SAT Initiative: Minnesota International Middle Charter School (Minneapolis, Minnesota)

This document describes the analysis of air monitoring and other data collected under EPA's initiative to assess potentially elevated air toxics levels at some of our nation's schools. The document has been prepared for technical audiences (e.g., risk assessors, meteorologists) and their management. It is intended to describe the technical analysis of data collected for this school in clear, but generally technical, terms. A summary of this analysis is presented on the page focused on this school on EPA's web site (www.epa.gov/schoolair).

I. Executive Summary

- Air monitoring has been conducted at the Minnesota International Middle Charter School as part of the EPA initiative to monitor specific air toxics in the outdoor air around priority schools in 22 states and 2 tribal areas.
- This school was selected for monitoring based on information indicating the potential for elevated ambient concentrations of hexavalent chromium, manganese, nickel, and three diisocyanate chemicals (hexamethylene-1,6-diisocyanate, 2,4-toluene diisocyanate, and methyl diphenyl diisocyanate) in air outside the school. That information included EPA's recently completed 2002 National Air Toxics Assessment and a USA Today analysis based on the 2005 Toxics Release Inventory.
- Air monitoring for hexavalent chromium, manganese, nickel, and other metals in PM_{10} was performed from July 30 through October 10, 2009. Air monitoring for hexamethylene-1,6-diisocyanate (1,6-HDI), methylene diphenyl diisocyanate (MDI), and 2,4-toluene diisocyanate (2,4-TDI) was performed from August 5 through October 10, 2009.
- There were no detections of 1,6-HDI, MDI, or 2,4-TDI.
- Measured levels of all pollutants and associated longer-term concentration estimates are below levels of concern for short- or long-term exposures. They are not as high as suggested by the information available prior to monitoring.
- The levels of hexavalent chromium, manganese, and nickel measured in the outdoor air at this school indicate influence of a nearby source.
- Based on the analysis described here, EPA does not presently plan to continue air toxics monitoring at this school.
- The Minnesota Pollution Control Agency (MPCA) will continue to oversee industrial facilities in the area through air permits and other programs. The MPCA continued to collect meteorological data at the school until the site was closed in November 2009.

II. Background on this Initiative

As part of an EPA initiative to implement Administrator Lisa Jackson's commitment to assess potentially elevated air toxics levels at some of our nation's schools, EPA and state and local air pollution control agencies are monitoring specific (key) air toxics in the outdoor air around priority schools in 22 states and 2 tribal areas (http://www.epa.gov/schoolair/schools.html).

- The schools selected for monitoring include some schools that are near large industries that are sources of air toxics, and some schools that are in urban areas, where emissions of air toxics come from a mix of large and small industries, cars, trucks, buses and other sources.
- EPA selected schools based on information available to us about air pollution in the vicinity of the school, including results of the 2002 National-scale Air Toxics Assessment (NATA), results from a 2008 USA Today analysis on air toxics at schools, and information from state and local air agencies. The analysis by USA Today involved use of EPA's Risk Screening Environmental Indicators tool and Toxics Release Inventory (TRI) for 2005.
  - Available information had raised some questions about air quality near these schools that EPA concluded merited investigation. In many cases, the information indicated that estimated long-term average concentrations of one or more air toxics were above the upper end of the range that EPA generally considers as acceptable (e.g., above 1-in-10,000 cancer risk for carcinogens).
- Monitors are being placed at each school for approximately 60 days, and will take air samples on at least 10 different days during that time. The samples will be analyzed for specific air toxics identified for monitoring at the school (i.e., key pollutants).[1]
- These monitoring results and other information collected at each school during this initiative will allow us to:
  - assess specific air toxics levels occurring at these sites and associated estimates of longer-term concentrations in light of health risk-based criteria for long-term exposures,
  - better understand, in many cases, potential contributions from nearby sources to key air toxics concentrations at the schools,
  - consider what next steps might be appropriate to better understand and address air toxics at the school, and
  - improve the information and methods we will use in the future (e.g., NATA) for estimating air toxics concentrations in communities across the U.S.

Assessment of air quality under this initiative is specific to the air toxics identified for monitoring at each school. This initiative is being implemented in addition to ongoing state, local and national air quality monitoring and assessment activities, including those focused on criteria pollutants (e.g., ozone and particulate matter) or existing, more extensive, air toxics programs.

Several technical documents prepared for this project provide further details on aspects of monitoring and data interpretation and are available on the EPA website (e.g., www.epa.gov/schoolair/techinfo.html). The full titles of these documents are provided here:

- *School Air Toxics Ambient Monitoring Plan*

[1] In analyzing air samples for these key pollutants, samples are also being analyzed for some additional pollutants that are routinely included in the analytical methods for the key pollutants.

- *Quality Assurance Project Plan For the EPA School Air Toxics Monitoring Program*
- *Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results*

Information on health effects of air toxics being monitored[2] and educational materials describing risk concepts[3] are also available from EPA's web site.

III. Basis for Selecting this School and the Air Monitoring Conducted

This school was selected for monitoring of hexavalent chromium in air outside the school because EPA's 2002 NATA analysis indicated the potential for levels of concern due to estimates of total chromium emissions in the 2002 National Emissions Inventory for a nearby large municipal solid waste incinerator. We were also interested in evaluating the ambient concentrations of manganese and nickel because of several nearby sources. Additionally, we were interested in evaluating the ambient concentrations of diisocyanates because the MPCA noted that these pollutants were identified in the USA Today analysis of this school based on emissions in the 2005 Toxics Release Inventory for a nearby coatings manufacturer.

Monitoring commenced at this school on July 30, 2009, and continued through October 10, 2009. During this period, twelve samples of airborne particles were collected using a PM_{10} sampler.[4] These samples were analyzed for manganese and nickel (two of the key pollutants at this school) and for a small standardized set of additional metals that are routinely included in the analytical methods for the key pollutants. Additional air samples were collected and analyzed for the other four key pollutants: hexavalent chromium; hexamethylene-1,6-diisocyanate (1,6-HDI); methylene diphenyl diisocyanate (MDI); and 2,4-toluene diisocyanate (2,4-TDI).[5] All sampling methodologies are described in EPA's schools air toxics monitoring plan (http://www.epa.gov/schoolair/techinfo.html).[6]

IV. Monitoring Results and Analysis

A. Background for the SAT Analysis

The majority of schools being monitored in this initiative were selected based on modeling analyses that indicated the potential for annual average air concentrations of some specific (key)

---

[2] For example, http://www.epa.gov/schoolair/pollutants.html, http://www.epa.gov/ttn/fera/risk_atoxic.html.
[3] For example, http://www.epa.gov/ttn/atw/3_90_022.html, http://www.epa.gov/ttn/atw/3_90_024.html.
[4] In general, this sampler collects airborne particles with a diameter of 10 microns or smaller, more of which would be considered to be in the respirable range which is what the health-based comparison level for manganese and nickel are based on.
[5] For one pollutant, 1,6-HDI, the method detection limit (0.119 $\mu g/m^3$) is above the long-term comparison level (0.01$\mu g/m^3$). As indicated in the air toxics monitoring plan, the method used is considered sufficient for this initiative and is in fact the best methodology available to us at this time.
[6] MPCA staff operated the monitors and sent the sample filters to the analytical laboratory under contract to EPA.

hazardous air pollutants (HAPs or air toxics)[7] to be of particular concern based on approaches that are commonly used in the air toxics program for considering potential for long-term risk. For example, such analyses suggested annual average concentrations of some air toxics greater than long-term risk-based concentrations associated with an additional cancer risk greater than 10-in-10,000 or a hazard index on the order of or above 10. To make projections of air concentrations, the modeling analyses combined estimates of air toxics emissions from industrial, motor vehicle and other sources, with past measurements of winds, and other meteorological factors that can influence air concentrations, from a weather station in the general area. In some cases, the weather station was very close (within a few miles), but in other cases, it was much further away (e.g., up to 60 miles) which may contribute to quite different conditions being modeled than actually exist at the school. The modeling analyses are intended to be used to prioritize locations for further investigation.

The primary objective of this initiative is to investigate - through monitoring air concentrations of key air toxics at each school over a 2-3 month period - whether levels measured and associated longer-term concentration estimates are of a magnitude, in light of health risk-based criteria, for which follow-up activities may need to be considered. To evaluate the monitoring results consistent with this objective, we developed health risk-based air concentrations (the long-term comparison levels summarized in Appendix A) for the monitored air toxics using established EPA methodology and practices for health risk assessment[8] and, in the case of cancer risk, consistent with the implied level of risk considered in identifying schools for monitoring. Consistent with the long-term or chronic focus of the modeling analyses, based on which these schools were selected for monitoring, we have analyzed the full record of concentrations of air toxics measured at this school, using routine statistical tools, to derive a 95 percent confidence interval[9] for the estimate of the longer-term average concentration of each of these pollutants. In this project, we are reporting all actual numerical values for pollutant concentrations including

---

[7] The term hazardous air pollutants (commonly called HAPs or air toxics) refers to pollutants identified in section 112(b) of the Clean Air Act which are the focus of regulatory actions involving stationary sources described by CAA section 112 and are distinguished from the six pollutants for which criteria and national ambient air quality standards (NAAQS) are developed as described in section 108. One of the criteria pollutants, lead, is also represented, as lead compounds, on the HAP list.

[8] While this EPA initiative will rely on EPA methodology, practices, assessments and risk policy considerations, we recognize that individual state methods, practices and policies may differ and subsequent analyses of the monitoring data by state agencies may draw additional or varying conclusions.

