Technical Memorandum

Aamjiwnaang Air Quality Mobile Survey, 2015

Report Prepared by:

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Introduction

During 2015, the Ministry of Environment and Climate Change (MOECC) Southwest region conducted a series of measurements with a mobile air monitoring van in the vicinity of the Aamjiwnaang First Nation south of Sarnia. These surveys took the form of consecutive half-hour measurements of sixteen volatile organic compounds (VOC) at six locations. These locations are shown on the map at the end of the document (Appendix: Figure 1).

The MOECC maintains a permanent air monitoring station at the Aamjiwnaang Community center and has reported air quality results from this station since 2008. As this site is stationary, it is acknowledged that the long-term monitoring data at the Aamjiwnaang First Nation station may not be representative of other locations in the area. Thus, to investigate whether the station's results are representative of the broader area air quality, periodic ½-hour measurements were made with a mobile monitor at other area locations so that any trends or consistent variations across the First Nation would be highlighted.

Data was collected on twelve separate days (one day per month), with sampling performed at the same set of locations and in the same order on each occasion. VOCs were measured using a gas-chromatography/mass-spectrometer (GC/MS). Air was sampled for 30 minutes at 33-34mL/min for a total of approximately 1000 mL through a tri-bed glass sorbent tube. Once sampling was completed, the sorbent tube was thermally desorbed, injected and analyzed for the sixteen target VOCs.

In order to provide context to these measurements, they need to be compared to levels the ministry has deemed acceptable. Non-source measurements are normally compared to Ambient Air Quality Criteria (AAQC). The averaging time of an air standard and AAQC is based on consideration of the toxicity of the contaminant as well how air concentrations are modelled and monitored; most of these are published as 24-hour or annual averages, while the survey results were based upon half-hour measurements.

Depending on the type of contaminant being assessed, it may not necessarily be appropriate to interpret long-term health risks using limited half-hour monitoring data, as some AAQC are based on the long-term average exposure, whereas others may be based off of certain short-term exposures. Thus the ministry prefers to rely on long-term monitoring at stations such as the one at the Aamjiwnaang Health Centre (1300 Tashmoo Avenue, Sarnia, ON) that reflect the normal variation in concentration in locations where changes in exposure can potentially have an impact.

In the absence of such data, conservative assumptions can be made to gauge worst case possibilities extrapolated from short term (half-hour in this case) monitoring data. Nonetheless, a straight comparison of short term data to longer average AAQC is not considered scientifically acceptable as long term exposure will usually include periods of higher and lower concentrations, but short-term sampling only reflects a short snapshot of conditions during the sampling time period.

To address this, the published AAQC have been scaled using the formula which is prescribed in O. Reg. 419/05 [Section 17 (3)], but which ministry staff use in other contexts, allowing the ministry to convert AAQC between different averaging periods.

In short, the concentration for one duration C_0 is multiplied by the factor

$$\left(\frac{t_0}{t_1}\right)^n$$

where t_0 is the averaging time of the original value, usually 24 hours for AAQC, and t_1 is the averaging time for which you wish to make the comparison, one-half hour in this case. The scaling exponent, n, is based upon atmospheric dynamics and is calculated using current atmospheric conditions. When detailed atmospheric information is not available a standard value, 0.28, is used (see reference above). This conversion has the effect of increasing the comparison value when going from longer averaging times to shorter ones as is done for this survey. Table 1 shows the current 24-hour AAQC and the derived comparison values that are used in this report.

Table 1: Derived ½-hr Comparison Values

	24-hr AAQC	**½-hr Comparison Value**
	(all values in µg/m^3)	
Propylene	4000	12000
Chloromethane	320	950
1,3-Butadiene	10	30
Hexane	2500	7400
Chloroform	1	3
Benzene	2.3	7
Carbon Tetrachloride	2.4	7
Cyclohexane	6100	18000
Trichloroethylene	12	35
Toluene	2000	6000
Tetrachloroethylene	360	1100
Ethyl benzene	1000	3000
m- & p- Xylene	730	2200
Styrene	400	1200
o-Xylene	730	2200
Naphthalene	22.5	67

These comparison values should only be considered indicators of possible issues, since they lie outside the realm of the ministry's published AAQC. Further, while concentrations above these values may indicate that a 24-hour or annual AAQC (as appropriate) may be exceeded, they do not reflect a health risk in and of themselves. Values that approach or surpass these comparison levels should be taken as indicators that longer term monitoring or other studies need to be undertaken, rather than definitive pronouncements that concerns exist. Indeed, the ministry believes that a long and continuous record of environmental measurements, as in

the multi-year data from the Aamjiwnaang station, is the best gauge of local long-term concentrations.

While the monitoring instrument reports measurements in parts per billion (ppb), the ministry publishes most standards and AAQC in micrograms per cubic metre ($\mu g/m^3$). Since conversion between the two depends, in part, on temperature and pressure, and these varied between measurements, it was more appropriate to convert the individual results to $\mu g/m^3$. Thus the results will not be reported in their original units. The ministry used temperature and pressure data from the Environment and Climate Change Canada data website.

As well, to avoid confusion with our usual term "exceedance", values in excess of the scaled AAQC are referred as "overages".

Measurements were made for all species at each location on each sampling day. As might be expected, not all of the contaminants were measured all of the time. In cases where the concentration of a contaminant was below the detection limit of the gas chromatography/ mass spectrometry (GC/MS), the result is reported as "not defined" or "n/d". Essentially, this indicates that those contaminants were tested for, but the amount sampled was less than the minimum detectable limit of that methodology.

