SAT Initiative: Additional Monitoring at Follansbee Middle School and Jefferson Primary School
(Follansbee, WV)

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 website (www.epa.gov/schoolair).

I. Executive Summary

- Air monitoring was initially conducted at Follansbee Middle School from August 11, 2009 to December 15, 2009 to assess manganese, arsenic, and other metals in particulate matter less than 10 microns (PM_{10}); benzene and other volatile organic compounds (VOC); and benzo(a)pyrene and other polycyclic aromatic hydrocarbons (PAHs). For the purposes of this study, results from the air monitoring at Follansbee Middle School are considered to be indicative of conditions at the nearby Jefferson Primary School (located within a half mile of Follansbee Middle School).
- This school was selected for monitoring based on information indicating the potential for elevated ambient concentrations of manganese and pollutants associated with coke oven operations, including benzene, arsenic, and benzo(a)pyrene, in air outside the school from several nearby facilities. That information included significant emissions of the key pollutants from EPA's 2002 National-Scale Air Toxics Assessment (NATA) from a nearby coke oven plant and steel facility. Additionally, the school was ranked in the top 25 on the USA Today list due to 2005 Toxics Release Inventory estimates of benzene emissions for a nearby tar plant, steel manufacturing complex, and coke oven plant.
- EPA extended air toxics monitoring at this school because measurements of pollutants associated with coke oven emissions, including benzene, arsenic and benzo(a)pyrene, indicated a potential concern for long-term, continuous exposure to the mixture of pollutants in the air. Information from the original report may be found at: http://www.epa.gov/schoolair/pdfs/FollansbeeTechReport.pdf.
- Additional air monitoring was conducted at this school from October 28, 2011 through August 9, 2012 for: arsenic and other metals in PM_{10}; benzene and other VOCs and benzo(a)pyrene and other PAHs.
- The levels of arsenic (PM_{10}), benzene and benzo(a)pyrene measured in the outdoor air at this school continue to indicate influence of several nearby sources, although benzene levels are appreciably reduced from the initial air monitoring period.
- The coke making facility near Follansbee Middle School was operating between 40 and 100% of capacity with an average operating rate of 70% of capacity during the majority of the time additional monitoring was conducted. However, in June 2012, the facility ceased coke making operations at 3 of the 4 coke batteries. The 3 coke batteries were put in a "hot idle" state by the company and did not produce coke. Currently, the

coke oven gas from the lone operating battery is being cleaned and recycled for use in keeping the other three idled batteries "hot" and available for coke production should market demand increase. In addition, the steel making facility located in Steubenville, Ohio just across the river from Follansbee discontinued operations in 2005. The land has since been sold for redevelopment and the 2 blast furnaces at that location were recently demolished. The Mingo Junction, Ohio steel facilities, located slightly downriver of Follansbee, shut down between 2008 and 2009.

- Based on the analysis described here, EPA does not recommend further monitoring at this school. EPA remains concerned about emissions from sources of air toxics and continues to work to reduce these emissions across the country, through national rules and by providing information and suggestions to assist with reductions in local areas (http://www.epa.gov/ttn/atw/eparules.html).
- The West Virginia Department of Environmental Protection (WVDEP) will continue to oversee industrial facilities in the Follansbee area through air permits and other programs. The Ohio Environmental Protection Agency will continue to oversee industrial facilities to the west of Follansbee on the other side of the Ohio River.

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

Follansbee Middle School was selected for monitoring in consultation with the West Virginia Department of Environmental Protection (WVDEP). For the purposes of this study, results from the air monitoring at Follansbee Middle School are considered to be indicative of conditions at the nearby Jefferson Primary School (located within a half mile of Follansbee Middle School) (Figure 1). We were interested in evaluating the ambient concentrations of manganese and of pollutants associated with coke oven operations, including benzene, arsenic, and benzo(a)pyrene, in air outside the school based on information in EPA's 2002 NATA modeling results for both a nearby coke oven and steel manufacturing complex. Additionally, the school was ranked in the top 25 on the USA Today list due to 2005 Toxics Release Inventory estimates of benzene emissions for several sources including a nearby tar plant, steel manufacturing complex, and coke oven (Figure 1). Monitoring conducted from August 11, 2009 through December 15, 2009 indicated potential for levels of concern for long-term continuous exposure to the mixture of pollutants in areas of this community.

Additional monitoring was conducted at this school from October 28, 2011 through August 9, 2012 collecting: 35 samples which were analyzed for arsenic (PM_{10})[1] and a small standardized set of additional metals; 39 samples which were analyzed for benzo(a)pyrene and a small, standardized set of additional PAHs; and 38 VOC samples which were analyzed for benzene and other VOCs. All sampling methodologies are described in EPA's schools air toxics monitoring plan (http://www.epa.gov/schoolair/techinfo.html).[2]

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[1] 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 is based on.

[2] EPA contractors operated the monitors and sent the filters and canisters to the analytical laboratory under contract to EPA.

III. Monitoring Results and Analysis

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

- The air sampling data collected over the ten-month sampling period for the monitored pollutants commonly associated with coke oven emissions, including benzene, arsenic, and benzo(a)pyrene, indicate influence from nearby sources.
- The air sampling data collected over the ten-month sampling period for two of these three monitored pollutants indicate levels similar to levels in prior sampling period. Levels of benzene, however, are appreciably lower.

A. Chemical Concentrations

Benzene, Arsenic, and Benzo(a)pyrene, key pollutants:

- Do the monitoring data indicate influence from nearby sources?
  - → The monitoring data include several benzene, arsenic (PM_{10}), and benzo(a)pyrene concentrations[3] that are higher than concentrations commonly observed in other locations nationally.
- Do the monitoring data indicate elevated levels that pose significant long-term health concerns?
  - → The monitoring data for these pollutants indicate longer-term concentration estimates to be below their long-term comparison levels.
    - The estimate of longer-term benzene concentration (i.e., the upper bound of the 95 percent confidence interval on the mean of the dataset) is less than the long-term cancer-based comparison levels (Table 1 and Figure 2a).[4] These comparison levels are based on consideration of continuous exposure concentrations (24 hours a day, all year, over a lifetime).
      - The longer-term concentration estimate is 35% of the cancer-based comparison level, indicating the longer-term estimate falls between continuous (24 hours a day, 7 days a week) lifetime exposure concentrations associated with 1-in-100,000 and 1-in-10,000 additional cancer risk.
      - We did not identify any concerns regarding short-term exposures during the ten-month sampling period, as each individual measurement

[3] For example, 24 of the concentrations of benzene, 24 of the concentrations of arsenic (PM_{10}), and 35 of the concentrations of benzo(a)pyrene at this site (Table 2) were higher than 75 percent of samples collected at the National Air Toxics Trends Stations (NATTS) from 2003-2010 (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 of indicating potential influence from a source nearby to the school.
[4] The upper end of the interval is only 1.4 times the mean of the monitoring data and approximately 35% of the long-term cancer-based comparison level.

is below the individual sample screening level for benzene (which is based on consideration of exposure all day, every day over a period ranging from a couple of weeks to longer for some pollutants).[5]

- The estimate of longer-term arsenic (PM_{10}) concentration (i.e., the upper bound of the 95 percent confidence interval on the mean of the dataset) is below the long-term comparison levels (Table 1 and Figure 2b).[6] These comparison levels are based on consideration of continuous exposure concentrations (24 hours a day, all year, over a lifetime).
  - The longer-term concentration estimate is more than tenfold lower than the cancer-based comparison level, indicating the longer-term estimate is below a continuous (24 hours a day, 7 days week) lifetime exposure concentration associated with 1-in-100,000 additional cancer risk.
  - We did not identify any concerns regarding short-term exposures during the ten-month sampling period, as each individual measurement is below the individual sample screening level for arsenic (which is based on consideration of exposure all day, every day over a period ranging from a couple of weeks to longer for some pollutants).[6]
- The estimate of longer-term benzo(a)pyrene concentration (i.e., the upper bound of the 95 percent confidence interval on the mean of the dataset) is below the long-term comparison level (Table 1 and Figure 2c).[7] This comparison level is based on consideration of a continuous exposure concentration (24 hours a day, all year, over a lifetime).
  - The longer-term concentration estimate is more than tenfold lower than the cancer-based comparison level, indicating the longer-term estimate is below a continuous (24 hours a day, 7 days a week) lifetime exposure concentration associated with 1-in-100,000 additional cancer risk.
  - We did not identify any concerns regarding short-term exposures during the ten-month sampling period, as each individual measurement is below the individual sample screening level for benzo(a)pyrene (which is based on consideration of exposure all day, every day over a period ranging from a couple of weeks to longer for some pollutants).[6]

<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?

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[5] This is described in detail in *Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results*.
[6] The upper end of the interval is only 1.2 times the mean of the monitoring data and approximately 9% of the long-term noncancer-based comparison level.
[7] The upper end of the interval is only 1.4 times the mean of the monitoring data and less than 4% of the long-term cancer-based comparison level.

→ With the exception of chromium, the monitoring data for the other HAPs monitored indicate longer-term concentration estimates below their long-term comparison levels (Appendix C). The comparison values for chromium are conservatively based on the most toxic form of chromium (hexavalent chromium, Cr^{+6}), which is only a fraction of the chromium in the ambient air. However, the combined presence of the key and other HAPs monitored indicate the potential for levels of concern for long-term, continuous exposure to the mixture of pollutants, particularly in areas of the community closer to the source of emissions.

Multiple Pollutants:

- 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 concentrations estimates indicate levels near those that might pose concerns for cumulative health risk from these pollutants (Appendix D).[8]

B. 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 Follansbee Middle School collected wind speed and wind direction measurements beginning on October 1, 2011 and ending on October 23, 2012. As a result, on-site data for these meteorological parameters are available for all dates of sample collection, and also for a period before and after the sampling period, producing a continuous record of over one year of on-site meteorological data. The meteorological data collected at the school site on sampling days are presented in Table 2 and Figures 3a-3c.

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[8] 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 are 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.

The nearest NWS station is at Wheeling-Ohio County Airport in Wheeling, WV. This station is approximately 11 miles south 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 one of the nearby key sources was contributing to conditions at the school location.
- The wind patterns at the monitoring site across sampling dates are similar to those observed across the record of on-site meteorological data during the sampling period.
- The NWS station at Wheeling-Ohio County Airport appears to represent the specific wind flow patterns at the school location. The historical data from the NWS station indicates that the winds are predominantly from the southwest, which was also the predominant wind direction during the ten-month monitoring event.

- What is the direction of the key sources of benzene, arsenic, and benzo(a)pyrene emissions in relation to the school location?
  - → The key sources of benzene, arsenic, and benzo(a)pyrene are identified as a coke plant and a tar plant located less than 1 to 1.5 miles west-northwest to northwest of the school. The steel manufacturing complex in Ohio was not operating during the sampling period and has closed down. This source will not be included in this analysis.
  - → Using the property boundaries of the full facilities (in lieu of information regarding the location of specific sources of benzene, arsenic, and benzo(a)pyrene emissions at the facility), we have identified an approximate range of wind directions to use in considering the potential influence of these facilities on air concentrations at the school.
  - → This general range of wind directions, from approximately 270 to 326 degrees, is referred to here as the expected zone of source influence (ZOI).

- On days the air samples were collected, how often did wind come from direction of the key source?
  - → For arsenic, there were 19 out of 35 days in which the on-site wind data had a portion of the winds from the expected ZOI. For benzene and benzo(a) pyrene there were 22 out of 38 and 39 sampling days respectively in which the on-site wind data had a portion of the winds from the ZOI (Figures 3a-3c, 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 for benzene, arsenic, and benzo(a)pyrene appear similar to those observed over the record of on-site meteorological data during the sampling period.

