}$)
- Specific volatile organic compounds (VOC)

Data from non-continuous sampling are presented for:

- Suspended particulate (SP)
    - 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 SO_2, TRS, NO_2, O_3, 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, metal, PAH, and canister VOC results are reported in micrograms per cubic metre ($\mu g/m^3$), 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 report *Air Quality in Ontario* 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 $\mu g/m^3$), the ministry's values are

converted to ppb assuming a temperature of 20° C and an atmospheric pressure of 1013 hPa.

A small but important point in the results is that there were some differences in how calculations were made for certain substances compared to 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 change that was also noted in last year's annual report occurred with the adoption of several new air standards by the ministry in July of 2011. It is the ministry's practice to phase standards in over five years 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 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. Scientific studies of carcinogens generally yield risk estimates based upon lifetime exposures. As such, they have AAQC with longer averaging periods, generally stated as annual averages. This is the case for the first three of the new list: benzene, benzo[a]pyrene, and 1,3-butadiene. Others 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 averages for SO_2 and $PM_{2.5}$, but a higher average values compared to 2011 year for O_3, TRS, and NO_2. As with the previous report, exceedances were only seen for $PM_{2.5}$ (10 versus 15 in the previous 2011 calendar year) and O_3 (50 versus 28 in 2011).

The average SP concentration decreased from the previous year and included no exceedances of the AAQC. Metal concentrations and maxima 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 remained unchanged from the previous year. Most averages were similar to the previous year, propylene showing the largest percentage gain, but hexane showing the largest percentage increase in maxima. Maxima were lower for the majority of the compounds except again, for hexane, whose maxima increased substantially. As with the previous report, only benzene (23 times) showed an exceedance of the 24-hour AAQC and none showed exceedances of the annual AAQC.

The ministry, in cooperation with Environment Canada 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, 50 have AAQC (either 24-hour, annual, or both) and 49 of these were detected. Only benzene exceeded the 24-hour AAQC (3 times). Six of the substances also have annual AAQC and, of these, only benzene exceeded this level.

Sulphur Dioxide

Report Values	Average (ppb)	Maximum (ppb)	AAQC Exceedances
AFN Station			
2012	2.4	105	0
2011	2.5	70	0
2010	2.8	75	0
2009	3.0	101	0
Other Stations, Current Report Period			
Sarnia AQI	4.1	110	0
Windsor West AQI	2.8	69	0

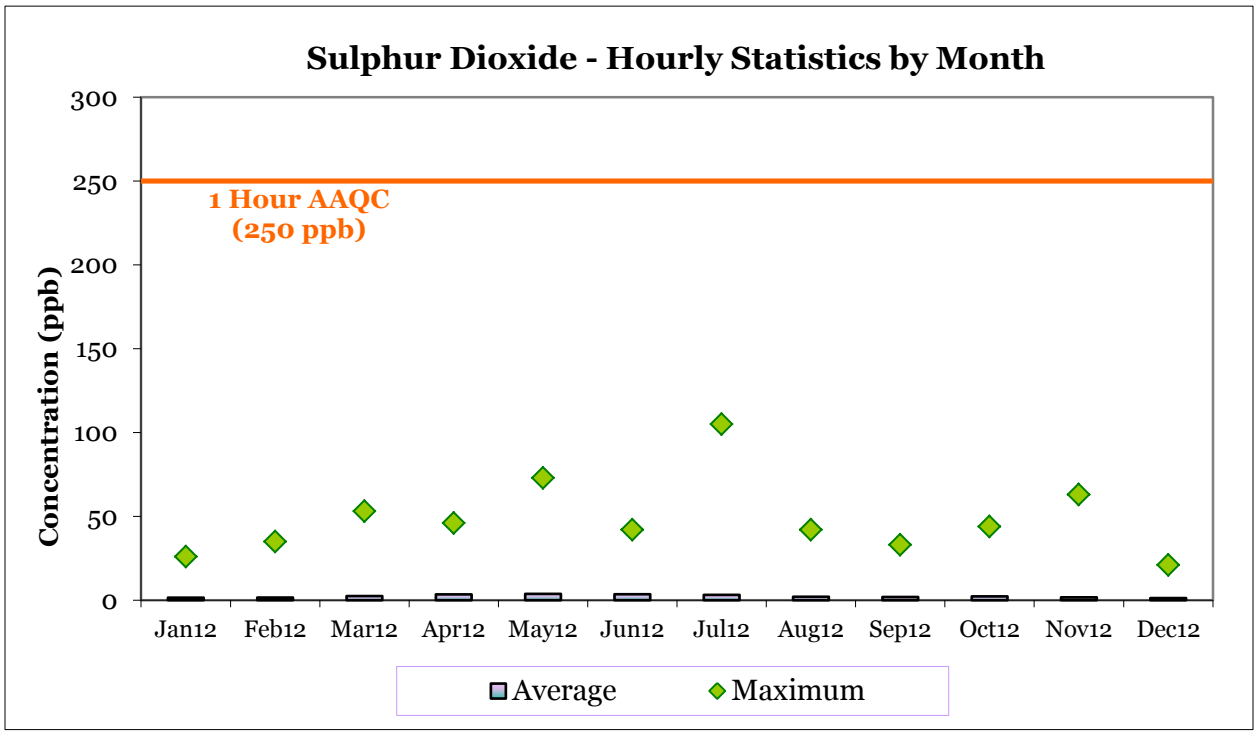
Sulphur dioxide (SO_2) is emitted from industrial facilities and sources that burn sulphur-containing fuel, notably electric power generators. It contributes to acid rain, and can have human health impacts including eye and respiratory tract irritation and lung damage at higher concentrations. Like some other gases, it can travel a considerable distance downwind 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.

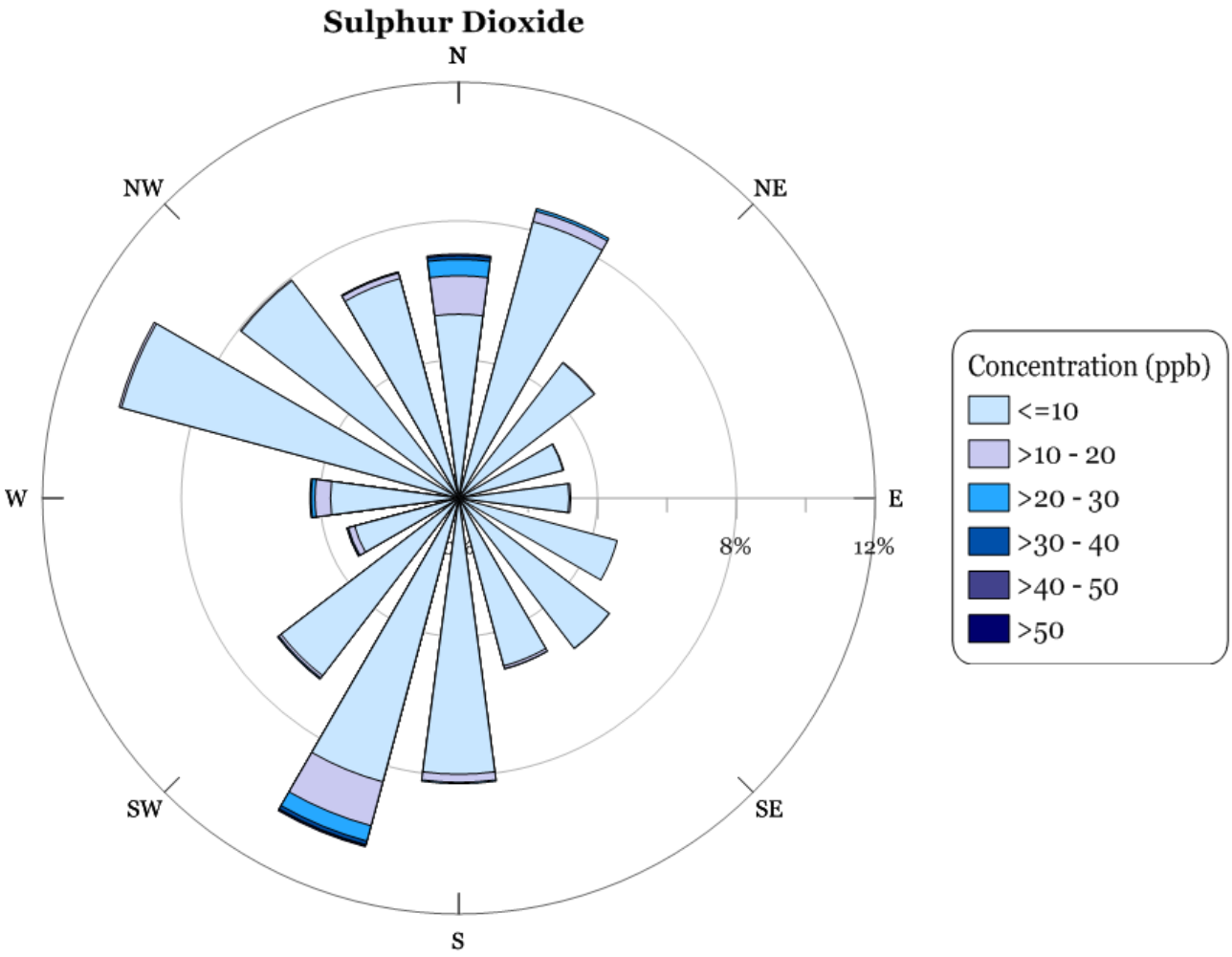
No exceedances were recorded during this monitoring period. The average sulphur dioxide concentration was lower than in any of the previous three years however the sulphur dioxide maximum was higher than the previous two years and comparable to 2009. Both values were lower than those measured at the Sarnia AQI station. The highest average was seen during July. These results are similar to those in the previous report.

This year, all the SO_2 measurements led to a *Very Good* SO_2 AQI sub-index. The month by month results are shown in the graph below.

Month by Month Statistics - 2012								
	Concentration		AAQC Exceedances	AQI Sub-index				
	Average (ppb)	Maximum (ppb)		Very Good	Good	Moderate	Poor	Very Poor
Jan	1.5	26	0	100%	0%	0%	0%	0%
Feb	1.6	35	0	100%	0%	0%	0%	0%
Mar	2.5	53	0	100%	0%	0%	0%	0%
Apr	3.5	46	0	100%	0%	0%	0%	0%
May	3.8	73	0	100%	0%	0%	0%	0%
Jun	3.6	42	0	100%	0%	0%	0%	0%
Jul	3.2	105	0	100%	0%	0%	0%	0%
Aug	2.1	42	0	100%	0%	0%	0%	0%
Sep	1.9	33	0	100%	0%	0%	0%	0%
Oct	2.3	44	0	100%	0%	0%	0%	0%
Nov	1.7	63	0	100%	0%	0%	0%	0%
Dec	1.3	21	0	100%	0%	0%	0%	0%

The pollution rose shown on the next page illustrates how SO_2 concentration varies with wind direction. There are small differences in the wind pattern and results from those seen previously but the sources to the north of the station appear to be unchanged from the previous three years.


Sulphur Dioxide - Hourly Statistics by Month
Concentration (ppb)
300
250
200
150
100
50
0
1 Hour AAQC
(250 ppb)
Jan12
Feb12
Mar12
Apr12
May12
Jun12
Jul12
Aug12
Sep12
Oct12
Nov12
Dec12
Average
Maximum


Sulphur Dioxide
N
NE
E
SE
S
SW
W
NW
8%
12%
Concentration (ppb)
<=10
>10 - 20
>20 - 30
>30 - 40
>40 - 50
>50

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.

