Technical Memorandum

Aamjiwnaang First Nation
Community Air Monitoring Station

Results for September 2009 – December 2010

Ontario Ministry of the Environment
Southwestern Region Technical Support Unit
Air Pesticides and Environmental Planning Section
733 Exeter Road
London, ON M9P 3V6

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 was equipped to monitor a range of air contaminants, some on an hourly basis while others were sampled for 24 hours every 6 or 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 summarizing the first year of operation was released in January of 2011. This report presents the next 16 months of monitoring data (September 2009 - December 2010). We have presented the data more succinctly, producing a two page summary for each monitoring method. 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 (TSP)
    - Certain TSP constituents – primarily metals
- Polycyclic aromatic hydrocarbons (PAH)
- A broader range of VOC

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 they remained below the detection limit all year so no results will be 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 $\Phi g/m^3$) 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. These differences are discussed briefly in the "Data Averaging" appendix.

Another significant change 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 are based upon the potential adverse health or other effects of each substance. 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. In some cases, a shorter term AAQC will also be given for these substances. This is a screening level that is meant to be used to determine if longer-term evaluation such as monitoring is necessary. Others substances are believed to have a discernable impact at less than lifetime exposures and so their AAQC reflect a shorter averaging period. Chromium, manganese and nickel fall into this category.

Results for this report are similar to those in the previous report. Results for AQI parameters showed higher averages for NO_2, and $PM_{2.5}$, lower averages for SO_2, and TRS, and similar averages for O_3. As with the previous report, exceedances were only seen for $PM_{2.5}$ (38 in 16 months versus 24 in the 12 months of the previous report) and O_3 (2 versus 1). None of these exceeded the ministry's AAQC where they exist.

Averages for TSP and (where available) metals were slightly lower that those in the previous report. There were no measured exceedances of either the existing values or the new AAQC. PAH results were also very similar to those in the previous report showing no exceedances of the existing AAQC for benzo(a)pyrene [B(a)P]. However, had the new AAQC been in place during the monitoring period, the annual AAQC would have been exceeded.

The target list for hourly VOC measurements was changed slightly based upon results from the first year of monitoring. One species, vinyl chloride, which was never seen and for which there are no known local sources, was removed from the target list, while two more were added. No exceedances of any current AAQC were recorded. As well, these measurements indicated that neither the benzene nor the 1,3-butadiene reached the new annual AAQC.

Of the 160 species for which the canister samples were analysed, the ministry had 46 AAQC during the monitoring period. None of these were exceeded. However, the average benzene concentration for these results would have exceeded the new annual AAQC had it been in place.

Sulphur Dioxide

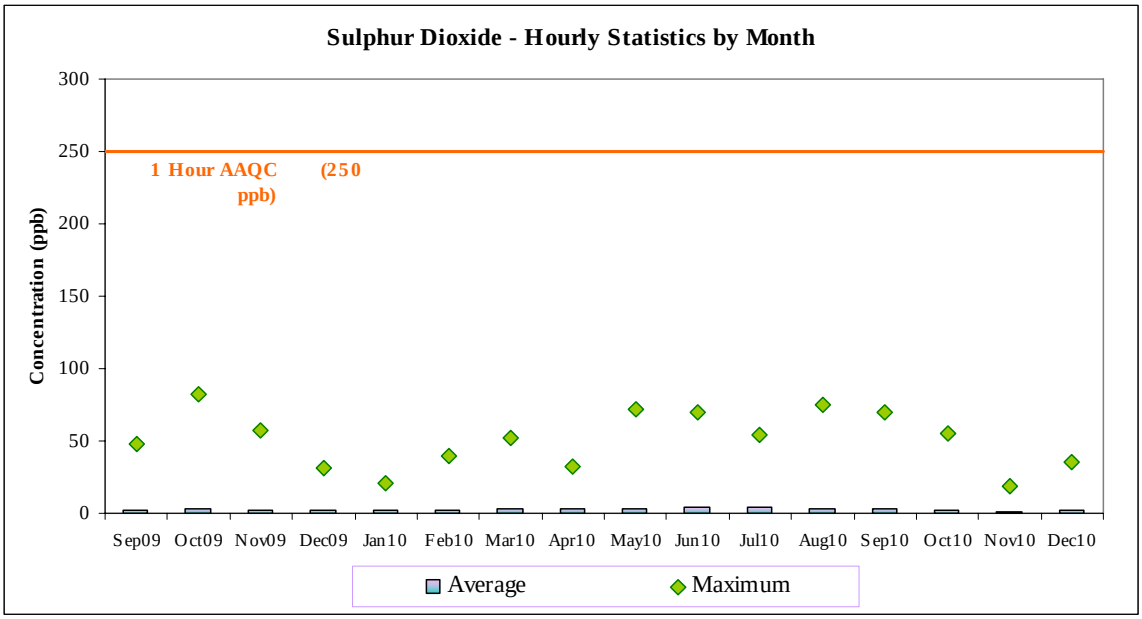
Report Values	Average (ppb)	Maximum (ppb)	AAQC Exceedances
AFN Station			
Current Report	2.73	82	0
Previous Report	3.30	101	0
Other Stations, Current Report Period			
Sarnia AQI	4.05	103	0
Windsor West AQI	3.41	74	0
London AQI	0.88	19	0

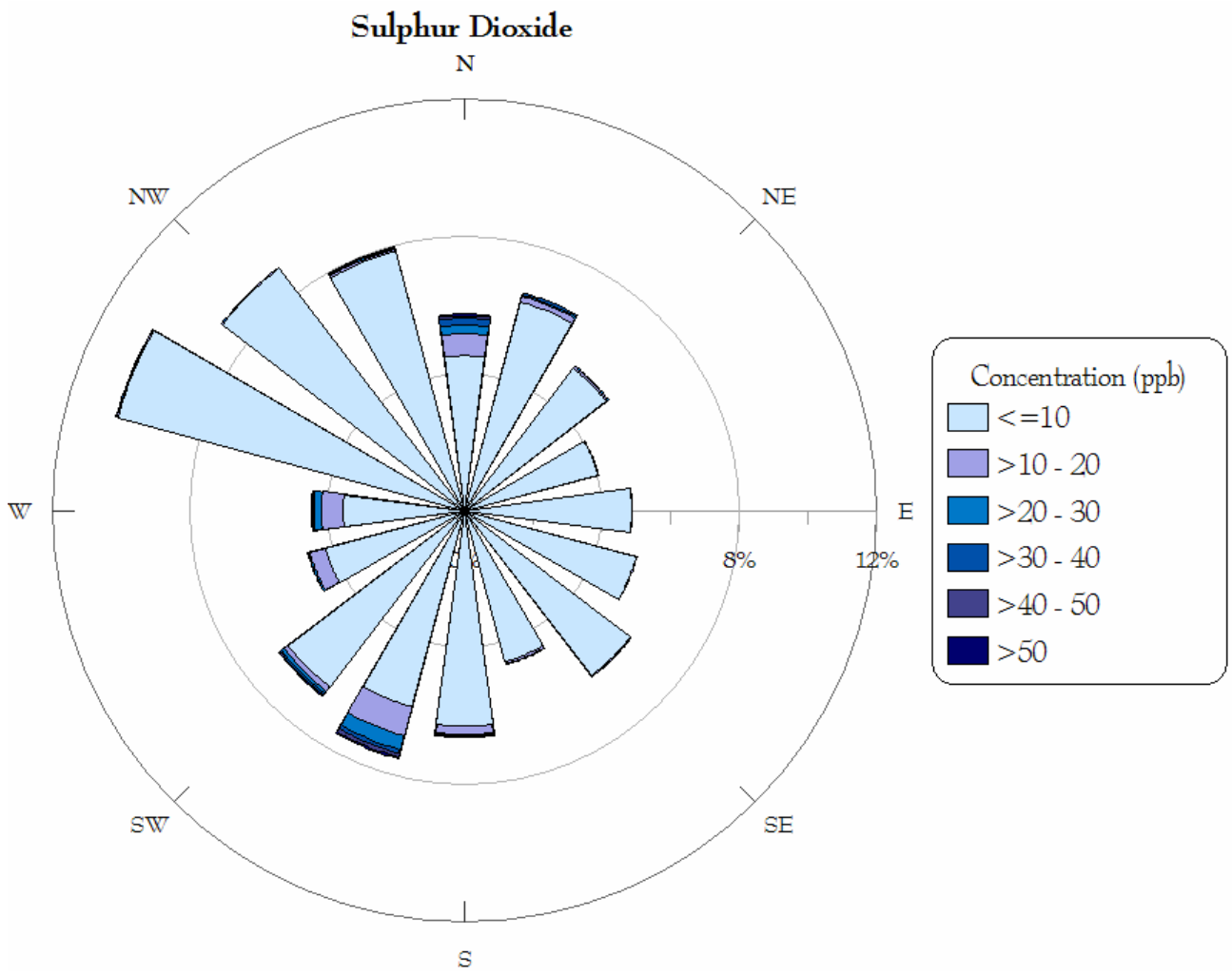
Sulphur dioxide (SO_2) is emitted from industrial facilities and sources that burn sulphur-containing fuel, notably electric power generators. It contributes to acid rain, and can have human health impacts including eye and respiratory tract irritation and lung damage at higher concentrations. The ministry 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. In spite of the longer duration covered by this report (16 months), both the average and maximum value of sulphur dioxide were lower than measured in the previous reporting period. They were also lower than those measured at the Sarnia AQI station, and comparable to those of the Windsor West AQI station though higher than the London measurements. The highest average was seen in the summer of 2010, perhaps because of the greater demand for electricity and the southwest winds which often transport pollutants from the industrial areas of the U.S. midwest. These results are similar to those in the previous report. Nearly all the SO_2 measurements led to a "very good" SO_2 AQI sub-index. The month by month results are shown graphically on the next page.