→ We note that the wind patterns at the nearest NWS station (Wheeling-Ohio County Airport) during the sampling period are similar to those recorded at the NWS station over the long-term (2002-2012 period; Appendix E), supporting the idea that regional meteorological patterns in the area during the monitoring period were consistent with long-term patterns. Winds in the area are generally from the south west during the majority of the year.

- How do wind patterns at the school compare to those at the Wheeling-Ohio County Airport NWS station, particularly with regard to prevalent wind directions and the direction of the key source?
  → During the sampling period for which data are available both at the school site and at the reference NWS station (approximately 10 months), prevalent winds at both locations are predominantly from the southwest. (Figures 3a-3c and Appendix E)

V. Key Source Information

- Was the source operating as usual during the monitoring period?
  - The nearby sources of benzene, arsenic, and benzo(a)pyrene have operating permits issued by WVDEP that include operating requirements.[9]
  - Information from the nearby sources indicates that the steel manufacturing complex directly across the river in Steubenville, Ohio closed in 2005 (prior to the additional monitoring that took place). The Mingo Junction, Ohio steel facilities, located slightly downriver of Follansbee, shut down between 2008 and 2009.
  - The coke plant was operating at a rate between 40% and 100% of capacity during the sampling period with an average operating rate of 70% of capacity. Of the four total batteries, batteries 1, 2, and 3 were placed on idle in June 2012, approximately 2 months prior to the end of the ten-month sampling period. Emissions during this 2 month period would have been less than that of the preceding 10 months of sampling. With the 3 batteries on idle, the coke plant is expected to be operating at less than normal capacity in the foreseeable future. Production rates at the coke battery are variable and market driven. The tar plant was operating at normal capacity (46%) during the sampling period.
  - The most recently available benzene emissions data from the tar plant (2011 TRI) are lower than those relied upon in previous modeling analysis for this area (2002 NATA, 2005 TRI). Arsenic and benzo(a)pyrene were not reported at this facility since 2005 TRI, which may indicate that the release levels for these pollutants were below reporting thresholds.
  - The most recently available benzene emissions from the coke oven (43.5 tpy in the 2011 TRI) are lower than the 2002 NATA (52.1 tpy). However, the facility has

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

shown an increase in benzene emissions in 2010 TRI and 2011 TRI when compared to previous TRI reporting years.

VI. Integrated Summary and Next Steps

A. Summary of Key Findings

1. What are the key HAPs for this school?
   - → Benzene, arsenic, and benzo(a)pyrene are the key HAPs for this school, identified based on emissions information considered in identifying the school for monitoring. The ambient air concentrations on multiple 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?
   - → The data collected for pollutants associated with coke oven emissions, including benzene, arsenic and benzo(a)pyrene and other monitored pollutants indicate levels near those that might pose concern for long-term continuous exposure to this mixture of pollutants in the air. Levels of benzene measured during this additional period were appreciably lower than those initially measured.
   - → Additionally, the steel facility across the river in Steubenville, Ohio shut down in 2005 and the 2 blast furnaces were recently demolished. The Mingo Junction, Ohio steel facilities, located slightly downriver of Follansbee, shut down between 2008 and 2009. (prior to the additional monitoring that took place). The coke plant was operating at 40% to 100% of capacity during monitoring with an average operating rate of 70% of capacity. Batteries 1, 2, and 3 were placed on hot idle in June 2012, approximately 2 months prior to the end of the ten-month sampling period. The coke plant has since been operating at less than normal capacity, and will be in the foreseeable future.
   - → EPA remains concerned about emissions from sources of air toxics and continues to work to reduce these emissions across the country, through national rules and by providing information and suggestions to assist with reductions in local areas.

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 appear to reflect air concentrations during the entire monitoring period, with no indications from the on-site meteorological data that the sampling day conditions were inconsistent with conditions overall during this period.
   - → 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 patterns at the nearest NWS station during the sampling period appear to be representative of long-term wind flow at that station.

B. Next Steps for Key Pollutants

1. Based on the analysis described here, EPA does not plan to extend air toxics monitoring at this school.
2. EPA remains concerned about emissions from sources of air toxics and continues to work to reduce these emissions across the country, through national rules and by providing information and suggestions to assist with reductions in local areas (http://www.epa.gov/ttn/atw/eparules.html).
3. The West Virginia Department of Environmental Protection (WVDEP) will continue to oversee industrial facilities in the Follansbee area through air permits and other programs. The Ohio Environmental Protection Agency will continue to oversee industrial facilities to the west of Follansbee on the other side of the Ohio River.

VII. Figures and Tables

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2. Follansbee Middle School Key Pollutant Concentrations and Meteorological Data.

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2b. Follansbee Middle School – Key Pollutant (Arsenic (PM_{10})) Analysis.

2c. Follansbee Middle School – Key Pollutant (Benzo(a)pyrene) Analysis.

3a. Follansbee Middle School (Follansbee, WV) Benzene Concentration and Wind Information.

3b. Follansbee Middle School (Follansbee, WV) Arsenic (PM_{10}) Concentration and Wind Information.

3c. Follansbee Middle School (Follansbee, WV) Benzo(a)pyrene Concentration and Wind Information.

VIII. Appendices

A. Summary Description of Long-term Comparison Levels.

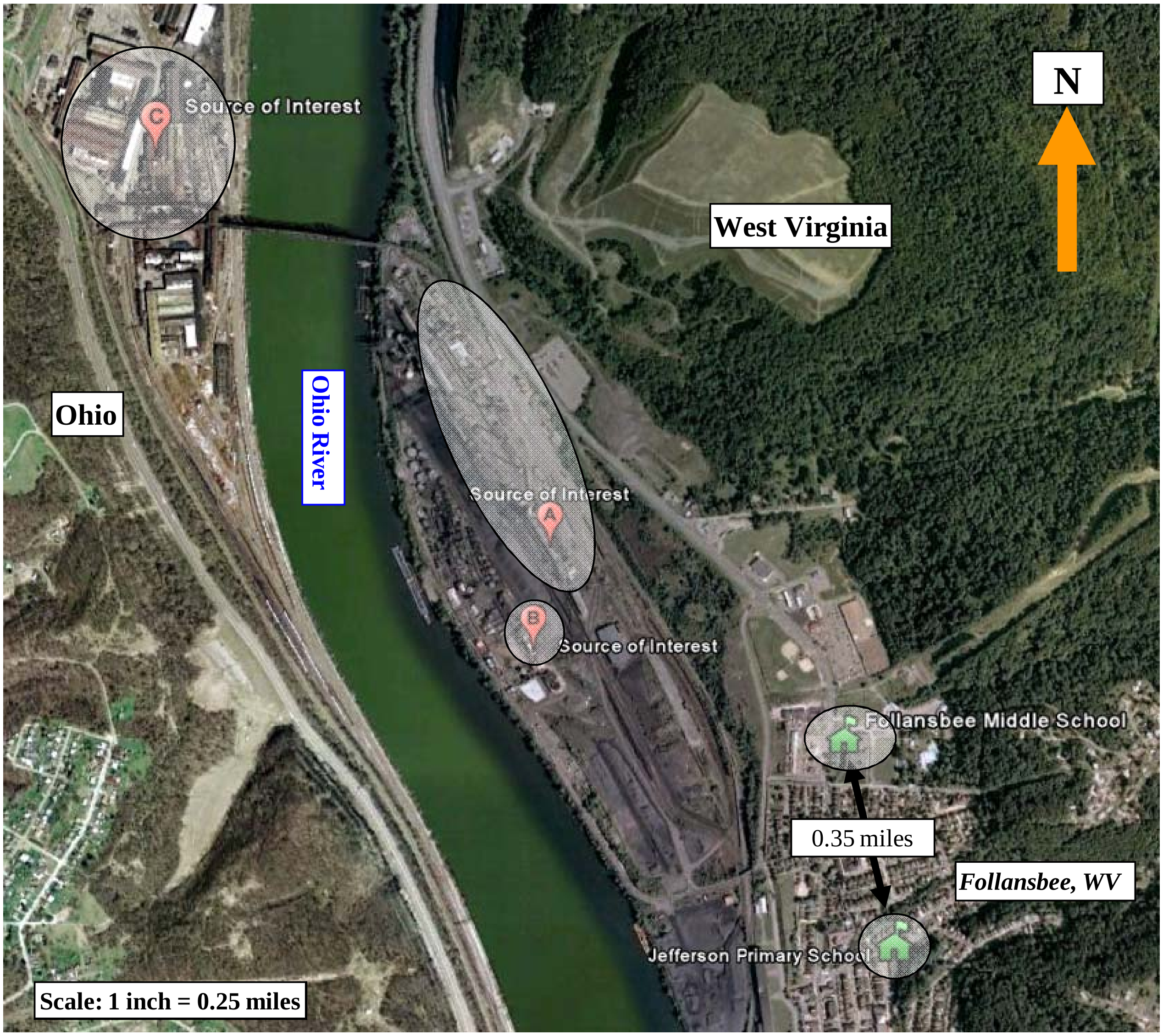
B. National Air Toxics Trends Stations Measurements (2003-2010).

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

D. Follansbee Middle School Pollutant Concentrations.

E. Windroses for Wheeling-Ohio County Airport NWS Station.

Figure 1. Follansbee Middle School, Jefferson Primary School, and the Sources of Interest (A,B,C).



Source of Interest	Distance to Follansbee Middle School (miles)
Coke Plant (A)	0.54
Tar Plant (B)	0.50
Steel Manufacturing Facility (C)	1.40

Table 1. Follansbee Middle School - Key Pollutant Analysis.

Parameter	Units	Mean of Measurements	95% Confidence Interval on the Mean	Long-term Comparison Cancer-Based[b]	Long-term Comparison Noncancer-Based[c]
Benzene	$\mu g/m^3$	3.34 [d]	2.09 - 4.59	13	30
Arsenic (PM_{10})	ng/m^3	1.20 [e]	1.01 - 1.38	23	15
Benzo(a)pyrene	ng/m^3	1.46 [f]	0.98 - 1.94	57	NA

$\mu g/m^3$ micrograms per cubic meter
ng/m^3 nanograms per cubic meter
NA Not available

[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 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.