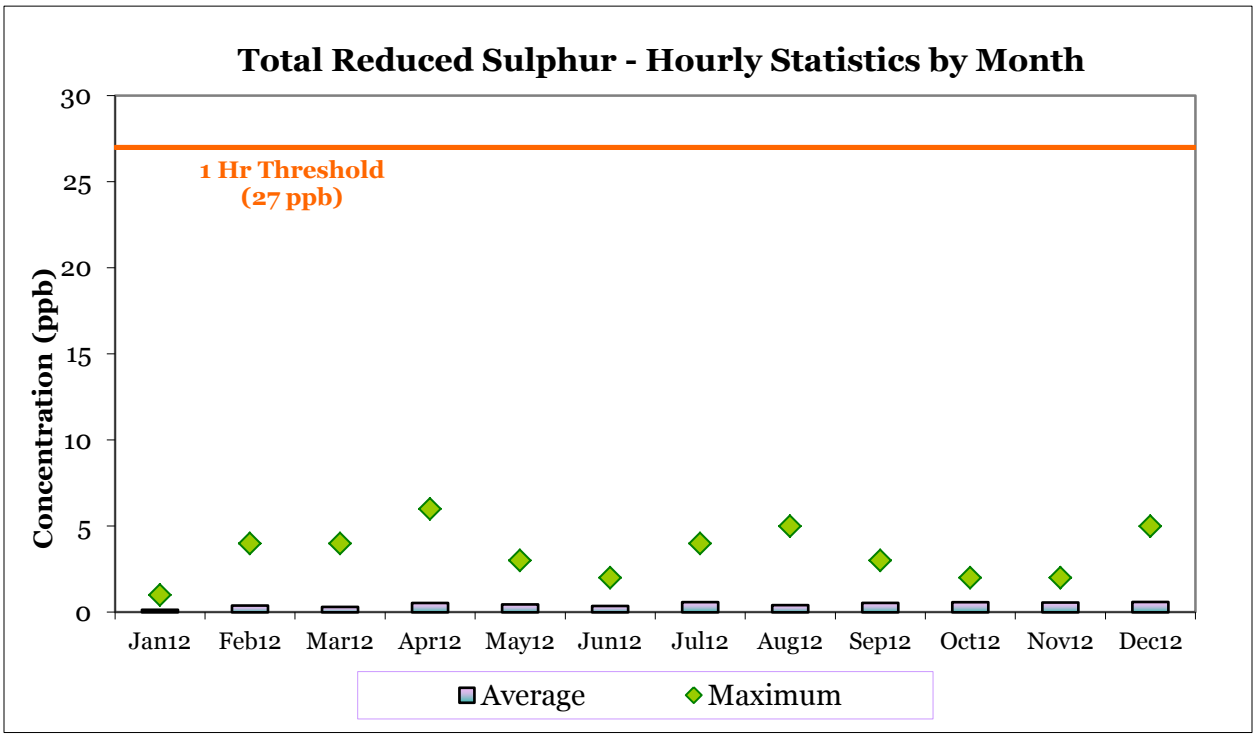
Report Values	Average (ppb)	Maximum (ppb)	AAQC Exceedances
AFN Station			
2012	0.5	6	0
2011	0.4	9	0
2010	0.8	25	0
2009	0.9	14	0
Other Stations, Current Report Period			
Sarnia AQI	0.7	5	0
Windsor West AQI	0.5	13	0

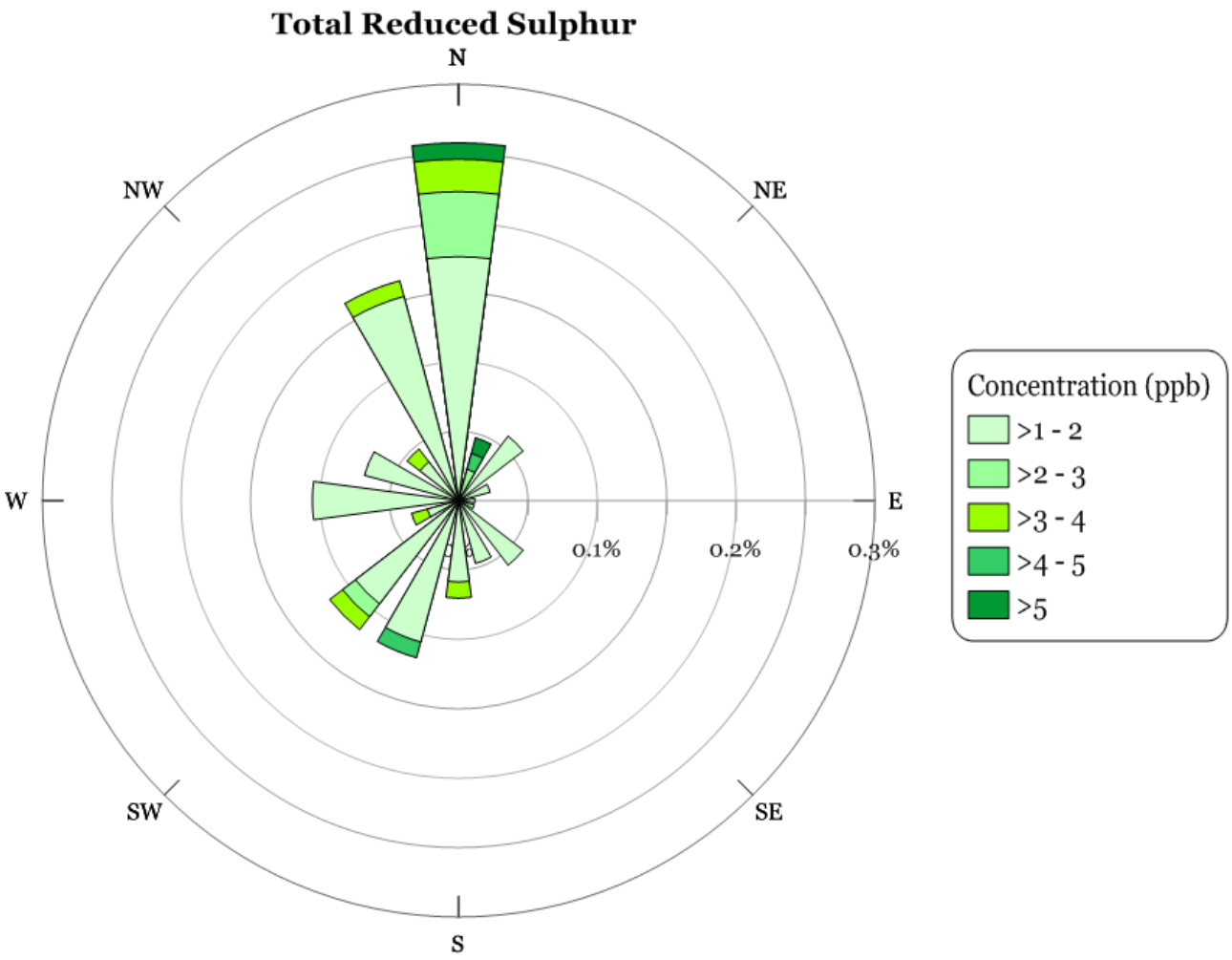
No exceedances of the comparison value of 27 ppb were measured in 2012. The maximum value was lower than the previous three years though the average was marginally higher. The average was also lower than the comparison Sarnia AQI station while the maximum was 1 ppb higher than the value for the Sarnia AQI station. These results reflect the relative proximity of sources to the AFN station compared to the Sarnia AQI site. The average was identical to that at the Windsor West station but the maximum was less than half of Windsor's.

Monthly results are given in the second table and illustrated on the next page. April had two hours during which the TRS AQI sub-index was *Good*, while during the rest of the year all the hours were *Very Good*. Average levels appeared to increase over the year, though the peak was seen April.

Month by Month Statistics - 2012								
	Concentration		AAQC Exceedances	AQI Sub-index				
	Average (ppb)	Maximum (ppb)		Very Good	Good	Moderate	Poor	Very Poor
Jan	0.2	1	0	100%	0%	0%	0%	0%
Feb	0.4	4	0	100%	0%	0%	0%	0%
Mar	0.3	4	0	100%	0%	0%	0%	0%
Apr	0.5	6	0	99.72%	0.28%	0%	0%	0%
May	0.5	3	0	100%	0%	0%	0%	0%
Jun	0.4	2	0	100%	0%	0%	0%	0%
Jul	0.6	4	0	100%	0%	0%	0%	0%
Aug	0.4	5	0	100%	0%	0%	0%	0%
Sep	0.5	3	0	100%	0%	0%	0%	0%
Oct	0.6	2	0	100%	0%	0%	0%	0%
Nov	0.6	2	0	100%	0%	0%	0%	0%
Dec	0.6	5	0	100%	0%	0%	0%	0%

A pollution rose for values greater than 1 ppb is shown on the next page. The lowest values 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.


Total Reduced Sulphur - Hourly Statistics by Month
Concentration (ppb)
30
25
20
15
10
5
0
1 Hr Threshold
(27 ppb)
Jan12
Feb12
Mar12
Apr12
May12
Jun12
Jul12
Aug12
Sep12
Oct12
Nov12
Dec12
Average
Maximum


Total Reduced Sulphur
N
NE
E
SE
S
SW
W
NW
0.1%
0.2%
0.3%
Concentration (ppb)
>1 - 2
>2 - 3
>3 - 4
>4 - 5
>5

Nitrogen Dioxide

Nitrogen Dioxide (NO_2) is a common combustion product. This is a consequence of the large amount of nitrogen in the atmosphere. The main sources are motor vehicles and stationary sources such as electric utilities and industrial boilers. NO_2 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 NO_2 is 200 ppb. This level is used for evaluation.