The pollution rose shown on the next page illustrates how SO_2 concentration varies with wind direction. While the wind pattern is different than that of the previous report, the overall impression is the same. Higher concentrations are seen in winds from the west to southwest and from the north.

Month by Month Statistics								
	Concentration		AAQC Exceedances	AQI Sub-index				
	Average (ppb)	Maximum (ppb)		Very Good	Good	Moderate	Poor	Very Poor
Sep-09	2.56	48	0	100.0%	0.00%	0.00%	0.00%	0.00%
Oct-09	3.23	82	0	99.9%	0.14%	0.00%	0.00%	0.00%
Nov-09	1.90	57	0	100.0%	0.00%	0.00%	0.00%	0.00%
Dec-09	2.35	31	0	100.0%	0.00%	0.00%	0.00%	0.00%
Jan-10	2.01	21	0	100.0%	0.00%	0.00%	0.00%	0.00%
Feb-10	1.60	40	0	100.0%	0.00%	0.00%	0.00%	0.00%
Mar-10	3.29	52	0	100.0%	0.00%	0.00%	0.00%	0.00%
Apr-10	3.45	32	0	100.0%	0.00%	0.00%	0.00%	0.00%
May-10	3.64	72	0	100.0%	0.00%	0.00%	0.00%	0.00%
Jun-10	4.15	70	0	100.0%	0.00%	0.00%	0.00%	0.00%
Jul-10	3.67	54	0	100.0%	0.00%	0.00%	0.00%	0.00%
Aug-10	2.72	75	0	100.0%	0.00%	0.00%	0.00%	0.00%
Sep-10	2.93	70	0	100.0%	0.00%	0.00%	0.00%	0.00%
Oct-10	2.40	55	0	100.0%	0.00%	0.00%	0.00%	0.00%
Nov-10	1.54	19	0	100.0%	0.00%	0.00%	0.00%	0.00%
Dec-10	1.84	35	0	100.0%	0.00%	0.00%	0.00%	0.00%


Sulphur Dioxide - Hourly Statistics by Month
Concentration (ppb)
300
250
200
150
100
50
0
1 Hour AAQC (250 ppb)
Sep09
Oct09
Nov09
Dec09
Jan10
Feb10
Mar10
Apr10
May10
Jun10
Jul10
Aug10
Sep10
Oct10
Nov10
Dec10
Average
Maximum


Sulphur Dioxide
N
NE
E
SE
S
SW
W
NW
4%
8%
12%
Concentration (ppb)
<=10
>10 - 20
>20 - 30
>30 - 40
>40 - 50
>50

Total Reduced Sulphur

Report Values	Average (ppb)	Maximum (ppb)	Exceedances
AFN Station			
Current Report	0.8	25	0
Previous Report	0.9	16	0
Other Stations, Current Report Period			
Sarnia AQI	.06	4	0
Windsor West AQI	0.6	34	0
London AQI	TRS is not measured in London		

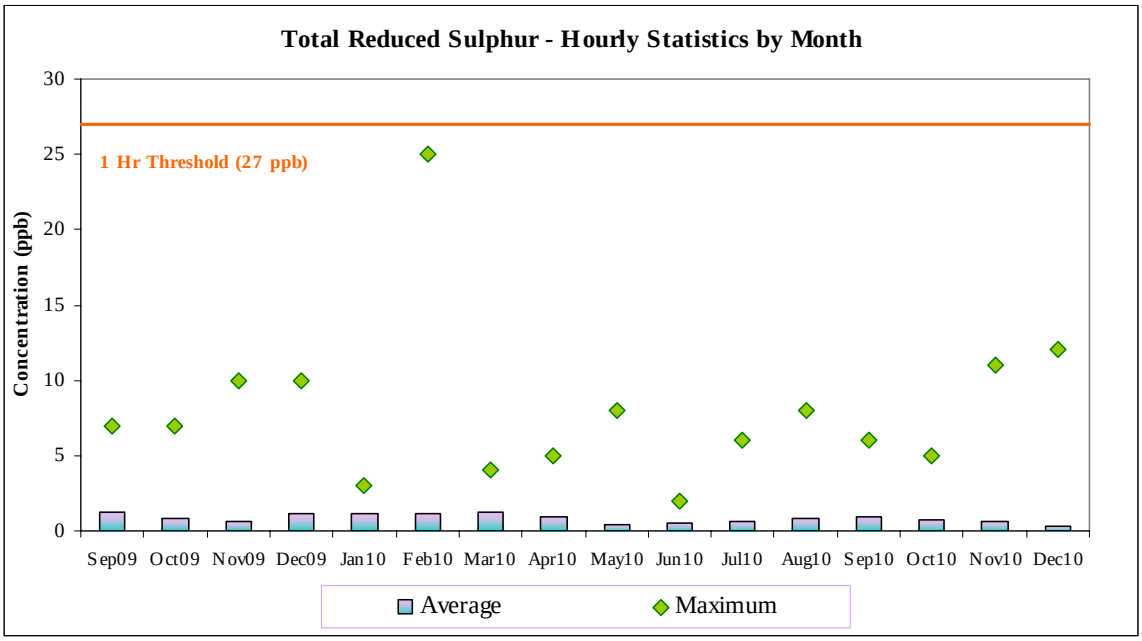
Total Reduced Sulphur (TRS) is a group of different sulphur-based compounds including hydrogen sulphide and various mercaptans. The ministry does not have a 1-hour AAQC so values were compared to 27 ppb, the highest concentration which would cause a "Moderate" AQI. This level is equivalent to the values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

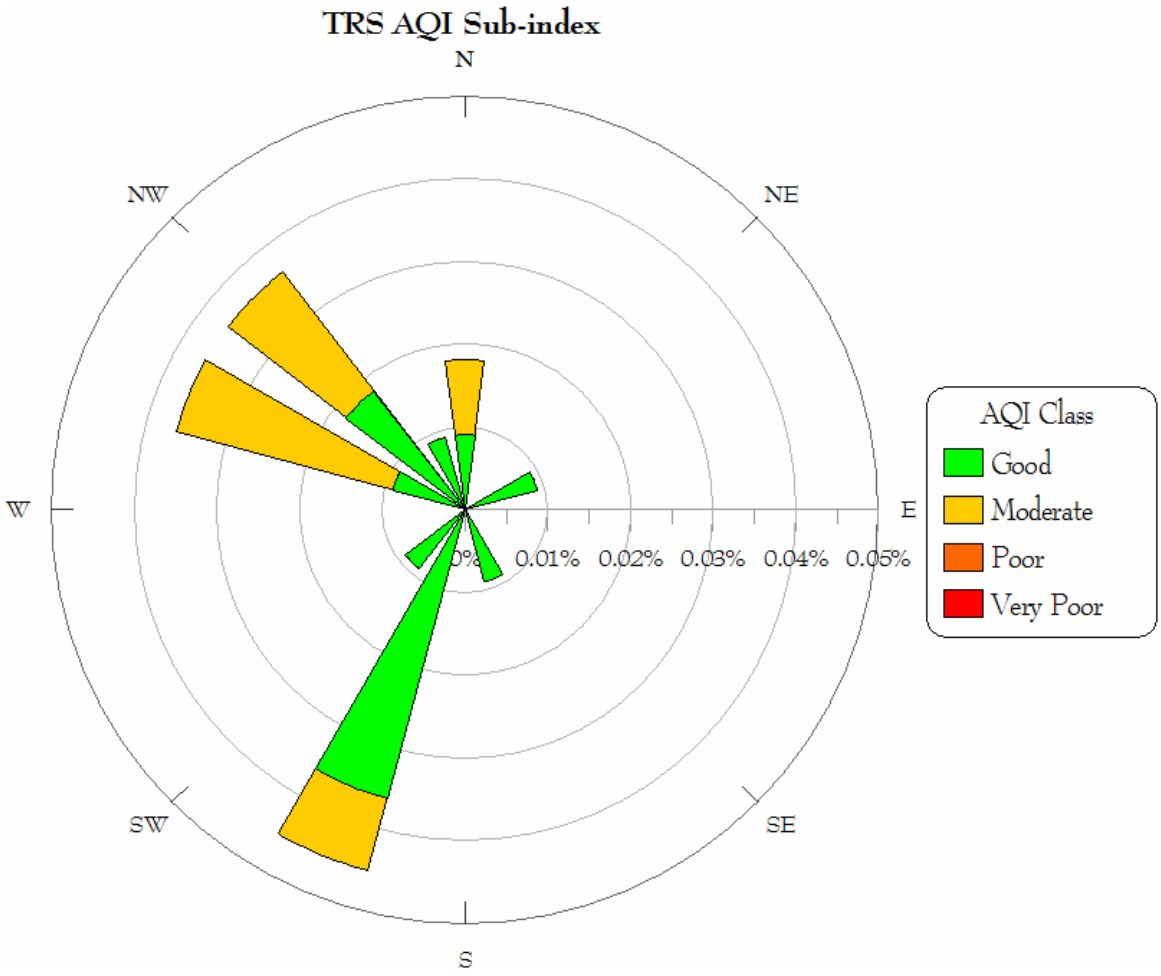
No exceedances of the comparison value were measured during the period of this report. The average was slightly lower but the maximum was slightly higher than during the previous year. Both the average and the maximum values were higher than the Sarnia AQI station. This result reflects the relative proximity to local sources of the AFN station compared to the Sarnia AQI site. The average was also slightly higher than that at the Windsor West station but the maximum was somewhat lower.