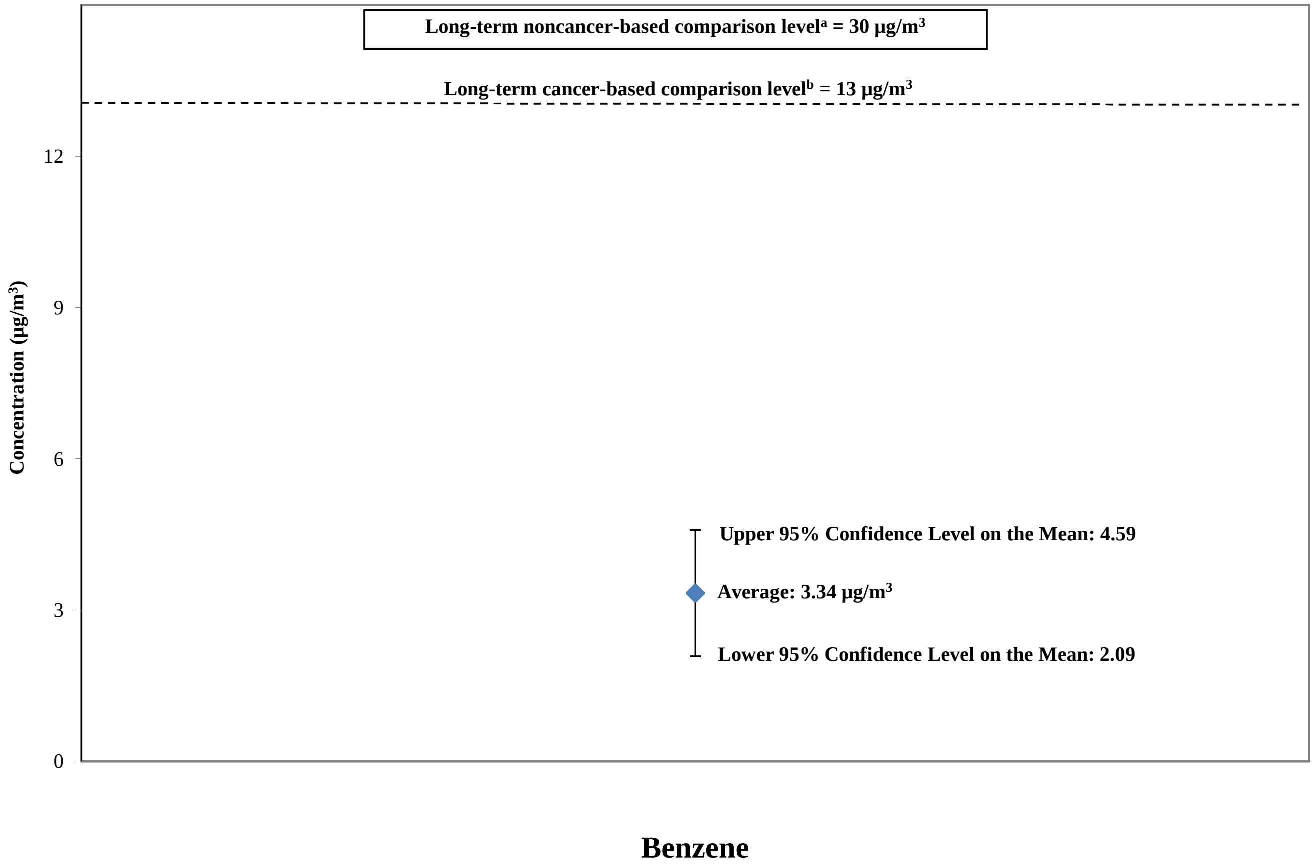
[c] Air toxics for which the upper 95% confidence limit on the mean concentration are near or below the noncancer-based comparison level are generally of low concern and will generally be considered a low priority for follow-up activity. Pollutants for which the 95% confidence limits extend appreciably 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 benzene is the average of all sample results, which include 38 detections that ranged from 0.43 to 20.2 $\mu g/m^3$.

[e] The mean of measurements for arsenic (PM_{10}) is the average of all sample results, which include 35 detections that ranged from 0.41 to 2.73 ng/m^3.

[f] The mean of measurements for benzo(a)pyrene is the average of all sample results, which include 39 detections that ranged from 0.051 to 5.63 ng/m^3.

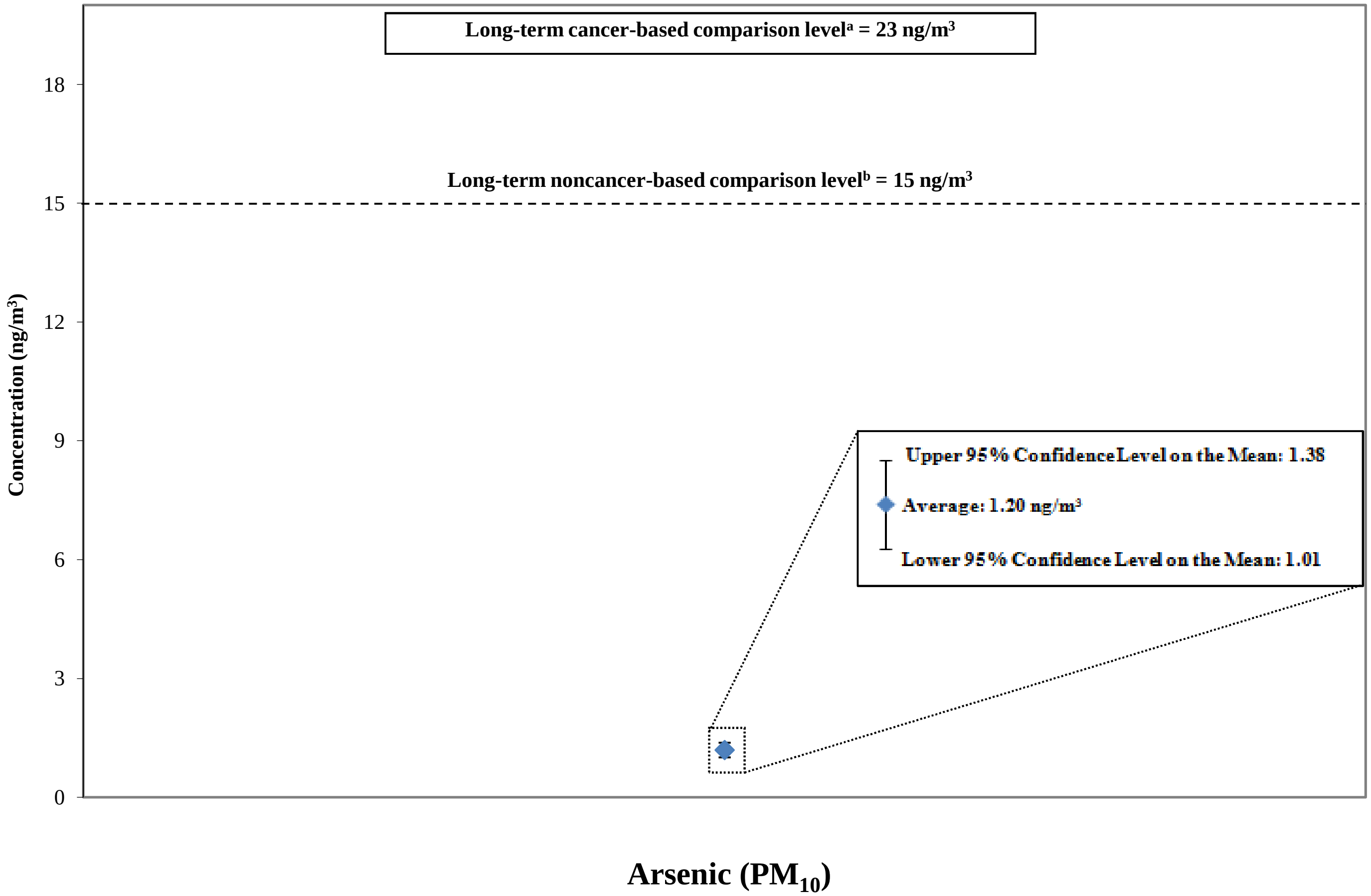
Figure 2a. Follansbee Middle School - Key Pollutant (Benzene) Analysis.



[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.

[b] 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.

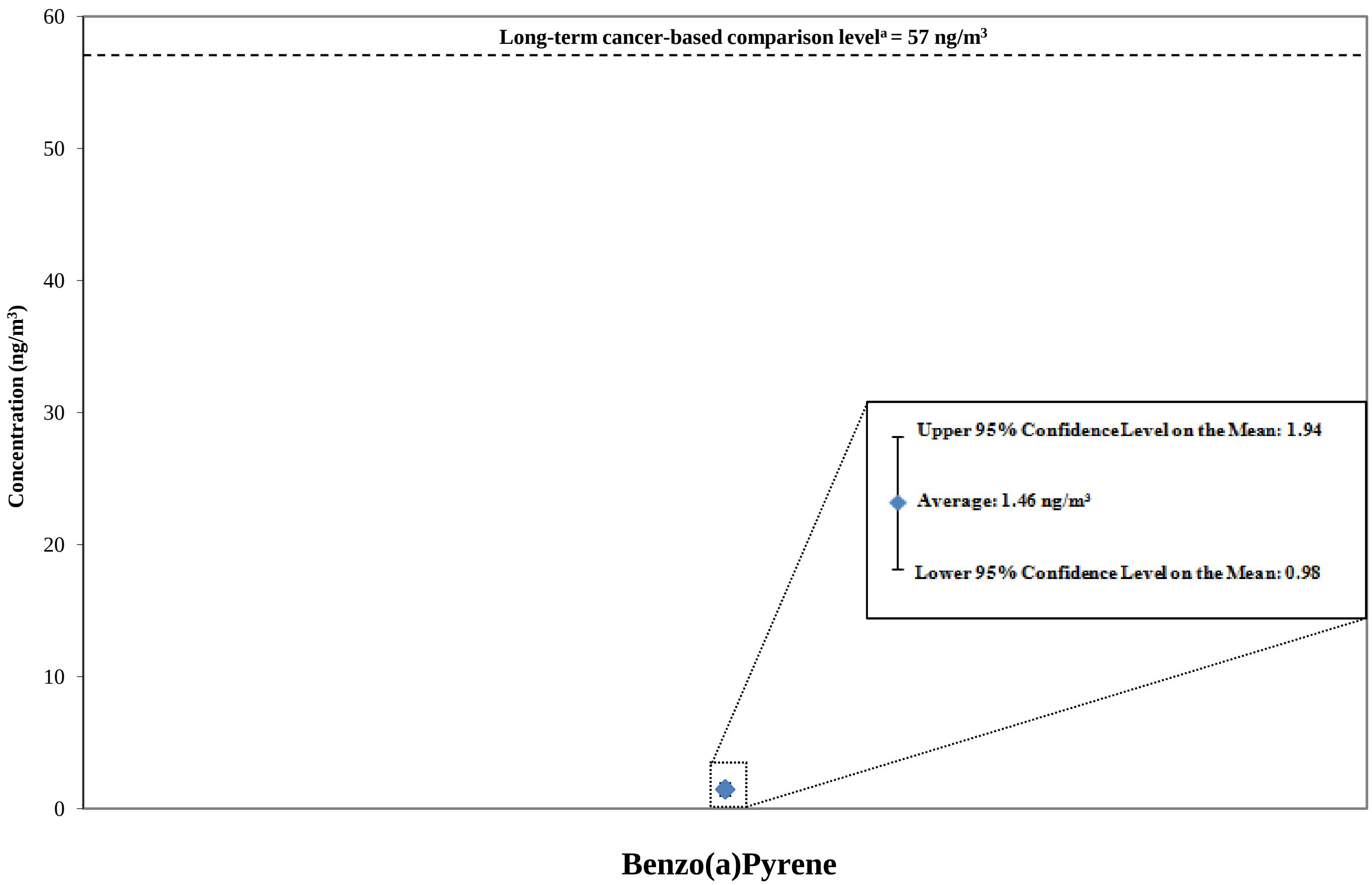
Figure 2b. Follansbee Middle School - Key Pollutant (Arsenic (PM_{10})) Analysis.



[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.

Figure 2c. Follansbee Middle School - Key Pollutant (Benzo(a)Pyrene) 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.

Table 2. Follansbee Middle School Key Pollutant Concentrations and Meteorological Data.