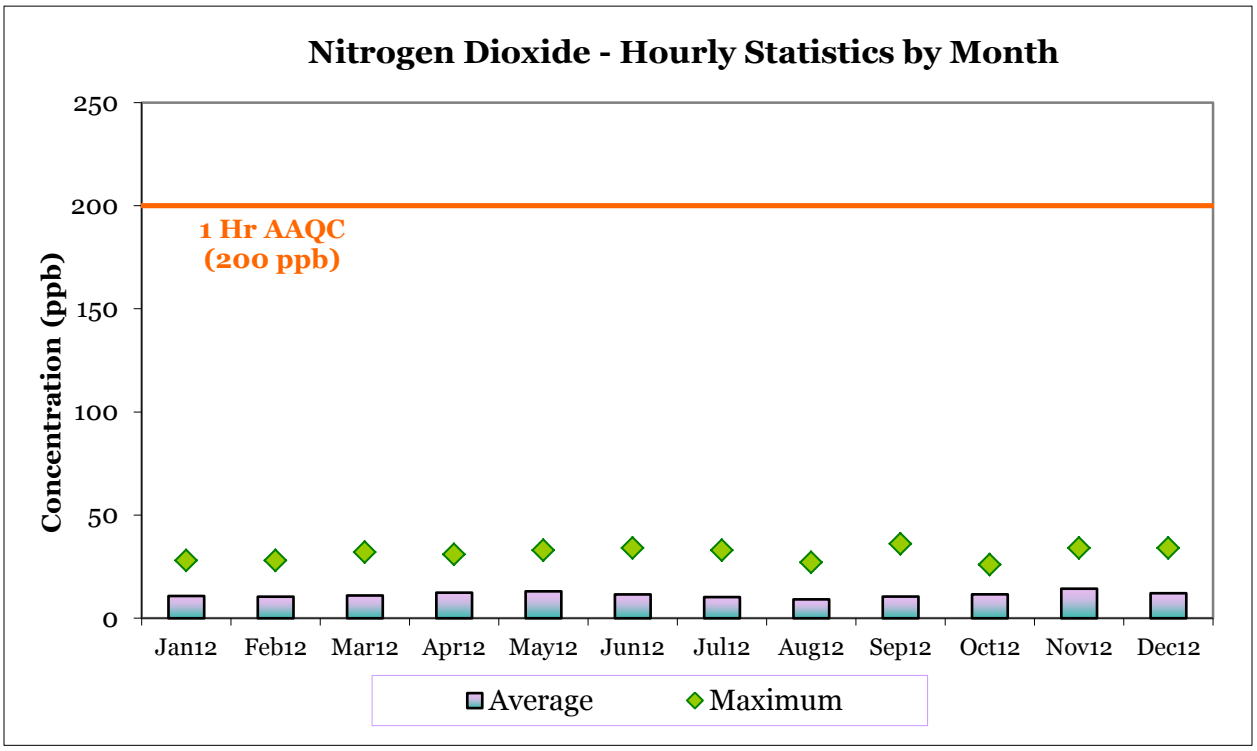
Report Values	Average (ppb)	Maximum (ppb)	AAQC Exceedances
AFN Station			
2012	11.5	36	0
2011	11.0	38	0
2010	14.4	80	0
2009	13.7	67	0
Other Stations, Current Report Period			
Sarnia AQI	8.6	53	0
Windsor West AQI	11.4	51	0
London AQI	6.3	36	0

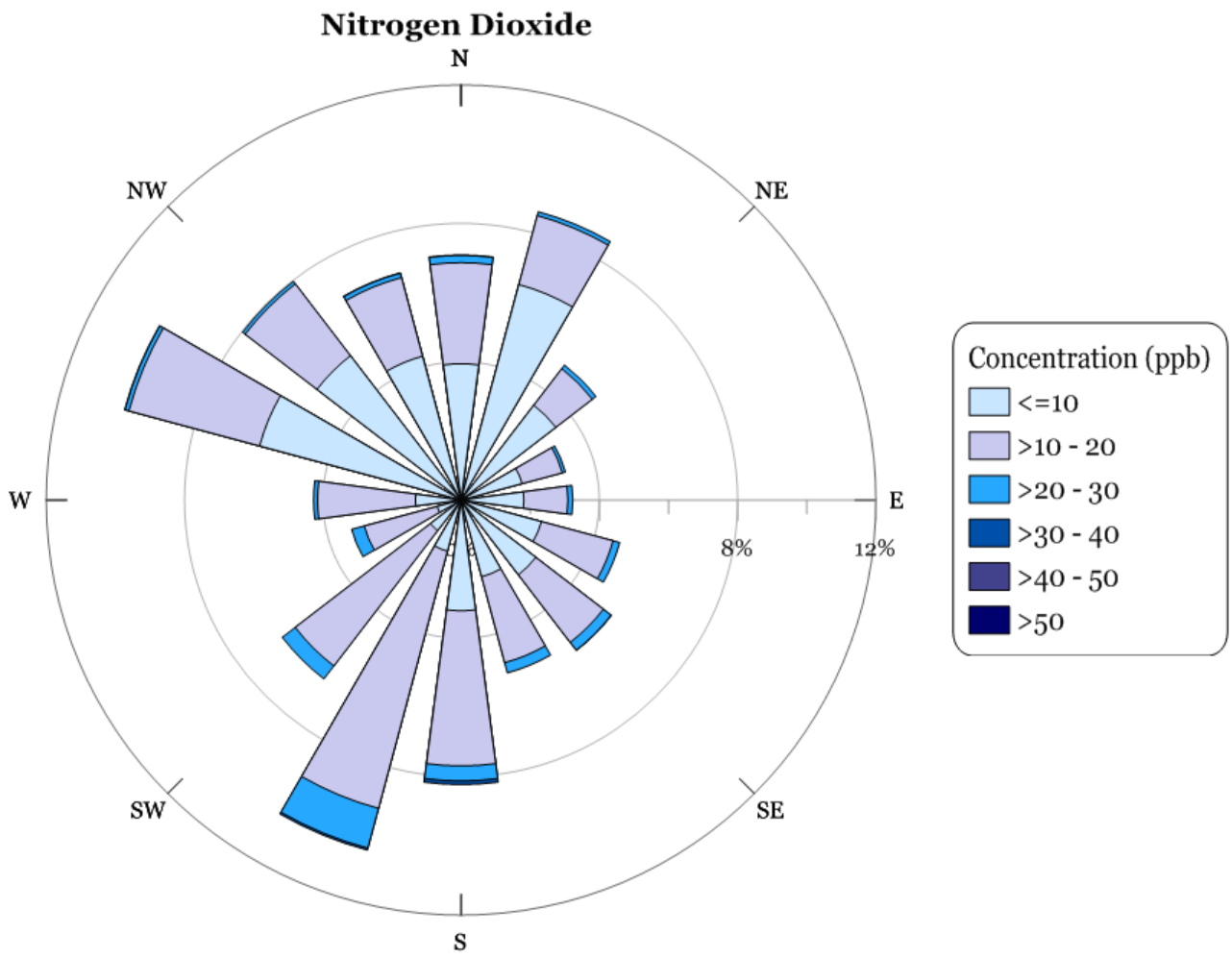
No exceedances of the AAQC were measured during 2012. The average showed a 0.5 part per billion increase over the 2011 average, while the maximum concentration was lower than any of the previous three years. The average was higher than those seen in London, Windsor West or at the Sarnia AQI stations. The maximum was lower than the Sarnia and Windsor West AQI stations and was identical to the London AQI comparison stations.

A month by month summary of the NO_2 concentrations is given in the table below. No strong seasonal influences are apparent. The NO_2 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 NO_2 concentration varied with wind direction. Higher concentrations are seen from all directions though, 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 - 2012								
	Concentration		AAQC Exceedances	AQI Sub-index				
	Average (ppb)	Maximum (ppb)		Very Good	Good	Moderate	Poor	Very Poor
Jan	10.8	28	0	100%	0%	0%	0%	0%
Feb	10.5	28	0	100%	0%	0%	0%	0%
Mar	11.0	32	0	100%	0%	0%	0%	0%
Apr	12.4	31	0	100%	0%	0%	0%	0%
May	13.1	33	0	100%	0%	0%	0%	0%
Jun	11.6	34	0	100%	0%	0%	0%	0%
Jul	10.3	33	0	100%	0%	0%	0%	0%
Aug	9.2	27	0	100%	0%	0%	0%	0%
Sep	10.5	36	0	100%	0%	0%	0%	0%
Oct	11.6	26	0	100%	0%	0%	0%	0%
Nov	14.3	34	0	100%	0%	0%	0%	0%
Dec	12.1	34	0	100%	0%	0%	0%	0%


Nitrogen Dioxide - Hourly Statistics by Month
Concentration (ppb)
250
200
150
100
50
0
1 Hr AAQC
(200 ppb)
Jan12
Feb12
Mar12
Apr12
May12
Jun12
Jul12
Aug12
Sep12
Oct12
Nov12
Dec12
Average
Maximum


Nitrogen Dioxide
N
NE
E
SE
S
SW
W
NW
8%
12%
Concentration (ppb)
<=10
>10 - 20
>20 - 30
>30 - 40
>40 - 50
>50

Ground-level Ozone

Unlike many other air contaminants, ozone (O_3) is not emitted to the atmosphere. 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 so high levels usually occur in the summer.

This effect also causes concentrations to rise during the day and fall at night. However year to year variation for ozone is greatly dependant on wind and weather patterns.

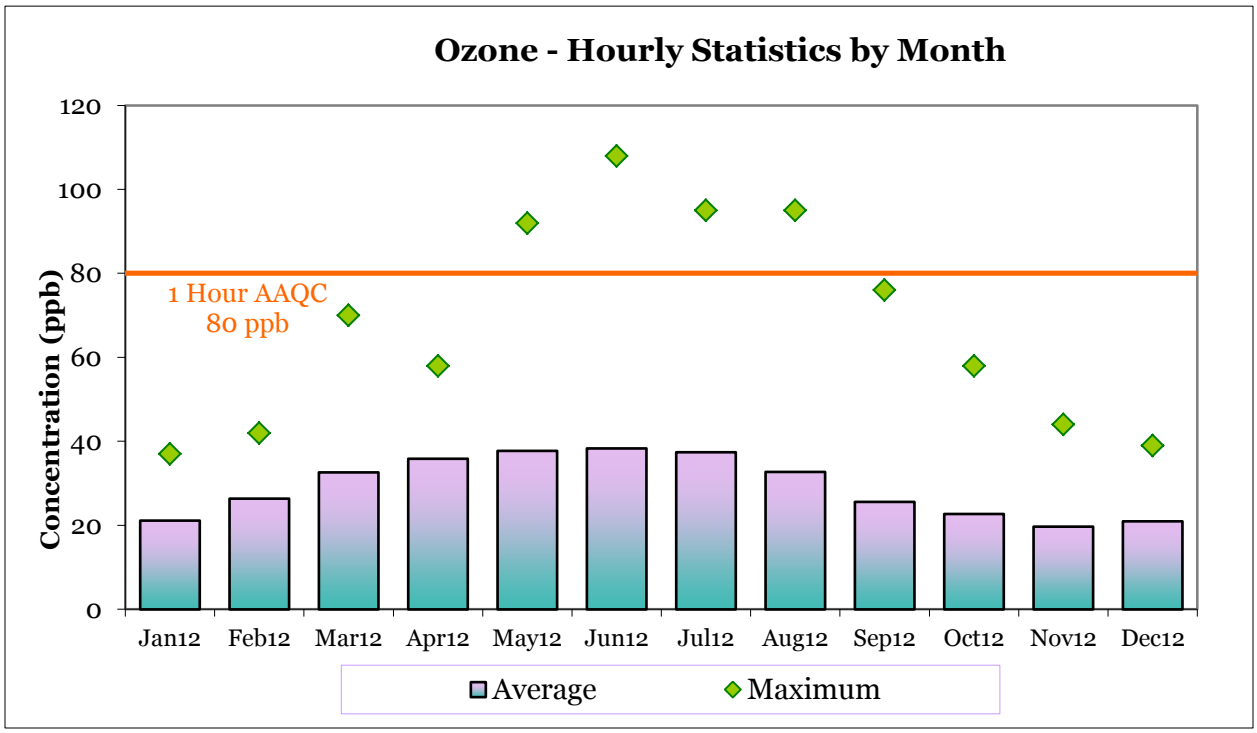
Report Values	Average (ppb)	Maximum (ppb)	AAQC Exceedances
AFN Station			
2012	29.4	108	50
2011	28.6	100	28
2010	26.8	86	2
2009	24.1	91	1
Other Stations, Current Report Period			
Sarnia AQI	29.7	101	41
Windsor West AQI	28.0	128	41
London AQI	27.7	88	26