Month by Month Statistics								
	Concentration		Exceedances	AQI Sub-index				
	Average (ppb)	Maximum (ppb)		Very Good	Good	Moderate	Poor	Very Poor
Sep-09	1.2	7	0	99.7%	0.3%	0.0%	0.0%	0.0%
Oct-09	0.9	7	0	99.9%	0.1%	0.0%	0.0%	0.0%
Nov-09	0.6	10	0	99.9%	0.1%	0.0%	0.0%	0.0%
Dec-09	1.2	10	0	99.9%	0.1%	0.0%	0.0%	0.0%
Jan-10	1.1	3	0	100.0%	0.0%	0.0%	0.0%	0.0%
Feb-10	1.1	25	0	98.7%	0.4%	0.9%	0.0%	0.0%
Mar-10	1.2	4	0	100.0%	0.0%	0.0%	0.0%	0.0%
Apr-10	0.9	5	0	100.0%	0.0%	0.0%	0.0%	0.0%
May-10	0.4	8	0	99.9%	0.1%	0.0%	0.0%	0.0%
Jun-10	0.6	2	0	100.0%	0.0%	0.0%	0.0%	0.0%
Jul-10	0.7	6	0	99.7%	0.3%	0.0%	0.0%	0.0%
Aug-10	0.8	8	0	99.9%	0.1%	0.0%	0.0%	0.0%
Sep-10	0.9	6	0	99.9%	0.1%	0.0%	0.0%	0.0%
Oct-10	0.7	5	0	100.0%	0.0%	0.0%	0.0%	0.0%
Nov-10	0.6	11	0	99.8%	0.0%	0.2%	0.0%	0.0%
Dec-10	0.3	12	0	99.9%	0.0%	0.1%	0.0%	0.0%

Monthly values are given in the second table and illustrated on the next page. Three months had "moderate" levels, while five had only "very good." Levels varied only a little though the colder months have higher maxima, perhaps related to increased use of sulphur-containing fuels.

The pollution rose on the next page ("very good" levels were not shown) suggests that there is not a dominant source of TRS but rather there may be a number of 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)
Sep09
Oct09
Nov09
Dec09
Jan10
Feb10
Mar10
Apr10
May10
Jun10
Jul10
Aug10
Sep10
Oct10
Nov10
Dec10
Average
Maximum


TRS AQI Sub-index
N
NE
E
SE
S
SW
W
NW
0%
0.01%
0.02%
0.03%
0.04%
0.05%
AQI Class
Good
Moderate
Poor
Very Poor

Nitrogen Dioxide

Nitrogen Dioxide (NO_2) is a common combustion product. This is a consequence of the large amount of nitrogen in the atmosphere. Vehicle exhaust is the most common source of nitrogen oxides including nitrogen dioxide. It reacts in the atmosphere to form a number of compounds, some of which have adverse health or environmental effects. It is an ozone precursor and one of the causes of acid rain. The 1-hour AAQC for NO_2 is 200 ppb. This level used for evaluation.

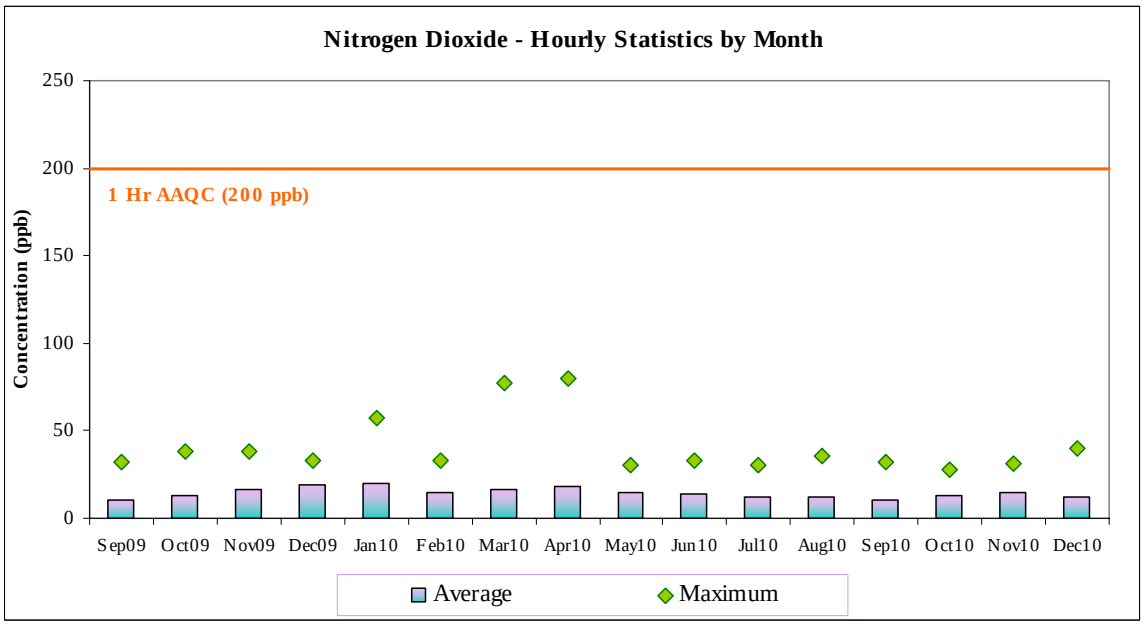
Report Values	Average (ppb)	Maximum (ppb)	AAQC Exceedances
AFN Station			
Current Report	14.6	80	0
Previous Report	10.3	67	0
Other Stations, Current Report Period			
Sarnia AQI	8.0	60	0
Windsor West AQI	14.4	80	0
London AQI	8.6	68	0