Parameter	Units	10/28/2011	11/1/2011	11/2/2011	11/8/2011	11/9/2011	11/14/2011	12/1/2011	12/7/2011	12/13/2011	12/19/2011	12/29/2011	1/4/2012	1/10/2012	1/19/2012	1/25/2012	1/31/2012	2/6/2012	2/15/2012	2/21/2012	2/27/2012	3/15/2012
Benzene	µg/m^3	--	1.09	--	1.09	--	0.76	1.73	3.15	1.85	0.69	0.43	0.86	7.06	2.59	1.84	0.59	1.54	8.27	0.97	3.06	0.58
Arsenic (PM_{10})	ng/m^3	--	--	1.12	1.22	--	0.65	1.19	0.71	2.73	0.41	0.46	0.87	1.90	0.98	1.45	0.54	1.12	1.94	0.51	1.05	1.01
Benzo(a)pyrene	ng/m^3	0.90	--	0.39	--	0.34	0.32	1.37	2.13	1.36	0.11	0.09	0.21	3.77	4.88	0.87	0.11	1.61	1.70	0.35	3.93	0.10
% Hours w/Wind Direction from Expected ZOI[a]	%	0.0	0.0	0.0	0.0	0.0	4.2	0.0	29.2	0.0	0.0	0.0	0.0	0.0	45.8	0.0	0.0	4.2	0.0	4.2	33.3	0.0
Wind Speed (avg. of hourly speeds)	mph	4.2	3.8	5.8	4.9	10.6	14.3	3.0	10.2	3.6	9.4	12.1	9.4	5.8	9.0	4.4	12.9	6.6	6.6	11.4	11.3	8.7
Wind Direction (avg. of unitized vector)[b]	deg.	53.8	168.5	175.3	164.5	178.4	220.1	278.9	265.1	166.0	236.5	199.3	203.1	153.6	288.5	71.8	223.2	245.3	153.8	226.5	269.3	209.9
% of Hours with Speed below 2 knots	%	33.3	29.2	4.2	20.8	0.0	0.0	45.8	0.0	16.7	0.0	0.0	0.0	0.0	16.7	12.5	0.0	4.2	0.0	0.0	16.7	0.0
Daily Average Temperature	° F	37.3	45.0	52.5	57.0	58.3	64.8	33.3	35.9	35.1	39.5	33.4	21.7	37.8	24.4	31.3	52.0	35.5	36.2	40.2	44.7	62.3
Daily Precipitation	inches	0.01	0.00	0.00	0.00	0.14	1.08	0.00	0.03	0.09	0.24	0.01	0.00	0.00	0.04	0.22	0.10	0.00	0.20	0.03	0.00	0.15

Parameter	Units	3/21/2012	3/27/2012	4/2/2012	4/12/2012	4/18/2012	4/24/2012	4/30/2012	5/10/2012	5/16/2012	5/22/2012	5/29/2012	6/4/2012	6/14/2012	6/21/2012	6/27/2012	7/2/2012	7/9/2012	7/23/2012	8/2/2012	8/9/2012
Benzene	µg/m^3	8.34	1.16	5.94	4.19	2.00	10.42	20.19	6.36	0.88	3.35	1.50	0.56	5.88	1.29	3.07	4.82	2.69	0.65	4.82	0.61
Arsenic (PM_{10})	ng/m^3	1.81	--	1.16	0.99	1.59	1.54	1.53	1.44	0.62	2.29	--	--	1.19	0.57	1.98	1.01	1.23	1.05	1.19	0.87
Benzo(a)pyrene	ng/m^3	2.97	0.79	2.88	1.56	0.51	5.63	4.52	2.54	0.73	1.79	0.64	0.19	2.51	0.14	1.18	0.71	0.62	0.05	2.44	0.07
% Hours w/Wind Direction from Expected ZOI[a]	deg.	0.0	0.0	8.3	41.7	4.2	37.5	4.2	54.2	4.2	66.7	12.5	4.2	0.0	20.8	37.5	12.5	12.5	0.0	20.8	16.7
Wind Speed (avg. of hourly speeds)	inches	6.1	7.9	5.9	4.9	4.5	9.2	9.6	6.8	8.7	4.6	5.7	8.1	6.9	6.5	6.9	4.2	4.7	7.9	3.5	5.4
Wind Direction (avg. of unitized vector)[b]	mph	94.8	171.7	29.7	15.0	166.2	253.1	232.9	268.7	23.9	308.3	208.6	12.2	96.7	253.4	231.1	243.1	14.9	220.9	116.5	184.2
% of Hours with Speed below 2 knots	deg.	16.7	0.0	0.0	8.3	4.2	4.2	0.0	12.5	0.0	4.2	4.2	0.0	0.0	8.3	0.0	16.7	37.5	0.0	37.5	4.2
Daily Average Temperature	inches	67.3	41.5	48.3	43.7	53.1	47.0	66.3	52.1	62.3	63.3	72.7	61.2	67.5	81.0	71.3	76.2	75.3	76.2	76.0	72.8
Daily Precipitation	mph	0.00	0.00	0.00	0.01	0.00	0.00	0.24	0.00	0.01	0.01	0.59	0.00	0.00	0.10	0.00	0.00	0.00	0.04	0.00	0.29

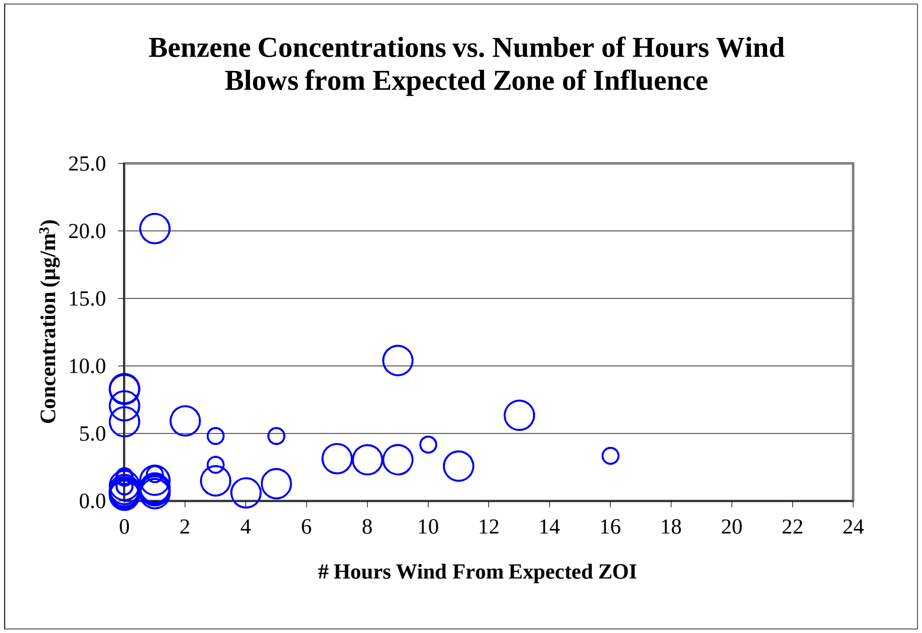
(yellow shading) All precipitation and temperature data were from the Wheeling-Ohio County Airport NWS Station (WBAN 14894).

[a] Based on count of hours for which vector wind direction is from expected zone of influence.

[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).

-- No sample was conducted for this pollutant on this day or the result was invalidated

Figure 3a. Follansbee Middle School - Benzene Concentrations and Wind Information.



KEY

Pollutant: Benzene
Timeframe: October 27, 2011 - August 9, 2012

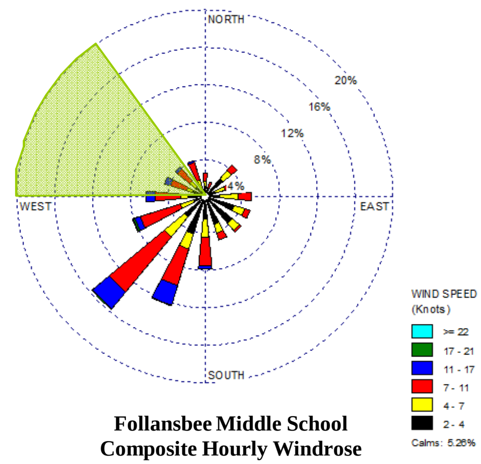
Wind Speed: 0.1-2.5 mph

Wind Speed: 2.5-5.0 mph

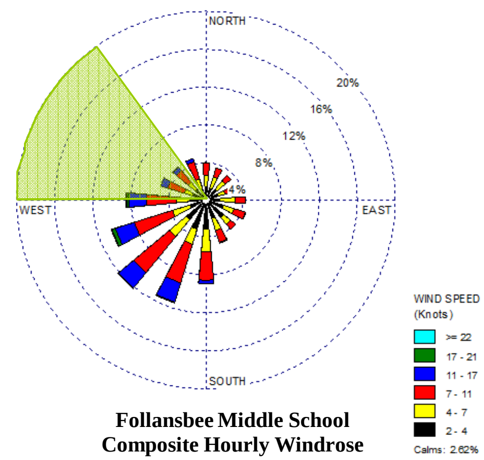
Wind Speed: > 5.0 mph

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.



Follansbee Middle School Composite Hourly Windrose on Sample Days (October 27, 2011- August 9, 2012)

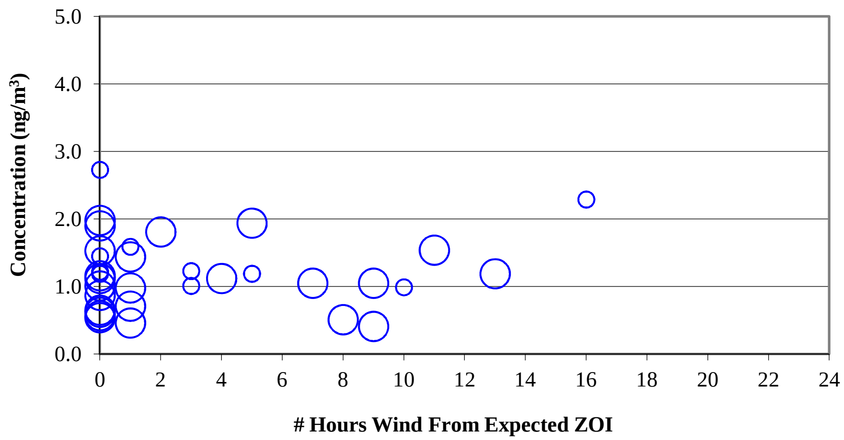


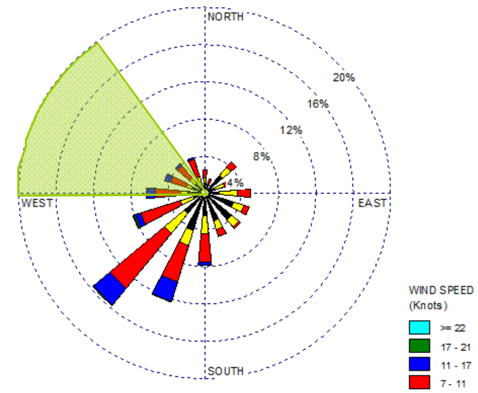
Follansbee Middle School Composite Hourly Windrose Across Sampling Period (October 27, 2011- August 9, 2012)

Expected Zone of Source Influence

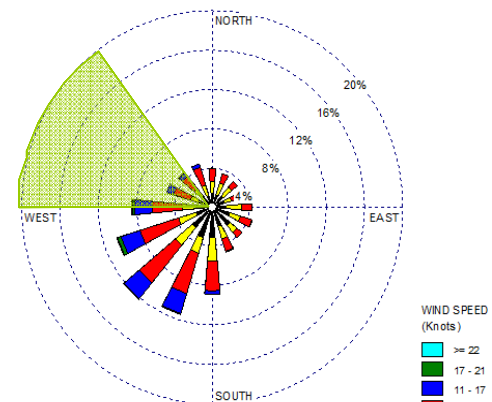
Figure 3b. Follansbee Middle School - Arsenic (PM_{10}) Concentrations and Wind Information.