Rather than present averages, the ministry has included all the measurements. In situations where very few values are measured, averages do not necessarily reveal much information. It should also be remembered that in this instance measurements should not be considered to reflect overall ambient levels for a number of reasons.

- The detection limit for various substances is not determined (it varies between contaminants).

- The measurements do not represent a random sample:
  - Sampling only occurred between Tuesday and Friday
  - Sampling only occurred between 7:55 and 13:55 (standard time)
  - Samples were always taken in the same order so samples at any site were always approximately at the same time of day.

- Samples were not simultaneous. Thus care must be taken in comparing them.
  - Wind speed and direction, temperature, and atmospheric pressure all vary by time of day.
  - Wind speed and direction may be influenced by local topography.

- Wind speed and direction were measured at the Aamjiwnaang air monitoring station and so may vary slightly from conditions at the differing monitoring sites.

- Similarly, temperature and pressure were taken from the Environment and Climate Change Canada website at the Sarnia airport and so may vary slightly from conditions at the monitoring sites.

- ❖ All the meteorological parameters (wind speed, wind direction, temperature and atmospheric pressure) are hourly averages and so may not accurately reflect the exact conditions for the half-hour sample.

Results

Eleven of the sixteen VOCs were detected during 2015 mobile monitoring. Chloromethane, 1,3-butadiene, chloroform, carbon tetrachloride, and trichloroethylene were not detected on any days. This is similar to results from the previous years' monitoring (2011-2014). The number of VOCs that were detected in previous years was: 12 (2011), 11 (2012), 11 (2013), and 13 (2014). Results are presented below in the order in which they are eluted by the instrument. The tables below illustrate the results, by chemical, for each site and date. The adjusted (half-hour) comparison value, based on conversion from a 24-hour or annual AAQC, is given in brackets and values higher than this are indicated in red.

VOCs were measured at all sites on all sampling days. If the contaminant was not detected during a particular measurement, the results are labelled as n/d.

Propylene

Propylene (12000)						
All values in µg/m^3						
Date	Health Centre	Community Centre	Vidal St. South	Cemetery	Administration Building	Scott Road
28-Jan	n/d	43.92	n/d	n/d	n/d	n/d
27-Feb	24.58	n/d	n/d	63.41	n/d	n/d
26-Mar	n/d	n/d	n/d	n/d	n/d	n/d
29-Apr	n/d	n/d	n/d	n/d	n/d	n/d
22-May	n/d	41.29	n/d	56.00	n/d	n/d
24-Jun	n/d	n/d	n/d	n/d	n/d	n/d
24-Jul	n/d	n/d	n/d	n/d	n/d	n/d
27-Aug	n/d	n/d	n/d	n/d	n/d	n/d
25-Sep	n/d	n/d	n/d	n/d	n/d	n/d
27-Oct	n/d	n/d	n/d	n/d	n/d	n/d
20-Nov	46.26	24.93	41.67	18.54	n/d	n/d
18-Dec	n/d	n/d	n/d	n/d	n/d	n/d

Propylene (also known as propene) is produced either directly or as a by-product of processing fossil fuels. It is the starting point for the production of a wide variety of other chemicals. It can cause inflammation of the nasal cavity, and is associated with narcotic effects. Propylene was detected a total of nine times in the seventy-two samples or in about 13% of the samples. It was measured intermittently at the first four sites and was not measured at all at the Administration Building or Scott Road locations. The maximum concentration was recorded on February 27 at the Cemetery (63.41 µg/m^3). Nonetheless it only reached about 0.5% of the comparison value. In the 2014 survey, propylene was

measured in 31% of the samples and the highest monitored value was only about 0.5% of the comparison value.

Propylene was associated mainly with wind from west-northwest. On January 28 and May 22 propylene was detected when wind was coming from south and north, respectively.

Chloromethane

Chloromethane (also known as methyl chloride or R-40) was once widely used as a refrigerant. Exposure can lead to effects on the nervous system including degeneration, reproductive effects, and cancer formation. Due to its toxicity and flammability, its use in most consumer products has ceased. Currently, it mostly finds use as an intermediary in various chemical processes. Chloromethane was not detected in 2015 and was detected once during the 2014 mobile sampling.

1,3-Butadiene

1,3-butadiene is a chemical used primarily in the production of synthetic rubber. It is also used in the production of nylon and as an intermediary in the production of certain cycloalkanes. 1,3-butadiene is linked to a variety of health effects including irritation and dryness of the eyes, nasal passages, throat, and lungs, effects on the nervous system (e.g., blurred vision, fatigue, headache, nausea), and the formation of leukaemia. The AAQC comparison value for half-hour measurements is 30 µg/m^3. However, as with the previous study, it was not detected.

Hexane

Hexane (7400)						
All values in µg/m^3						
Date	Health Centre	Community Centre	Vidal St. South	Cemetery	Administration Building	Scott Road
28-Jan	17.62	5.31	37.81	22.13	7.39	3.62
27-Feb	4.19	2.31	2.33	4.52	1.60	0.29
26-Mar	7.49	0.82	n/d	0.51	n/d	4.88
29-Apr	n/d	n/d	n/d	n/d	n/d	80.63
22-May	n/d	n/d	19.89	n/d	8.80	n/d
24-Jun	n/d	n/d	n/d	n/d	n/d	n/d
24-Jul	n/d	n/d	n/d	n/d	n/d	n/d
27-Aug	n/d	n/d	n/d	n/d	n/d	n/d
25-Sep	n/d	n/d	n/d	n/d	n/d	n/d
27-Oct	n/d	n/d	n/d	n/d	n/d	n/d
20-Nov	n/d	n/d	n/d	n/d	n/d	n/d
18-Dec	n/d	0.27	n/d	n/d	n/d	n/d

Hexane is a major component of gasoline. It is used as a solvent and also as an intermediate in various industrial applications. It is not considered especially toxic though it may cause

drowsiness and skin, eye, or respiratory tract irritation. Long term exposure may cause damage to the nervous system, and possibly impaired fertility.