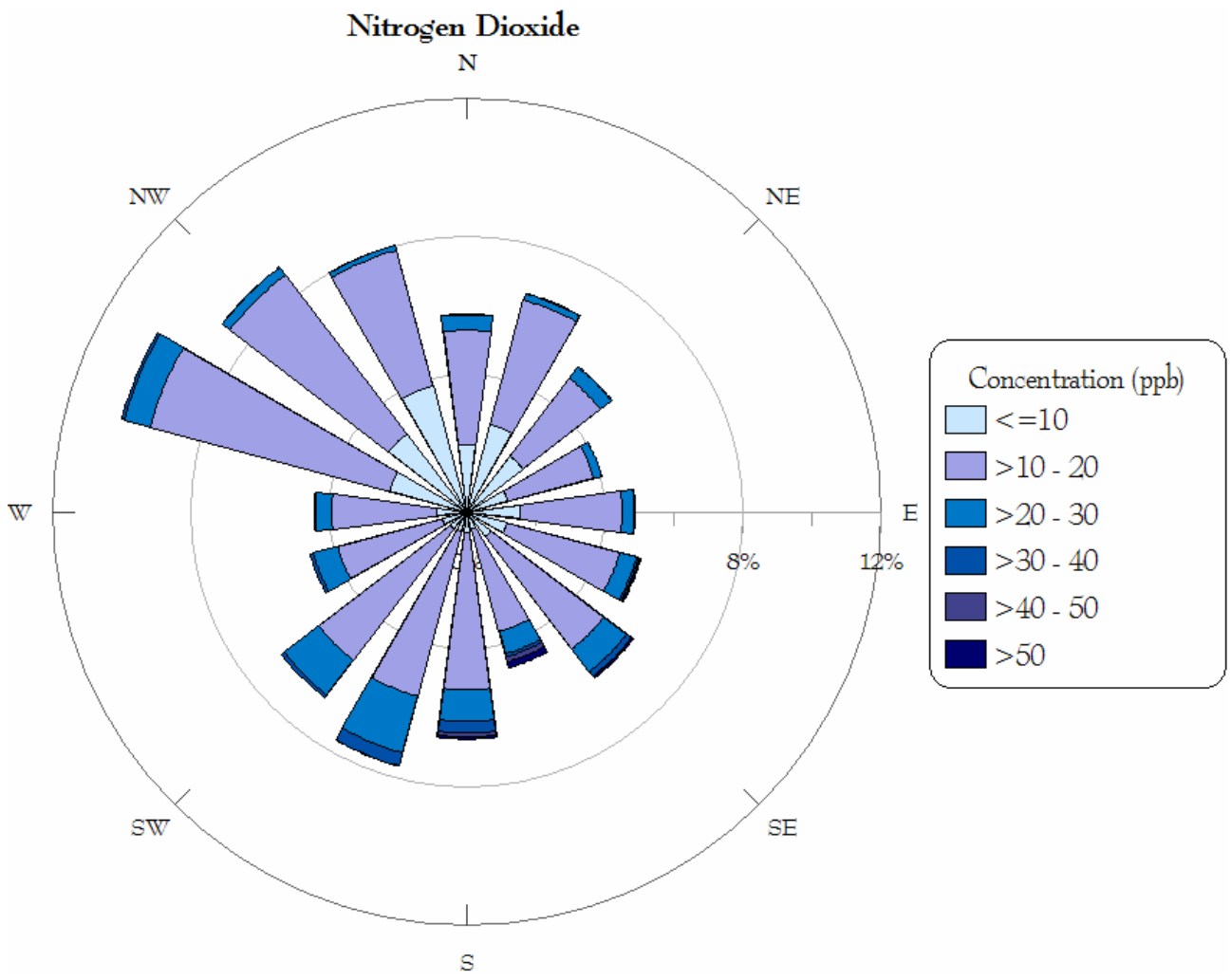
No exceedances of the AAQC were measured during the period covered by this report. Both the average and maximum concentration increased compared to the previous reporting period. Levels were somewhat higher than those seen at the Sarnia and London AQI stations though were nearly identical to those at Windsor West.

A month by month summary of the NO_2 concentrations are given in the table below. No strong seasonal influences are apparent although there are some higher concentrations in the spring of 2010. Even in theses cases, only a few hours are seen in the "good" category and concentrations did not reach levels corresponding to the "moderate" category. The remaining months only have levels in the "very good" category.

Month by Month Statistics								
	Concentration		AAQC Exceedances	AQI Sub-index				
	Average (ppb)	Maximum (ppb)		Very Good	Good	Moderate	Poor	Very Poor
Sep-09	10.2	32	0	100.0%	0.0%	0.0%	0.0%	0.0%
Oct-09	13.3	38	0	100.0%	0.0%	0.0%	0.0%	0.0%
Nov-09	16.8	38	0	100.0%	0.0%	0.0%	0.0%	0.0%
Dec-09	19.2	33	0	100.0%	0.0%	0.0%	0.0%	0.0%
Jan-10	20.0	57	0	99.9%	0.1%	0.0%	0.0%	0.0%
Feb-10	14.5	33	0	100.0%	0.0%	0.0%	0.0%	0.0%
Mar-10	16.1	77	0	96.8%	3.2%	0.0%	0.0%	0.0%
Apr-10	18.6	80	0	98.2%	1.8%	0.0%	0.0%	0.0%
May-10	14.9	30	0	100.0%	0.0%	0.0%	0.0%	0.0%
Jun-10	13.8	33	0	100.0%	0.0%	0.0%	0.0%	0.0%
Jul-10	11.9	30	0	100.0%	0.0%	0.0%	0.0%	0.0%
Aug-10	12.5	36	0	100.0%	0.0%	0.0%	0.0%	0.0%
Sep-10	10.5	32	0	100.0%	0.0%	0.0%	0.0%	0.0%
Oct-10	13.1	28	0	100.0%	0.0%	0.0%	0.0%	0.0%
Nov-10	14.9	31	0	100.0%	0.0%	0.0%	0.0%	0.0%
Dec-10	12.6	40	0	100.0%	0.0%	0.0%	0.0%	0.0%

The pollution rose on the next page shows how the concentration varies with wind direction. Lowest concentrations are most common during NNW winds. Higher concentrations are seen from all directions though they are more frequent during southerly winds. In addition to local sources, long range atmospheric transport may also contribute to local concentrations.


Nitrogen Dioxide - Hourly Statistics by Month
Concentration (ppb)
250
200
150
100
50
0
1 Hr AAQC (200 ppb)
Sep09
Oct09
Nov09
Dec09
Jan10
Feb10
Mar10
Apr10
May10
Jun10
Jul10
Aug10
Sep10
Oct10
Nov10
Dec10
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

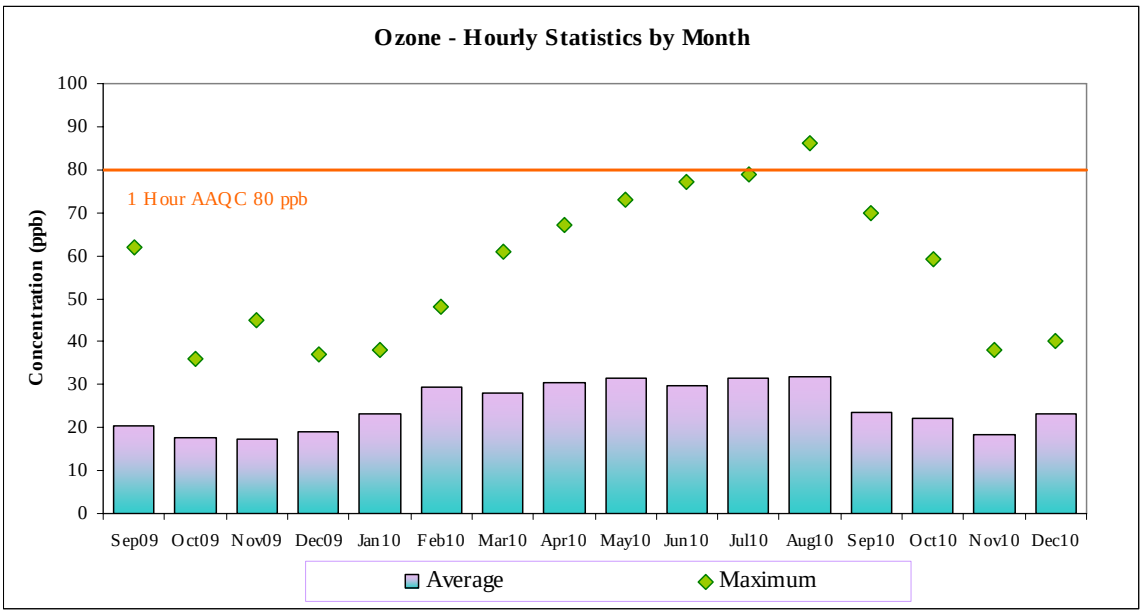
Unlike many other air contaminants, ozone (O_3) is not emitted to the atmosphere. It is formed in the presence of sunlight from reactions between nitrogen oxides and volatile organic compounds. This is a relatively slow process and some of the gases that form ground level ozone may have been emitted hundreds of kilometres away. Strong sunlight and warm conditions speed up production and so high levels often occur in the summer. This relationship also causes ozone concentrations to rise during the day and fall at night. 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. An in-depth discussion of this is included in the ministry report on transboundary air pollution: http://www.ene.gov.on.ca/environment/en/resources/STD01_076512.html

Report Values	Average (ppb)	Maximum (ppb)	AAQC Exceedances
AFN Station			
Current Report	24.8	86	2
Previous Report	24.4	91	1
Other Stations, Current Report Period			
Sarnia AQI	28.1	90	14
Windsor West AQI	24.5	96	6
London AQI	25.8	77	0