[9] When data are available for only a portion of the period of interest (e.g., samples not collected on every day during this period), statisticians commonly calculate the 95% confidence interval around the dataset mean (or average) in order to have a conservative idea of how high or low the "true" mean may be. More specifically, this interval is the range in which the mean for the complete period of interest is expected to fall 95% of the time (95% probability is commonly used by statisticians). The interval includes an equal amount of quantities above and below the sample dataset mean. The interval that includes these quantities is calculated using a formula that takes into account the size of the data set (i.e., the 'n') as well as the amount by which the individual data values vary from the dataset mean (i.e., the "standard deviation"). This calculation yields larger confidence intervals for smaller data sets as well as ones with more variable data points. For example, a dataset including {1.0, 3.0, and 5.0}, results in a mean of 3.0 and a 95% confidence interval of 3.0 +/- ~5 (or -2.0 to 8.0). For comparison purposes, a dataset including {2.5, 3 and 3.5} results in a mean of 3.0 and a 95% confidence interval of 3.0 +/- ~1.2 (or 1.8 to 4.2). The smaller variation within the data in the second set of values causes the second confidence interval to be smaller.

any values below method detection limit (MDL).[10] Additionally, a value of 0.0 is used when a measured pollutant has no value detected (ND). The projected range for the longer-term concentration estimate for each chemical (most particularly the upper end of the range) is compared to the long-term comparison level(s). These long-term comparison levels conservatively presume continuous (all-day, all-year) exposure over a lifetime. The analysis of the air concentrations also includes a consideration of the potential for cumulative multiple pollutant impacts.[11] In general, where the monitoring results indicate estimates of longer-term average concentrations that are above the comparison levels - i.e., above the cancer-based comparison levels or notably above the noncancer-based comparison levels - we will consider the need for follow-up actions such as:

- → Additional monitoring of air concentrations and/or meteorology in the area,
- → Evaluation of potentially contributing sources to help us confirm their emissions and identify what options (regulatory and otherwise) may be available to us to achieve emissions reductions, and
- → Evaluation of actions being taken or planned nationally, regionally or locally that may achieve emission and or exposure reductions. An example of this would be actions taken to address the type of ubiquitous emissions that come from mobile sources.

We have further analyzed the dataset to describe what it indicates in light of some other criteria and information commonly used in prioritizing state, local and national air toxics program activities. State, local and national programs often develop long-term monitoring data sets in order to better characterize pollutants near particular sources. The 2-3 month dataset developed under this initiative will be helpful to those programs in setting priorities for longer term monitoring projects. The intent of this analysis is to make this 2-3 month monitoring dataset as useful as possible to state, local and national air toxics program in their longer term efforts to improve air quality nationally. To that end, this analysis:

- → Describes the air toxics measurements in terms of potential longer-term concentrations, and, as available, compares the measurements at this school to monitoring data from national monitoring programs.
- → Describes the meteorological data by considering conditions on sampling days as compared to those over all the days within the 2-3 month monitoring period and what conditions might be expected over the longer-term (as indicated, for example, by information from a nearby weather station).
- → Describes available information regarding activities and emissions at the nearby source(s) of interest, such as that obtained from public databases such as TRI and/or consultation with the local air pollution authority.

---

[10] Method detection limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99% confidence that the pollutant concentration is greater than zero and is determined from the analysis of a sample in a given matrix containing the pollutant.

[11] As this analysis of a 2-3 month monitoring dataset is not intended to be a full risk assessment, consideration of potential multiple pollutant impacts may differ among sites. For example, in instances where no individual pollutant appears to be present above its comparison level, we will also check for the presence of multiple pollutants at levels just below their respective comparison levels (giving a higher priority to such instances).

B. Chemical Concentrations

We developed two types of long-term health risk-related comparison levels (summarized in Appendix A below) to address our primary objective. The primary objective is to investigate through the monitoring data collected for key pollutants at the school, whether pollutant levels measured and associated longer-term concentration estimates are elevated enough in comparison with health risk-based criteria to indicate that follow-up activities be considered. These comparison levels conservatively presume continuous (all-day, all-year) exposure over a lifetime.

In developing or identifying these comparison levels, we have given priority to use of relevant and appropriate air standards and EPA risk assessment guidance and precedents.[12] These levels are based upon health effects information, exposure concentrations and risk estimates developed and assessed by EPA, the U.S. Agency for Toxic Substances and Disease Registry, and the California EPA. These agencies recognize the need to account for potential differences in sensitivity or susceptibility of different groups (e.g., asthmatics) or lifestages/ages (e.g., young children or the elderly) to a particular pollutant's effects so that the resulting comparison levels are relevant for these potentially sensitive groups as well as the broader population.

In addition to evaluating individual pollutants with regard to their corresponding comparison levels, we also considered the potential for cumulative impacts from multiple pollutants in cases where individual pollutant levels fall below the comparison levels but where multiple pollutant mean concentrations are within an order of magnitude of their comparison levels.

Using the analysis approach described above, we analyzed the chemical concentration data (Table 1 and Figure 1) with regard to areas of interest identified below.

Key findings drawn from the information on chemical concentrations and the considerations discussed below include:

- The air sampling data collected over the 2-month sampling period and the related longer-term concentration estimates, while indicating influence from a nearby source of hexavalent chromium, manganese, and nickel emissions, are well below concentrations of significant concern for short- or long-term exposures. None of the three diisocyanate compounds were detected in any of the samples collected.

[12] This is described in detail in *Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results*

Hexavalent Chromium, key pollutant:

- Do the monitoring data indicate influence from a nearby source?
  - → Yes. The data collected include one hexavalent chromium concentration that is just above concentrations commonly observed in other locations nationally.[13]
- Do the monitoring data indicate elevated levels that pose significant long-term health concerns?
  - → No. The monitoring data for hexavalent chromium do not indicate levels of significant health concern for long-term exposures.
    - ▪ The highest measured concentration is more than 200-fold lower than both of the long-term comparison levels (Table 1). These comparison levels are based on consideration of continuous exposure concentrations (24 hours a day, all year, over a lifetime).
  - → Additionally, we did not identify any concerns regarding short-term exposures, as each individual measurement is below the individual sample screening level for hexavalent chromium (which is based on consideration of exposure all day, every day over a period ranging up to at least a couple of weeks, and longer for some pollutants).[12]
  - → In summary, the individual measurements do not indicate concentrations of concern for short-term exposures and the combined contributions of all individual measurements in the estimate of longer-term concentration do not indicate a level of concern for long-term exposure.

Manganese, key pollutant:

- Do the monitoring data indicate influence from a nearby source?
  - → Yes. The data collected include some manganese PM_{10} concentrations that are higher than concentrations commonly observed in other locations nationally.[14]
- Do the monitoring data indicate elevated levels that pose significant long-term health concerns?
  - → No. The monitoring data for manganese do not indicate levels of significant health concern for long-term exposures.
    - ▪ The estimate of longer-term manganese PM_{10} concentration (i.e., the upper bound of the 95 percent confidence interval on the mean of the dataset) is well

---

[13] For example, one of the concentrations at this site (Table 2) was greater than or equal to 75 percent of samples collected at the National Air Toxics Trends Stations (NATTS) from 2004-2008 (Appendix B). Because the NATTS sites are generally sited so as not to be influenced by specific nearby sources, EPA is using the 75th percentile point of concentrations at these sites as a benchmark for indicating potential influence from a source nearby to this school.

[14] For example, five of the concentrations at this site (Table 2) were higher than 75 percent of samples collected at the National Air Toxics Trends Stations (NATTS) from 2004-2008 (Appendix B). Because these NATTS sites are generally sited so as to not be influenced by specific nearby sources, EPA is using the 75th percentile point of concentrations at these sites as a benchmark for indicating potential influence from a source nearby to the school.

below its long-term comparison level (Table 1).[15] This comparison level is a continuous exposure concentration (24 hours a day, all year, over a lifetime) associated with little risk of adverse effect; it is not an exposure concentration at which effects have been observed or are predicted to occur.[16]

- As manganese has not been found to be carcinogenic, it has no cancer-based comparison level.[17]

→ Additionally, we did not identify any concerns regarding short-term exposures as each individual measurement is below the individual sample screening level for manganese (which is based on consideration of exposure all day, every day over a period ranging up to at least a couple of weeks, and longer for some pollutants).[12]

→ In summary, the individual measurements do not indicate concentrations of concern for short-term exposures and the combined contributions of all individual measurements in the estimate of longer-term concentration do not indicate a level of concern for long-term exposure.

<u>Nickel, key pollutant:</u>

- Do the monitoring data indicate influence from a nearby source?
  - → Yes. The data collected include one nickel PM_{10} concentration that is higher than concentrations commonly observed in other locations nationally.[18]
- Do the monitoring data indicate elevated levels that pose significant long-term health concerns?
  - → No. The monitoring data for nickel do not indicate levels of significant health concern for long-term exposures.
    - The estimate of longer-term nickel PM_{10} concentration (i.e., the upper bound of the 95 percent confidence interval on the mean of the dataset) is below both of the long-term comparison levels (Table 1).[19] These comparison levels are based on consideration of continuous exposure concentrations (24 hours a day, all year, over a lifetime).
    - Further, the longer-term concentration estimate is more than one hundred-fold lower than the cancer-based comparison level, indicating the longer-term

[15] The upper end of the interval is nearly one and a half times the mean of the monitoring data, but only 25% of the noncancer-based long-term comparison level.
[16] The comparison level for manganese is based on the RfC. Manganese concentrations at which health effects have been documented are higher than the RfC (http://www.atsdr.cdc.gov/tfacts151.html, http://www.epa.gov/ttn/atw/hlthef/manganes.html#conversion)
[17] www.epa.gov/iris
[18] For example, one of the concentrations at this site (Table 2) was higher than 75 percent of samples collected at the National Air Toxics Trends Stations (NATTS) from 2004-2008 (Appendix B). Because these NATTS sites are generally sited so as to not be influenced by specific nearby sources, EPA is using the 75th percentile point of concentrations at these sites as a benchmark for indicating potential influence from a source nearby to the school.
[19] The upper end of the interval is nearly two times the mean of the monitoring data, but less than 2% of the noncancer-based long-term comparison level.

estimate is below a continuous (24 hr/day, 7 days/wk) lifetime exposure concentration associated with 1-in-1-million additional cancer risk.

→ Additionally, we did not identify any concerns regarding short-term exposures as each individual measurement is below the individual sample screening level for nickel (which is based on consideration of exposure all day, every day over a period ranging up to at least a couple of weeks, and longer for some pollutants).[12]

→ In summary, the individual measurements do not indicate concentrations of concern for short-term exposures and the combined contributions of all individual measurements in the estimate of longer-term concentration do not indicate a level of concern for long-term exposure.

<u>1,6-HDI, MDI, and 2,4-TDI, key pollutants:</u>

- Do the monitoring data indicate influence from a nearby source?

  → No. There were no detections of these pollutants in any of the samples.