Hexane was detected a total of twenty times in the seventy-two samples or in about 28% of the samples. All of the sites recorded concentrations on January 28 and February 27. The maximum concentration was recorded on April 29 at the Scott Road site (80.63 µg/m^3). Nonetheless, it only reached about 1% of the comparison value. In the 2014 survey, hexane was measured in 27% of the samples and the highest monitored value was only about 3% of the comparison value.

Most of the measureable readings came during periods of south to north-west wind. Given the variation in location and time, the source or sources seem to be varying over the workday. The absence of any results on six of the days also supports this.

Chloroform

Chloroform is a chlorinated hydrocarbon used in industry as a solvent, refrigerant and precursor to the manufacture of Teflon. It may also be used within certain industrial processes as a solvent. Chloroform has a number of human health effects, and is a possible human carcinogen. Chloroform was not detected in the 2015 survey and has not been detected since the 2011 survey.

Benzene

Benzene (7)						
All values in µg/m^3						
Date	Health Centre	Community Centre	Vidal St. South	Cemetery	Administration Building	Scott Road
28-Jan	15.88	17.20	20.07	25.08	29.04	10.16
27-Feb	11.40	12.56	17.69	6.99	12.63	4.55
26-Mar	2.25	1.16	9.89	1.70	n/d	1.69
29-Apr	2.04	1.81	3.93	2.42	11.62	10.70
22-May	1.73	n/d	0.97	0.36	10.44	1.54
24-Jun	0.86	0.70	5.57	0.47	0.55	3.25
24-Jul	1.65	n/d	9.12	0.75	0.75	2.32
27-Aug	n/d	1.44	15.18	n/d	n/d	9.57
25-Sep	n/d	n/d	6.23	n/d	n/d	0.38
27-Oct	4.30	n/d	4.12	n/d	n/d	2.39
20-Nov	n/d	n/d	n/d	n/d	n/d	n/d
18-Dec	1.20	4.26	n/d	0.17	n/d	n/d

Benzene is found in many petroleum products including gasoline, and occurs naturally in crude oil. It is used in a large number of industrial processes. To reduce the exposure of Canadians to benzene, the Canadian Council of Ministers of the Environment (CCME) (except the Province of Québec1) endorsed the Canada-wide Standard (CWS) for Benzene. By the end of 2008 a 71.4% reduction in emissions had been achieved relative to 1995. The reduction in

ambient levels is a positive step forward in reducing the risk of exposure of Canadians to benzene, as desired by CCME. Benzene is classified as a known human carcinogen by the International Agency for Research on Cancer (IARC). It is associated particularly with leukaemia. It also affects the nervous system (e.g., vertigo, drowsiness, headaches) and the haematopoietic system.

Benzene was detected a total of fifty times in the seventy-two samples or in about 69% of the samples. Seventeen of the samples, or about 24%, were above the comparison value. It was above the comparison value at all sites on January 28. The maximum concentration was measured on January 28 at the Administration Building (29.04 µg/m^3). In the 2014 study, benzene was detected a total of seventeen times in the forty-eight samples or in about 35% of the samples. Six of the samples, or about 12.5%, were above the comparison value.

Benzene was detected from a variety of wind directions depending upon time and location. This is illustrated in Figure 2 (Appendix). Length of the lines is proportional to the corresponding concentration and the lines point in the direction from which the wind was blowing during the sample.

Benzene was detected in excess of the scaled AAQC comparison value at all six sampling locations on January 28. Figure 2 suggests that two different sources affected the sites. Site 1-3 had common sources in the south-east direction whereas Site 4-6 had common sources in the south-west direction. It was also detected at all six locations on February 27 when the wind was coming from the north-east (285-290º) and the benzene concentration was in excess of the scaled AAQC comparison value at four sites. Hexane, toluene, ethyl benzene, and the xylenes were detected at all locations on the same two days. Overall, benzene overages were associated with wind direction in between south to north-west (161-353º).

In addition to the carcinogenic effects, the ministry has also considered the potential for benzene to cause adverse effects from acute exposures. The ministry does not have a benzene AAQC to address acute effects. Based on a review of toxicity information and available acute guidelines from other jurisdictions, the ministry has developed a draft screening value for use in short-term exposures to benzene of 200 µg/m^3. This is a protective value for periodic one-hour exposures, but may not be appropriate for other exposure scenarios. Even assuming periodic exposure to the maximum monitored benzene concentration of 29.04 µg/m^3, no acute adverse health effects would be expected.

As previously stated, the ministry believes that a long and continuous record of environmental measurements, as in the multi-year data from the Aamjiwnaang station, is the best gauge of local long-term concentrations and associated health risks. Nonetheless, a conservative assumption can be made to derive a worst-case long-term scenario by similarly using the highest ½-hour monitored value (without conversion) and assuming long-term continuous exposure. If a person were to be continuously exposed to benzene at 29.04 µg/m^3, such an exposure would reflect an incremental lifetime cancer risk of approximately 65 in 1,000,000. This is 65 times higher than the 1 in 1,000,000 risk level reflected by the annual AAQC of 0.45 µg/m^3. However, this is a hypothetical risk estimate, since the monitored data provided indicate that air concentrations are variable (reflected by the many n/d at the same

location throughout other parts of the year) and, therefore 29.04 µg/m^3 is not representative of long-term continuous exposure. For a better indication of the long-term cancer risk associated with exposure to ambient benzene levels, consulting the most recent Annual Report on the Aamjiwnaang First Nation Community Air Monitoring Station is recommended.