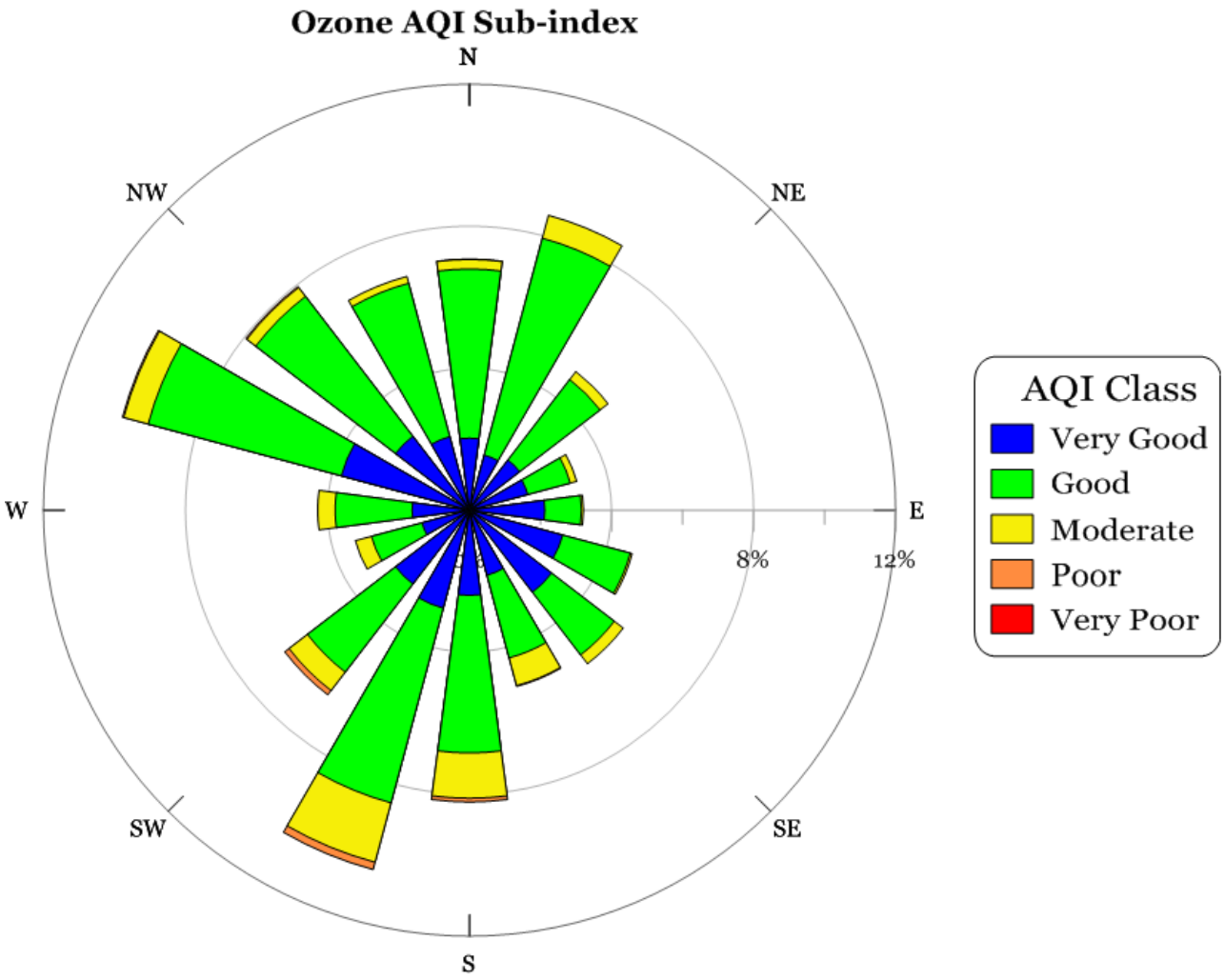
Ground-level ozone is a major component of smog and can have human health impacts, particularly respiratory tract irritation. It also adversely affects certain plants. The ministry's 1-hour AAQC for O_3 is 80 ppb. This level is used for evaluation in this report.

Both the average and the maximum concentrations were higher than in the previous three years and there were 50 AAQC exceedances. This translates to a 0.6 % exceedance rate of the 1-hour AAQC. The average concentration was slightly higher than two of three comparison stations, the Sarnia AQI station being marginally higher. The maximum was higher than Sarnia or London but lower than Windsor West.

Month by Month Statistics - 2012								
	Concentration		AAQC Exceedances	AQI Sub-index				
	Average (ppb)	Maximum (ppb)		Very Good	Good	Moderate	Poor	Very Poor
Jan	21.2	37	0	57.2%	42.8%	0.0%	0.0%	0.0%
Feb	26.4	42	0	36.6%	63.4%	0.0%	0.0%	0.0%
Mar	32.6	70	0	16.5%	80.1%	3.4%	0.0%	0.0%
Apr	35.9	58	0	10.8%	83.0%	6.1%	0.0%	0.0%
May	37.8	92	12	18.0%	61.2%	19.1%	1.6%	0.0%
Jun	38.3	108	16	22.0%	52.7%	23.0%	2.3%	0.0%
Jul	37.4	95	8	24.1%	49.9%	25.0%	1.1%	0.0%
Aug	32.7	95	14	37.0%	43.4%	17.7%	1.9%	0.0%
Sep	25.6	76	0	45.0%	49.2%	5.8%	0.0%	0.0%
Oct	22.7	58	0	55.4%	43.7%	0.8%	0.0%	0.0%
Nov	19.7	44	0	57.9%	42.1%	0.0%	0.0%	0.0%
Dec	21.0	39	0	58.5%	41.5%	0.0%	0.0%	0.0%

In general, southerly winds bring more of the ozone precursors (or building blocks) to the region. These originate in the 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.


Ozone - Hourly Statistics by Month
Concentration (ppb)
120
100
80
60
40
20
0
1 Hour AAQC
80 ppb
Jan12
Feb12
Mar12
Apr12
May12
Jun12
Jul12
Aug12
Sep12
Oct12
Nov12
Dec12
Average
Maximum


Ozone AQI Sub-index
N
NE
E
SE
S
SW
W
NW
8%
12%
AQI Class
Very Good
Good
Moderate
Poor
Very Poor

Fine Particulate Matter

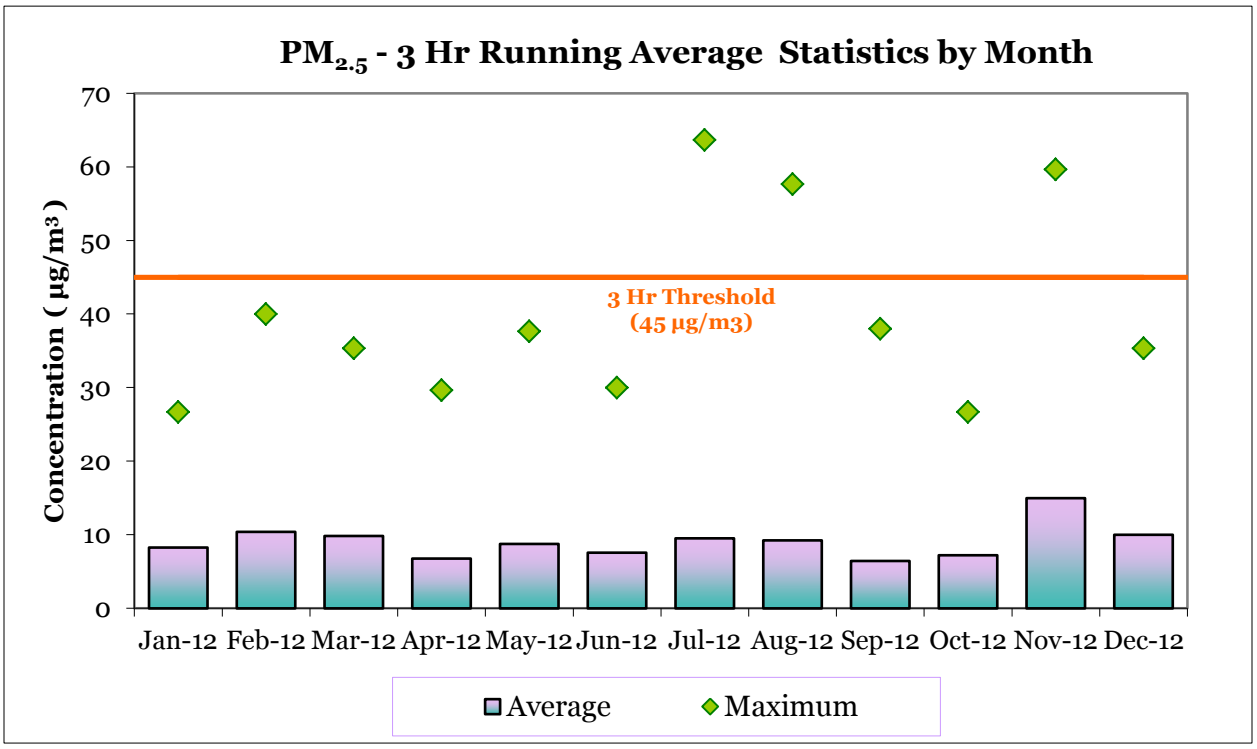
Fine particulate matter, sometimes called respirable particulate or $PM_{2.5}$, is the fraction of atmospheric particulate that is smaller than 2½ microns in diameter. These particles are important because their small size enables them to bypass the body's natural defences and reach the deepest parts of the lung. $PM_{2.5}$ often forms from chemical processes in the atmosphere and acts much like a gas due to its small size. As a result, fine particulate may be measured 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, though unlike many of the other AQI parameters the $PM_{2.5}$ AQI sub-index is based upon a 3-hour running average. This process 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 statistics were also calculated for 3-hour averages.