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





Follansbee Middle School
Composite Hourly Windrose
on Sample Days
(October 27, 2011- August 9, 2012)



Follansbee Middle School
Composite Hourly Windrose
Across Sampling Period
(October 27, 2011- August 9, 2012)

Expected Zone of Source Influence

KEY

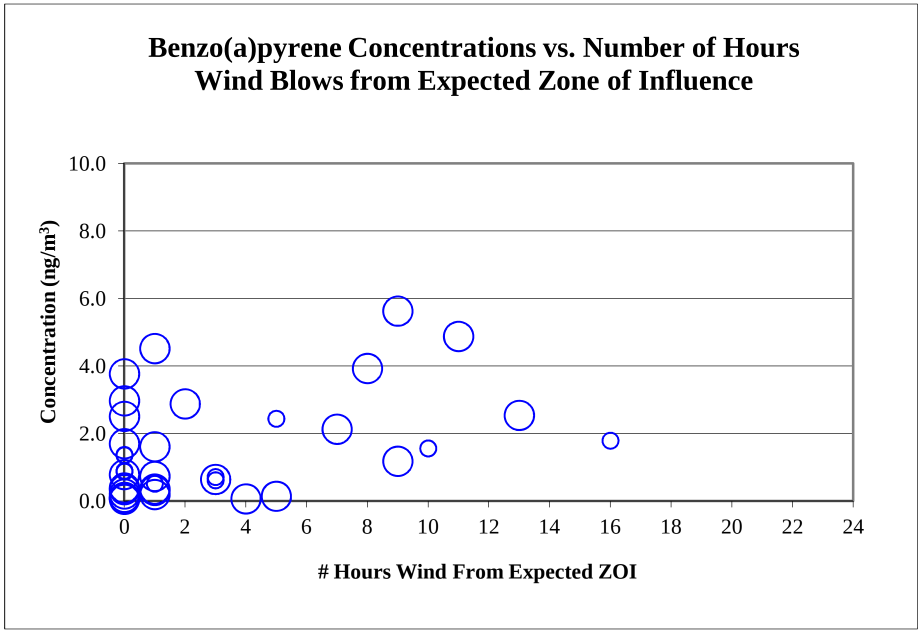
Pollutant: Arsenic (PM_{10})
Timeframe: October 27, 2011 - August 9, 2012

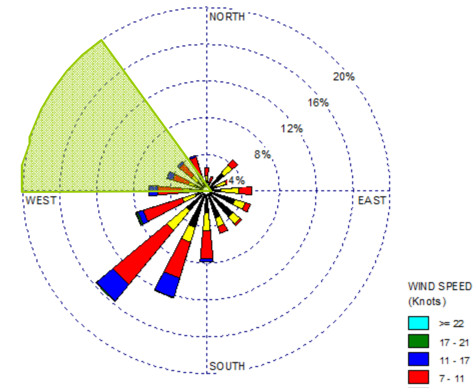
Wind Speed: 0.1-2.5 mph
Wind Speed: 2.5-5.0 mph
Wind Speed: > 5.0 mph

Note

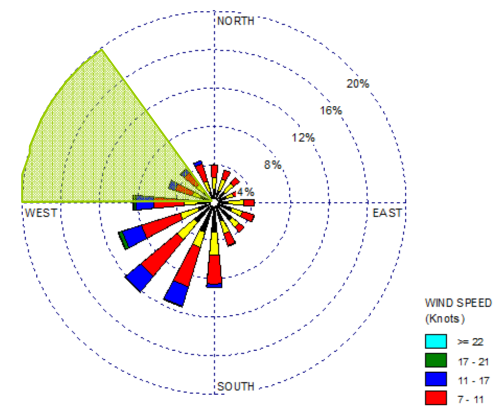
Each circle denotes a 24-hour collection of air for chemical analysis. The size of the circle indicates the magnitude of the wind speed for that day (wind data shown in Table 2). The expected zone of source influence is a rough approximation of the range of directions from which winds carrying chemicals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

Figure 3c. Follansbee Middle School - Benzo(a)pyrene Concentrations and Wind Information.





Follansbee Middle School
Composite Hourly Windrose
on Sample Days
(October 27, 2011- August 9, 2012)



Follansbee Middle School
Composite Hourly Windrose
Across Sampling Period
(October 27, 2011- August 9, 2012)

Expected Zone of Source Influence

KEY

Pollutant: Benzo(a)pyrene
Timeframe: October 27, 2011 - August 9, 2012

<u>Note</u>

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

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.[10]

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.[11] 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.

[10] These comparison levels are described in more detail *Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results.*
[11] 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.[12] 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.

[12] 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 (2003-2010).[a]

Pollutant	Units	# Samples Analyzed	% Detections	Maximum	Arithmetic Mean[b]	Geometric Mean	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
Acetonitrile	$\mu g/m^3$	3,419	72%	554.05	8.24	0.90	ND	ND	0.35	0.94	26.11
Acrylonitrile	$\mu g/m^3$	5,848	28%	5.51	0.04	0.07	ND	ND	ND	0.02	0.22
Benzene	$\mu g/m^3$	13,170	96%	43.14	1.08	0.82	0.10	0.46	0.77	1.28	3.00
Benzyl Chloride	$\mu g/m^3$	5,081	10%	2.49	<0.01	0.04	ND	ND	ND	ND	0.05
Bromoform	$\mu g/m^3$	4,699	4%	1.45	0.01	0.15	ND	ND	ND	ND	ND
Bromomethane	$\mu g/m^3$	8,793	58%	120.76	0.08	0.05	ND	ND	0.03	0.05	0.12
Butadiene, 1,3-	$\mu g/m^3$	12,030	71%	18.81	0.14	0.10	ND	ND	0.06	0.14	0.48
Carbon disulfide	$\mu g/m^3$	3,350	91%	46.71	1.97	0.22	ND	0.03	0.09	0.46	12.38
Carbon tetrachloride	$\mu g/m^3$	10,861	90%	9.00	0.54	0.57	ND	0.48	0.57	0.65	0.85
Chlorobenzene	$\mu g/m^3$	9,475	28%	1.68	0.02	0.03	ND	ND	ND	<0.01	0.09
Chloroethane	$\mu g/m^3$	7,450	35%	0.58	0.02	0.04	ND	ND	ND	0.03	0.08
Chloroform	$\mu g/m^3$	11,146	77%	145.50	0.20	0.15	ND	0.02	0.10	0.20	0.63
Chloromethane	$\mu g/m^3$	9,233	95%	19.70	1.18	1.21	0.49	1.04	1.20	1.36	1.67
Chloroprene	$\mu g/m^3$	3,749	8%	0.33	<0.01	0.03	ND	ND	ND	ND	0.02
Dichlorobenzene, *p*-	$\mu g/m^3$	8,924	59%	17.50	0.16	0.14	ND	ND	0.05	0.14	0.85
Dichloroethane, 1,1-	$\mu g/m^3$	9,296	16%	0.81	<0.01	0.02	ND	ND	ND	ND	0.03
Dichloroethylene, 1,1-	$\mu g/m^3$	9,047	18%	0.56	<0.01	0.03	ND	ND	ND	ND	0.04
Dichloromethane	$\mu g/m^3$	10,727	84%	5245.19	2.06	0.43	ND	0.17	0.33	0.61	2.08
Dichloropropane, 1,2-	$\mu g/m^3$	10,467	17%	2.99	0.02	0.04	ND	ND	ND	ND	0.05
Dichloropropylene, *cis* -1,3-	$\mu g/m^3$	9,754	15%	11.03	0.02	0.04	ND	ND	ND	ND	0.04
Dichloropropylene, *trans* -1,3-	$\mu g/m^3$	9,728	16%	8.78	0.02	0.04	ND	ND	ND	ND	0.04
Ethyl acrylate	$\mu g/m^3$	3,159	1%	0.20	<0.01	0.04	ND	ND	ND	ND	ND
Ethylbenzene	$\mu g/m^3$	12,641	84%	10.43	0.41	0.31	ND	0.10	0.25	0.52	1.31
Ethylene dibromide	$\mu g/m^3$	9,769	17%	4.97	0.02	0.05	ND	ND	ND	ND	0.05
Ethylene dichloride	$\mu g/m^3$	10,247	39%	4.49	0.04	0.06	ND	ND	ND	0.04	0.12
Hexachloro-1,3-butadiene	$\mu g/m^3$	6,263	19%	2.13	0.02	0.10	ND	ND	ND	ND	0.15
Methyl chloroform	$\mu g/m^3$	9,942	67%	6.44	0.08	0.09	ND	ND	0.06	0.11	0.21
Methyl isobutyl ketone	$\mu g/m^3$	4,968	60%	5.28	0.10	0.09	ND	ND	0.02	0.12	0.43

Appendix B. National Air Toxics Trends Stations Measurements (2003-2010).[a]

Pollutant	Units	# Samples Analyzed	% Detections	Maximum	Arithmetic Mean[b]	Geometric Mean	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
Methyl methacrylate	µg/m^3	3,243	7%	14.05	0.08	0.34	ND	ND	ND	ND	0.11
Methyl *tert* -butyl ether	µg/m^3	7,249	37%	37.50	0.30	0.13	ND	ND	ND	0.03	1.80
Styrene	µg/m^3	12,381	64%	40.72	0.15	0.11	ND	ND	0.04	0.14	0.55
Tetrachloroethane, 1,1,2,2-	µg/m^3	9,538	19%	4.44	0.02	0.05	ND	ND	ND	ND	0.07
Tetrachloroethylene	µg/m^3	11,083	73%	518.86	0.38	0.20	ND	ND	0.14	0.27	0.90
Toluene	µg/m^3	12,418	96%	482.53	2.47	1.58	0.11	0.75	1.51	3.01	7.67
Trichlorobenzene, 1,2,4-	µg/m^3	7,018	21%	45.27	0.05	0.08	ND	ND	ND	ND	0.15
Trichloroethane, 1,1,2-	µg/m^3	8,544	17%	5.89	<0.01	0.04	ND	ND	ND	ND	0.04
Trichloroethylene	µg/m^3	11,085	47%	89.74	0.08	0.08	ND	ND	ND	0.05	0.27
Vinyl chloride	µg/m^3	10,722	20%	1.65	0.01	0.02	ND	ND	ND	ND	0.04
Xylene, *m/p-*	µg/m^3	12,128	91%	24.46	1.09	0.71	ND	0.29	0.65	1.35	3.62
Xylene, *o-*	µg/m^3	12,628	85%	9.21	0.42	0.30	ND	0.09	0.24	0.52	1.42
Antimony (PM_{10})	ng/m^3	5,381	94%	43.30	1.55	1.07	ND	0.52	0.95	2.00	4.38
Arsenic (PM_{10})	ng/m^3	8,874	87%	44.10	0.96	0.68	ND	0.28	0.56	1.03	2.94
Beryllium (PM_{10})	ng/m^3	8,459	63%	1.97	0.05	0.01	ND	ND	<0.01	0.02	0.50
Cadmium (PM_{10})	ng/m^3	8,537	84%	30.58	0.26	0.15	ND	0.05	0.11	0.25	0.93
Chromium (PM_{10})	ng/m^3	8,189	92%	172.06	2.46	1.46	ND	0.80	1.79	2.57	6.61
Cobalt (PM_{10})	ng/m^3	5,508	91%	20.30	0.32	0.18	ND	0.07	0.14	0.32	1.00
Manganese (PM_{10})	ng/m^3	8,475	99%	734.00	9.57	4.65	0.96	2.19	4.05	8.66	30.22
Mercury (PM_{10})	ng/m^3	1,941	84%	2.07	0.05	0.02	ND	<0.01	0.02	0.04	0.24
Nickel (PM_{10})	ng/m^3	8,555	91%	135.88	1.93	1.36	ND	0.67	1.26	2.39	5.39
Selenium (PM_{10})	ng/m^3	4,968	95%	44.00	1.10	0.54	0.01	0.24	0.53	0.89	5.00
Acenaphthene	ng/m^3	4,427	97%	175.00	4.19	2.29	0.24	1.02	2.22	4.85	13.97
Acenaphthylene	ng/m^3	4,403	59%	175.00	0.88	0.60	ND	ND	0.17	0.74	3.92
Anthracene	ng/m^3	4,412	61%	69.10	0.44	0.32	ND	ND	0.12	0.41	1.42
Benzo(a)anthracene	ng/m^3	4,429	67%	35.80	0.11	0.07	ND	ND	0.03	0.10	0.39
Benzo(a)pyrene	ng/m^3	4,653	60%	42.70	0.12	0.09	ND	ND	0.03	0.11	0.43
Benzo(b)fluoranthene	ng/m^3	4,420	89%	38.70	0.24	0.13	ND	0.05	0.10	0.24	0.80