Carbon Tetrachloride

Carbon tetrachloride is a VOC that is declining in use. It was used as a solvent, a fire extinguishing agent, and a reactant in the production of refrigerants. The combination of toxicity and declining use of halons has led to the reduction of its use though it still has industrial applications. It was not detected during this sampling survey. It was detected only once in the 2014 sampling survey– the first time since the mobile surveys began.

Cyclohexane

Cyclohexane (18000)						
All values in µg/m^3						
Date	Health Centre	Community Centre	Vidal St. South	Cemetery	Administration Building	Scott Road
28-Jan	3.59	75.88	252.48	307.96	167.65	14.19
27-Feb	n/d	0.42	n/d	n/d	0.23	n/d
26-Mar	1.67	n/d	n/d	n/d	n/d	n/d
29-Apr	n/d	n/d	n/d	n/d	n/d	n/d
22-May	n/d	n/d	n/d	n/d	0.84	n/d
24-Jun	n/d	n/d	n/d	n/d	n/d	n/d
24-Jul	n/d	17.52	5.45	5.94	1.77	0.85
27-Aug	n/d	n/d	n/d	n/d	n/d	n/d
25-Sep	n/d	2.24	n/d	n/d	n/d	n/d
27-Oct	n/d	n/d	n/d	n/d	n/d	n/d
20-Nov	n/d	n/d	n/d	n/d	n/d	n/d
18-Dec	6.32	n/d	n/d	n/d	n/d	n/d

Cyclohexane is used as a solvent and also as a raw material in various chemical processes. It may cause irritation to the eyes, nose and throat, and has sedative and narcotic effects. It is also associated with developmental effects.

Cyclohexane was detected a total of seventeen times in the seventy-two samples or in about 24% of the samples. All of the sites recorded concentrations on January 28. The maximum concentration was recorded on January 28 at the Cemetery (307.96 µg/m^3) which only reached about 2% of the comparison value. In the 2014 survey, cyclohexane was measured in 17% of samples and the highest monitored value was only about 0.2% of the comparison value.

The sites seem to be affected by winds from all directions during the survey. However, higher concentrations were associated with wind coming in between south-east and south-west indicating the presence of a source in that direction.

Trichloroethylene

Trichloroethylene is an industrial solvent. It was originally developed as an anaesthetic but has been found to have a variety of health effects. These include nausea, headache, dizziness, loss of appetite, weakness, tremors and, damage to the liver and kidney. It is associated with several types of cancers. With respect to the AAQC, the comparison value for this survey is 35 $\mu g/m^3$. However, as in previous years, it was not detected during any of the surveys.

Toluene

Toluene (6000)						
All values in $\mu g/m^3$						
Date	Health Centre	Community Centre	Vidal St. South	Cemetery	Administration Building	Scott Road
28-Jan	1.62	4.61	12.99	7.07	5.31	3.17
27-Feb	25.84	21.55	22.47	15.99	11.92	9.30
26-Mar	3.44	n/d	8.36	39.47	0.38	5.22
29-Apr	2.44	0.90	3.60	1.97	6.52	7.38
22-May	1.36	n/d	1.38	0.29	1.33	1.92
24-Jun	0.92	0.37	3.42	1.42	0.42	2.14
24-Jul	0.95	4.96	9.85	6.09	1.59	1.73
27-Aug	n/d	1.86	22.14	n/d	0.93	11.02
25-Sep	n/d	5.44	8.93	0.69	1.37	0.30
27-Oct	7.07	n/d	2.93	n/d	n/d	1.17
20-Nov	n/d	n/d	n/d	n/d	n/d	n/d
18-Dec	0.52	8.71	0.32	0.47	1.46	n/d

Toluene is widely used as a solvent and is also used in many industrial processes. It is also found in many common household products such as, nail polish, paints and thinners, lacquers, adhesives; as well as in gasoline. Exposure can cause irritation of the eyes and respiratory system, sore throat, dizziness, fatigue, headache, and nausea.

The broad use is reflected in the large number of measurements of toluene during the survey; it was detected at least once on all sampling days except November 20, and was measured in all locations. Toluene was detected a total of fifty-seven times in the seventy-two samples or in about 79% of the samples. The maximum concentration was recorded on March 26 at the Cemetery (39.47 $\mu g/m^3$) which only reached about 0.7% of the comparison value. In the 2014 survey, toluene was measured in 67% of samples and the highest monitored value was only about 0.2% of the comparison value.

Detection occurred in all wind directions experienced in the sampling campaign, but most of the concentrations were associated with wind coming from west-northwest.

In addition to the health-related AAQC, the ministry has a ten-minute average odour-based POI Standard of 2000 µg/m^3. Normally, POI standards are used for gauging impacts from single facilities rather than assessing general quality. However, no equivalent value exists in the current AAQC listings.

No attempts were made to scale this as it is based upon an immediate physiological response which is not believed to have any long-term health effects. There were no exceedances of this value at any time.