- Do the monitoring data indicate elevated levels that pose significant long-term health concerns?

  → No. There were no detections of these pollutants in any of the samples.

<u>Other Air Toxics:</u>

- Do the monitoring data indicate elevated levels of any other air toxics (or HAPs) that pose significant long-term health concerns?

  → No. The monitoring data show low levels of the other HAPs monitored, with longer-term concentration estimates for these HAPs below their long-term comparison levels (Appendix C). Additionally each individual measurement for these pollutants is below the individual sample screening level for that pollutant.[12]

<u>Multiple Pollutants:</u>

- Do the data collected for the air toxics monitored indicate the potential for other monitored pollutants to be present at levels that in combination with the key pollutant levels indicate an increased potential for cumulative impacts of significant concern (e.g., that might warrant further investigation)?

  → No. The data collected for the key and other air toxics and the associated longer-term concentration estimates do not together pose significant concerns for cumulative health risk from these pollutants (Appendix C).[20]

---

[20] We note that this initiative is focused on investigation for a school-specific set of key pollutants indicated by previous analyses (and a small set of others for which measurements are obtained in the same analysis). Combined impacts of pollutants or stressors other than those monitored in this project is a broader area of consideration in other EPA activities. General information on additional air pollutants is available at http://www.epa.gov/air/airpollutants.html

C. Wind and Other Meteorological Data

At each school monitored as part of this initiative, we are collecting meteorological data, minimally for wind speed and direction, during the sampling period. Additionally, we have identified the nearest National Weather Service (NWS) station at which a longer record is available.

In reviewing these data at each school in this initiative, we are considering if these data indicate that the general pattern of winds on our sampling dates are significantly different from those occurring across the full sampling period or from those expected over the longer term. Additionally, we are noting, particularly for school sites where the measured chemical concentrations show little indication of influence from a nearby source, whether wind conditions on some portion of the sampling dates were indicative of a potential to capture contributions from the nearby "key" source in the air sample collected.

The meteorological station at the Minnesota International Middle Charter School collected wind speed and wind direction measurements during the sampling period, beginning on July 30, 2009 and continuing through the end of the sampling period (October 10, 2009). As a result, on-site data for these meteorological parameters are available for all dates of sample collection, and also for intervening days, producing an approximately 72-day record. On-site meteorological data collection continued beyond the last sample collection until the site was closed in November 2009, but which is not summarized in this document. The data collected at the school are presented in Table 2.

The nearest NWS station is at Crystal Airport in Minneapolis, MN. This station is approximately 6 miles northwest of the school. Measurements taken at that station include wind, temperature and precipitation. These are presented in Table 2 and Appendix E.

Key findings drawn from this information and the considerations discussed below include:

- Both the sampling results and the on-site wind data indicate that some of the air samples were collected on days when the nearby key sources were contributing to conditions at the school location.
- The wind patterns at the monitoring site across sampling dates are not generally similar to those observed across the full record of on-site meteorological data.
- Our ability to provide a confident characterization of the wind flow patterns at the monitoring site over the long-term is somewhat limited as the NWS site at Crystal Airport does not appear to represent the specific wind flow patterns at the school location.
- Although we lack long-term wind data at the monitoring site, the wind pattern at the NWS site during the sampling period is generally similar to the historical long-term wind flow pattern at that location. This suggests that, on a regional scale, the 2-month sampling period may be representative of year-round wind patterns.

- What is the direction of the key source of hexavalent chromium, manganese, nickel, and diisocyanate emissions in relation to the school location?
  - → The nearby industrial facilities emitting the key pollutants into the air (described in section III above) lie less than one mile south-southeast of the school and less than one mile north of the school.
  - → Using the property boundaries of the full facilities (in lieu of information regarding the location of specific sources of emissions at the facilities), we have identified approximate ranges of wind directions to use in considering the potential influences of these facilities on air concentrations at the school.
  - → The general ranges of wind directions are referred to here as the expected zones of influence (ZOI). In this case, there are two sources and two ZOIs: ZOI A is 145 to 190 degrees (for hexavalent chromium, manganese, and nickel) and ZOI B is 349 to 34 degrees (for diisocyanates).

- On days the air samples were collected, how often did wind come from direction of the key source?
  - → On three of the 12 sampling days, a portion of the winds were from the expected ZOI (ZOI A) for hexavalent chromium, manganese, and nickel. On four of the 12 sampling days, a portion of the winds were from the expected ZOI (ZOI B) for diisocyanates (Figure 2, Table 2).

- How do wind patterns on the air monitoring days compare to those across the complete monitoring period and what might be expected over the longer term at the school location?

→ Wind patterns across the air monitoring days generally appear not to be similar to those observed over the full record of on-site meteorological data during the monitoring period, although they are similar with regard to the expected ZOI for diisocyanates.

→ While wind data are not available at the school over the longer term, we note that wind patterns at the nearest NWS station (at Crystal Airport) during the monitoring period are very similar to those recorded at the NWS station over the long-term (2002-2007 period; Appendix E), supporting the idea that regional meteorological patterns in the area during the monitoring period were consistent with long-term patterns. However, there is some uncertainty as to whether this would also be the case at the school location as the general wind patterns at the Crystal Airport station appear to differ from those at the school (see below).

- How do wind patterns at the school compare to those at the Crystal Airport station, particularly with regard to prevalent wind directions and the direction of the key source?
  → During the period for which data are available both at the school site and at the reference NWS station (approximately 72 days), winds at the school site are from all directions except the northeast quadrant, while those at the NWS station are from the northwest and southeast quadrants. The windroses for the two sites during the sampling period (Figure 2 and Appendix E) show differences in wind flow patterns, most likely resulting from nearby terrain influences.
  → Wind speeds at the school monitoring site are somewhat similar than those measured at the Crystal Airport station.

- Are there other meteorological patterns that may influence the measured concentrations at the school monitoring site?
  → No, we did not observe other meteorological patterns that may influence the measured concentrations at the school monitoring site.

V. Key Source Information

- Was the source operating as usual during the monitoring period?
  - The nearby source of hexavalent chromium emissions and other metals (described in section III above) has an operating permit issued by MPCA that includes operating requirements.[21] The nearby source of diisocyanate emissions has not had an operating permit since 2006 because the source's potential emissions are below permitting thresholds.
  - Information from the nearby source of key pollutant metals indicates that the source was operating normally during the monitoring period. The nearby source of diisocyanates revised its estimate of emissions for the 2005 TRI, and the source has

[21] Operating permits, which are issued to air pollution sources under the Clean Air Act, are described at: http://www.epa.gov/air/oaqps/permits/

no reported emissions in the TRI since 2001, indicating that the source either no longer emits diisocyanates or that emissions are below TRI reporting thresholds.

- The most recently available chromium emissions for this source (2005 NATA) are lower than those relied upon in previous modeling analysis for this area (2002 NATA). Conversely, the nickel emissions estimates for this source (2005 NEI) are slightly higher than those relied upon in previous modeling analyses for this area (2002 NATA). There were no emission estimates of manganese, 1,6-HDI, MDI, or 2,4-TDI from the 2005 NEI, or the 2005-2008 TRIs.[22]

VI. Integrated Summary and Next Steps

A. Summary of Key Findings

1. What are the key HAPs for this school?
   → Hexavalent chromium; manganese; nickel; 1,6-HDI; MDI; and 2,4-TDI are the key HAPs for this school, identified based on emissions information considered in identifying the school for monitoring. The ambient air concentrations of hexavalent chromium, manganese, and nickel on a few days during the monitoring period indicate contributions from sources in the area.

2. Do the data collected at this school indicate an elevated level of concern, as implied by information that led to identifying this school for monitoring?
   → No; the measured levels and associated longer-term concentration estimates are not as high as that suggested by the information available prior to monitoring and are below levels of concern for long-term exposures.

3. Are there indications, e.g., from the meteorological or other data, that the sample set may not be indicative of longer-term air concentrations? Would we expect higher (or lower) concentrations at other times of year?
   → The data we have collected may not reflect air concentrations during the entire monitoring period. Although there were seven sampling days during which a portion of the winds were from the expected ZOIs, wind patterns over the full record of on-site meteorological data during the monitoring period indicate higher frequencies of winds from the expected ZOI for hexavalent chromium, manganese, and nickel.
   → Among the data collected for this site, we have none that would indicate generally higher (or lower) concentrations during other times of year. The wind flow pattern at the nearest NWS station during the sampling period may be representative of long-term wind flow patterns at that site. The lack of long-term meteorological data at the school location and our finding that the wind patterns from the nearest NWS station differ from those at the school,

[22] The estimates in TRI for the diisocyanates source in this area are available only in terms of the generic category "diisocyantes" without any specification as to amounts for each of the 3 HAP diisocyanate chemicals that are the focus here.

however, limit somewhat our ability to confidently predict longer-term wind patterns at the school (which might provide further evidence relevant to concentrations during other times).

B. Next Steps for Key Pollutants

1. Based on the analysis described here, EPA does not presently plan to continue air toxics monitoring at this school.

VII. Figures and Tables

A. Tables

1. Minnesota International Middle Charter School – Key Pollutant Analysis.

2a. Minnesota International Middle Charter School – Key Pollutant Concentrations (PM_{10} Metals and Hexavalent Chromium) and Meteorological Data.

2b. Minnesota International Middle Charter School – Key Pollutant Concentrations (Diisocyanates) and Meteorological Data.

B. Figures

1a. Minnesota International Middle Charter School – Key Pollutant (Manganese PM_{10}) Analysis.

1b. Minnesota International Middle Charter School – Key Pollutant (Nickel PM_{10}) Analysis.

2a. Minnesota International Middle Charter School – Manganese PM_{10} Concentration and Wind Direction.

2b. Minnesota International Middle Charter School – Nickel PM_{10} Concentration and Wind Direction.

2c. Minnesota International Middle Charter School – Hexavalent Chromium Concentration and Wind Direction.

2d. Minnesota International Middle Charter School – 1,6-HDI, MDI, and 2,4-TDI Concentration and Wind Direction.

VIII. Appendices

A. Summary Description of Long-term Comparison Levels.

B. National Air Toxics Trends Stations Measurements (2004 through 2008).

C. Analysis of Other (non-key) Air Toxics Monitored at the School and Multiple-pollutant Considerations.

D. Minnesota International Middle Charter School Pollutant Concentrations.

E. Windrose for Crystal Airport.

Table 1. Minnesota International Middle Charter School - Key Pollutant Analysis.