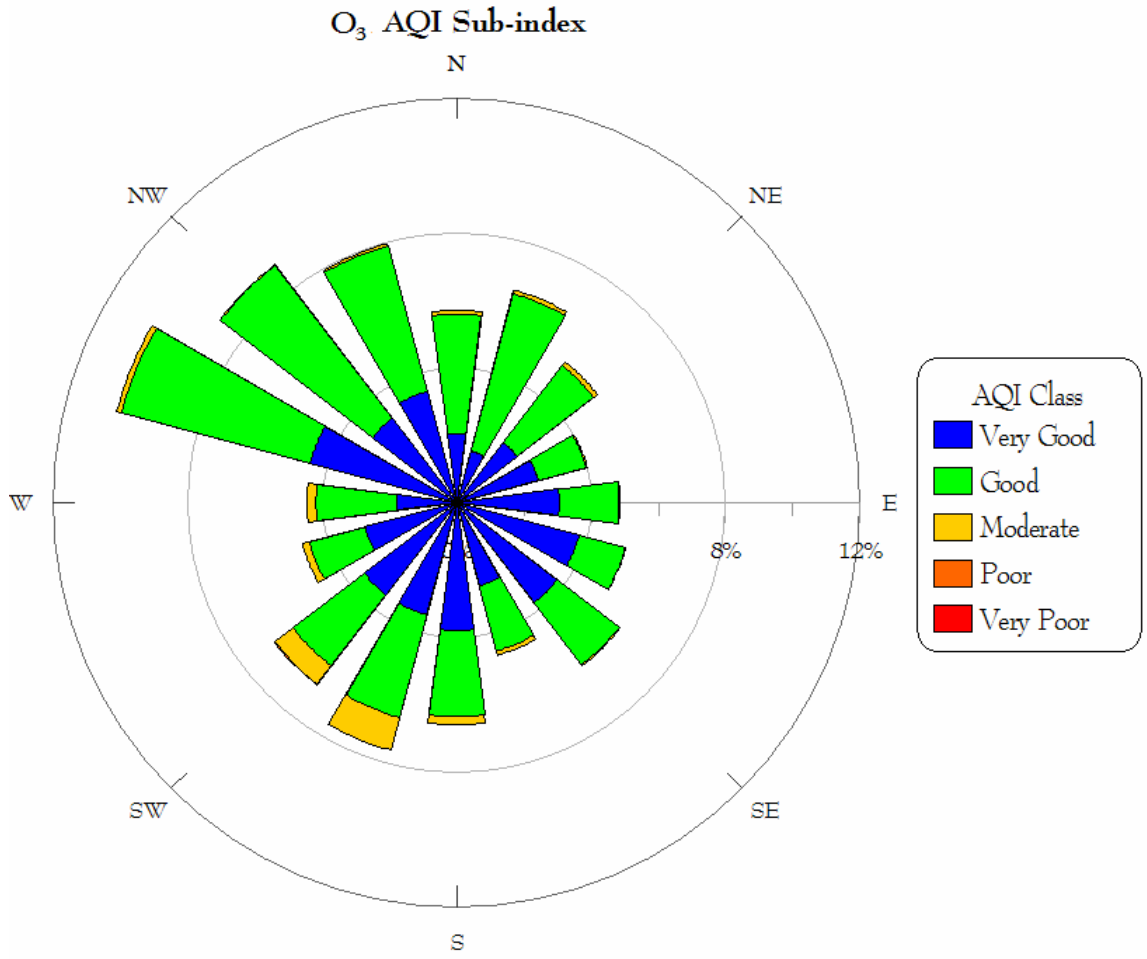
The ministry's 1-hour AAQC for ozone is 80 ppb. This level is used for evaluation in this report. Two exceedances of this value were recorded during this monitoring period, both in August. The average concentration was up slightly from the previous report but lower than two of the three comparison stations in the region. The maximum was lower than the one in the previous report and similar to the other stations. The highest values were seen in the summer of 2010 and the maximum occurred in the same month as the highest average.

Month by Month Statistics								
	Concentration		AAQC Exceedances	AQI Sub-index				
	Average (ppb)	Maximum (ppb)		Very Good	Good	Moderate	Poor	Very Poor
Sep-09	20.5	62	0	64.8%	33.2%	1.9%	0.0%	0.0%
Oct-09	17.6	36	0	78.0%	22.0%	0.0%	0.0%	0.0%
Nov-09	17.5	45	0	76.5%	23.5%	0.0%	0.0%	0.0%
Dec-09	19.1	37	0	72.0%	28.0%	0.0%	0.0%	0.0%
Jan-10	23.2	38	0	45.3%	54.7%	0.0%	0.0%	0.0%
Feb-10	29.4	48	0	16.7%	83.3%	0.0%	0.0%	0.0%
Mar-10	27.9	61	0	30.1%	67.1%	2.8%	0.0%	0.0%
Apr-10	30.5	67	0	26.7%	70.1%	3.2%	0.0%	0.0%
May-10	31.5	73	0	23.7%	69.0%	7.4%	0.0%	0.0%
Jun-10	29.9	77	0	31.3%	62.9%	5.8%	0.0%	0.0%
Jul-10	31.6	79	0	32.1%	56.9%	11.0%	0.0%	0.0%
Aug-10	31.7	86	2	37.0%	48.0%	14.8%	0.3%	0.0%
Sep-10	23.5	70	0	53.7%	43.3%	3.1%	0.0%	0.0%
Oct-10	22.0	59	0	57.2%	42.1%	0.7%	0.0%	0.0%
Nov-10	18.2	38	0	75.6%	24.4%	0.0%	0.0%	0.0%
Dec-10	23.4	40	0	45.2%	54.8%	0.0%	0.0%	0.0%

In addition to the heat and sunshine, prevailing winds in the summer bring more of the ozone precursors (or building blocks) to the region. As a result, ozone is often the driving factor in a higher AQI and number of hours in the "moderate" and "good" categories increase at the cost of those in the "very good" category. No "very poor" conditions were recorded though the two exceedances resulted in "poor" air quality. The results are illustrated on the next page.



The pollution rose below shows how ozone concentration varies with wind direction. While most wind directions are associated with "moderate" air quality, it strongly favours the south-western winds which bring pollutants from the industrial areas of the US midwest. This is a common feature in most of south-western Ontario.



Fine Particulate Matter

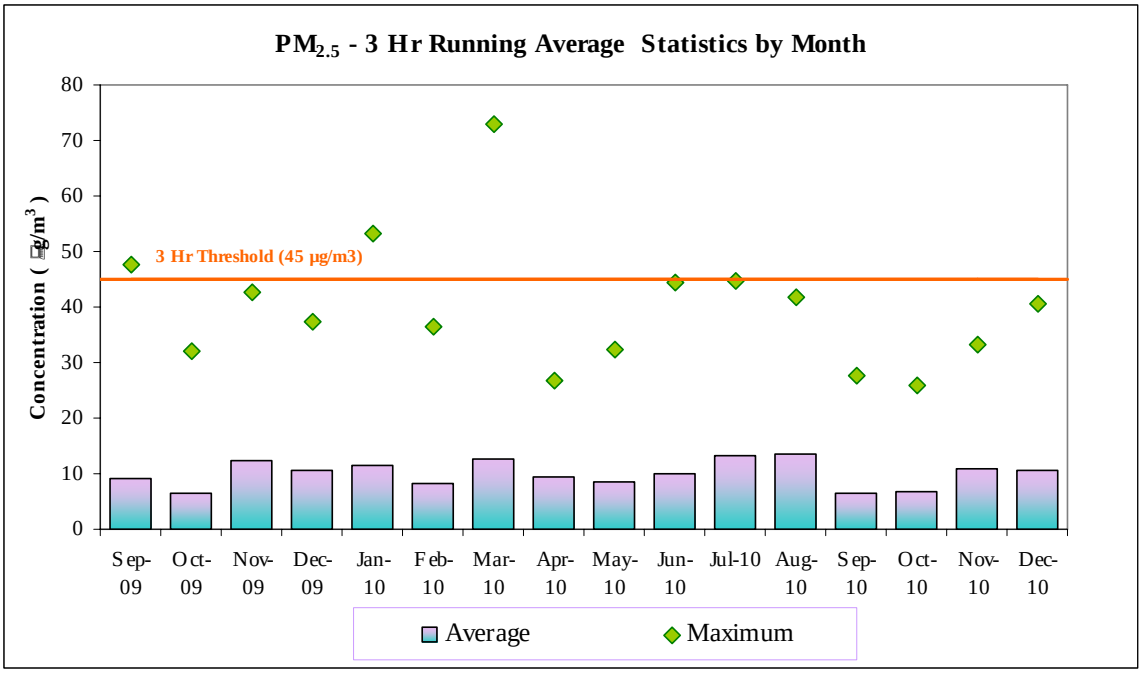
Report Values (3 hr. av.)	Average ($\mu g/m^3$)	Maximum ($\mu g/m^3$)	Exceedances
AFN Station			
Current Report	10.1	73	38
Previous Report	9.5	60	24
Other Stations, Current Report Period			
Sarnia AQI	10.3	65	4
Windsor West AQI	7.7	49	3
London AQI	6	44	0