Tetrachloroethylene

Tetrachloroethylene (1100)						
All values in µg/m^3						
Date	Health Centre	Community Centre	Vidal St. South	Cemetery	Administration Building	Scott Road
28-Jan	n/d	n/d	n/d	n/d	n/d	n/d
27-Feb	n/d	n/d	n/d	n/d	n/d	n/d
26-Mar	n/d	n/d	n/d	n/d	n/d	n/d
29-Apr	n/d	n/d	n/d	n/d	n/d	n/d
22-May	n/d	n/d	n/d	n/d	n/d	n/d
24-Jun	n/d	n/d	n/d	n/d	n/d	n/d
24-Jul	n/d	n/d	n/d	n/d	n/d	n/d
27-Aug	n/d	n/d	n/d	1.86	n/d	n/d
25-Sep	n/d	1.13	0.47	n/d	n/d	n/d
27-Oct	n/d	n/d	n/d	n/d	n/d	n/d
20-Nov	n/d	n/d	n/d	n/d	n/d	n/d
18-Dec	n/d	n/d	n/d	n/d	n/d	n/d

Tetrachloroethylene is also known as perchloroethylene or "perc". While it has various industrial uses, it is most widely known as a dry-cleaning agent. It has a low odour threshold, and is easily detected by most people. It can cause irritation of the eyes, dizziness, headaches, and effects on the liver, kidney and nervous system including disorientation, ataxia, and short-term memory deficits.

It was only detected on two days (only 4% of total samples); on August 27 at the Cemetery and on September 25 at the Community Center and Vidal St. South. The maximum value (1.86 µg/m^3) was just 0.2% of the comparison value. In the 2014 survey, it was detected six times and the maximum value was just less than 1% of the comparison value.

Ethyl Benzene

Ethyl benzene (3000)						
All values in µg/m^3						
Date	Health Centre	Community Centre	Vidal St. South	Cemetery	Administration Building	Scott Road
28-Jan	0.65	0.47	1.39	0.68	0.75	0.25

27-Feb	6.42	5.30	16.47	13.73	11.95	8.91
26-Mar	1.71	0.32	0.79	0.91	0.30	1.02
29-Apr	0.80	n/d	1.83	0.82	2.69	3.61
22-May	0.29	0.15	0.19	0.09	0.26	0.74
24-Jun	0.10	0.03	0.25	0.18	0.10	0.58
24-Jul	0.14	0.15	1.86	0.32	0.16	0.42
27-Aug	n/d	0.42	0.92	n/d	0.19	2.51
25-Sep	n/d	0.29	0.47	0.18	0.39	0.15
27-Oct	0.46	n/d	0.74	n/d	0.21	0.31
20-Nov	n/d	n/d	n/d	n/d	n/d	n/d
18-Dec	n/d	8.35	n/d	0.28	0.42	n/d

Ethyl benzene, like toluene, is an aromatic hydrocarbon used in a variety of processes in the petrochemical industry including the production of styrene. Exposure can cause irritation of the eyes and respiratory system, sore throat, dizziness, fatigue, headache, and nausea.

Ethyl benzene was detected on all sampling days except November 20 and was detected at all locations. It was detected a total of fifty-seven times in the seventy-two samples or in about 79% of the samples. The maximum concentration was recorded on February 27 at the Vidal St South site (16.47 µg/m^3) which only reached about 0.5% of the comparison value. In the 2014 survey, ethyl benzene was measured in 58% of the samples, and the highest monitored value was only about 0.6% of the comparison value.

As was the case with toluene, ethyl benzene was detected when wind was coming from all directions but higher concentrations were associated with wind coming from west-northwest.

<u>m- & p- Xylene</u>

m- & p- Xylene (2200)						
All values in µg/m^3						
Date	Health Centre	Community Centre	Vidal St. South	Cemetery	Administration Building	Scott Road
28-Jan	0.49	1.10	3.20	1.43	0.57	0.37
27-Feb	23.59	19.79	17.98	14.98	13.04	9.73
26-Mar	1.87	0.36	3.81	1.38	0.32	3.90
29-Apr	0.88	n/d	1.99	0.90	2.94	3.94
22-May	0.32	0.17	0.49	0.10	0.28	0.81
24-Jun	0.11	0.10	1.15	0.20	0.11	0.63
24-Jul	0.47	0.27	2.00	0.35	0.18	0.46
27-Aug	n/d	0.46	4.59	n/d	0.20	2.71
25-Sep	n/d	1.11	2.04	0.19	0.42	0.17
27-Oct	2.37	0.24	0.80	n/d	0.22	0.34
20-Nov	n/d	n/d	n/d	n/d	n/d	n/d
18-Dec	0.23	9.11	n/d	0.29	0.45	n/d

Meta-xylene (m-xylene) and para-xylene (p-xylene) are two of the three isomers of xylene (dimethyl benzene). They often co-elute from chromatographic columns and so are not distinguishable. Thus, they are reported as the sum of the two isomers. They are used in chemical processes or sometimes as a solvent. Xylenes can cause irritation of the eyes and respiratory system, sore throat, dizziness, fatigue, headache, and nausea.

These isomers were detected at all locations and on all sampling days, except November 20. It was detected a total of fifty-nine times in the seventy-two samples or in about 82% of the samples. The maximum concentration was recorded on February 27 at the Health Center (23.59 µg/m^3) which only reached about 1% of the comparison value. In the 2014 survey, these isomers were measured 65% of the time, and at all the sites. The highest values only reached slightly over 0.2% of the comparison value.

Detection occurred in all wind directions experienced in the sampling campaign but higher concentrations were associated with wind coming from west-northwest.