Parameter	Units	Mean of Measurements	95% Confidence Interval on the Mean	Long-term Comparison Level[a]	
				Cancer-Based[b]	Noncancer-Based[c]
Manganese PM_{10}	ng/m³	8.68 [d]	4.87 - 12.5	NA	50
Nickel PM_{10}	ng/m³	0.79 [e]	0.11 - 1.47	420	90
Hexavalent Chromium	ng/m³	58% of results were ND[f]		8.3[g]	100
Hexamethylene diisocyanate (1,6-HDI)	µg/m³	100% of results were ND[h]		NA	0.01
Methylenediphenyl Diisocyanate (MDI), 4,4-	µg/m³	100% of results were ND[h]		NA	0.6
Toluene Diisocyanate, 2,4- (2,4-TDI)	µg/m³	100% of results were ND[h]		NA	0.07

µg/m³ micrograms per cubic meter

ng/m³ nanograms per cubic meter

NA Not applicable

ND No detection of this chemical was registered by the laboratory analytical equipment. The value is assumed to be zero.

[a] Details regarding these values are in the technical report, Schools Air Toxics Monitoring Activity (2009) Uses of Health Effects Information.

[b] Air toxics for which the upper 95% confidence limit on the mean concentration is above this level will be fully discussed in the text and may be considered a priority for potential follow-up activities, if indicated in light of the full set of information available for the site. Findings of the upper 95% confidence limit below 1% of the comparison level (i.e., where the upper 95% confidence limit is below the corresponding 1-in-1-million cancer risk based concentration) are generally considered a low priority for follow-up activity. Situations where the summary statistics for a pollutant are below this comparison level but above 1% of this level are fully discussed in the text of the report.

[c] Air toxics for which the upper 95% confidence limit on the mean concentration are near or below the noncancer-based comparison level are generally of low concern and will generally be considered a low priority for follow-up activity. Pollutants for which the 95% confidence limits extend appreciably above the noncancer-based comparison level are fully discussed in the school-specific report and may be considered a priority for follow-up activity, if indicated in light of the full set of information available for the site.

[d] The mean of measurements for manganese PM_{10} is the average of all sample results, which include twelve detections that ranged from 1.19 to 21.5 ng/m³.

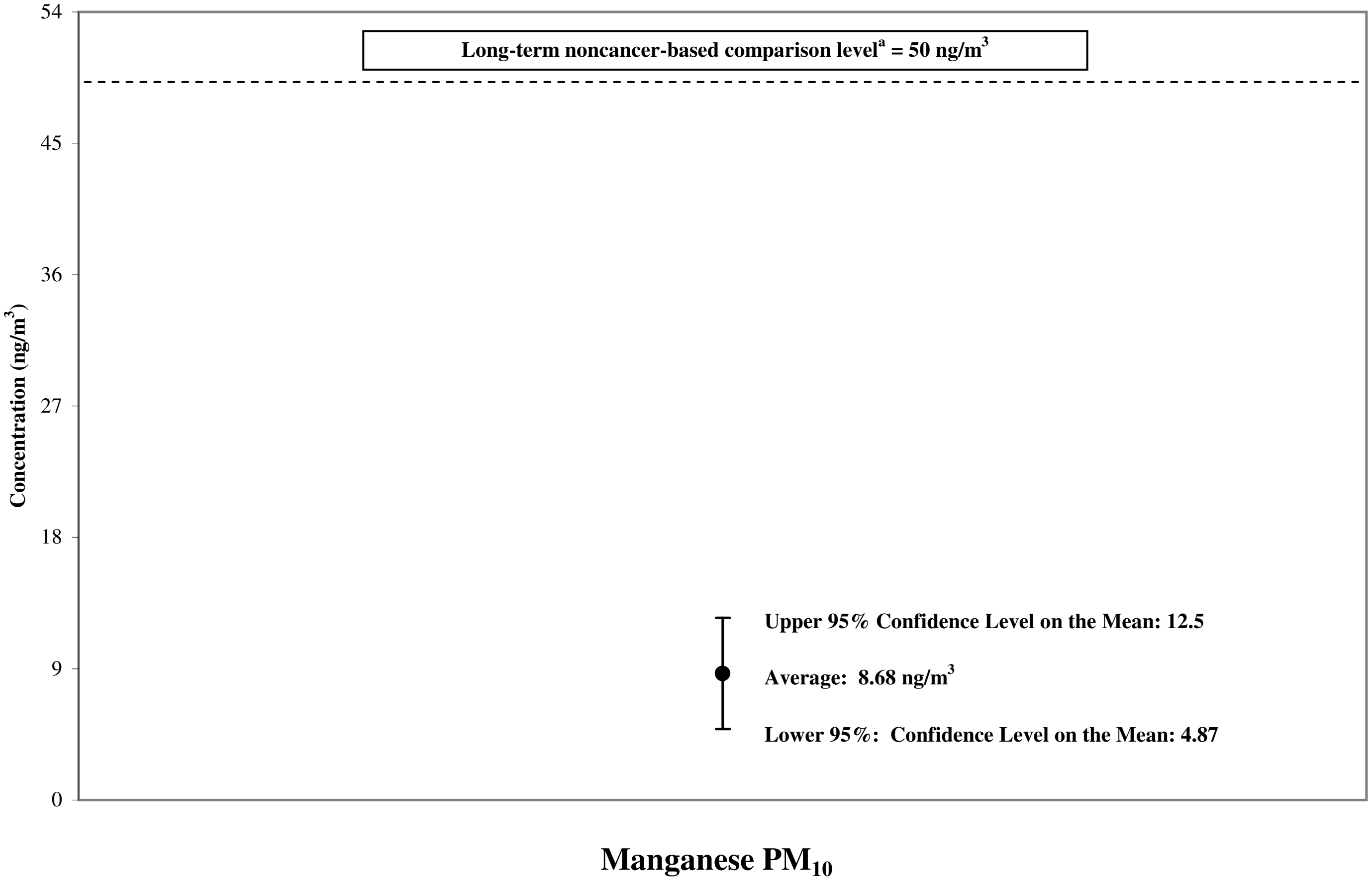
[e] The mean of measurements for nickel PM_{10} is the average of all sample results, which include eleven detections that ranged from 0.15 to 4.06 ng/m³, as well as one sample in which no chemical was registered by the laboratory analytical equipment. This value was assumed to be zero when calculating the mean.

[f] Hexavalent chromium was detected in only 5 of 13 samples, ranging from 0.009 to 0.040 ng/m³. The MDL is 0.0043 ng/m³.

[g] This comparison value is based on the EPA IRIS cancer assessment. It is noted that the EPA is currently updating this assessment with regard to the mode of action. If the update were to conclude that this chemical is carcinogenic by a mutagenic mode of action, this comparison level would be revised to a slightly lower value of 5.2 ng/m³, consistent with EPA's Supplemental Guidance for Assessing Susceptibility from Early-Life exposure.

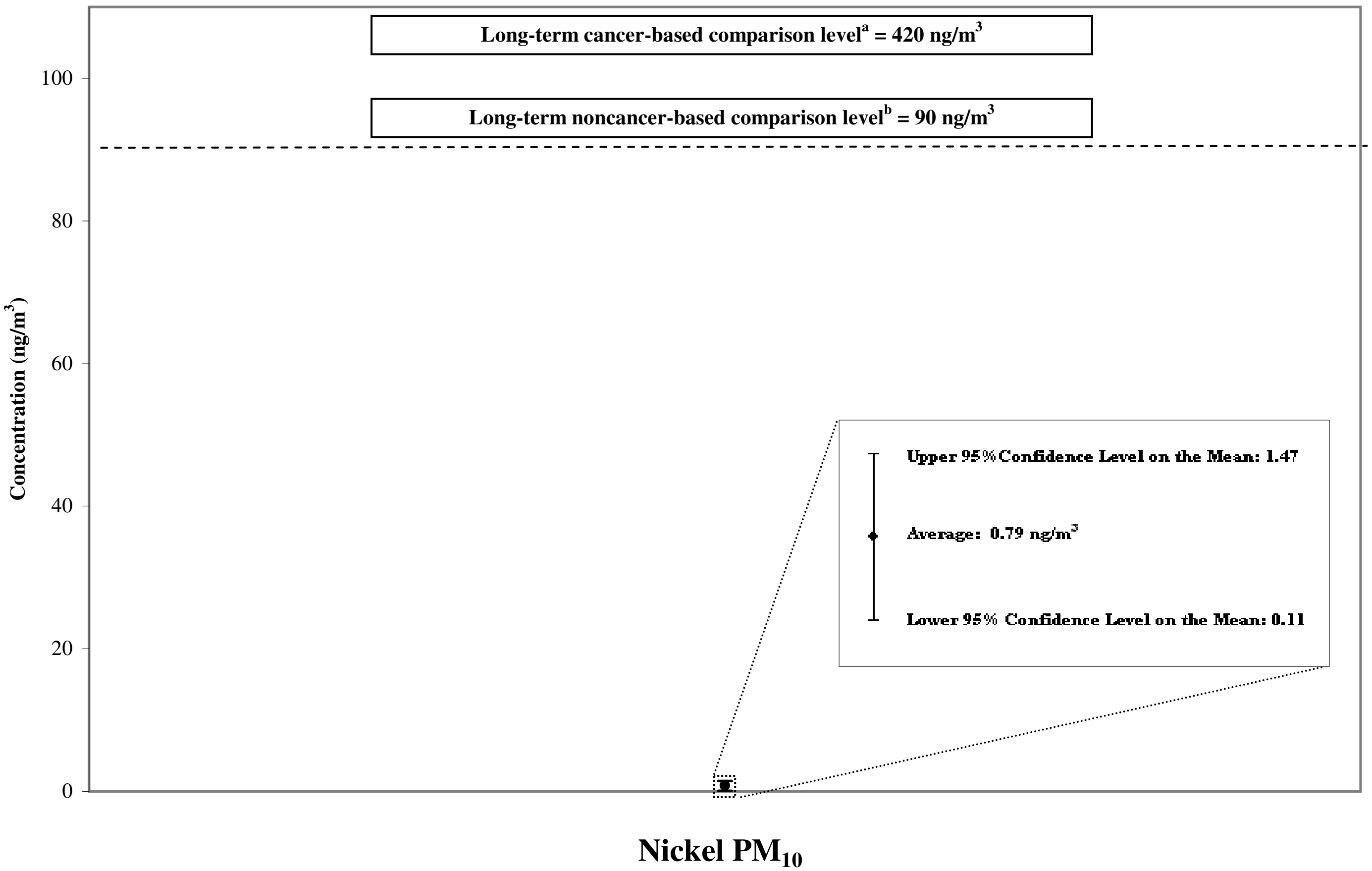
[h] There were no detections of this compound in eleven samples.