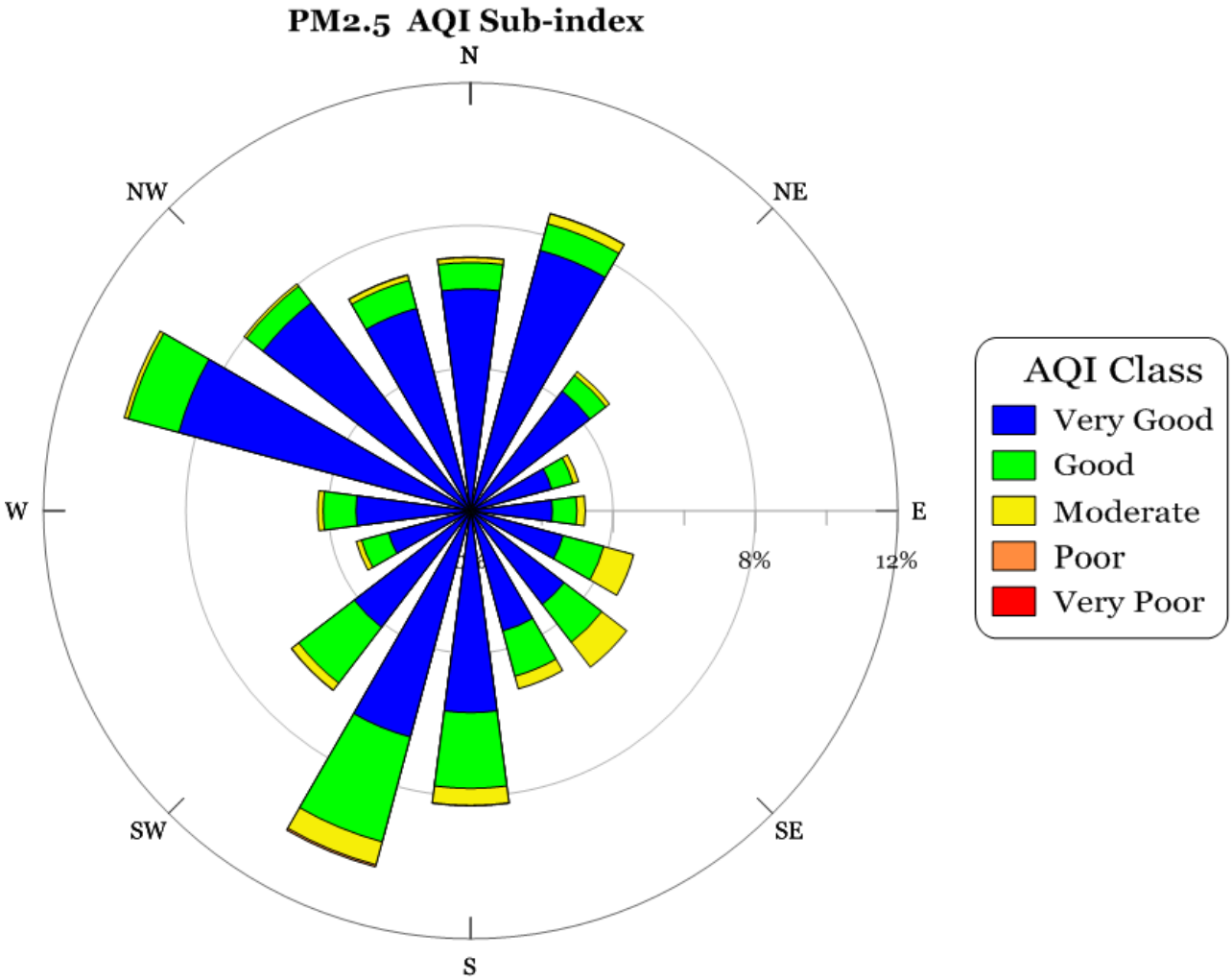
Annual Values (3-hour)	Average (µg/m³)	Maximum (µg/m³)	Exceedances
AFN Station			
2012	9.1	63.7	10
2011	9.8	54.3	15
2010	10.2	73.0	37
2009	10.1	51.0	19
Other Stations, Current Report Period			
Sarnia AQI	10.2	53.7	8
Windsor West AQI	7.6	54.0	2
London AQI	6.5	58.0	3

The average value was lower than that seen in the previous years, and the maximum was higher than two of the previous three years. The average was lower than the value seen at the Sarnia station however higher than the two other comparison stations

A month by month summary of $PM_{2.5}$ concentrations is given in the second table and illustrated in the graph on the next page. The data shows the *Poor* conditions occurred in the summer and late fall. The highest average occurred during November. *Moderate* levels were more frequent when the wind was from the south, but was associated with wind from all directions.

Month by Month Statistics - 2012								
	Concentration (3-hour)		Exceedances	AQI Sub-index				
	Average (µg/m³)	Maximum (µg/m³)		Very Good	Good	Moderate	Poor	Very Poor
Jan	8.3	27	0	74.9%	23.8%	1.3%	0.0%	0.0%
Feb	10.4	40	0	63.5%	33.1%	3.4%	0.0%	0.0%
Mar	9.8	35	0	72.5%	21.7%	5.8%	0.0%	0.0%
Apr	6.8	30	0	88.1%	9.1%	2.8%	0.0%	0.0%
May	8.8	38	0	79.4%	15.9%	4.7%	0.0%	0.0%
Jun	7.6	30	0	86.0%	12.7%	1.3%	0.0%	0.0%
Jul	9.5	64	1	76.9%	20.6%	2.4%	0.1%	0.0%
Aug	9.2	58	2	78.5%	17.2%	4.0%	0.3%	0.0%
Sep	6.4	38	0	88.4%	9.6%	2.0%	0.0%	0.0%
Oct	7.2	27	0	81.8%	15.6%	2.6%	0.0%	0.0%
Nov	15.0	60	7	51.9%	22.4%	24.7%	1.0%	0.0%
Dec	10.0	35	0	67.9%	26.1%	6.0%	0.0%	0.0%


PM2.5 - 3 Hr Running Average Statistics by Month
Concentration (µg/m³)
70
60
50
40
30
20
10
0
3 Hr Threshold
(45 µg/m3)
Jan-12
Feb-12
Mar-12
Apr-12
May-12
Jun-12
Jul-12
Aug-12
Sep-12
Oct-12
Nov-12
Dec-12
Average
Maximum


PM2.5 AQI Sub-index
N
NE
E
SE
S
SW
W
NW
8%
12%
AQI Class
Very Good
Good
Moderate
Poor
Very Poor

Suspended Particulate & Metals

In addition to hourly measurements of respirable particulate, a twenty-four hour samples of suspended particulate (SP) is taken every 6th day following the same schedule used by Environment Canada and most other network samplers 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.

Table 1 Suspended Particulate Monitoring Results (µg/m³)

	2012			2011			2010			2009		
	Ave	Max	No > mdl	Ave	Max	No > mdl	Ave	Max	No > mdl	Ave	Max	No > mdl
Suspended Particulate	10.69	40.00	59	15.325	296	54	12.241	95	56	15.386	54	55
Silicon	0.29	2.40	59	0.258	2.1	53	0.386	4.7	57	0.412	1.7	56
Calcium	0.47	2.10	59	0.517	2.1	57	0.713	6.7	56	0.796	4.2	56
Vanadium	-	0.056	19	-	0.013	13	-	0.058	19	0.004	0.046	32
Chromium	-	0.001	0	-	0.002	3	-	0.002	4	-	0.005	9
Manganese	-	0.015	12	-	0.012	13	-	0.027	10	-	0.014	26
Iron	0.119	0.730	59	0.107	0.52	56	0.140	1.4	57	0.151	0.63	56
Nickel	-	0.005	6	-	0.005	3	-	0.004	12	-	0.019	20
Copper	-	0.006	14	-	0.006	18	-	0.01	14	-	0.007	19
Zinc	0.007	0.040	43	0.006	0.026	44	0.007	0.044	38	0.014	0.093	47
Cadmium	-	0.004	18	-	0.008	11	-	0.006	27	0.004	0.006	48
Lead	-	0.006	9	-	0.012	3	-	0.009	12	0.006	0.01	50

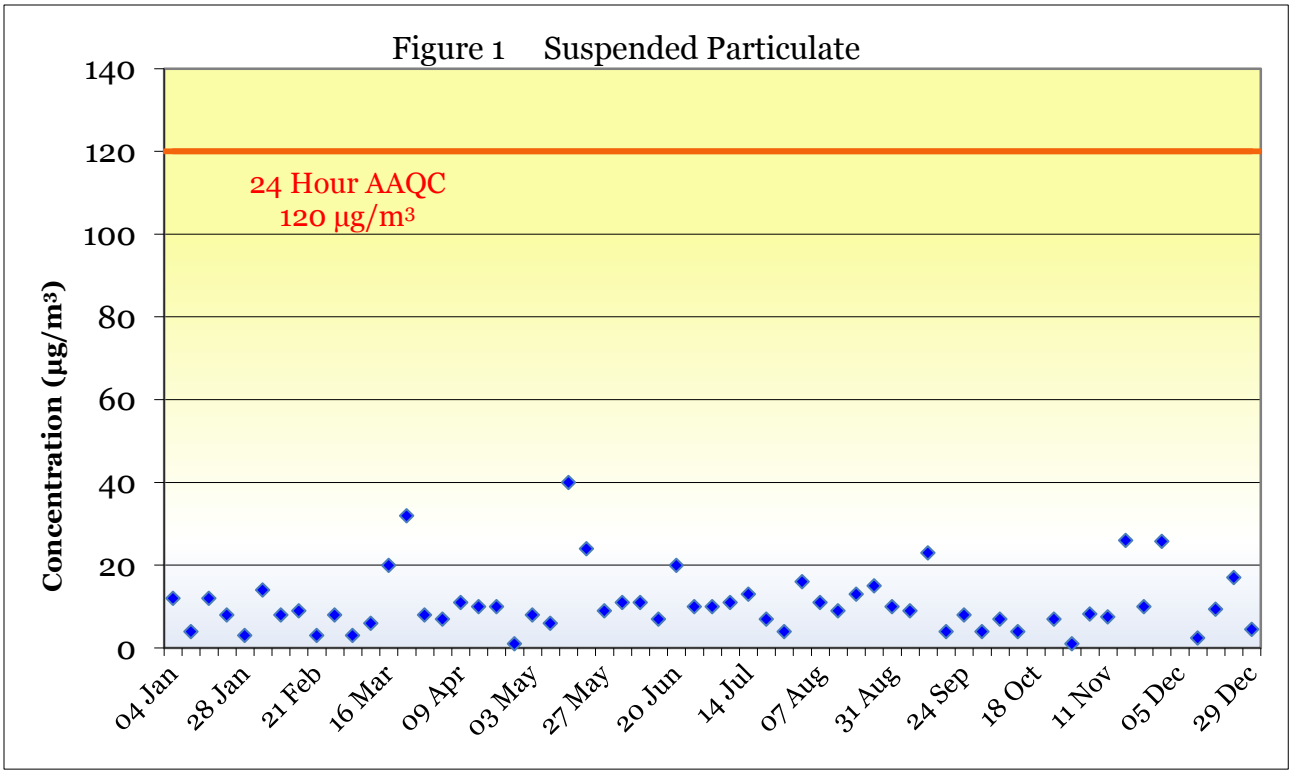
The maximum suspended particulate concentration was lower than those of the previous three years. The average was lower than the previous three years as well. The other species measured on the filters were generally the same as the previous three years with calcium showing a lower average than the previous three years.

The ministry has a 24-hour AAQC for SP and for most of the determined particulate constituents. None of the AAQC were exceeded. The comparison is summarised in Table 2.

Table 2 Maximum Concentrations Compared to AAQC		
Test	**AAQC (µg/m3)**	**% of AAQC**
TSP	120	33.33%
Silicon	-	-
Calcium	-	-
Vanadium	2	2.80%
Chromium	0.5	0.07%
Manganese	0.4	0.60%
Iron	4	18.25%
Nickel	0.2	0.25%
Copper	50	0.01%
Zinc	120	0.03%
Cadmium	0.025	16.00%
Lead	0.5	1.20%

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. Larger particulate loading may be related in part to influences of agriculture and changes in snow cover. The individual results can be seen in Figure 1, below.



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 often have a presence in the atmosphere. This is usually enhanced in areas where people live and work.

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

Hourly levels of 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 since been changed to reflect results, dropping some substances that weren't detected, in favour of new ones. Some of the these chemicals are constituents of crude oil (e.g. benzene, ethyl benzene, hexane). Others are used in one or more chemical processes common in the area (e.g. xylenes, toluene, styrene). A few, such as propylene, also occur in nature as a result of fermentation or other processes. Table 1 summarises the 2012 results and compares them to the results from previous years, where available.