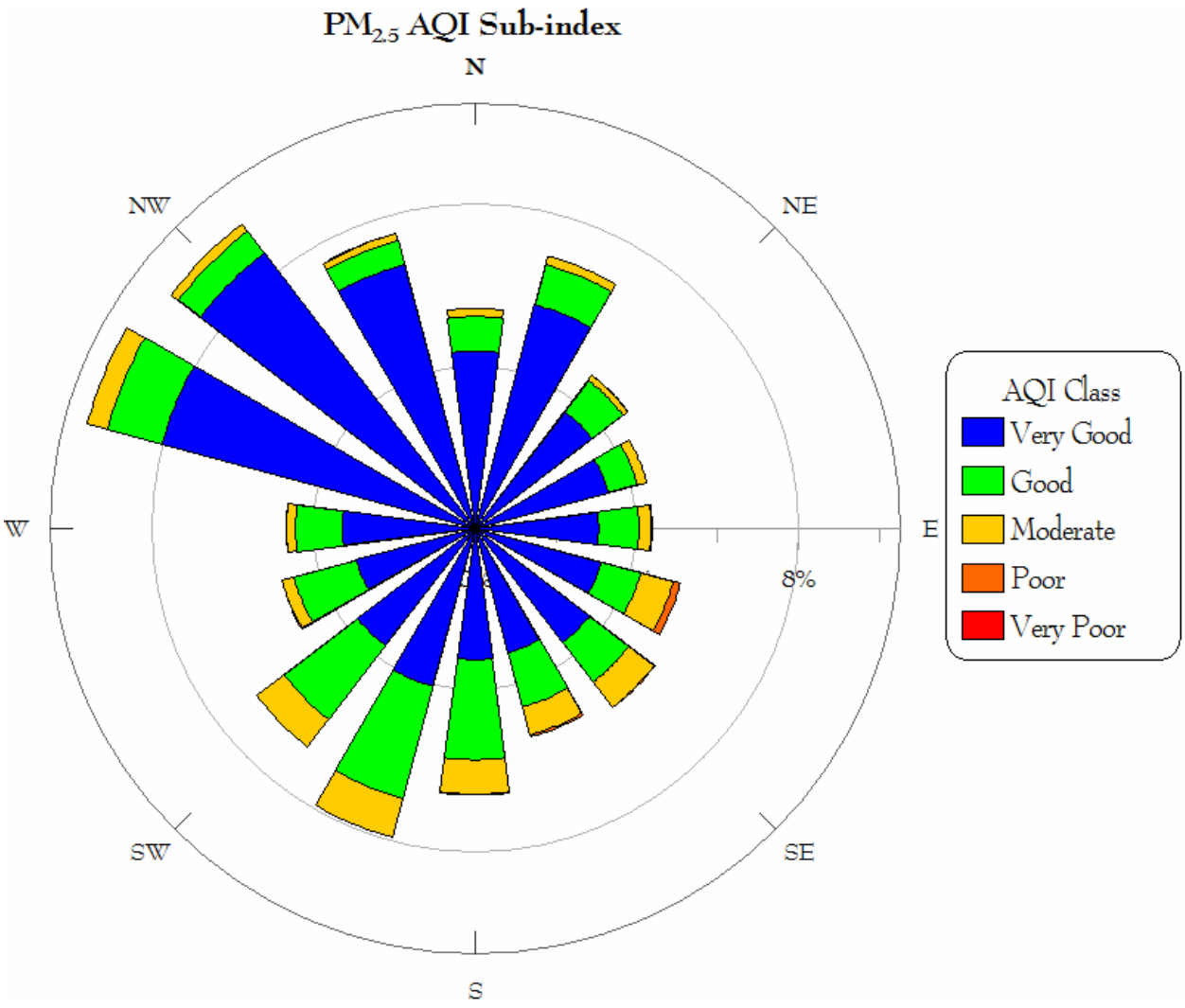
Fine particulate matter, sometimes called respirable particulate or $PM_{2.5}$, is the fraction of atmospheric particulate that is smaller than 2½ microns in diameter. These particles are important because their small size enables them to bypass the body's natural defences and reach the deepest parts 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 $PM_{2.5}$. As a result, "exceedances" for $PM_{2.5}$ were determined relative to the top of the "Moderate" AQI range, 45 $\mu g/m^3$. This level is consistent with the values used for the other AQI pollutants and so gives an equivalent measure of the number of undesirable periods. However, unlike many of the other AQI parameters, the $PM_{2.5}$ AQI sub-index is based upon a 3-hour running average.

The AFN station average is slightly lower the Sarnia station's but slightly up from the last report. The maximum also increased from the previous year as did the number of exceedances. Average and maximum values are higher than both West Windsor and London.

Month by Month Statistics								
	Concentration		Exceedances	AQI Sub-index				
	Average ($\mu g/m^3$)	Maximum ($\mu g/m^3$)		Very Good	Good	Moderate	Poor	Very Poor
Sep-09	9.2	48	1	74.8%	20.1%	5.0%	0.1%	0.0%
Oct-09	6.6	32	0	90.1%	7.4%	2.6%	0.0%	0.0%
Nov-09	12.4	43	0	62.2%	19.6%	18.2%	0.0%	0.0%
Dec-09	10.5	37	0	65.5%	30.9%	3.6%	0.0%	0.0%
Jan-10	11.3	53	3	67.2%	19.4%	13.0%	0.4%	0.0%
Feb-10	8.3	36	0	77.3%	17.0%	5.7%	0.0%	0.0%
Mar-10	12.6	73	34	67.8%	14.4%	13.3%	4.6%	0.0%
Apr-10	9.4	27	0	71.8%	24.0%	4.2%	0.0%	0.0%
May-10	8.5	32	0	77.7%	19.2%	3.1%	0.0%	0.0%
Jun-10	9.9	44	0	71.8%	22.9%	5.3%	0.0%	0.0%
Jul-10	13.3	45	0	54.7%	33.9%	11.4%	0.0%	0.0%
Aug-10	13.5	42	0	49.8%	36.2%	14.0%	0.0%	0.0%
Sep-10	6.5	28	0	84.8%	13.2%	2.0%	0.0%	0.0%
Oct-10	6.7	26	0	86.5%	12.0%	1.5%	0.0%	0.0%
Nov-10	10.9	33	0	63.3%	30.4%	6.3%	0.0%	0.0%
Dec-10	10.6	41	0	62.0%	25.1%	12.9%	0.0%	0.0%

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 that nearly all the "poor" conditions occurred in the March 2010. In particular, these exceedances occurred over a three day period between the 9th and 11th, during a period of south-easterly winds. "Moderate" concentrations seem more strongly related to southerly winds but are seen from with all wind directions.


PM2.5 - 3 Hr Running Average Statistics by Month
Concentration (µg/m3)
80
70
60
50
40
30
20
10
0
3 Hr Threshold (45 µg/m3)
Sep-09
Oct-09
Nov-09
Dec-09
Jan-10
Feb-10
Mar-10
Apr-10
May-10
Jun-10
Jul-10
Aug-10
Sep-10
Oct-10
Nov-10
Dec-10
Average
Maximum


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

Suspended Particulate & Metals

In addition to hourly measurements of respirable particulate, a twenty-four hour sample of total suspended particulate (TSP) was taken every 6th day. Over the report period seventy-four samples were taken, while technical problems led to two missed samples. In addition to determining particulate mass concentrations, this method permits analysis for a variety of particulate constituents such as metals. Samples were taken midnight to midnight EST.

Some of the metal concentrations were so low they could not be quantified – less than the method detection limit (MDL). The table below includes the percentage 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.

Particulate Monitoring Results (µg/m³)												
	Total Suspended Particulate	Silicon	Calcium	Vanadium	Chromium	Manganese	Iron	Nickel	Copper	Zinc	Cadmium	Lead
Current Report												
Average	12.42	0.38	0.72	-	-	-	0.14	-	-	.008	-	-
Maximum	95	4.7	6.7	0.058	0.002	0.027	1.4	0.005	0.010	0.062	0.006	0.009
% > MDL	100%	99%	97%	35%	9%	24%	99%	22%	29%	66%	49%	32%
Previous Report												
Average	15.35	0.44	0.83	0.005	-	0.004	0.15	0.003	-	0.015	-	-
Maximum	54	1.7	4.2	0.046	0.005	0.010	0.630	0.019	0.007	0.093	0.006	0.010
% > MDL	100%	100%	100%	76%	43%	57%	100%	70%	46%	95%	5%	8%

Particulate results for this reporting period are quite similar to those of the last report. Average concentration appears to be lower though particulate can vary from one year to the next based upon a variety of factors including weather and the economy.

The ministry has AAQC for TSP most of the determined particulate constituents. None were exceeded during the report period. However, the province has announced that, as of July 1, 2011, it has adopted new standards and related AAQC for three of these metals: chromium, nickel, and manganese. No exceedances of these would have been measured had they been in force during the period of this report. The table on the next page compares the maximum measured concentration to both existing and new AAQC for all of these substances, where an AAQC exists.