Figure 1a. Minnesota International Middle Charter School - Key Pollutant (Manganese PM_{10}) Analysis.



[a] Air toxics for which the upper 95% confidence limit on the mean concentration are near or below the noncancer-based comparison level are generally of low concern and will generally be considered a low priority for follow-up activity. Pollutants for which the 95% confidence limits extend appreciably above the noncancer-based comparison level are fully discussed in the school-specific report and may be considered a priority for follow-up activity, if indicated in light of the full set of information available for the site.

Figure 1b. Minnesota International Middle Charter School - Key Pollutant (Nickel PM_{10}) Analysis.



[a] Air toxics for which the upper 95% confidence limit on the mean concentration is above this cancer-based comparison level will be fully discussed in the text and may be considered a priority for potential follow-up activities, if indicated in light of the full set of information available for the site. Findings of the upper 95% confidence limit below 1% of the comparison level (i.e., where the upper 95% confidence limit is below the corresponding 1-in-1-million cancer risk based concentration) are generally considered a low priority for follow-up activity. Situations where the summary statistics for a pollutant are below this comparison level but above 1% of this level are fully discussed in the text of the report.

[b] Air toxics for which the upper 95% confidence limit on the mean concentration are near or below the noncancer-based comparison level are generally of low concern and will generally be considered a low priority for follow-up activity. Pollutants for which the 95% confidence limits extend appreciably above the noncancer-based comparison level are fully discussed in the school-specific report and may be considered a priority for follow-up activity, if indicated in light of the full set of information available for the site.

Table 2a. Minnesota International Middle Charter School Key Pollutant Concentrations (PM_{10} metals and hexavalent chromium) and Meteorological Data.

Parameter	Units	7/30/2009	8/5/2009	8/11/2009	8/17/2009	8/23/2009	8/29/2009	9/4/2009	9/10/2009	9/16/2009	9/22/2009	10/4/2009	10/10/2009
Manganese PM_{10}	ng/m^3	6.66	10.9	11.5	7.44	5.33	2.80	21.5	17.0	10.7	6.85	1.19	2.24
Nickel PM_{10}	ng/m^3	0.42	0.60	1.17	0.50	ND	0.28	4.06	0.84	0.88	0.28	0.29	0.15
Hexavalent Chromium	ng/m^3	ND	0.009	0.040	ND	ND	ND	0.017	0.020	0.010	ND	ND	ND
% Hours w/Wind Direction from Expected ZOI[a]	%	0.0	0.0	0.0	0.0	29.2	0.0	0.0	45.8	4.2	0.0	0.0	0.0
Wind Speed (avg. of hourly speeds)	mph	5.4	4.2	2.8	6.6	4.3	8.2	2.9	4.8	4.6	3.7	6.0	11.1
Wind Direction (avg. of unitized vector)[b]	deg.	283.1	335.9	299.7	238.6	205.0	2.8	357.2	179.1	72.7	305.4	302.3	266.2
% of Hours with Speed below 2 knots	%	12.5	20.8	41.7	0.0	20.8	0.0	50.0	0.0	4.2	0.0	0.0	0.0
Daily Average Temperature	° F	65.2	68.8	72.0	69.9	66.8	57.3	63.5	72.6	64.8	63.8	48.9	31.8
Daily Precipitation	inches	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02

[Yellow box] All precipitation and temperature data were from the Crystal Airport NWS Station.

ng/m^3 nanograms per cubic meter

ND No detection of this chemical was registered by the laboratory analytical equipment.

[a] Based on count of hours for which vector wind direction is from expected zone of influence (ZOI). For these pollutants, the ZOI is 145 to 190 degrees.

[b] Wind direction for each day is represented by values derived by scalar averaging of hourly estimates that were produced (by wind instrumentation's logger) as unitized vectors (specified as degrees from due north).

Table 2b. Minnesota International Middle Charter School Key Pollutant Concentrations (Diisocyanates) and Meteorological Data.

Parameter	Units	8/5/2009	8/11/2009	8/17/2009	8/23/2009	8/29/2009	9/4/2009	9/10/2009	9/16/2009	9/28/2009	10/4/2009	10/10/2009
Hexamethylene diisocyanate (1,6-HDI)	$\mu g/m^3$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylenediphenyl Diisocyanate (MDI), 4,4-	$\mu g/m^3$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene Diisocyanate, 2,4- (2,4-TDI)	$\mu g/m^3$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
% Hours w/Wind Direction from Expected ZOI[a]	%	16.7	16.7	0.0	0.0	83.3	16.7	0.0	0.0	0.0	0.0	0.0
Wind Speed (avg. of hourly speeds)	mph	4.2	2.8	6.6	4.3	8.2	2.9	4.8	4.6	12.2	6.0	11.1
Wind Direction (avg. of unitized vector)[b]	deg.	335.9	299.7	238.6	205.0	2.8	357.2	179.1	72.7	311.0	302.3	266.2
% of Hours with Speed below 2 knots	%	20.8	41.7	0.0	20.8	0.0	50.0	0.0	4.2	0.0	0.0	0.0
Daily Average Temperature	° F	68.8	72.0	69.9	66.8	57.3	63.5	72.6	64.8	53.7	48.9	31.8
Daily Precipitation	inches	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02

[yellow shading] All precipitation and temperature data were from the Crystal Airport NWS Station.

$\mu g/m^3$ micrograms per cubic meter

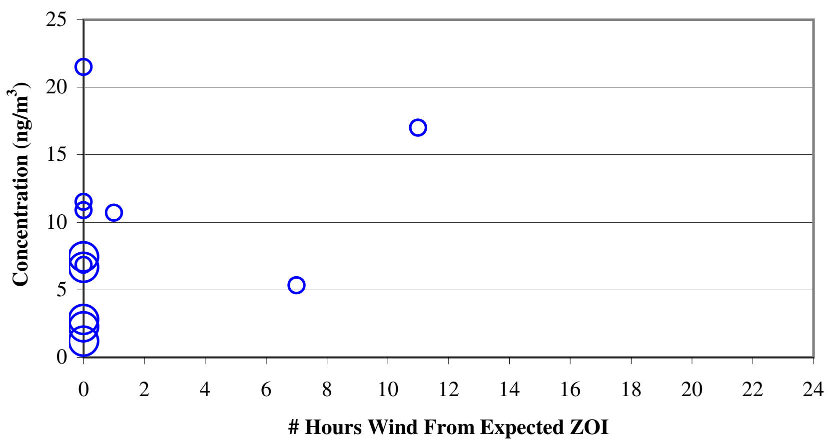
[a] Based on count of hours for which vector wind direction is from expected zone of influence (ZOI). For these pollutants, the ZOI is 349 to 34 degrees.

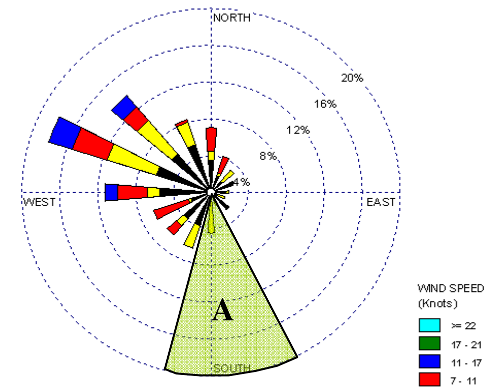
[b] Wind direction for each day is represented by values derived by scalar averaging of hourly estimates that were produced (by wind instrumentation's logger) as unitized vectors (specified as degrees from due north).

ND No detection of this chemical was registered by the laboratory analytical equipment.

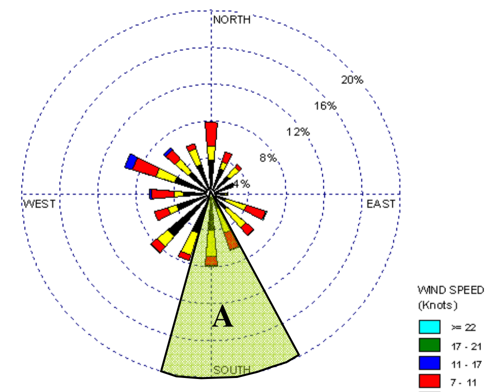
Figure 2a. Minnesota International Middle Charter School (Minneapolis, MN) Manganese PM_{10} Concentration and Wind Information.