Styrene

Styrene (1200)						
All values in µg/m^3						
Date	Health Centre	Community Centre	Vidal St. South	Cemetery	Administration Building	Scott Road
28-Jan	n/d	0.38	1.05	0.62	n/d	n/d
27-Feb	2.98	2.94	2.36	2.54	1.84	1.45
26-Mar	0.57	0.35	1.33	0.70	0.31	1.04
29-Apr	n/d	1.68	1.98	1.67	4.74	4.64
22-May	0.88	0.63	1.36	0.72	100.70	2.17
24-Jun	0.11	0.23	1.83	0.34	0.38	1.02
24-Jul	n/d	0.43	1.96	0.74	0.79	0.92
27-Aug	n/d	n/d	3.55	n/d	0.55	2.26
25-Sep	n/d	0.64	1.63	0.38	n/d	0.45
27-Oct	2.37	n/d	n/d	n/d	0.43	n/d
20-Nov	n/d	n/d	n/d	n/d	n/d	n/d
18-Dec	n/d	1.36	n/d	n/d	n/d	n/d

Styrene is used in the production of polystyrene and other related substances. Styrene exposure can lead to irritation of the eyes and mucous membranes, as well as effects on the nervous system (e.g., changes in color vision, tiredness, slowed reaction time, concentration problems, balance problems). It is considered a possible carcinogen.

Styrene was detected a total of forty-seven times in the seventy-two samples or in about 65% of the samples. It was detected at all sites and at least once on all sampling days except November 20. The maximum concentration was recorded on May 22 at the Administration Building (100.7 µg/m^3) which reached about 8% of the comparison value. In the 2014 survey, styrene was measured in 13% of the samples and the highest monitored value was only about

0.2% of the comparison value.

Detection occurred in all wind directions experienced in the sampling campaign, but most of the concentrations were associated with wind coming from west-northwest.

In addition to the health-related AAQC, the ministry has a ten-minute average odour-based POI Standard of 400 µg/m^3. Normally, POI standards are used for gauging impacts from single facilities rather than assessing general air quality. However, no equivalent value exists in the current AAQC listings.

No attempts were made to scale this as it is based upon an immediate physiological response which is not believed to have any long-term health effects. There were no exceedances of this value at any time.

o-Xylene

o-Xylene (2200)						
All values in µg/m^3						
Date	Health Centre	Community Centre	Vidal St. South	Cemetery	Administration Building	Scott Road
28-Jan	n/d	0.63	0.43	0.27	n/d	n/d
27-Feb	11.66	1.68	6.14	5.68	5.38	4.33
26-Mar	0.64	n/d	n/d	n/d	n/d	0.36
29-Apr	n/d	n/d	0.84	n/d	1.37	1.54
22-May	n/d	n/d	n/d	n/d	n/d	n/d
24-Jun	n/d	n/d	0.15	n/d	n/d	0.29
24-Jul	0.15	0.18	0.41	0.15	0.12	0.11
27-Aug	n/d	0.12	0.98	n/d	0.14	0.65
25-Sep	n/d	0.30	0.44	0.07	0.11	0.11
27-Oct	0.65	0.16	0.23	n/d	0.15	0.23
20-Nov	n/d	n/d	n/d	n/d	n/d	n/d
18-Dec	n/d	n/d	n/d	0.20	0.12	n/d

Ortho-xylene (o-xylene) is the third of three xylene isomers. It does not usually co-elute with the others and so can be measured separately. Xylenes can cause irritation of the eyes and respiratory system, sore throat, dizziness, fatigue, headache, and nausea.

o-Xylene was detected a total of thirty-eight times in the seventy-two samples, or in about 53% of the samples. It was detected at all sites on ten sampling days (except May 22 and November 20). The maximum concentration was recorded on February 17 at the Health Center (11.66 µg/m^3) which only reached about 0.5% of the comparison value. In the 2014 survey, o-Xylene was detected in 38% of the samples and the highest monitored value was only about 0.2% of the comparison value.

Detection occurred in all wind directions experienced in the sampling campaign, but higher concentrations were associated with wind coming from west-northwest.

Total Xylenes

The standard and AAQC for xylene are based upon the total of the three isomers. Thus, xylene concentrations have been summed for comparison with the AAQC value. The result is presented below. The largest values occur when all three isomers were the highest, the maximum being 35.25 µg/m^3. This is about 1.6% of the comparison value for Xylene (2200 µg/m^3).

Table 2: Total Xylene (2200)						
All values in µg/m^3						
Date	Health Centre	Community Centre	Vidal St. South	Cemetery	Administration Building	Scott Road
28-Jan	0.49	1.73	3.62	1.70	0.57	0.37
27-Feb	35.25	21.48	24.12	20.66	18.42	14.06
26-Mar	2.51	0.36	3.81	1.38	0.32	4.26
29-Apr	0.88	n/d	2.83	0.90	4.30	5.48
22-May	0.32	0.17	0.49	0.10	0.28	0.81
24-Jun	0.11	0.10	1.31	0.20	0.11	0.92
24-Jul	0.62	0.45	2.41	0.50	0.29	0.57
27-Aug	n/d	0.57	5.58	n/d	0.34	3.36
25-Sep	n/d	1.41	2.48	0.26	0.53	0.28
27-Oct	3.02	0.40	1.02	n/d	0.37	0.56
20-Nov	n/d	n/d	n/d	n/d	n/d	n/d
18-Dec	0.23	9.11	n/d	0.49	0.57	n/d

Naphthalene

Naphthalene (67)						
All values in µg/m^3						
Date	Health Centre	Community Centre	Vidal St. South	Cemetery	Administration Building	Scott Road
28-Jan	n/d	n/d	n/d	n/d	n/d	n/d
27-Feb	n/d	n/d	n/d	n/d	n/d	n/d
26-Mar	n/d	n/d	n/d	n/d	n/d	n/d
29-Apr	n/d	11.56	11.42	n/d	20.23	24.74
22-May	n/d	5.51	n/d	7.44	11.51	17.36
24-Jun	n/d	1.14	5.59	2.97	3.30	3.19
24-Jul	3.29	n/d	11.80	4.77	7.76	6.58
27-Aug	3.80	2.18	16.73	3.08	8.00	12.49
25-Sep	n/d	1.99	5.73	5.10	6.66	8.63
27-Oct	8.18	3.17	8.45	3.59	6.29	6.81
20-Nov	0.68	n/d	n/d	n/d	n/d	n/d
18-Dec	n/d	3.68	n/d	n/d	7.10	n/d

Naphthalene is an organic chemical consisting of two fused benzene rings. It is a by-product of petroleum distillation and was previously used to manufacture mothballs. However, it is now used primarily as a component in various chemical reactions. Exposure can cause effects on the nervous system (e.g., headaches, dizziness) and in severe cases, may lead to anemia. It is also a possible carcinogen.