Appendix B. National Air Toxics Trends Stations Measurements (2003-2010).[a]

Pollutant	Units	# Samples Analyzed	% Detections	Maximum	Arithmetic Mean[b]	Geometric Mean	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
Benzo(e)pyrene	ng/m^3	3,886	78%	22.20	0.13	0.10	ND	0.02	0.06	0.15	0.42
Benzo(g,h,i)perylene	ng/m^3	4,427	84%	29.20	0.15	0.10	ND	0.03	0.07	0.15	0.51
Benzo(k)fluoranthene	ng/m^3	4,433	68%	13.50	0.07	0.06	ND	ND	0.03	0.07	0.24
Chrysene	ng/m^3	4,426	95%	28.80	0.23	0.15	ND	0.07	0.13	0.25	0.71
Dibenz(a,h)anthracene	ng/m^3	4,482	16%	3.52	0.01	0.04	ND	ND	ND	ND	0.06
Fluoranthene	ng/m^3	4,402	100%	111.00	2.17	1.33	0.26	0.72	1.33	2.47	6.55
Fluorene, 9H-	ng/m^3	4,421	99%	152.00	4.52	3.09	0.78	1.75	2.97	5.32	12.40
Indeno(1,2,3-cd)pyrene	ng/m^3	4,426	65%	30.70	0.12	0.11	ND	ND	0.05	0.13	0.44
Naphthalene	$\mu g/m^3$	4,634	100%	1.24	0.08	0.05	<0.01	0.03	0.06	0.10	0.21
Perylene	ng/m^3	3,902	32%	6.88	0.03	0.06	ND	ND	ND	0.03	0.17
Phenanthrene	ng/m^3	4,422	100%	239.00	9.67	6.02	1.23	3.17	6.02	11.60	28.10
Pyrene	ng/m^3	4,411	100%	154.00	1.34	0.80	0.14	0.45	0.83	1.50	4.03

Key Pollutant

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

ng/m^3 nanograms per cubic meter

ND No results of this chemical were registered by the laboratory analytical equipment.

[a] The summary statistics in this table represent the range of actual daily HAP measurement values taken at NATTS sites from 2003 through 2010. These data were extracted from AQS in December 2011. During the time period of interest, there were 30 sites measuring VOCs, carbonyls, metals, PAHs, 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 2003. 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] In calculations involving non-detects (ND), a value of zero is used.

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).[13] 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).

Other Air Toxics (HAPs)

- Do the monitoring data indicate elevated levels of any other air toxics or hazardous air pollutant (HAPs) that pose significant long-term health concerns?
  - → With the exception of chromium, the longer-term concentration estimates for the other HAPs monitored are below their long-term comparison levels.
    - ▪ The longer-term concentration estimate for chromium is above its long-term comparison level. The comparison values for chromium are conservatively based on the most toxic form of chromium (hexavalent chromium, Cr^{+6}), which is only a fraction of the chromium in the ambient air. Nonetheless, the longer-term concentration estimate for chromium (PM_{10}) is above these very restrictive comparison values.
  - → For pollutants with cancer-based comparison levels, the longer-term concentration estimates for all but one of these (naphthalene) are more than 10-fold lower and all but six of these (also 1,3-butadiene, carbon tetrachloride, ethylene dichloride, ethylbenzene, tetrachloroethylene, and *p*-dichlorobenzene) are more than 100-fold lower.[14]
    - However, as described in the Multiple Pollutants section below, levels of chromium and naphthalene considered in combination with levels of the key pollutants, benzene, arsenic and benzo(a)pyrene, indicate a potential for levels of concern for long-term continuous exposure to this mixture of pollutants in the air.

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[13] 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.

[14] For pollutants with cancer-based comparison levels, this would indicate longer-term estimates below continuous (24 hours a day, 7 days a week) lifetime exposure concentrations associated with 10^{-5} and 10^{-6} excess cancer risk, respectively.

→ Additionally, each individual measurement for these pollutants is below the individual sample (short-term) screening level developed for considering potential short-term exposures for that pollutant.[15]

Additional Information on Seven HAPs:

- The first HAP mentioned above is naphthalene. The mean and 95 percent upper bound on the mean for naphthalene are approximately 52-73% of the cancer-based comparison level. A review of information available at other sites nationally shows that the mean concentration of naphthalene at this site is above the 95th percentile of samples collected from 2007 to 2010 (the most recently compiled period) at the NATTS sites (Appendix B).

- The second HAP mentioned above is 1,3-butadiene. The mean and 95 percent upper bound on the mean for 1,3-butadiene are approximately 3% of the cancer-based comparison level. A review of information available at other sites nationally shows that the mean concentration of 1,3-butadiene at this site is between the 50th and 75th percentile of samples collected from 2003 to 2010 (the most recently compiled period) at the NATTS sites (Appendix B).

- The third HAP mentioned above is carbon tetrachloride. The mean and 95 percent upper bound on the mean for carbon tetrachloride are approximately 4% of the cancer-based comparison level. A review of information available at other sites nationally shows that the mean concentration of carbon tetrachloride at this site is between the 75th and 95th percentile of samples collected from 2003 to 2010 (the most recently compiled period) at the NATTS sites (Appendix B). Carbon tetrachloride is found globally as a result of its significant past uses in refrigerants and propellants for aerosol cans and its chemical persistence. Virtually all uses have been discontinued. However, it is still measured throughout the world as a result of its slow rate of degradation in the environment and global distribution in the atmosphere.

- The fourth HAP mentioned above is ethylene dichloride. The mean and 95 percent upper bound on the mean for ethylene dichloride are approximately 2-3% of the cancer-based comparison level. A review of information available at other sites nationally shows that the mean concentration of ethylene dichloride at this site is between the 75th and 95th percentile of samples collected from 2003 to 2010 (the most recently compiled period) at the NATTS sites (Appendix B).

- The fifth HAP mentioned above is ethylbenzene. The mean and 95 percent upper bound on the mean for ethylbenzene are approximately 1% of the cancer-based comparison level. A review of information available at other sites nationally shows that the mean concentration of ethylbenzene at this site is between the 50th and 75th percentile of samples collected from 2003 to 2010 (the most recently compiled period) at the NATTS sites (Appendix B).

[15] The individual sample screening levels and their use is summarized on the website and described in detail in *Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results.*

- The sixth HAP mentioned above is tetrachloroethylene. The mean and 95 percent upper bound on the mean for tetrachloroethylene are approximately 1% of the cancer-based comparison level. A review of information available at other sites nationally shows that the mean concentration of tetrachloroethylene at this site is less than the 50th percentile of samples collected from 2003 to 2010 (the most recently compiled period) at the NATTS sites (Appendix B).

- The seventh HAP mentioned above is *p*-dichlorobenzene. The mean and 95 percent upper bound on the mean for *p*-dichlorobenzene are approximately 1% of the cancer-based comparison level. A review of information available at other sites nationally shows that the mean concentration of *p*-dichlorobenzene at this site is between the 50th and 75th percentile of samples collected from 2003 to 2010 (the most recently compiled period) at the NATTS sites (Appendix B).

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.[16]

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 chromium, naphthalene and the key pollutants, benzene, arsenic and benzo(a) pyrene and the associated longer-term concentration estimates considered together indicate the potential for levels of concerns for cumulative health risk from these pollutants. The longer-term concentration estimates for benzene, chromium, and naphthalene are more than ten percent of their lowest comparison levels. The lowest comparison levels for these pollutants are based on carcinogenic risk. As described in the Other Air Toxics section above, however, the chromium comparison level is based on the most toxic form of chromium, hexavalent chromium, which is generally only a fraction

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

of the total chromium in the ambient air.[17] When aggregated as a group, the fractions of the cancer-based comparison levels comprised by the longer-term concentration estimates are near 100%. This indicates that pollutant levels are near those that might pose concern for long-term continuous exposure to the mixture of these pollutants.

- The long-term concentration estimate for manganese (PM_{10}) is also more than ten percent of its lowest comparison level. However, this comparison level is based on noncarcinogenic effects to the central nervous system and pollutant levels are well below the comparison level.

[17] Hexavalent chromium is commonly a small fraction of the total chromium reported. The long-term comparison level for noncancer-based chromium is much higher than the cancer-based level and is based on risk of other effects posed to the respiratory system by hexavalent chromium in particulate form.

Table C-1. Follansbee Middle 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 greater than 10% of the lowest comparison level					
Chromium (PM_{10})	ng/m^3	14.85	13.4 - 16.3	8.3 [e]	100 [e]
Naphthalene	$\mu g/m^3$	1.51	0.89 - 2.14	2.9	3
Manganese (PM_{10})	ng/m^3	15.18	13.6 - 16.8	NA	50
Non-Key HAPs with mean lower than 10% of the lowest comparison level					
Butadiene, 1,3-	$\mu g/m^3$	0.09	0.067 - 0.103	3.3	2
Carbon Tetrachloride	$\mu g/m^3$	0.68	0.64 - 0.71	17	100
Lead (PM_{10})	ng/m^3	5.78	4.60 - 6.97	NA	150
Ethylene dichloride	$\mu g/m^3$	0.09	0.08 - 0.10	3.8	2400
Cadmium (PM_{10})	ng/m^3	0.22	0.17 - 0.28	56	10
Nickel (PM_{10})	ng/m^3	1.82	1.26 - 2.38	420	90
Chloromethane	$\mu g/m^3$	1.14	1.09 - 1.18	NA	90
Xylene, *m/p*-	$\mu g/m^3$	1.04	0.79 - 1.30	NA	100
Antimony (PM_{10})	ng/m^3	2.06	1.57 - 2.54	NA	200
Ethylbenzene	$\mu g/m^3$	0.35	0.28 - 0.43	40	1000
Tetrachloroethylene	$\mu g/m^3$	0.13	0.11 - 0.15	17	270
Bromomethane	$\mu g/m^3$	0.04	0.03 - 0.05	NA	5
Dichlorobenzene, *p*-	$\mu g/m^3$	0.05	0.04 - 0.06	9.1	800
Benzo (b) fluoranthene	ng/m^3	2.66	1.82 - 3.50	570	NA
Dibenz (a,h) anthracene	ng/m^3	0.23	0.15 - 0.31	52	NA
Acetonitrile	$\mu g/m^3$	0.26	0.18 - 0.33	NA	60
Xylene, *o*-	$\mu g/m^3$	0.38	0.30 - 0.46	NA	100
Benzo (a) anthracene	ng/m^3	1.81	1.19 - 2.43	570	NA
Dichloromethane	$\mu g/m^3$	0.48	0.39 - 0.56	210	1000
Cobalt (PM_{10})	ng/m^3	0.21	0.16 - 0.26	NA	100
Indeno(1,2,3-cd)pyrene	ng/m^3	1.05	0.72 - 1.37	570	NA
Benzo (k) fluoranthene	ng/m^3	0.86	0.57 - 1.15	570	NA
Chloroform	$\mu g/m^3$	0.11	0.08 - 0.14	NA	98
Beryllium (PM_{10})	ng/m^3	0.021	0.015 - 0.026	42	20
Toluene	$\mu g/m^3$	2.40	1.57 - 3.23	NA	5000
Chrysene	ng/m^3	2.71	1.86 - 3.56	5700	NA
Styrene	$\mu g/m^3$	0.27	0.19 - 0.34	NA	1000
Carbon Disulfide	$\mu g/m^3$	0.13	0.09 - 0.17	NA	700
Selenium (PM_{10})	ng/m^3	1.59	1.32 - 1.87	NA	20000
Mercury (PM_{10})	ng/m^3	0.018	0.014 - 0.022	NA	300 [f]
Methyl isobutyl ketone	$\mu g/m^3$	0.13	0.11 - 0.15	NA	3000
Methyl Chloroform	$\mu g/m^3$	0.06	0.05 - 0.07	NA	5000
Non-Key HAPs with more than 50% ND Results.					
Acrylonitrile	$\mu g/m^3$	89% of the results were ND[g]		1.5	2
Ethylene dibromide	$\mu g/m^3$	84% of the results were ND[h]		0.17	9
Tetrachloroethane, 1,1,2,2-	$\mu g/m^3$	82% of the results were ND[i]		1.7	NA
Hexachloro-1,3-butadiene	$\mu g/m^3$	71% of the results were ND[j]		4.5	90
Trichloroethylene	$\mu g/m^3$	63% of the results were ND[k]		50	600
Trichloroethane, 1,1,2-	$\mu g/m^3$	92% of the results were ND[l]		6.3	400
Bromoform	$\mu g/m^3$	76% of the results were ND[m]		91	NA

Table C-1. Follansbee Middle 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]
Vinyl chloride	µg/m^3	84% of the results were ND[n]		11	100
Trichlorobenzene, 1,2,4-	µg/m^3	89% of the results were ND[o]		NA	200
Chlorobenzene	µg/m^3	82% of the results were ND[p]		NA	1000
Methyl Methacrylate	µg/m^3	95% of the results were ND[q]		NA	700
Dichloroethylene, 1,1-	µg/m^3	97% of the results were ND[r]		NA	200
Chloroethane	µg/m^3	97% of the results were ND[s]		NA	10000
No other HAPs were detected in any other samples.					

ng/m^3 nanograms per cubic meter
µg/m^3 micrograms per cubic meter
NA Not applicable
ND No detection of this chemical was registered by the laboratory analytical equipment.