Manganese PM_{10} Concentrations vs. Number of Hours Wind Blows from Expected Zone of Influence





Minnesota International Middle Charter School Composite Hourly Windrose on Sample Days (Jul. 30-Oct. 10, 2009)



Minnesota International Middle Charter School Composite Hourly Windrose For Full Period (Jul. 30-Oct. 10, 2009)

Expected Zone of Source Influence

KEY

Pollutant: Manganese PM_{10}

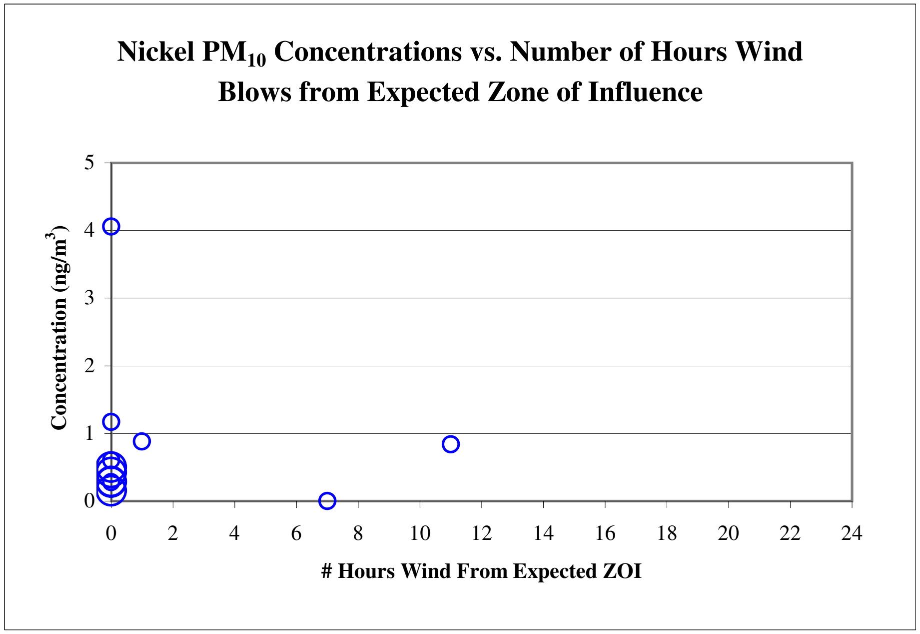
Timeframe: July 30 - October 10, 2009

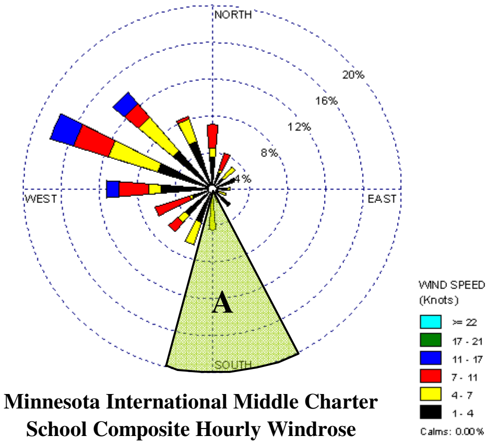
Note

Each circle denotes a 24-hour collection of air for chemical analysis. The size of the circle indicates the magnitude of the wind speed for that day (wind data shown in Table 2). The expected zone of source influence is a rough approximation of the range of directions from which winds carrying chemicals emitted by the key source may originate.

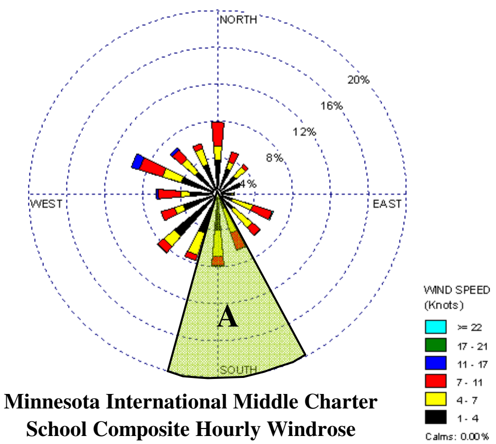
- Wind Speed: 0.1-2.5 mph
- Wind Speed: 2.5-5.0 mph
- Wind Speed: > 5.0 mph

Figure 2b. Minnesota International Middle Charter School (Minneapolis, MN) Nickel PM_{10} Concentration and Wind Information.





Minnesota International Middle Charter School Composite Hourly Windrose on Sample Days (Jul. 30-Oct. 10, 2009)



Minnesota International Middle Charter School Composite Hourly Windrose For Full Period (Jul. 30-Oct. 10, 2009)

Expected Zone of Source Influence

KEY

Pollutant: Nickel PM_{10}

Timeframe: July 30 - October 10, 2009

Wind Speed: 0.1-2.5 mph

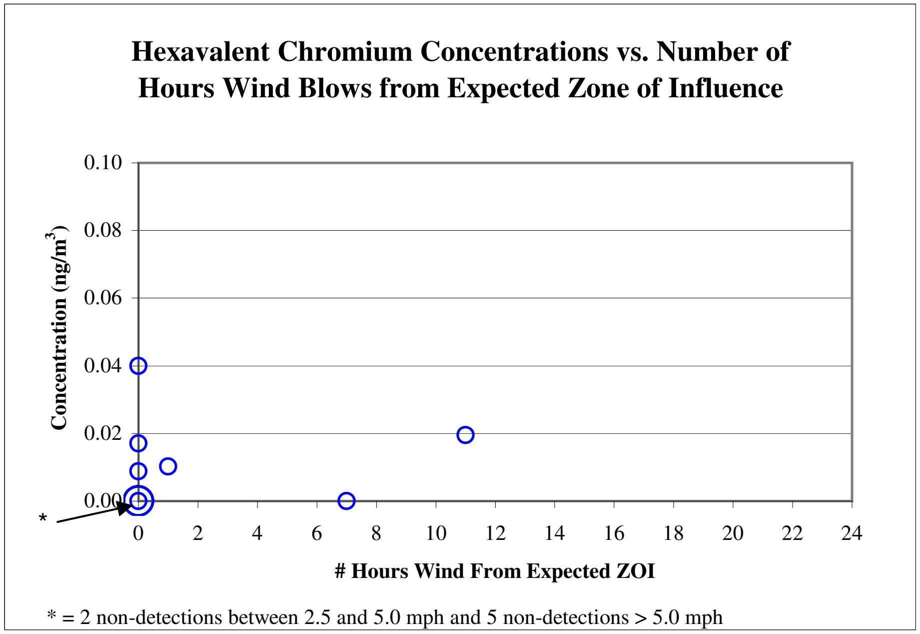
Wind Speed: 2.5-5.0 mph

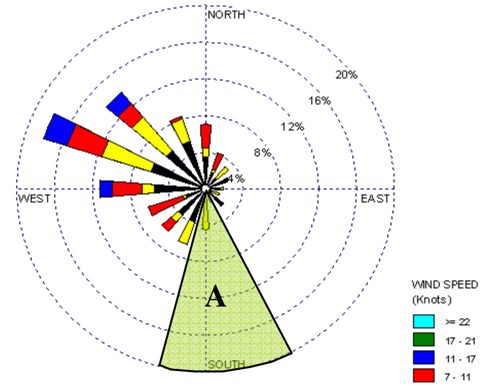
Wind Speed: > 5.0 mph

Note

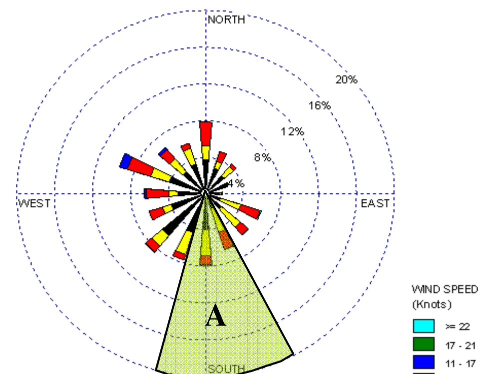
Each circle denotes a 24-hour collection of air for chemical analysis. The size of the circle indicates the magnitude of the wind speed for that day (wind data shown in Table 2). The expected zone of source influence is a rough approximation of the range of directions from which winds carrying chemicals emitted by the key source may originate.

Figure 2c. Minnesota International Middle Charter School (Minneapolis, MN) Hexavalent Chromium Concentration and Wind Information.





Minnesota International Middle Charter School Composite Hourly Windrose on Sample Days (Jul. 30-Oct. 10, 2009)



Minnesota International Middle Charter School Composite Hourly Windrose For Full Period (Jul. 30-Oct. 10, 2009)

Expected Zone of Source Influence

KEY

Pollutant: Hexavalent Chromium
Timeframe: July 30 - October 10, 2009

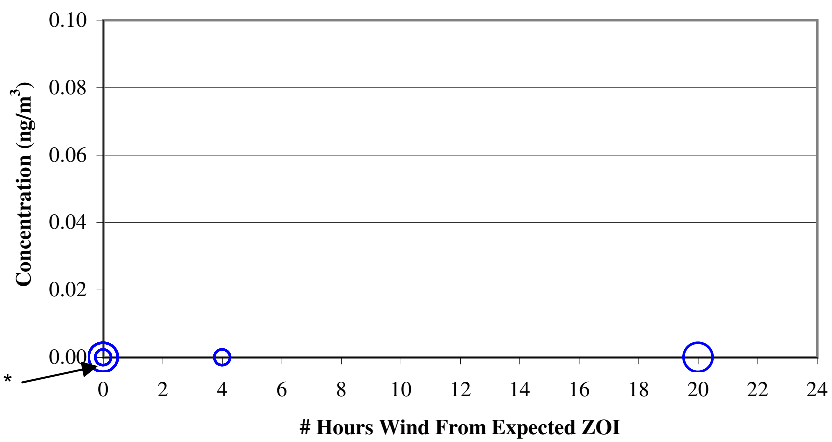
Wind Speed: 0.1-2.5 mph
Wind Speed: 2.5-5.0 mph
Wind Speed: > 5.0 mph

Note

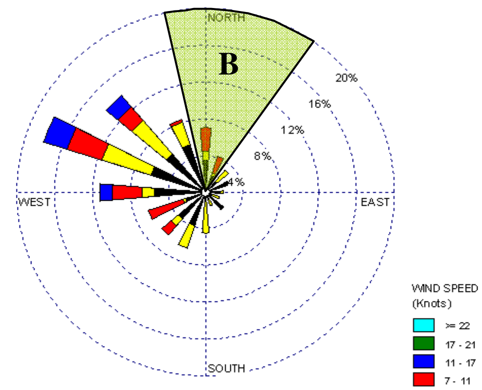
Each circle denotes a 24-hour collection of air for chemical analysis. The size of the circle indicates the magnitude of the wind speed for that day (wind data shown in Table 2). The expected zone of source influence is a rough approximation of the range of directions from which winds carrying chemicals emitted by the key source may originate.

Figure 2d. Minnesota International Middle Charter School (Minneapolis, MN) 1,6-HDI, MDI, and 2,4-TDI Concentration and Wind Information.