Naphthalene was detected at all the monitoring sites. However, it was not detected at any sites during January, February and March. It was detected a total of thirty-eight times in the seventy-two samples or in about 53% of the samples. The maximum concentration was recorded on April 29 at the Scott Road site (24.74 µg/m^3) which reached about 37% of the comparison value. In the 2014 survey, naphthalene was detected in 25% of the samples and the highest monitored value was only about 52% of the comparison value.

Detection occurred in all wind directions except east-northeast during the sampling campaign.

In addition to the health-related AAQC, the ministry has a ten-minute average odour-based AAQC of 50 µg/m^3. No attempts were made to scale this as it is based upon an immediate physiological response which is not believed to have any long-term health effects. There were no exceedances of this value, though it is possible that the half-hour measurements may have reflected short periods of higher concentration which then could have exceeded the odour-based value.

Summary

Twelve sets of VOC measurements were made by SWR's mobile monitor at six sites in the industrial region south of Sarnia in 2015. The instrument measured levels of sixteen different substances and detected eleven of them. This pattern is similar to the previous study conducted in 2014.

Naphthalene reached levels over 37% of its comparison value, lower than the 52% detected in 2014. Levels of naphthalene monitored at the permanent Aamjiwnaang First Nation station in 2015, using a more accurate sampling method (summa canisters collecting a 24 hour sample every 12 days), showed a maximum concentration that was 0.8% of the 24-hour AAQC. The ministry will continue to monitor to identify potential concerns or reductions in naphthalene levels.

Of the VOC detected, only benzene was measured at levels that exceeded a comparison value derived from the ministry's AAQC. Levels of benzene monitored at the permanent Aamjiwnaang First Nation station in 2015, using a more accurate sampling method (summa canisters collecting a 24 hour sample every 12 days), showed a maximum concentration that was 140% of the 24-hour AAQC. The results of this mobile monitoring survey confirm that more work needs to be done to improve air quality in regards to concentrations of benzene in the area of the Aamjiwnaang First Nation.

For a better gauge of the local long-term concentrations and associated health risks, the MOECC recommends consulting the most recent report on air monitoring conducted at the Aamjiwnaang First Nation Community Air Monitoring Station.

The ministry, in conjunction with industry and local communities including the Aamjiwnaang First Nation has developed Technical Standards for the petroleum and petrochemical industries. These Technical Standards will include improved air pollution control equipment and procedures which should promote lowered benzene emissions in the Sarnia area. In addition they will eventually require fence line monitoring which provide on-going performance checks by both the industries and ministry staff.