[a] Mean of measurements is the average of all sample results which include actual measured values. If no chemical was registered, then a value of zero is used 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 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.

[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] The comparison levels are specific to hexavalent chromium (recognized as the most toxic form) which is a fraction of the total chromium reported.

[f] The comparison level is specific to elemental mercury, which is more readily and completely absorbed into the body than mercury

[g] Acrylonitrile was detected in 4 out of 38 samples, ranging from 0.28 to 4.28 µg/m^3. The MDL range is from 0.03 to 0.04 µg/m^3.

[h] Ethylene dibromide was detected in 6 out of 38 samples, ranging from 0.05 to 0.08 µg/m^3. The MDL range is from 0.13 to 0.14 µg/m^3.

[i] 1,1,2,2-Tetrachloroethane was detected in 7 out of 38 samples, ranging from 0.04 to 0.09 µg/m^3. The MDL range is from 0.12 to 0.17 µg/m^3.

[j] Hexachloro-1,3-butadiene was detected in 11 out of 38 samples, ranging from 0.04 to 0.12 µg/m^3. The MDL range is from 0.24 to 0.40 µg/m^3.

[k] Trichloroethylene was detected in 14 out of 38 samples, ranging from 0.05 to 0.58 µg/m^3. The MDL range is from 0.12 to 0.13 µg/m^3.

[l] 1,1,2-Trichloroethane was detected in only 3 out of 38 samples, ranging from 0.04 to 0.07 µg/m^3. The MDL range is from 0.12 to 0.14 µg/m^3.

[m] Bromoform was detected in only 9 out of 38 samples, ranging from 0.07 to 0.12 µg/m^3. The MDL range is from 0.21 to 0.26 µg/m^3.

[n] Vinyl chloride was detected in only 6 out of 38 samples, ranging from 0.013 to 0.020 µg/m^3. The MDL range is from 0.02 to 0.03 µg/m^3.

[o] 1,2,4-Trichlorobenzene was detected in only 4 out of 38 samples, ranging from 0.03 to 0.08 µg/m^3. The MDL range is from 0.16 0.27 µg/m^3.

[p] Chlorobenzene was detected in only 7 out of 38 samples, ranging from 0.04 to 0.08 µg/m^3. The MDL range is from 0.10 to 0.12 µg/m^3.

[q] Methyl methacrylate was detected in only 2 out of 38 samples, ranging from 0.09 to 0.10 µg/m^3. The MDL range is from 0.09 to 0.10 µg/m^3.

[r] 1,1-Dichloroethylene was detected in only 1 out of 38 samples, with a value of 0.03 µg/m^3. The MDL range is from 0.04 to 0.06 µg/m^3.

[s] Chlorethane was detected in only 1 out of 38 samples, with a value of 0.03 µg/m^3. The MDL range is from 0.02 to 0.05 µg/m^3.

Appendix D. Follansbee Middle School - Pollutant Concentrations (10/28/11-3/15/12).

Parameter	Units	10/28/2011	11/1/2011	11/2/2011	11/8/2011	11/9/2011	11/14/2011	12/1/2011	12/7/2011	12/13/2011	12/19/2011	12/29/2011	1/4/2012	1/10/2012	1/19/2012	1/25/2012	1/31/2012	2/6/2012	2/15/2012	2/21/2012	2/27/2012	3/15/2012	Sample Screening Level[a]
Benzene	$\mu g/m^3$	--	1.09	--	1.09	--	0.76	1.73	3.15	1.85	0.69	0.4	0.86	7.06	2.59	1.84	0.59	1.54	8.27	0.97	3.06	0.58	30
Arsenic (PM_{10})	ng/m^3	--	--	1.12	1.22	--	0.65	1.19	0.71	2.73	0.41	0.46	0.87	1.90	0.98	1.45	0.54	1.12	1.94	0.51	1.05	1.01	150
Benzo(a)pyrene	ng/m^3	0.90	--	0.39	--	0.34	0.32	1.37	2.1	1.36	0.11	0.09	0.21	3.77	4.88	0.87	0.11	1.61	1.70	0.35	3.93	0.10	6400
Chromium (PM_{10})	ng/m^3	--	--	15.3	13.1	--	11.4	9.54	8.91	10.7	9.70	13.0	10.4	10.1	20.9	15.9	11.1	14.1	13.8	15.6	18.4	13.6	580[b]
Naphthalene	$\mu g/m^3$	0.40	--	0.21	--	0.18	0.31	0.68	0.95	0.43	0.12	0.08	0.30	1.98	1.74	0.54	0.05	0.40	6.97	0.23	1.50	0.13	30
Manganese (PM_{10})	ng/m^3	--	--	19.6	21.5	--	9.06	14.1	6.81	28.1	8.06	8.74	19.3	13.8	9.12	17.0	19.9	16.2	12.3	10.2	15.8	15.4	500
Butadiene, 1,3-	$\mu g/m^3$	--	0.13	--	0.13	--	0.03	0.21	0.06	0.25	0.06	0.04	0.06	0.22	0.10	0.11	0.03	0.14	0.17	0.06	0.08	ND	20
Carbon Tetrachloride	$\mu g/m^3$	--	0.50	--	0.87	--	0.84	0.70	0.76	0.67	0.64	0.50	0.69	0.71	0.47	0.65	0.60	0.65	0.53	0.77	0.65	0.61	200
Lead (PM_{10})	ng/m^3	--	--	5.40	3.97	--	1.56	4.44	4.59	18.0	2.69	2.20	3.41	6.95	4.37	7.57	2.45	3.93	3.85	2.19	5.00	3.54	150
Ethylene dichloride	$\mu g/m^3$	--	0.12	--	0.09	--	0.10	ND	0.08	0.08	0.09	0.05	0.08	0.07	0.07	0.11	0.08	0.10	0.09	0.10	0.06	0.10	270
Cadmium (PM_{10})	ng/m^3	--	--	0.24	0.19	--	0.06	0.44	0.10	0.58	0.11	0.11	0.11	0.59	0.11	0.26	0.10	0.11	0.17	0.07	0.10	0.20	30
Nickel (PM_{10})	ng/m^3	--	--	2.13	1.85	--	0.96	1.01	0.60	1.90	0.61	1.22	0.76	1.05	3.17	4.29	0.84	0.79	1.28	0.68	0.73	1.20	200
Chloromethane	$\mu g/m^3$	--	1.18	--	1.12	--	1.31	1.05	1.08	1.07	1.01	0.78	1.03	0.89	1.02	0.99	1.07	1.20	1.04	1.11	1.05	1.43	1000
Xylene, *m/p-*	$\mu g/m^3$	--	0.87	--	1.10	--	0.29	0.99	0.67	0.91	0.46	0.20	0.32	1.29	0.46	0.79	0.19	0.49	1.70	0.28	0.54	0.29	3000
Antimony (PM_{10})	ng/m^3	--	--	1.97	1.80	--	0.37	1.65	0.65	2.72	1.06	1.01	1.17	1.88	0.61	1.64	0.78	1.41	3.63	0.56	0.88	0.70	2000
Ethylbenzene	$\mu g/m^3$	--	0.32	--	0.38	--	0.15	0.43	0.31	0.34	0.20	0.07	0.14	0.37	0.16	0.31	0.08	0.20	0.46	0.12	0.18	0.12	40000
Tetrachloroethylene	$\mu g/m^3$	--	0.20	--	0.25	--	0.06	0.13	0.07	0.16	0.09	0.05	0.12	0.10	0.05	0.19	0.06	0.12	0.15	0.09	0.10	0.08	1400
Bromomethane	$\mu g/m^3$	--	0.07	--	0.06	--	ND	0.03	ND	0.04	0.05	ND	ND	ND	ND	ND	ND	0.05	0.05	0.05	ND	0.05	200
Dichlorobenzene, *p-*	$\mu g/m^3$	--	0.08	--	0.08	--	0.04	0.04	ND	0.07	0.04	ND	0.05	ND	ND	0.05	ND	0.06	0.06	0.05	ND	ND	10000
Benzo (b) fluoranthene	ng/m^3	2.02	--	0.78	--	0.71	0.79	2.56	5.01	2.28	0.25	0.23	0.50	5.14	8.16	1.66	0.17	2.34	2.71	0.69	6.61	0.26	64000
Dibenz (a,h) anthracene	ng/m^3	0.17	--	0.05	--	0.05	0.07	0.18	0.38	0.19	ND	ND	0.03	0.53	0.81	0.15	ND	0.22	0.21	0.05	0.63	ND	5800
Acetonitrile	$\mu g/m^3$	--	0.16	--	0.15	--	0.21	0.10	0.09	0.15	0.12	0.07	0.07	0.13	0.08	0.23	0.15	0.18	0.16	0.11	0.10	0.25	600
Xylene, *o-*	$\mu g/m^3$	--	0.36	--	0.44	--	0.11	0.40	0.24	0.37	0.22	0.08	0.13	0.44	0.16	0.32	0.08	0.20	0.57	0.11	0.18	0.13	9000
Benzo (a) anthracene	ng/m^3	1.23	--	0.38	--	0.29	0.61	1.56	2.91	1.20	0.12	0.10	0.28	4.60	6.83	0.89	0.10	1.42	2.82	0.45	4.48	0.16	64000
Dichloromethane	$\mu g/m^3$	--	0.44	--	0.55	--	0.57	0.36	0.27	1.26	0.28	0.85	0.26	0.42	0.24	0.45	0.39	0.42	0.38	0.34	0.35	0.37	2000
Cobalt (PM_{10})	ng/m^3	--	--	0.16	0.15	--	0.10	0.10	0.06	0.17	0.06	0.08	0.10	0.10	0.24	0.36	0.10	0.08	0.37	0.15	0.12	0.09	100
Indeno(1,2,3-cd)pyrene	ng/m^3	0.83	--	0.35	--	0.30	0.29	1.07	2.06	1.04	0.13	0.11	0.18	2.04	3.24	0.73	0.08	1.20	0.88	0.26	2.55	0.12	640000
Benzo (k) fluoranthene	ng/m^3	0.70	--	0.18	--	0.16	0.22	0.79	1.53	0.65	0.08	0.06	0.13	1.80	2.96	0.52	0.06	0.79	0.89	0.25	2.23	0.08	64000
Chloroform	$\mu g/m^3$	--	0.26	--	0.19	--	0.10	0.12	0.08	0.12	0.11	0.06	0.11	ND	0.07	0.12	0.08	0.12	0.14	0.12	0.09	0.10	500
Beryllium (PM_{10})	ng/m^3	--	--	0.03	0.04	--	0.01	0.02	0.09	0.03	0.00	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.002	0.01	0.03	0.02	20
Toluene	$\mu g/m^3$	--	1.40	--	1.96	--	0.60	1.90	1.51	2.02	0.76	0.43	0.65	3.25	1.14	1.86	0.47	1.29	4.75	0.89	1.65	0.81	4000
Chrysene	$\mu g/m^3$	1.68	--	0.66	--	0.54	0.95	2.41	4.04	1.91	0.30	0.26	0.56	5.25	8.04	1.40	0.19	1.84	3.19	0.73	5.52	0.47	640000
Styrene	$\mu g/m^3$	--	0.15	--	0.12	--	0.10	0.27	0.15	0.29	0.16	0.03	0.07	0.26	0.11	0.15	ND	0.09	0.53	0.06	0.12	ND	9000
Carbon Disulfide	$\mu g/m^3$	--	0.10	--	0.09	--	0.06	0.07	0.06	0.06	0.04	0.03	0.04	0.08	0.05	0.04	0.02	0.06	0.07	0.04	0.06	0.07	7000
Selenium (PM_{10})	ng/m^3	--	--	2.15	2.25	--	0.64	2.49	1.01	4.70	0.84	2.06	1.79	1.31	1.38	1.37	1.14	1.03	2.10	0.96	1.17	1.01	20000

Appendix D. Follansbee Middle School - Pollutant Concentrations (10/28/11-3/15/12).