There did not appear to be any seasonal trends in the data. As well, 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.

Maximum Concentrations Compared to AAQC				
Test	**Current AAQC ($\mu g/m^3$)**	**% of AAQC**	**New AAQC ($\mu g/m^3$)**	**% of AAQC**
TSP	120	79.17%	-	-
Silicon	-	-	-	-
Calcium	-	-	-	-
Vanadium	2	2.90%	-	-
Chromium	1.5	0.13%	0.5	0.40%
Manganese	2.5	1.08%	0.4	6.75%
Iron	4	35.00%	-	-
Nickel	2	0.25%	0.2	2.50%
Copper	50	0.02%	-	-
Zinc	120	0.05%	-	-
Cadmium	0.025	24.00%	-	-
Lead	0.5	1.80%	-	-

Polycyclic Aromatic Hydrocarbons

The ministry samples for polycyclic aromatic hydrocarbons (PAH) at the AFN site every twelfth day (following the 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.

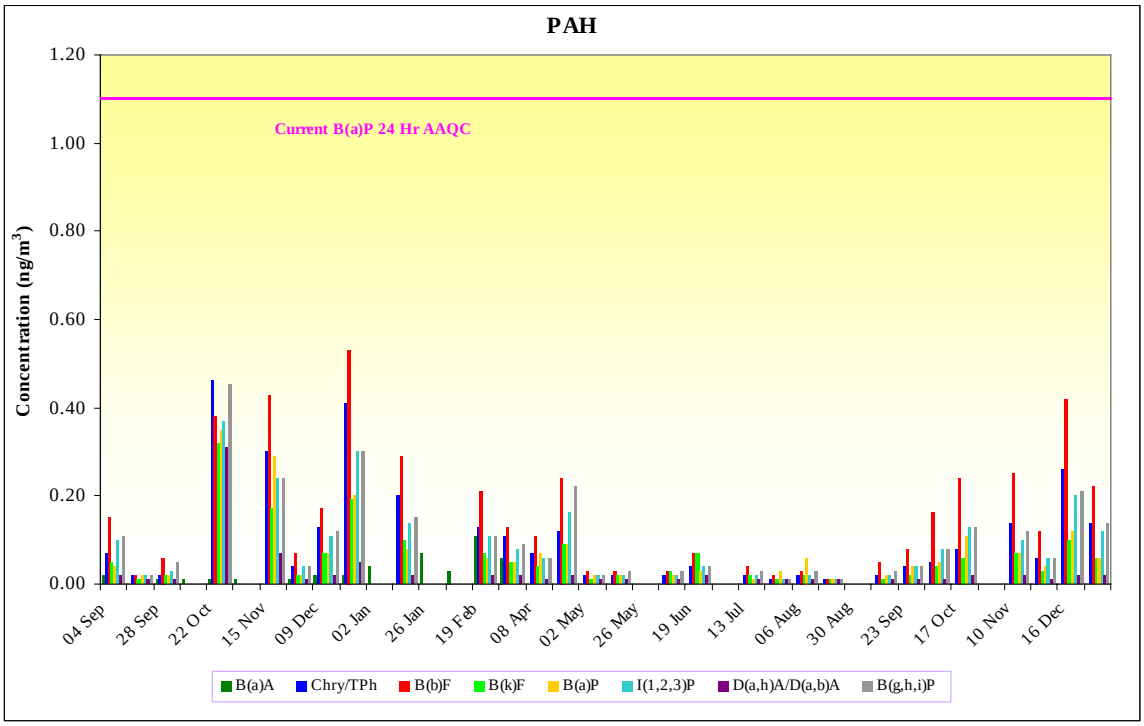
During this reporting period, the ministry collected 38 samples of which 29 yielded results. These results are summarized in the table below. Some of the concentrations were so low they could not be determined in these samples. Averages are not reported when more than half of the values during the reporting period are below the method detection limit, as level of uncertainty would be too high.

Summary of PAH Monitoring								
	Benzo(a)Anthracene	Chrysene / Triphenylene	Benzo(b)Fluoranthene	Benzo(k)Flouranthene	Benzo(a)Pyrene	Indeno(1,2,3-c,d)Pyrene	Dibenzo(a,h)Anthracene Dibenzo(a,b)Anthracene	Benzo(g,h,i)Perylene
Abbreviation	B(a)A	Chry Tph	B(b)F	B(k)F	B(a)P	I(1,2,3)P	D(a,h)A D(a,b)A	B(g,h,i)P
Current Report								
%>mdl	62.1%	93.1%	96.6%	82.8%	93.1%	93.1%	48.3%	93.1%
Average (ng/m³)	0.052	0.104	0.158	0.061	0.071	0.092		0.102
Maximum (ng/m³)	0.37	0.46	0.53	0.32	0.35	0.37	0.31	0.45
Previous Report								
%>mdl	76.0%	96.0%	100.0%	96.0%	96.0%	100.0%	40.0%	100.0%
Average (ng/m³)	0.035	0.112	0.154	0.061	0.057	0.085		0.087
Maximum (ng/m³)	0.12	0.44	0.62	0.2	0.14	0.25	0.03	0.21
West Windsor								
%>mdl	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	93.5%	100.0%
Average (ng/m³)	0.429	0.664	0.971	0.358	0.487	0.478	0.157	0.484
Maximum (ng/m³)	2.48	2.83	3.66	1.4	2.38	1.84	0.75	1.62

Average and maximum concentrations were higher during this reporting period than during to the previous one. They were, however, much lower than were seen at the ministry's monitoring station in West Windsor which is across the Detroit River from a steel mill.

The ministry previously had a 24-hour AAQC for B(a)P of 1.1 ng/m^3. None of the samples approached this level for B(a)P or any of the other PAH. However the average B(a)P concentration measured over the monitoring period, 0.071 ng/m^3 would have exceeded the new annual AAQC of 0.01 ng/m^3.

The graph below illustrates the variation of PAH levels over the course of the year. Levels are much higher in the winter suggesting that seasonal emission sources such as building heating are significant contributors to local concentrations.



Non-continuous Volatile Organic Compounds

In addition to the hourly VOC monitoring conducted by the ministry at AFN, Environment Canada (EC) collected twenty-four hour samples every twelfth day. As a result 41 samples were collected over the period of this report. EC collected samples using specially prepared evacuated canisters. This method permits determination of a much wider range of target compounds (160) and detection at much lower concentrations. However, only 46 of these compounds have an AAQC. Of these, one, 1,1-dichloroethane, was not detected. For the remaining 45, the average and maximum are compared to the AAQC in the table below.

Environment Canada VOC Concentrations Compared to 24-hour AAQC							
Compound	**24 Hr AAQC (µg/m³)**	**Maximum (% of AAQC)**	**Average (% of AAQC)**	**Compound**	**24 Hr AAQC (µg/m³)**	**Maximum (% of AAQC)**	**Average (% of AAQC)**
Freon113	800,000	0.0001%	0.0001%	Styrene	400	0.1542%	0.0402%
Freon114	700,000	0.0000%	0.0000%	iso-Propylbenzene	400	0.0134%	0.0040%
Freon12	500,000	0.0006%	0.0005%	1,2,4-Trichlorobenzene	400	0.0093%	0.0030%
Freon22	350,000	0.0003%	0.0002%	Tetrachloroethylene	360	0.1156%	0.0213%
1,1,1-Trichloroethane	115,000	0.0002%	0.0000%	Chloromethane	320	5.8412%	0.9272%
Octane	61,800	0.0017%	0.0002%	1,3,5-Trimethylbenzene	220	0.1110%	0.0205%
1-Decene	60,000	0.0001%	0.0000%	1,2,4-Trimethylbenzene	220	0.4004%	0.0734%
Decane	60,000	0.0018%	0.0002%	1,2,3-Trimethylbenzene	220	0.1147%	0.0287%
Acetylene	56,000	0.0022%	0.0010%	Dichloromethane	220	0.1896%	0.1061%
1,2-Dichlorobenzene	30,500	0.0000%	0.0000%	trans-1,2-Dichloroethylene	105	0.0155%	0.0024%
Heptane	11,000	0.0087%	0.0020%	cis-1,2-Dichloroethylene	105	0.3984%	0.0141%
Hexane	7,500	0.3300%	0.0326%	1,4-Dichlorobenzene	95	0.0476%	0.0187%
Methyl tert-butyl ether	7,000	0.0004%	0.0000%	Bromoform	55	0.0705%	0.0312%
Cyclohexane	6,100	0.1867%	0.0262%	Ethylene	40	62.9671%	10.7648%
Freon11	6,000	0.0306%	0.0269%	Naphthalene	22.5	1.7151%	0.3725%
Chloroethane	5,600	0.0011%	0.0004%	Trichloroethylene	12	0.9075%	0.2317%
Propylene	4,000	0.3067%	0.0557%	1,1-Dichloroethylene	10	0.2570%	0.0111%
Chlorobenzene	3,500	0.0008%	0.0003%	Ethylene dibromide	3	0.1033%	0.0247%
1,2-Dichloropropane	2,400	0.0219%	0.0011%	Carbontetrachloride	2.4	27.9167%	23.6302%
Toluene	2,000	0.2542%	0.0678%	1,2-Dichloroethane	2	11.7050%	3.7070%
Bromomethane	1,350	0.0116%	0.0040%	Vinyl chloride	1	2.8400%	0.4768%
Ethylbenzene	1,000	0.1364%	0.0272%	Chloroform	1	13.6100%	8.3124%
m and p-Xylene	730	0.2099%	0.0609%				