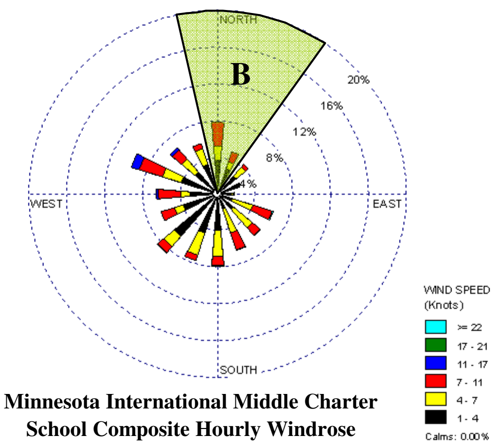
1,6-HDI, MDI, and 2,4-TDI Concentrations vs. Number of Hours Wind Blows from Expected Zone of Influence



* = 3 non-detections between 2.5 and 5.0 mph and 4 non-detections > 5.0 mph



Minnesota International Middle Charter School Composite Hourly Windrose on Sample Days (Jul. 30-Oct. 10, 2009)



Minnesota International Middle Charter School Composite Hourly Windrose For Full Period (Jul. 30-Oct. 10, 2009)

Expected Zone of Source Influence

KEY

Pollutants: 1,6-HDI, MDI, 2,4-TDI
Timeframe: August 5 - October 10, 2009

Wind Speed: 0.1-2.5 mph

Wind Speed: 2.5-5.0 mph

Wind Speed: > 5.0 mph

Note

Each circle denotes a 24-hour collection of air for chemical analysis. The size of the circle indicates the magnitude of the wind speed for that day (wind data shown in Table 2). The expected zone of source influence is a rough approximation of the range of directions from which winds carrying chemicals emitted by the key source may originate.

Appendix A. Summary Description of Long-term Comparison Levels

In addressing the primary objective identified above, to investigate through the monitoring data collected for key pollutants at the school whether levels are of a magnitude, in light of health risk-based criteria, to indicate that follow-up activities be considered, we developed two types of long-term health risk-related comparison levels. These two types of levels are summarized below.[23]

Cancer-based Comparison Levels

- For air toxics where applicable, we developed cancer risk-based comparison levels to help us consider whether the monitoring data collected at the school indicate the potential for concentrations to pose incremental cancer risk above the range that EPA generally considers acceptable in regulatory decision-making to someone exposed to those concentrations continuously (24 hours a day, 7 days a week) over an entire lifetime.[24] This general range is from 1 to 100 in a million.
- Air toxics with long-term mean concentrations below one one-hundredth of this comparison level would be below a comparably developed level for 1-in-a-million risk (which is the lower bound of EPA's traditional acceptable risk range). Such pollutants, with long-term mean concentrations below the Agency's traditional acceptable risk range, are generally considered to pose negligible risk.
- Air toxics with long-term mean concentrations above the acceptable risk range would generally be a priority for follow-up activities. In this evaluation, we compare the upper 95% confidence limit on the mean concentration to the comparison level. Pollutants for which this upper limit falls above the comparison level are fully discussed in the school monitoring report and may be considered a priority for potential follow-up activities in light of the full set of information available for that site.
- Situations where the summary statistics for a pollutant are below the cancer-based comparison level but above 1% of that level are fully discussed in Appendix C.

[23] These levels are described in more detail *Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results*.

[24] While no one would be exposed at a school for 24 hours a day, every day for an entire lifetime, we chose this worst-case exposure period as a simplification for the basis of the comparison level in recognition of other uncertainties in the analysis. Use of continuous lifetime exposure yields a lower, more conservative, comparison level than would use of a characterization more specific to the school population (e.g., 5 days a week, 8-10 hours a day for a limited number of years).

Noncancer-based Comparison Levels

- To consider concentrations of air toxics other than lead (for which we have a national ambient air quality standard) with regard to potential for health effects other than cancer, we derived noncancer-based comparison levels using EPA chronic reference concentrations (or similar values). A chronic reference concentration (RfC) is an estimate of a long-term continuous exposure concentration (24 hours a day, every day) without appreciable risk of adverse effect over a lifetime.[25] This differs from the cancer risk-based comparison level in that it represents a concentration without appreciable risk *vs* a risk-based concentration.
- In using this comparison level in this initiative, the upper end of the 95% confidence limit on the mean is compared to the comparison level. Air toxics for which this upper confidence limit is near or below the noncancer-based comparison level (i.e., those for which longer-term average concentration estimates are below a long-term health-related reference concentration) are generally of low concern and will generally be considered a low priority for follow-up activity. Pollutants for which the 95% confidence limits extend appreciably above the noncancer-based comparison level are fully discussed below and may be considered a priority for follow-up activity if indicated in light of the full set of information available for the pollutant and the site.
- For lead, we set the noncancer-based comparison level equal to the level of the recently revised national ambient air quality standard (NAAQS). It is important to note that the NAAQS for lead is a 3-month rolling average of lead in total suspended particles. Mean levels for the monitoring data collected in this initiative that indicate the potential for a 3-month average above the level of the standard will be considered a priority for consideration of follow-up actions such as siting of a NAAQS monitor in the area.

In developing or identifying these comparison levels, we have given priority to use of relevant and appropriate air standards and EPA risk assessment guidance and precedents. These levels are based upon health effects information, exposure concentrations and risk estimates developed and assessed by EPA, the U.S. Agency for Toxic Substances and Disease Registry, and the California EPA. These agencies recognize the need to account for potential differences in sensitivity or susceptibility of different groups (e.g., asthmatics) or lifestages/ages (e.g., young children or the elderly) to a particular pollutant's effects so that the resulting comparison levels are relevant for these potentially sensitive groups as well as the broader population.

[25] EPA defines the RfC as "an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a NOAEL, LOAEL, or benchmark concentration, with uncertainty factors generally applied to reflect limitations of the data used. Generally used in EPA's noncancer health assessments." http://www.epa.gov/ncea/iris/help_gloss.htm#r

Appendix B. National Air Toxics Trends Stations Measurements (2004-2008).[a]

TYPE	Pollutant	Units	# Samples Analyzed	% Detections	Maximum	Arithmetic Mean	Geometric Mean	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
Hexavalent Chromium	Chromium VI	ng/m^3	4,233	66%	2.97	0.03	0.03	ND[b]	ND[b]	0.01	0.04	0.13
METAL	Antimony (PM_{10})	ng/m^3	2,372	94%	43.30	1.71	1.21	ND[b]	0.60	1.13	2.17	4.33
METAL	Arsenic (PM_{10})	ng/m^3	5,076	86%	47.70	0.93	0.70	ND[b]	0.29	0.56	1.02	2.89
METAL	Beryllium (PM_{10})	ng/m^3	4,771	64%	1.97	0.05	0.02	ND[b]	ND[b]	<0.01	0.02	0.50
METAL	Cadmium (PM_{10})	ng/m^3	4,793	85%	15.30	0.27	0.17	ND[b]	0.05	0.13	0.29	0.94
METAL	Cobalt (PM_{10})	ng/m^3	2,614	91%	20.30	0.28	0.18	ND[b]	0.08	0.15	0.27	1.00
METAL	Manganese (PM_{10})	ng/m^3	4,793	99%	734.00	10.39	5.20	<0.01	2.41	4.49	9.96	33.78
METAL	Mercury (PM_{10})	ng/m^3	1,167	81%	2.07	0.07	0.04	ND[b]	0.01	0.02	0.06	0.32
METAL	Nickel (PM_{10})	ng/m^3	4,815	90%	110.10	2.05	1.49	ND[b]	0.74	1.44	2.50	5.74
METAL	Selenium (PM_{10})	ng/m^3	2,382	96%	13.00	1.10	0.53	<0.01	0.24	0.53	1.07	5.50

Key Pollutant

[a] The summary statistics in this table represent the range of actual daily HAP measurement values taken at NATTS sites from 2004 through 2008. These data were extracted from AQS in summer 2008 and 2009. During the time period of interest, there were 28 sites measuring VOCs, carbonyls, metals, and hexavalent chromium. We note that some sites did not sample for particular pollutant types during the initial year of the NATTS Program, which was 2004. Most of the monitoring stations in the NATTS network are located such that they are not expected to be impacted by single industrial sources. The concentrations typically measured at NATTS sites can thus provide a comparison point useful to considering whether concentrations measured at a school are likely to have been influenced by a significant nearby industrial source, or are more likely to be attributable to emissions from many small sources or to transported pollution from another area. For example, concentrations at a school above the 75th percentile may suggest that a nearby industrial source is affecting air quality at the school.

[b] No results of this chemical were registered by the laboratory analytical equipment. The value is assumed to be zero.

Appendix C. Analysis of Other (non-key) Air Toxics Monitored at the School and Multiple-pollutant Considerations.

At each school, monitoring has been targeted to get information on a limited set of key hazardous air pollutants (HAPs).[26] These pollutants are the primary focus of the monitoring activities at a school and a priority for us based on our emissions, modeling and other information. In analyzing air samples for these key pollutants, we have also obtained results for some other pollutants that are routinely included with the same test method. Our consideration of the data collected for these additional HAPs is described in the first section below. In addition to evaluating monitoring results for individual pollutants, we also considered the potential for cumulative impacts from multiple pollutants as described in the second section below (See Table C-1).

<u>**Other Air Toxics (HAPs)**</u>

- Do the monitoring data indicate elevated levels of any other air toxics or hazardous air pollutant (HAPs) that pose significant long-term health concerns?
  - → No. Longer-term concentration estimates for the other HAPs monitored are below their long-term comparison levels.
  - → Further, for pollutants with cancer-based comparison levels, longer-term concentration estimates for all but one (arsenic PM_{10}) are more than 100-fold lower than those levels.[27]
  - → Additionally each individual measurement for these pollutants is below the individual sample screening level developed for considering potential short-term exposures for that pollutant.[28]

<u>Additional Information on one HAP:</u>

- The mean and 95 percent upper bound on the mean for the HAP mentioned above (arsenic PM_{10}) are approximately 3-6% of the cancer-based comparison level. Additionally, a review of information available at other sites nationally shows that the mean concentration of arsenic PM_{10} at this site falls between the mean and median of samples collected from 2004 to 2008 (the most recently compiled period) at the NATTS (Appendix B).

---

[26] Section 112(b) of the Clean Air Act identifies 189 hazardous air pollutants, three of which have subsequently been removed from this list. These pollutants are the focus of regulatory actions involving stationary sources described by CAA section 112 and are distinguished from the six pollutants for which criteria and national ambient air quality standards (NAAQS) are developed as described in section 108. One of the criteria pollutants, lead, is also represented, as lead compounds, on the HAP list.