Appendix

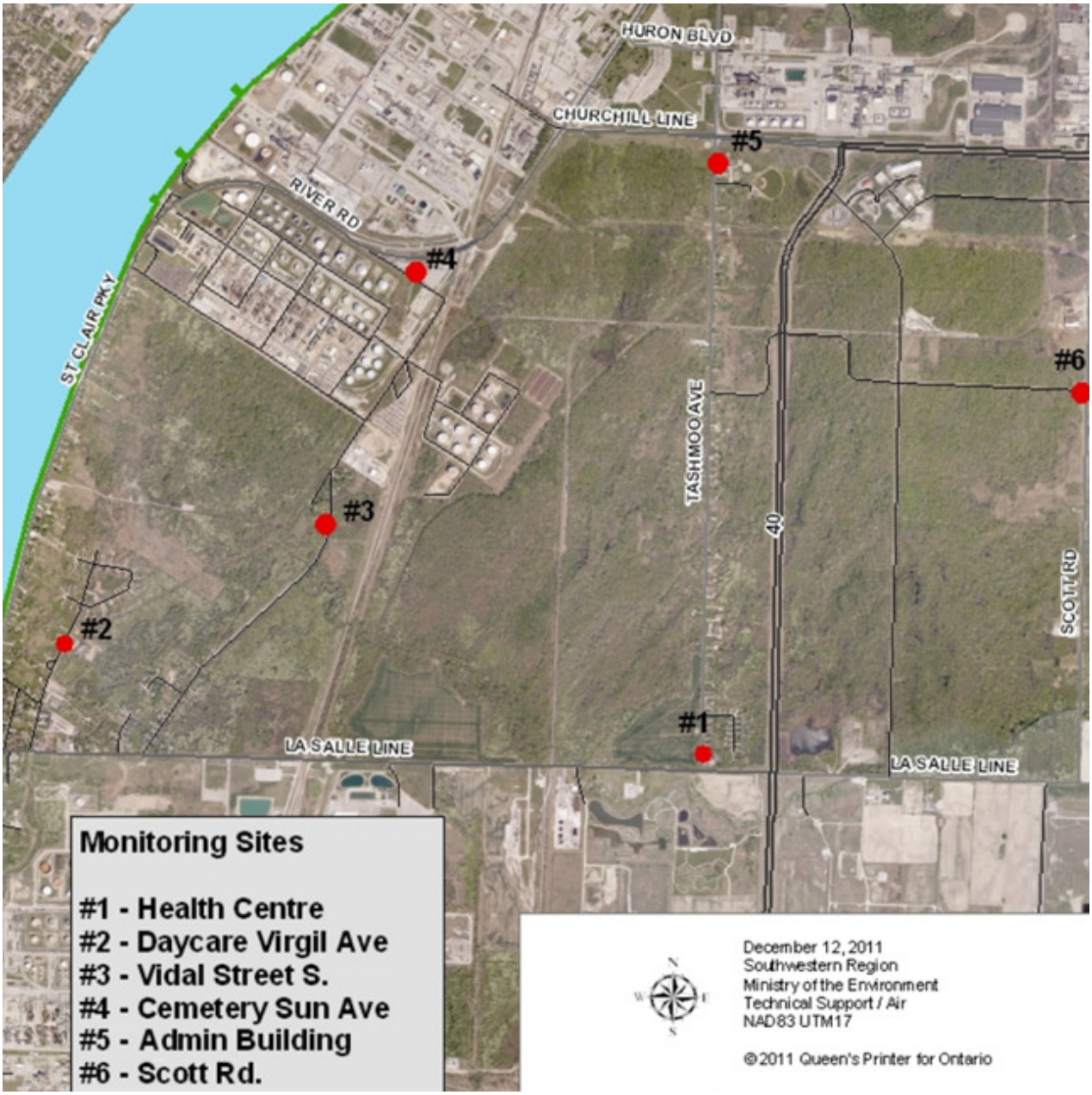

Figure 1: Monitoring sites for mobile survey in 2015

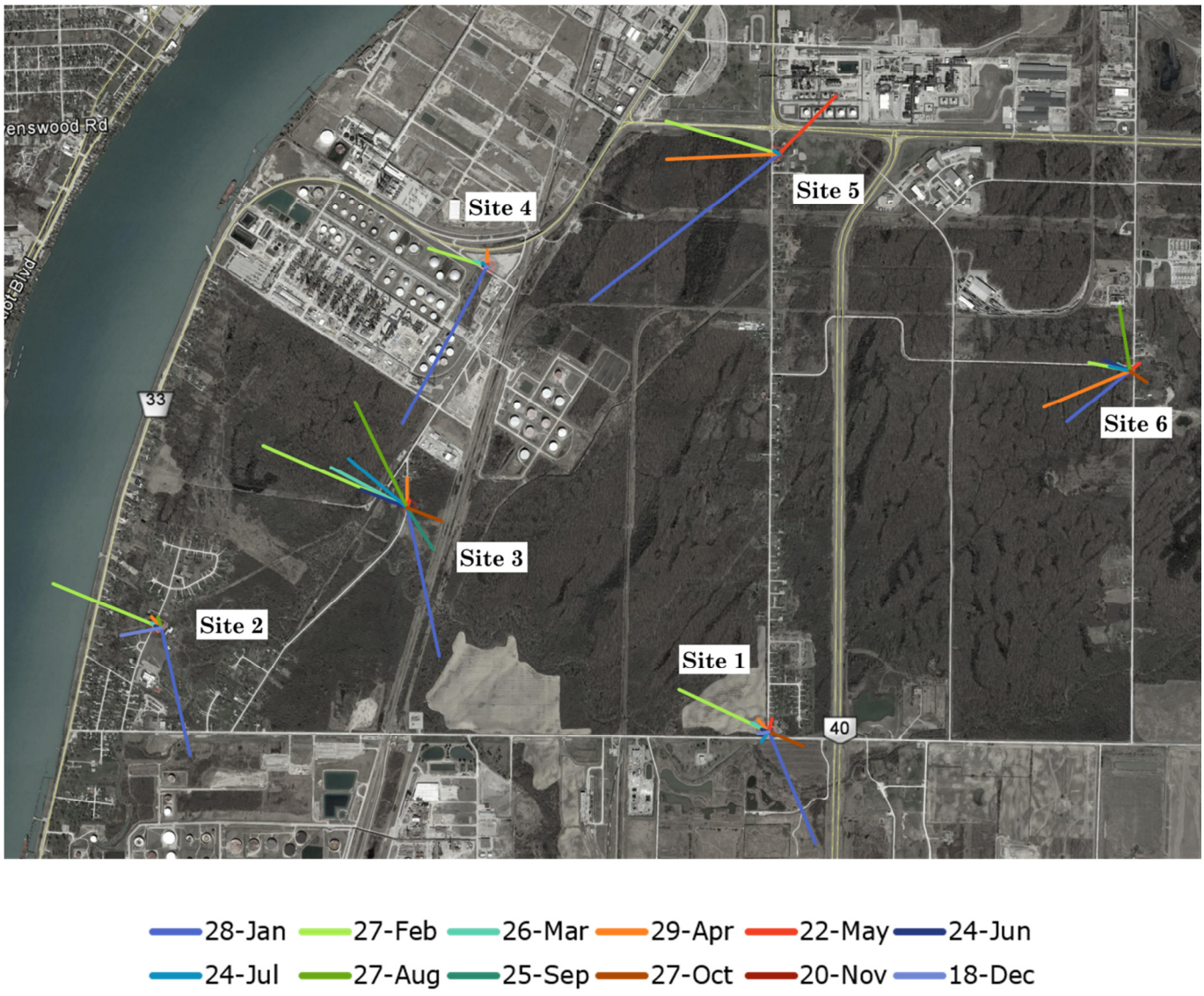

Figure 2: Benzene concentrations with associated wind directions for six sites in Aamjiwnaang First Nation community area (line lengths are proportional to concentration and the lines point in the direction from which the wind was blowing during the sampling hour).