Table 1 1-Hour VOC Measurements

	2012			2011			2010			2009		
	Average (ppb)	Max (ppb)	% > mdl	Average (ppb)	Max (ppb)	% > mdl	Average (ppb)	Max (ppb)	% > mdl	Average (ppb)	Max (ppb)	% > mdl
Propylene	1.045	141.90	7.04%	0.515	151.44	2.16%	0.378	234.02	0.50%	0.135	95.14	0.33%
Chloromethane	0.258	47.17	2.11%	0.183	56.35	1.17%	0.025	71.00	0.07%	-	-	-
1,3-Butadiene	0.010	26.97	0.23%	0.046	111.95	0.15%	0.003	19.29	0.01%	0.202	702.75	0.05%
Hexane	0.399	91.61	4.00%	0.265	54.87	2.69%	0.001	2.64	0.06%	-	-	-
Cyclohexane	0.252	60.91	3.80%	0.167	58.78	2.03%	0.191	50.08	1.38%	0.055	48.89	0.62%
Benzene	0.115	16.48	4.07%	0.125	23.15	3.20%	0.065	24.02	1.90%	0.128	12.60	4.78%
Toluene	0.117	52.06	6.09%	0.172	45.28	7.21%	0.124	29.63	4.83%	0.276	29.11	14.87%
Ethyl Benzene	0.027	13.80	2.84%	0.066	17.10	3.39%	0.035	4.48	3.74%	0.079	18.76	6.82%
m & p-Xylene	0.026	6.56	2.64%	0.049	11.16	3.20%	0.072	8.97	3.59%	0.149	29.20	6.57%
o-Xylene	0.020	3.35	2.40%	0.035	6.72	2.89%	0.039	3.72	3.86%	0.085	19.83	6.49%
Styrene	0.001	1.55	0.11%	0.001	1.24	0.09%	0.002	1.52	0.23%	0.014	6.11	0.85%

While only propylene and toluene were detected more than 5% of the time, many of the species were seen more frequently than in 2010 or 2011. This could be due to improvements in the instrument, variations in the wind direction or changes in processes at the local plants. Most average concentrations were slightly lower than those of 2011.

24-hour averages were calculated and compared with the 24-hour AAQC. These are summarised in Table 2. Only benzene (23 times) exceeded its 24-hour AAQC. Since the ministry publishes its standards in micrograms per cubic metre (µg/m^3) but the instrument reports values in parts per billion (ppb), the published value and a converted equivalent are included in the table. The measurements should be compared to the AAQC values in given in ppb – the purple shaded line.

Table 2 Comparison to 24-hour AAQC											
	Propylene	Chloromethane	1,3-Butadiene	Hexane	Cyclohexane	Benzene	Toluene	Ethyl Benzene	M &p-Xylene	o-Xylene	Styrene
24-hour AAQC (µg/m³)	4000	320	10	7500	6100	2.3	2000	1000	730	730	400
24-hour AAQC (ppb)	2287	152	4.3	2093	1743	0.7	522	226	165	165	92
#> AAQC	0	0	0	0	0	23	0	0	0	0	0
Maximum 24-hour Value (ppb)	21.77	9.33	1.17	23.24	8.02	2.85	8.52	2.18	0.92	0.52	0.07

The annual averages were also compared to annual AAQC where they exist. Only two of the measured compounds have annual AAQC, benzene (AAQC=0.134 ppb) and 1,3-butadiene (AAQC=0.859 ppb). Neither were exceeded.

Table 3 summarises the month to month variation in the 11 species that were seen. Some increased in late spring and early summer and then declined in late summer but this did not occur in all cases. The results are are illustrated in Figure 1.

Table 3 Monthly VOC Averages (ppb)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Propylene	0.452	0.497	1.110	0.898	0.551	1.086	0.979	0.601	0.901	0.682	2.790	1.766
Chloromethane	0.130	0.071	0.636	0.628	0.580	0.435	0.361	0.069	0.047	0.039	0.067	0.064
1,3-Butadiene	0.000	0.025	0.000	0.006	0.048	0.015	0.006	0.007	0.000	0.000	0.000	0.006
Cyclohexane	0.408	0.314	0.182	0.107	0.031	0.161	0.421	0.294	0.135	0.214	0.382	0.376
Hexane	0.030	0.044	1.269	1.015	0.604	0.782	0.538	0.238	0.058	0.063	0.172	0.000
Benzene	0.119	0.014	0.083	0.043	0.091	0.207	0.091	0.138	0.051	0.090	0.348	0.092
Toluene	0.079	0.021	0.036	0.086	0.006	0.022	0.180	0.354	0.084	0.082	0.353	0.052
Ethyl Benzene	0.049	0.000	0.011	0.097	0.009	0.026	0.015	0.041	0.025	0.012	0.050	0.005
m & p-Xylene	0.075	0.000	0.016	0.038	0.007	0.025	0.016	0.039	0.031	0.022	0.056	0.004
o-Xylene	0.038	0.000	0.014	0.021	0.001	0.003	0.016	0.043	0.023	0.014	0.062	0.005
Styrene	0.002	0.000	0.000	0.000	0.000	0.000	0.004	0.001	0.003	0.000	0.001	0.000

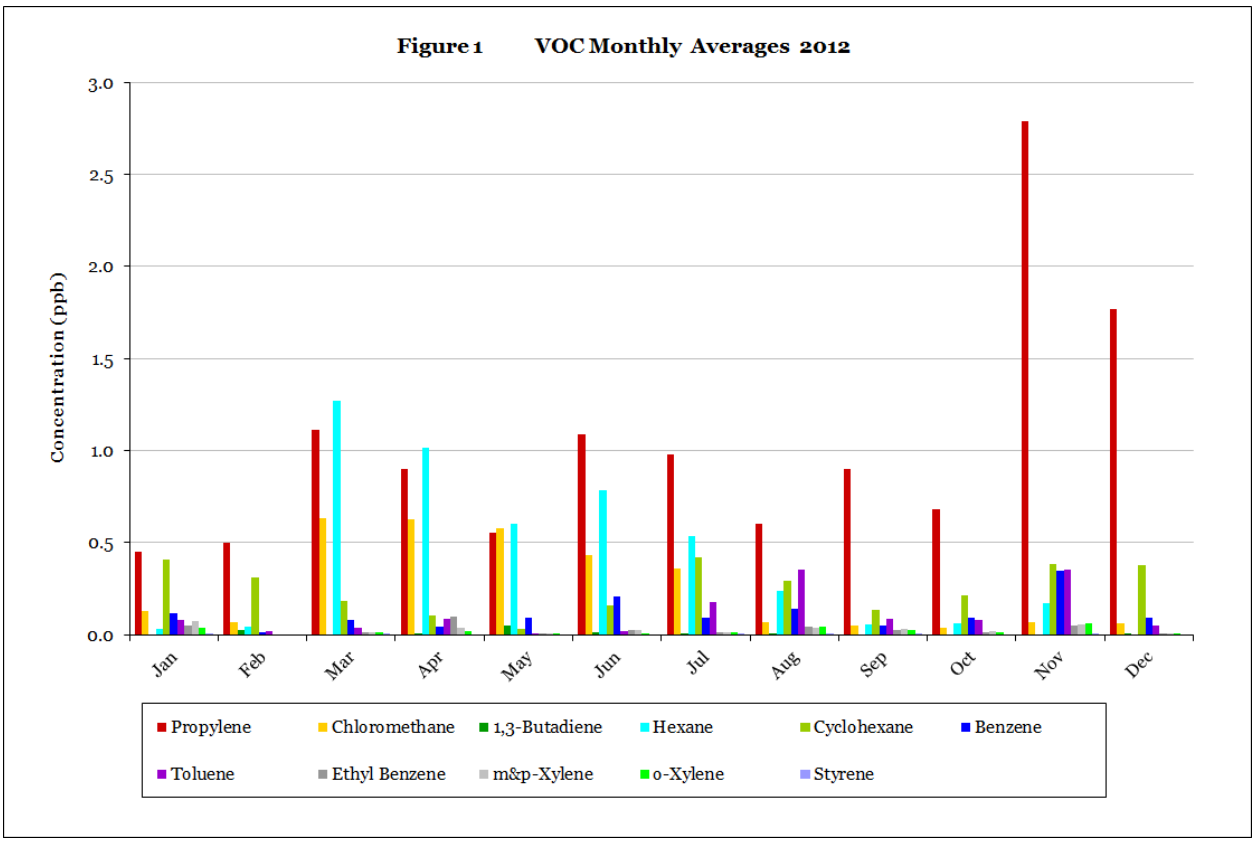


Figure 1 VOC Monthly Averages 2012
Concentration (ppb)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Propylene
Chloromethane
1,3-Butadiene
Hexane
Cyclohexane
Benzene
Toluene
Ethyl Benzene
m&p-Xylene
o-Xylene
Styrene

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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 samples every twelfth day. This is conducted in conjunction with EC's *National Air Pollution Surveillance* (NAPS) sampling network. This program is run across 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.

47 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.

Table 1 Environment Canada VOC Concentrations Compared to 24-hour AAQC

Compound	24 Hour AAQC (µg/m³)	Maximum (% of AAQC)	Average (% of AAQC)	Compound	24 Hour AAQC (µg/m³)	Maximum (% of AAQC)	Average (% of AAQC)
Freon113	800000	0.0001%	0.0001%	1,2,4-Trichlorobenzene	400	0.0071%	0.0022%
Freon114	700000	0.0000%	0.0000%	iso-Propylbenzene	400	0.0092%	0.0032%
Freon 12	500000	0.0006%	0.0005%	Tetrachloroethylene	360	0.0441%	0.0154%
Freon22	350000	0.0004%	0.0002%	Chloromethane	320	5.1066%	0.6608%
1,1,1-Trichloroethane	115000	0.0000%	0.0000%	Dichloromethane	220	0.1601%	0.1119%
1-Decene	60000	0.0002%	0.0000%	1,2,4-Trimethylbenzene	220	0.1457%	0.0563%
Acetylene	56000	0.0015%	0.0008%	1,2,3-Trimethylbenzene	220	0.0515%	0.0198%
1-Octene	50000	0.0003%	0.0001%	1,3,5-Trimethylbenzene	220	0.0402%	0.0153%
1,2-Dichlorobenzene	30500	0.0000%	0.0000%	trans-1,2-Dichloroethylene	105	0.0425%	0.0071%
Heptane	11000	0.0086%	0.0022%	cis-1,2-Dichloroethylene	105	0.0030%	0.0007%
Hexane	7500	0.2350%	0.0286%	1,4-Dichlorobenzene	95	0.0369%	0.0155%
Methyltertbutylether	7000	0.0001%	0.0000%	Bromoform	55	0.1353%	0.0301%
Cyclohexane	6100	0.1975%	0.0380%	Ethylene	40	71.3810%	11.7595%
Freon 11	6000	0.0315%	0.0265%	Naphthalene	22.5	0.9711%	0.3604%
Chloroethane	5600	0.0009%	0.0004%	Trichloroethylene	12	0.5292%	0.1731%
Propylene	4000	0.2163%	0.0545%	1,3-Butadiene	10	6.1030%	0.9489%
1,2-Dichloropropane	2400	0.0012%	0.0006%	1,1-Dichloroethylene	10	0.0210%	0.0045%
Toluene	2000	0.2544%	0.0692%	Ethylene dibromide	3	0.1367%	0.0203%
Bromomethane	1350	0.0161%	0.0045%	Carbon tetrachloride	2.4	29.9542%	22.9274%
Ethylbenzene	1000	0.0680%	0.0188%	Benzene	2.3	150.3522%	48.7797%
m- & p-Xylene	730	0.1551%	0.0504%	1,2-Dichloroethane	2	7.3400%	3.6476%
o-Xylene	730	0.0520%	0.0186%	Chloroform	1	14.6200%	9.4484%
Styrene	400	0.1459%	0.0196%	Vinyl chloride	1	1.1000%	0.2816%

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

Three other compounds have AAQC for other averaging periods. One, octane, has a 10-minute AAQC, and two others, decane and chlorobenzene, each have a 1-hour AAQC. In cases where AAQC do not exist in the appropriate time scale, the ministry uses a method

outlined in O.Reg. 419/05 to calculate an equivalent concentration for comparison purposes. This level was determined for each compounds with a different AAQC-averaging period and the results were compared to these values. These are summarised in Table 2.