[27] For pollutants with cancer-based comparisonlevels, this would indicate longer-term estimates below continuous (24 hr/day, 7 days/wk) lifetime exposure concentrations associated with 10^{-6} excess cancer risk.

[28] The comparison levels and their use is summarized on the web site and described in detail in *Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results*.

Multiple Pollutants

As described in the main body of the report and background materials, this initiative and the associated analyses are focused on investigation of key pollutants for each school that were identified by previous analyses. This focused design does not provide for the consideration of combined impacts of pollutants or stressors other than those monitored in this project. Broader analyses and those involving other pollutants may be the focus of other EPA activities.[29]

In our consideration of the potential for impacts from key pollutants at the monitored schools, we have also considered the potential for other monitored pollutants to be present at levels that in combination with the key pollutant levels contribute to an increased potential for cumulative impacts. This was done in cases where estimates of longer-term concentrations for any non-key HAPs are within an order of magnitude of their comparison levels even if these pollutant levels fall below the comparison levels. This analysis is summarized below.

- Do the data collected for the air toxics monitored indicate the potential for other monitored pollutants to be present at levels that in combination with the key pollutant levels indicate an increased potential for cumulative impacts of significant concern (e.g., that might warrant further investigation)?
    - → The data collected for the key and other air toxics and the associated longer-term concentration estimates do not together pose significant concerns for cumulative health risk from these pollutants.
        - ▪ Longer-term concentration estimates for all non-key HAPs (and all but one of the key HAPs) are more than an order of magnitude lower than their comparison levels.

[29] General information on additional air pollutants is available at http://www.epa.gov/air/airpollutants.html.

Table C-1. Minnesota International Middle Charter School - Other Monitored Pollutant Analysis.

Parameter	Units	Mean of Measurements[a]	95% Confidence Interval on the Mean	Long-term Comparison Level[b]	
				Cancer-Based[c]	Noncancer-Based[d]
Non-Key HAPs with mean lower than 10% of the lowest comparison level					
Arsenic PM_{10}	ng/m^3	0.82	0.23 - 1.41	23	15
Cadmium PM_{10}	ng/m^3	0.10	0.06 - 0.15	56	10
Antimony PM_{10}	ng/m^3	1.47	0.76 - 2.17	NA	200
Cobalt PM_{10}	ng/m^3	0.10	0.05 - 0.14	NA	100
Selenium PM_{10}	ng/m^3	0.69	0.21 - 1.17	NA	20,000
Beryllium PM_{10}	ng/m^3	0.006 [e]	0.0004 - 0.011 [e]	42	20
Non-Key HAPs with more than 50% ND results.					
Mercury PM_{10}	ng/m^3	50% of results were ND[f]		NA	300 [g]

ng/m^3 nanograms per cubic meter
NA Not Applicable
ND No detection of this chemical was registered by the laboratory analytical equipment. The value is assumed to be zero.

[a] Mean of measurements is the average of all sample results which include actual measured values. If no chemical was registered, then the value is assumed to be zero when calculating the mean.

[b] Details regarding these values are in the technical report, Schools Air Toxics Monitoring Activity (2009) Uses of Health Effects Information.

[c] Air toxics for which the upper 95% confidence limit on the mean concentration is above this level will be fully discussed in the text and may be considered a priority for potential follow-up activities, if indicated in light of the full set of information available for the site. Findings of the upper 95% confidence limit below 1% of the comparison level (i.e., where the upper 95% confidence limit is below the corresponding 1-in-1-million cancer risk based concentration) are generally considered a low priority for follow-up activity. Situations where the summary statistics for a pollutant are below this comparison level but above 1% of this level are fully discussed in the text of the report.

[d] Air toxics for which the upper 95% confidence limit on the mean concentration are near or below the noncancer-based comparison level are generally of low concern and will generally be considered a low priority for follow-up activity. Pollutants for which the 95% confidence limits extend appreciably above the noncancer-based comparison level are fully discussed in the school-specific report and may be considered a priority for follow-up activity, if indicated in light of the full set of information available for the site.

[e] Beryllium was detected in 7 of 12 samples, ranging from 0.0001 to 0.02 ng/m^3. The MDL is 0.03 ng/m^3.

[f] Mercury was detected in only 6 of 12 samples, ranging from 0.01 to 0.04 ng/m^3. The MDL is 1.12 ng/m^3.

[g] The comparison level is specific to elemental mercury, which is more readily and completely absorbed into the body than mercury conveyed on particles (e.g., divalent species).

Appendix D. Minnesota International Middle Charter School Pollutant Concentrations.

Parameter	Units	7/30/2009	8/5/2009	8/11/2009	8/17/2009	8/23/2009	8/29/2009	9/4/2009	9/10/2009	9/16/2009	9/22/2009	9/28/2009	10/4/2009	10/10/2009	Sample Screening Level[a]
Manganese PM_{10}	ng/m^3	6.66	10.9	11.5	7.44	5.33	2.80	21.5	17.0	10.7	6.85	--	1.19	2.24	500
Nickel PM_{10}	ng/m^3	0.42	0.60	1.17	0.50	ND	0.28	4.06	0.84	0.88	0.28	--	0.29	0.15	200
Hexavalent Chromium	ng/m^3	ND	0.01	0.04	ND	ND	ND	0.02	0.02	0.01	ND	--	ND	ND	580
Hexamethylene diisocyanate (1,6-HDI)	µg/m^3	--	ND	ND	ND	ND	ND	ND	ND	ND	--	ND	ND	ND	0.2
Methylenediphenyl Diisocyanate (MDI), 4,4-	µg/m^3	--	ND	ND	ND	ND	ND	ND	ND	ND	--	ND	ND	ND	6
Toluene Diisocyanate, 2,4- (2,4-TDI)	µg/m^3	--	ND	ND	ND	ND	ND	ND	ND	ND	--	ND	ND	ND	0.7
Arsenic PM_{10}	ng/m^3	0.34	0.19	1.95	ND	2.26	0.43	2.67	1.00	0.38	0.10	--	0.39	0.12	150
Cadmium PM_{10}	ng/m^3	0.05	0.12	0.17	0.07	0.16	0.05	0.22	0.20	0.10	0.01	--	0.05	0.02	30
Antimony PM_{10}	ng/m^3	1.04	1.35	2.80	0.94	1.92	0.63	4.18	2.13	0.94	0.62	--	0.72	0.33	2,000
Cobalt PM_{10}	ng/m^3	0.08	0.13	0.17	0.07	ND	0.04	0.25	0.17	0.14	0.07	--	0.02	ND	100
Selenium PM_{10}	ng/m^3	0.38	0.36	0.53	2.59	0.55	0.11	1.69	1.01	0.78	0.26	--	ND	ND	20,000
Beryllium PM_{10}	ng/m^3	ND	0.02	0.02	0.02	ND	0.002	0.0001	ND	0.001	ND	--	0.01	ND	20
Mercury PM_{10}	ng/m^3	0.04	0.04	0.04	0.03	0.01	ND	ND	ND	0.01	ND	--	ND	ND	3,000 [b]

Key Pollutant (yellow shading)

ng/m^3 nanograms per cubic meter

µg/m^3 micrograms per cubic meter

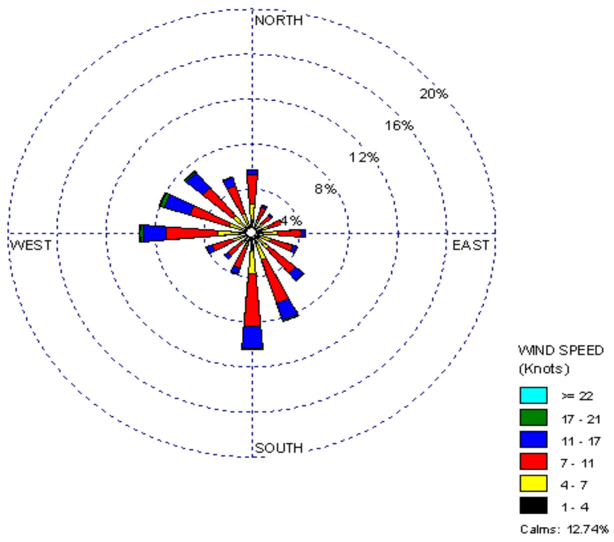
ND No detection of this chemical was registered by the laboratory analytical equipment.

-- No sample was taken for this compund on this day or the sample was invalidated.

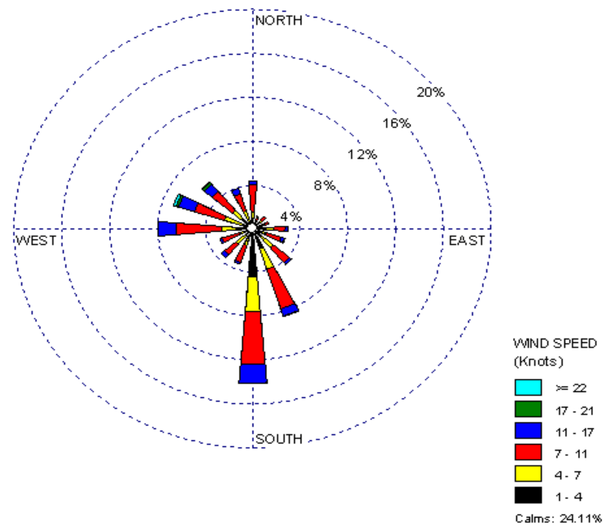
[a] The comparison levels and their use is summarized on the web site and described in detail in Schools Air Toxics Monitoring Activity (2009), "Uses of Health Effects Information in Evaluating Sample Results." These short-term screening levels are based on consideration of exposure all day, every day over a period ranging up to at least a couple of weeks, and longer for some pollutants.

[b] The sample screening level is specific to elemental mercury, which is more readily and completely absorbed into the body than mercury conveyed on particles (e.g., divalent species).

Appendix E. Windrose for Crystal Airport NWS Station.



CRYSTAL AIRPORT NWS Station Composite
Hourly Windrose,
2002-2007[1]



CRYSTAL AIRPORT NWS Station Composite
Hourly Windrose for Full Period
(July 30-October 10, 2009)[1]

[1] **CRYSTAL AIRPORT (WBAN 94960) is 5.92 miles from Minnesota International Middle Charter School.**