Most of these results are comparable to those in the previous report. Some comparisons with other EC sites are highlighted in the next table. Chloroform and carbon tetrachloride concentrations are similar to levels seen at other sites. Trichloroethylene and 1, 2-dichloroethane are slightly elevated over the surrounding area but both remain well below their respective AAQC. The vinyl chloride concentrations have decreased from the previous report and, while still higher than other local sites, appear to be approaching them. Naphthalene concentrations are higher those at surrounding stations but are still low compared to the AAQC. Chloromethane continues to be elevated compared to other sites, probably due to its use at various local industries, but is still well below the AAQC.

Comparison of Selected VOC 24-Hour Concentrations at NAPS Sites (μg/m³)						
Compounds		**AFNS**		**Longwoods**	**Pt Petre**	**Wallaceburg**
		Current	Previous			
Ethylene	Average	4.306	4.965	2.561	0.301	0.497
	Maximum	25.187	25.043	11.671	1.214	3.595
Carbon tetrachloride	Average	0.567	0.532	0.524	0.520	0.519
	Maximum	0.670	0.622	0.652	0.683	0.659
Chloroform	Average	0.083	0.083	0.069	0.072	0.072
	Maximum	0.136	0.155	0.150	0.130	0.124
1,2-Dichloroethane	Average	0.074	0.062	0.054	0.054	0.054
	Maximum	0.234	0.099	0.119	0.080	0.101
Chloromethane	Average	2.967	3.984	1.181	1.176	1.191
	Maximum	18.692	32.008	1.497	1.408	2.253
Vinyl chloride	Average	0.005	0.025	0.002	0.008	0.002
	Maximum	0.028	0.419	0.010	0.002	0.010
Naphthalene	Average	0.084	0.124	0.017	0.013	0.020
	Maximum	0.386	0.394	0.117	0.084	0.182
Trichloroethylene	Average	0.028	0.029	0.014	0.023	0.015
	Maximum	0.109	0.116	0.267	1.460	0.087

Had the new benzene AAQC, 0.45 μg/m^3, been in force during the monitoring period, the average over this monitoring period, 1.24 μg/m^3 would have exceeded it.

The average over this reporting period for 1,3-butadiene was 0.164 μg/m^3. This would not have exceeded the new annual AAQC which is 2 μg/m^3.

Volatile Organic Compounds – Hourly Measurements

When the AFN station began operation, hourly levels of twelve VOC were measured using a state-of-the-art gas chromatograph/mass spectrometer (GC/MS). The target list was chosen based upon the ministry's expectations of what might be detected in the area. During the first year, three of the twelve: carbon disulphide, acrylonitrile, and vinyl chloride, were not detected. As monitoring progressed, this continued to be the case and so, as of April 1, 2010, the list was updated to better utilize the instrument, dropping vinyl chloride (for which there are no known local sources) and adding chloromethane and hexane. Table 1 summarizes the hourly averages of the substances for the period of September 2009 to December 2010. No vinyl chloride, carbon disulphide, or acrylonitrile were detected and so these compounds are not included in the tables.

Table 1 1-Hour VOC Statistics

	Propylene	Chloromethane	1,3-Butadiene	Hexane	Cyclohexane	Benzene	Toluene	Ethyl Benzene	m &p-Xylene	o-Xylene	Styrene
Current Report											
Average (ppb)	0.273	0.025	0.161	0.001	0.147	0.062	0.124	0.041	0.083	0.042	0.002
Max (ppb)	234.02	71.00	702.75	2.64	50.08	24.02	29.63	18.76	29.20	19.83	2.87
%>DL	0.57%	0.07%	0.05%	0.06%	1.16%	1.92%	4.50%	3.52%	3.42%	3.59%	0.21%
Previous Report											
Average (ppb)	0.133	n/a	0.000	n/a	0.066	0.142	0.283	0.083	0.145	0.087	0.017
Max (ppb)	95.14	n/a	0.00	n/a	48.89	12.60	29.11	9.52	16.97	10.70	6.11
% >DL	0.30%	n/a	0.00%	n/a	0.60%	4.90%	15.70%	6.90%	6.70%	6.60%	1.00%
Monthly Average (ppb)											
Sep-09	0.103		1.881		0.011	0.054	0.088	0.084	0.141	0.089	0.006
Oct-09	0.000		0.491		0.018	0.063	0.088	0.022	0.041	0.027	0.004
Nov-09	0.000		0.000		0.003	0.058	0.225	0.109	0.237	0.073	0.002
Dec-09	0.000		0.000		0.099	0.051	0.101	0.017	0.036	0.022	0.000
Jan-10	0.000		0.000		0.062	0.023	0.042	0.041	0.094	0.041	0.004
Feb-10	0.093		0.000		0.000	0.017	0.015	0.007	0.035	0.019	0.002
Mar-10	0.289		0.000		0.095	0.175	0.181	0.056	0.107	0.063	0.007
Apr-10	0.277	0.000	0.000	0.000	0.038	0.108	0.370	0.172	0.344	0.159	0.003
May-10	0.241	0.000	0.000	0.000	0.100	0.120	0.059	0.027	0.051	0.028	0.002
Jun-10	0.000	0.023	0.000	0.000	0.074	0.011	0.082	0.027	0.051	0.034	0.002
Jul-10	0.557	0.183	0.000	0.000	0.545	0.006	0.135	0.035	0.065	0.039	0.000
Aug-10	0.000	0.000	0.000	0.004	0.110	0.000	0.014	0.000	0.000	0.000	0.000
Sep-10	0.000	0.000	0.000	0.004	0.026	0.098	0.200	0.027	0.054	0.039	0.000
Oct-10	0.068	0.000	0.000	0.000	0.261	0.000	0.133	0.004	0.003	0.001	0.000
Nov-10	2.241	0.000	0.000	0.000	0.277	0.185	0.261	0.031	0.081	0.041	0.000
Dec-10	0.628	0.000	0.026	0.000	0.632	0.045	0.053	0.005	0.000	0.007	0.000

None of these VOC were detected more than 5% of the time, an improvement over the previous report when four were seen over 6% of the time and one, toluene, was detected nearly 16% of the time. This is encouraging as continued work on the instrument has improved its detection ability and so lower levels should be detectable. Several average concentrations were lower than those in the previous report though some of the maxima increased.

Concentrations were assessed based upon 24-hour AAQC for species which had any measurements above 0.0, and for which an AAQC exists. These are summarized in Table 2. No exceedances were seen. The highest 24-hour value for each is included in the table.

Table 2 VOC 24 Hour Concentrations

		Propylene	Chloromethane	Hexane	Cyclohexane	Toluene	Ethyl Benzene	m&p-Xylene	o-Xylene	Styrene
24 hour AAQC	µg/m³	4000	320	7500	6100	2000	1000	730	730	400
	ppb (approx.)	2287	152	2093	1743	522	226	165	165	92
Maximum Concentration (ppb)		**24.86**	**6.09**	**0.14**	**8.20**	**6.26**	**3.28**	**7.17**	**2.12**	**0.13**

The new annual AAQC for benzene, 0.45 µg/m³ (approximately 0.14 ppb), did not come into effect during the monitoring period. However, had it been in place, the average of the measurements over this monitoring period, 0.20 µg/m³ (0.06 ppb) would have been about half the AAQC.

1,3-Butadiene was only seen for 1 four-hour interval during this monitoring period. As a result the average concentration was 0.36 µg/m³ (0.016 ppb), well below the annual AAQC of 2 µg/m³ (0.86 ppb) annual AAQC.

Terminology

Ambient Air Quality Criteria (AAQC): Desirable average concentrations for specific atmospheric contaminants. They usually reflect ½-hour, 1-hour, or 24-hour averages though occasionally other periods are determined to be more appropriate. They are based upon the most sensitive endpoint: health, environmental effects, odours, or soiling.

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 of the AQI pollutants 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: An concentration of some 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

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 oxidized.

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

Data Averaging

There are ministry protocols that have been established 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 0 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 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.