Table 2 Environment Canada VOC Concentrations Compared to Other AAQC

Compound	AAQC (µg/m³)	AAQC Averaging time	Equivalent 24 hour benchmark (µg/m³)	Maximum (% of benchmark)	Average (% of benchmark)
Octane	61800	10 minutes	15000	0.0034%	0.0008%
Decane	60000	1 hour	25000	0.0028%	0.0005%
Chlorobenzene	3500	1 hour	1400	0.0021%	0.0010%

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

Table 3 Annual Averages

Substance	**Annual AAQC (µg/m³)**	**Average (µg/m³)**			
		2012	**2011**	**2010**	**2009**
1,3-Butadiene	2.0	0.0949	0.0909	0.1843	0.1072
Benzene	0.45	1.1219	1.2036	1.2336	1.3622
Vinyl chloride	0.2	0.0028	0.0043	0.0050	0.0199
Dichloromethane	44.0	0.2463	0.2327	0.2419	0.2490
Chloroform	0.45	0.0945	0.0877	0.0820	0.0803
1,2-Dichloroethane	0.4	0.0730	0.0688	0.0806	0.0632

The values have remained fairly consistent over the four years of available data. As it did with the daily values, benzene exceeds the new annual AAQC. However, it is at its lowest value in the last four years.

These results are one of a number from a Canada-wide network of monitors run by Environment Canada. In 2011, many of the monitors were not operational, but during 2012, monitoring was instituted and results again became available.

As a result, the AFN results can be compared to those from other locations in the area. Table 4 presents the results for 13 species. This list includes all the species whose average exceed 0.1% of their respective AAQC. However as the EC sampling began in stages, data from the other stations does not span the entire year. The other stations' sampling began either in February (Sarnia and London) or March (Windsor). As a result, the data sets from these other stations are not strictly comparable. Nonetheless they offer a context within which to evaluate the AFN data and so are presented here.

The most noticeable difference between the AFN station and the others is in the results for ethylene. Ethylene is produced or used by several facilities in the area and so its higher concentration is expected. Ethylene is primarily a concern because of its effect on vegetation.

Chloromethane and benzene had higher average concentrations at AFN than at the Sarnia AQI station or the other sites, however the 1,3-butadiene average was lower. Most other species had average concentrations similar to those at other stations.

Table 4 Comparison of Selected Environment Canada VOC Results (µg/m³)

Compounds		AFN	Sarnia AQI [1]	London [1]	Windsor [2]
1,2,3-Trimethylbenzene	Average	0.043	*0.053*	*0.037*	*0.066*
	Maximum	0.113	*0.249*	*0.156*	*0.201*
1,2-Dichloroethane	Average	0.073	*0.069*	*0.066*	*0.069*
	Maximum	0.147	*0.130*	*0.113*	*0.113*
1,3,5-Trimethylbenzene	Average	0.034	*0.058*	*0.038*	*0.069*
	Maximum	0.089	*0.282*	*0.162*	*0.219*
1,3-Butadiene	Average	0.095	*0.202*	*0.031*	*0.046*
	Maximum	0.610	*1.679*	*0.184*	*0.184*
Benzene	Average	1.122	*0.903*	*0.455*	*0.558*
	Maximum	3.458	*4.339*	*1.413*	*1.056*
Carbon tetrachloride	Average	0.550	*0.529*	*0.553*	*0.550*
	Maximum	0.719	*0.688*	*0.723*	*0.681*
Chloromethane	Average	2.115	*1.577*	*1.137*	*1.129*
	Maximum	16.341	*6.060*	*1.393*	*1.547*
Chloroform	Average	0.094	*0.107*	*0.097*	*0.112*
	Maximum	0.146	*0.517*	*0.179*	*0.275*
Dichloromethane	Average	0.246	*0.297*	*0.310*	*0.291*
	Maximum	0.352	*0.784*	*0.643*	*0.402*
Ethylene	Average	4.704	*2.809*	*0.750*	*1.062*
	Maximum	28.552	*15.802*	*3.713*	*2.570*
Naphthalene	Average	0.081	*0.105*	*0.101*	*0.183*
	Maximum	0.219	*0.369*	*0.468*	*0.568*
Trichloroethylene	Average	0.021	*0.029*	*0.025*	*0.039*
	Maximum	0.064	*0.237*	*0.096*	*0.247*
Vinyl chloride	Average	0.003	*0.002*	*0.001*	*0.002*
	Maximum	0.011	*0.011*	*0.005*	*0.008*

1 February to December
2 March to December

Table 5 presents a comparison of maxima and averages over the last four years. 19 of the maxima are lower than the previous year, and 22 of the averages are down as well. Year to year variations are to be expected as they depend, in part, on wind direction and speed, and the variation in production cycles.

Table 5 4 Year Comparison of Canister VOC Results									
Compounds (All values in µg/m3)	24 Hour AAQC	2012		2011		2010		2009	
		Max	Average	Max	Average	Max	Average	Max	Average
Freon113	800000	0.7530	0.6066	0.7209	0.5971	0.6656	0.5806	0.7198	0.5945
Freon 114	700000	0.1627	0.1178	0.1549	0.1182	0.1258	0.1084	0.1408	0.1121
Freon 12	500000	3.0153	2.5236	2.8954	2.5451	2.8820	2.5318	3.2226	2.5554
Freon 22	350000	1.3516	0.7691	0.9417	0.7459	0.9322	0.7048	1.0641	0.7178
1,1,1-Trichloroethane	115000	0.0570	0.0357	0.0503	0.0398	0.2060	0.0524	0.0670	0.0562
Octane	(15000)	0.5086	0.1225	0.2758	0.1143	1.0601	0.1481	0.5612	0.1731
1-Decene	60000	0.0987	0.0124	0.0395	0.0083	0.0333	0.0050	0.0336	0.0095
Decane	(25000)	0.7039	0.1277	0.2134	0.0724	1.0533	0.1248	0.4237	0.1292
Acetylene	56000	0.8665	0.4634	1.2344	0.5243	1.2513	0.5796	1.2159	0.5083
1-Octene	50000	0.1720	0.0438	0.1360	0.0358	0.1580	0.0373	0.1038	0.0370
1,2-Dichlorobenzene	30500	0.0086	0.0033	0.0545	0.0052	0.0067	0.0033	0.0094	0.0038
Heptane	11000	0.9473	0.2424	0.4216	0.2026	0.9616	0.2301	0.9570	0.3219
Hexane	7500	17.6245	2.1419	28.7922	3.0667	24.7470	2.8863	11.5532	1.7220
Methyltertbutylether	7000	0.0079	0.0013	0.0087	0.0003	0.0271	0.0009	0.0099	0.0003
Cyclohexane	6100	12.0498	2.3203	7.7861	0.7978	11.3910	1.5114	9.9159	1.5218
Freon 11	6000	1.8915	1.5908	1.9530	1.5363	1.8344	1.6063	1.9214	1.5625
Chloroethane	5600	0.0512	0.0239	0.0657	0.0283	0.0596	0.0249	0.0966	0.0312
Propylene	4000	8.6539	2.1780	6.2454	1.5476	12.2688	2.4755	8.2430	1.7837
Chlorobenzene	(1400)	0.0300	0.0135	0.0164	0.0110	0.0283	0.0115	0.0426	0.0133
1,2-Dichloropropane	2400	0.0288	0.0151	0.0312	0.0164	0.5265	0.0314	0.0200	0.0131
Toluene	2000	5.0885	1.3848	2.8257	1.2127	5.0839	1.4233	5.4952	1.6958
Bromomethane	1350	0.2167	0.0602	0.1081	0.0579	0.1561	0.0541	0.0637	0.0521
Ethylbenzene	1000	0.6795	0.1881	0.5836	0.2264	1.3636	0.3005	1.1424	0.3316
m- & p-Xylene	730	1.1320	0.3681	1.0546	0.4106	1.5325	0.4623	1.3547	0.5437
o-Xylene	730	0.3796	0.1357	0.3643	0.1439	0.5666	0.1657	0.6081	0.2073
Styrene	400	0.5835	0.0784	0.4529	0.0665	0.6167	0.1392	81.8215	3.3632
1,2,4-Trichlorobenzene	400	0.0282	0.0088	0.0546	0.0110	0.0371	0.0107	0.0595	0.0151
iso-Propylbenzene	400	0.0368	0.0129	0.0349	0.0132	0.0535	0.0164	0.5809	0.0478
Tetrachloroethylene	360	0.1586	0.0553	0.7551	0.0897	0.4163	0.0821	0.2195	0.0706
Chloromethane	320	16.3410	2.1146	10.1021	2.5625	18.6917	3.1242	16.6220	3.4558
1,2,4-Trimethylbenzene	220	0.3206	0.1238	0.3348	0.1161	0.8809	0.1677	1.1731	0.2125
1,2,3-Trimethylbenzene	220	0.1134	0.0435	0.1060	0.0406	0.2523	0.0653	0.2005	0.0854
1,3,5-Trimethylbenzene	220	0.0885	0.0336	0.0920	0.0325	0.2443	0.0473	0.2047	0.0537
Dichloromethane	220	0.3522	0.2463	0.3617	0.2327	0.4172	0.2419	0.7809	0.2490
trans-1,2-Dichloroethylene	105	0.0446	0.0074	0.0109	0.0037	0.0163	0.0029	0.0173	0.0017
cis-1,2-Dichloroethylene	105	0.0032	0.0008	0.0058	0.0011	0.4183	0.0189	0.3576	0.0161
1,4-Dichlorobenzene	95	0.0351	0.0147	0.2855	0.0243	0.0452	0.0190	0.0548	0.0174
Bromoform	55	0.0744	0.0166	0.0940	0.0196	0.0388	0.0168	0.0342	0.0160
Ethylene	40	28.5524	4.7038	10.9947	3.1391	25.1868	4.9179	25.0431	4.2775
Naphthalene	22.5	0.2185	0.0811	0.1806	0.0802	0.3859	0.0878	0.2243	0.0889
Trichloroethylene	12	0.0635	0.0208	0.1161	0.0221	0.1089	0.0294	0.1160	0.0290
1,3-Butadiene	10	0.6103	0.0949	0.3836	0.0909	1.3790	0.1843	0.5383	0.1072
1,1-Dichloroethylene	10	0.0021	0.0004	0.0025	0.0002	0.0257	0.0014	0.0088	0.0007
Ethylene dibromide	3	0.0041	0.0006	0.0047	0.0008	0.0031	0.0006	0.0052	0.0009
Carbon tetrachloride	2.4	0.7189	0.5503	0.6783	0.5393	0.6700	0.5606	0.6219	0.5559
Benzene	2.3	3.4581	1.1219	2.8684	1.2036	4.1489	1.2336	5.8458	1.3622
1,2-Dichloroethane	2	0.1468	0.0730	0.1300	0.0688	0.2341	0.0806	0.0987	0.0632
Chloroform	1	0.1462	0.0945	0.1412	0.0877	0.1349	0.0820	0.1485	0.0803
Vinyl chloride	1	0.0110	0.0028	0.0298	0.0043	0.0284	0.0050	0.4186	0.0199

Polycyclic Aromatic Hydrocarbons

The ministry samples for several polycyclic aromatic hydrocarbons (PAH) at the AFN site every twelfth day (following the National Air Pollution Surveillance [NAPS] schedule). PAH are a group of complex hydrocarbons that may be formed by incomplete combustion of organic compounds. They are common products of both industrial processes such as coking, burning fuel such as coal or wood, and even barbecuing. Some of them are known to be carcinogenic. PAH are sampled on a filter which is returned to the ministry's laboratory for analysis. A sample is collected for 24 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, a unit that is one thousand times smaller than the unit used for most other measurements in this report.

During this 2012 reporting period, the ministry collected 31 samples. These results are summarised in the table below. 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 the reporting period are below the method detection limit (mdl), as the degree of uncertainty would be too high.

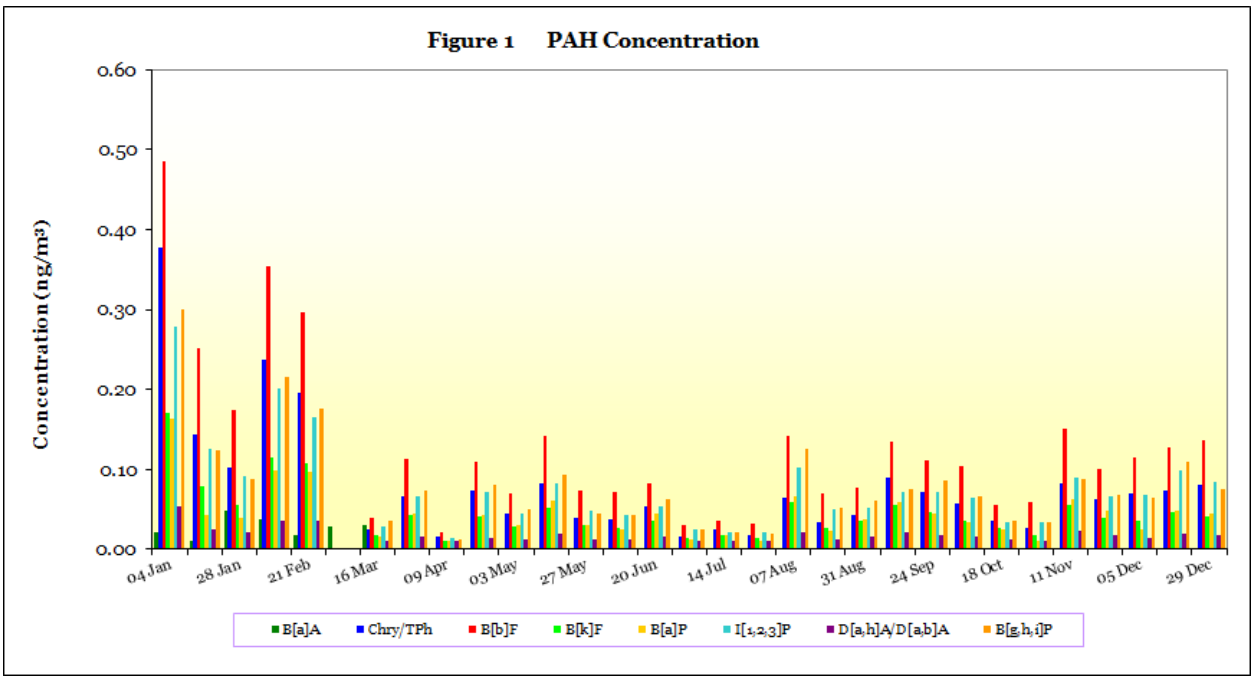
Polycyclic Aromatic Hydrocarbons Monitoring Results (ng/m³)

	2012			2011			2010			2009		
	Ave	Max	>mdl	Ave	Max	>mdl	Ave	Max	>mdl	Ave	Max	>mdl
Benz[a]anthracene	0.032	0.151	80.6%	0.058	0.600	75.9%	0.028	0.110	46.4%	0.038	0.120	64.5%
Chrysene / Triphenylene	0.078	0.378	93.5%	0.147	1.900	82.8%	0.075	0.260	67.9%	0.117	0.440	77.4%
Benzo[b]fluoranthene	0.126	0.485	93.5%	0.251	2.750	89.7%	0.132	0.420	71.4%	0.160	0.620	74.2%
Benzo[k]fluoranthene	0.046	0.170	93.5%	0.074	0.700	89.7%	0.043	0.100	60.7%	0.062	0.200	74.2%
Benzo[a]pyrene	0.043	0.163	90.3%	0.069	0.630	79.3%	0.050	0.120	67.9%	0.059	0.140	77.4%
Indeno[1,2,3-cd]Pyrene	0.076	0.278	93.5%	0.123	1.250	89.7%	0.069	0.200	67.9%	0.095	0.250	74.2%
Dibenz[a,h]Anthracene Dibenz[a,b]Anthracene	0.017	0.053	77.4%	0.024	0.230	41.4%	0.011	0.020	32.1%	0.015	0.030	38.7%
Benzo[g,h,i]perylene	0.080	0.300	93.5%	0.134	1.230	89.7%	0.078	0.220	67.9%	0.093	0.210	74.2%

Average and maximum concentrations were lower during this reporting period than during the previous one. They were also much lower than levels previously measured at the ministry's monitoring station in West Windsor which is across the Detroit River from a steel mill. This monitor was not operating during 2012 as the station was closed temporarily as it was located at the site of the developing international crossing. A monitoring station has now been re-established in the same vicinity and so comparison values will be available in the future. The sample by sample results are illustrated in Figure 1 on the following page.

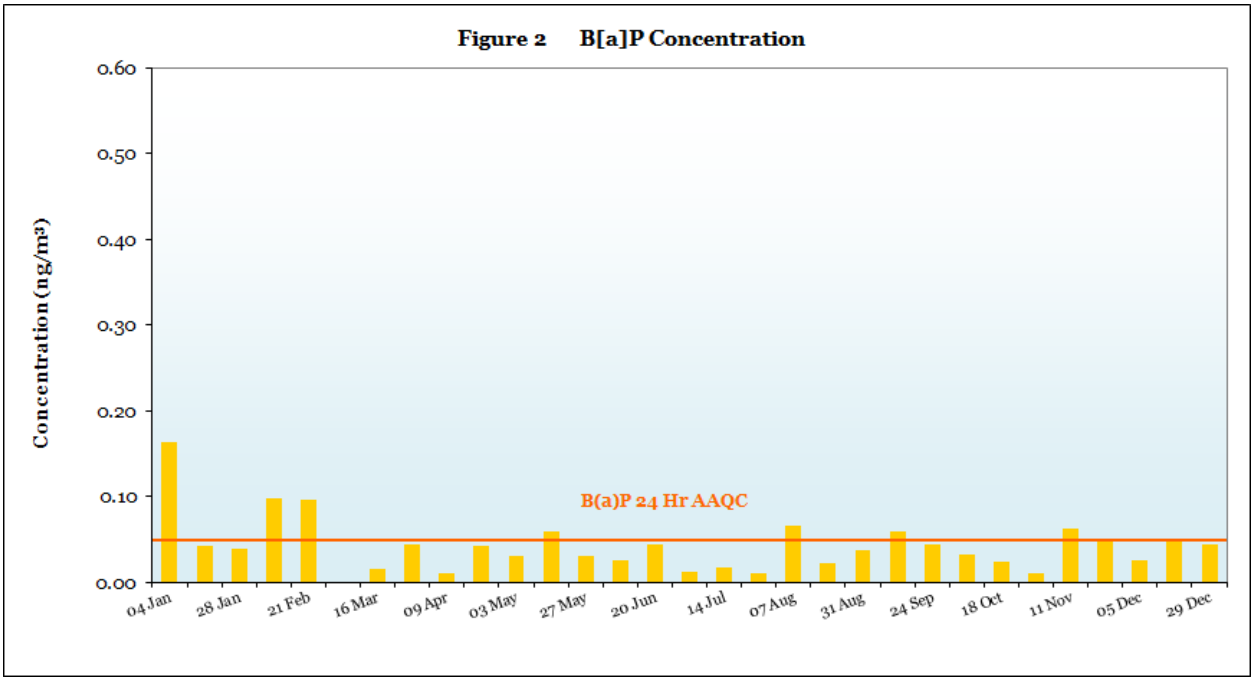
Table 2 Abbreviations for PAH

Benz[a]anthracene	B[a]A	Benzo[a]pyrene	B[a]P
Chrysene	Chry	Indeno[1,2,3-cd]Pyrene	I[1,2,3]P
Triphenylene	TPh	Dibenz[a,b]Anthracene	D[a,b]A
Benzo[b]fluoranthene	B[b]F	Dibenz[a,h]Anthracene	D[a,h]A
Benzo[k]fluoranthene	B[k]F	Benzo[g,h,i]perylene	B[g,h,i]P



The ministry previously had a 24-hour AAQC for B[a]P of 1.1 ng/m3. None of the samples approached this level. However the new 24-hour AAQC of 0.05 ng/m3 is much lower and 7 of the 24-hour B[a]P concentrations exceeded this value. For comparison, this occurred 10 times in 2011 and 9 times in 2010.

In addition ,the annual average in 2012 exceeded the new annual AAQC of 0.01 ng/m3. B[a]P results are illustrated in Figure 2.



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: health, environmental effects, odours, or soiling. Where more than one significant effect occurs, the ministry may have multiple AAQC for the same substance. The averaging time 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 air pollutants that have adverse effects on human health and the environment. The pollutants are 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 ($\mu g/m^3$): A concentration unit used to report pollutant concentrations in the atmosphere. One microgram is a millionth of a gram.

Micron (µm): One millionth of a metre = one thousandth of a millimetre = about three millionths of a foot. A human hair ranges from 40 to 120 microns thick.

NAPS: Environment Canada's National Air Pollution Surveillance Program was established in 1969 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 ½ 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 concentrations that are reported as "0". 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 0. However, the "real" value of that concentration could be anywhere below this level (DL) and 0. 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. In addition, 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 0 in average calculations. The ministry has chosen to use the same methodology in this report so that these results may be compared to those found in AQI reports. While most real-time instruments will record a "0" from time to time, this decision will only have a noticeable impact on SO2, and TRS which usually exhibit very low levels.

This practice was also adopted for the real time VOC monitor but for very different reasons. Because of the experimental nature of the instrument, we have 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 ($\mu g/m^3$) or nanograms per cubic metre (ng/m^3). All 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 (1013 hectopascals [hPa]).

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 Nations & Surrounding Area