Parameter	Units	10/28/2011	11/1/2011	11/2/2011	11/8/2011	11/9/2011	11/14/2011	12/1/2011	12/7/2011	12/13/2011	12/19/2011	12/29/2011	1/4/2012	1/10/2012	1/19/2012	1/25/2012	1/31/2012	2/6/2012	2/15/2012	2/21/2012	2/27/2012	3/15/2012	Sample Screening Level[a]
Mercury (PM_{10})	ng/m^3	--	--	0.03	0.02	--	0.03	0.03	0.03	0.02	0.01	0.01	0.03	0.05	0.04	0.02	0.01	0.01	0.003	0.004	0.02	0.02	3000[c]
Methyl isobutyl ketone	$\mu g/m^3$	--	0.12	--	0.11	--	0.07	0.09	0.07	0.09	0.05	ND	ND	0.12	ND	0.13	0.07	0.08	0.12	0.07	0.10	0.14	30000
Methyl Chloroform	$\mu g/m^3$	--	0.08	--	0.07	--	0.06	0.09	ND	0.05	0.07	ND	0.06	0.05	0.03	0.07	0.05	0.07	0.05	0.08	0.04	0.06	10000
Acrylonitrile	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	200
Ethylene dibromide	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	0.05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	12
Tetrachloroethane, 1,1,2,2-	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	120
Hexachloro-1,3-butadiene	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	0.11	0.04	ND	ND	ND	ND	ND	ND	0.09	ND	0.12	ND	ND	320
Trichloroethylene	$\mu g/m^3$	--	0.10	--	ND	--	ND	ND	ND	0.12	0.06	ND	ND	ND	0.58	0.06	ND	0.05	ND	ND	ND	ND	10000
Trichloroethane, 1,1,2-	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	440
Bromoform	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	0.07	ND	ND	ND	ND	ND	ND	0.08	ND	ND	ND	ND	6400
Vinyl chloride	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1000
Trichlorobenzene, 1,2,4-	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	0.08	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2000
Chlorobenzene	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.04	ND	ND	ND	10000
Methyl Methacrylate	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7000
Dichloroethylene, 1,1-	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	80
Chloroethane	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	40000
Benzyl Chloride	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	140
Chloroprene	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	70
Dichloroethane, 1,1-	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4400
Dichloropropane, 1,2-	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	200
Dichloropropylene, cis-1,3-	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	14
Dichloropropylene, trans-1,3-	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	14
Ethyl Acrylate	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	20000
Methyl tert-Butyl Ether	$\mu g/m^3$	--	ND	--	ND	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7000

Key Pollutant

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

ng/m^3 nanograms per cubic meter

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

-- No sample was conducted for this pollutant on this day or the result was invalidated

[a] The individual sample screening 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", see http://www.epa.gov/schoolair/pdfs/UsesOfHealthEffectsInfoinEvalSampleResults.pdf. These screening levels are based on consideration of exposure all day, every day over a period ranging up to a couple of weeks, and longer for some pollutants.

[b] The sample screening levels are specific to hexavalent chromium (recognized as the most toxic form) which is a fraction of the total chromium reported.

[c] 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 D. Follansbee Middle School - Pollutant Concentrations (3/21/12-8/9/12).

Parameter	Units	3/21/2012	3/27/2012	4/2/2012	4/12/2012	4/18/2012	4/24/2012	4/30/2012	5/10/2012	5/16/2012	5/22/2012	5/29/2012	6/4/2012	6/14/2012	6/21/2012	6/27/2012	7/2/2012	7/9/2012	7/23/2012	8/2/2012	8/9/2012	Sample Screening Level[a]
Benzene	$\mu g/m^3$	8.34	1.16	5.94	4.19	2.00	10.4	20.2	6.36	0.88	3.35	1.50	0.56	5.88	1.29	3.07	4.82	2.69	0.65	4.82	0.61	30
Arsenic (PM_{10})	ng/m^3	1.81	I	1.16	0.99	1.59	1.54	1.53	1.44	0.62	2.3	I	I	1.2	0.57	2.0	1.01	1.23	1.05	1.19	0.87	150
Benzo(a)pyrene	ng/m^3	2.97	0.79	2.88	1.56	0.51	5.6	4.52	2.54	0.73	1.8	0.64	0.19	2.51	0.14	1.2	0.71	0.62	0.05	2.44	0.07	6400
Chromium (PM_{10})	ng/m^3	15.3	I	15.3	17.4	17.1	23.7	21.9	30.2	17.6	15.7	I	I	15.0	13.9	11.9	12.9	15.5	13.6	14.6	12.7	580[b]
Naphthalene	$\mu g/m^3$	7.06	0.34	2.48	1.16	0.44	3.46	4.84	2.68	0.25	2.60	0.9	0.1	6.5	0.3	2.0	2.1	0.9	0.3	3.3	0.1	30
Manganese (PM_{10})	ng/m^3	12.4	I	13.4	14.8	15.3	16.5	18.6	12.8	17.2	24.0	I	I	13.2	15.9	18.6	9.8	20.7	13.3	16.4	13.3	500
Butadiene, 1,3-	$\mu g/m^3$	0.09	0.07	0.11	0.08	0.07	0.09	0.11	0.09	0.05	0.06	0.05	ND	0.07	0.04	0.07	0.05	0.06	0.04	0.10	0.04	20
Carbon Tetrachloride	$\mu g/m^3$	0.88	0.60	0.68	0.61	0.75	0.76	0.81	0.40	0.77	0.68	0.63	0.94	0.67	0.62	0.84	0.77	0.65	0.64	0.59	0.61	200
Lead (PM_{10})	ng/m^3	14.4	I	9.65	6.30	5.51	7.16	6.22	5.12	11.0	10.4	I	I	4.80	4.26	5.45	5.63	8.02	3.52	5.57	3.24	150
Ethylene dichloride	$\mu g/m^3$	0.09	0.10	0.08	0.08	0.11	0.13	0.12	0.09	0.15	0.08	0.09	ND	0.20	0.08	0.11	0.09	0.06	0.06	0.07	0.04	270
Cadmium (PM_{10})	ng/m^3	0.26	I	0.51	0.22	0.40	0.13	0.10	0.15	0.53	0.65	I	I	0.10	0.11	0.14	0.23	0.26	0.15	0.17	0.11	30
Nickel (PM_{10})	ng/m^3	2.04	I	1.53	1.21	2.10	6.53	5.39	7.35	1.82	1.88	I	I	1.46	1.00	1.03	1.29	1.28	0.77	1.14	0.81	200
Chloromethane	$\mu g/m^3$	1.26	1.20	1.18	1.12	1.17	1.15	1.43	1.23	1.31	1.15	1.21	1.26	1.19	1.22	1.19	1.12	1.10	1.18	1.08	0.99	1000
Xylene, *m/p-*	$\mu g/m^3$	2.55	0.56	1.09	1.03	0.88	1.81	3.18	1.04	0.81	1.23	0.82	0.26	2.70	0.95	3.09	1.53	1.38	0.59	1.65	0.56	3000
Antimony (PM_{10})	ng/m^3	5.46	I	2.73	2.08	1.66	1.94	1.39	1.55	2.22	3.14	I	I	4.63	1.32	3.87	2.00	6.16	2.37	4.05	0.95	2000
Ethylbenzene	$\mu g/m^3$	0.78	0.23	0.33	0.33	0.30	0.49	0.91	0.30	0.31	0.43	0.30	0.09	0.87	0.38	0.99	0.52	0.46	0.26	0.56	0.24	40000
Tetrachloroethylene	$\mu g/m^3$	0.18	0.16	0.09	0.09	0.12	0.15	0.31	0.09	0.17	0.12	0.07	0.22	0.35	0.12	0.19	0.17	0.09	0.07	0.09	0.07	1400
Bromomethane	$\mu g/m^3$	0.06	0.05	0.03	0.03	0.03	0.05	0.07	0.04	0.06	0.04	0.04	ND	0.04	0.04	0.06	0.05	0.03	0.10	0.04	0.03	200
Dichlorobenzene, *p-*	$\mu g/m^3$	0.10	0.07	0.02	0.03	0.07	0.07	0.08	0.04	0.08	0.04	0.06	ND	0.10	0.09	0.11	0.11	0.06	0.05	0.07	0.05	10000
Benzo (b) fluoranthene	ng/m^3	5.26	1.47	5.09	2.99	1.01	10.1	9.10	4.62	1.23	3.65	1.31	0.45	4.54	0.43	2.22	1.43	1.26	0.15	4.30	0.20	64000
Dibenz (a,h) anthracene	ng/m^3	0.50	0.13	0.39	0.27	0.10	0.93	0.81	0.42	0.10	0.29	0.11	0.03	0.33	0.05	0.20	0.13	0.12	ND	0.42	ND	5800
Acetonitrile	$\mu g/m^3$	0.36	0.13	0.16	0.13	0.15	0.27	0.50	0.20	0.42	0.23	0.36	0.18	0.38	0.32	0.35	0.38	0.28	0.35	1.29	0.88	600
Xylene, *o-*	$\mu g/m^3$	0.87	0.25	0.39	0.37	0.36	0.60	0.99	0.38	0.36	0.49	0.31	0.11	1.04	0.44	0.68	0.55	0.55	0.28	0.64	0.26	9000
Benzo (a) anthracene	ng/m^3	3.29	0.79	3.51	1.94	0.61	6.64	6.82	2.48	0.72	2.46	0.98	0.27	3.36	0.38	1.48	1.01	0.81	0.12	2.45	0.13	64000
Dichloromethane	$\mu g/m^3$	0.36	0.35	0.38	0.42	1.10	0.33	0.35	0.33	1.35	0.39	0.33	0.31	0.80	0.36	0.58	0.36	0.33	0.27	0.64	0.59	2000
Cobalt (PM_{10})	ng/m^3	0.38	I	0.29	0.24	0.38	0.39	0.43	0.30	0.14	0.27	I	I	0.52	0.11	0.14	0.20	0.12	0.09	0.56	0.13	100
Indeno(1,2,3-cd)pyrene	ng/m^3	1.93	0.55	1.61	1.06	0.40	3.77	3.48	2.20	0.57	1.38	0.58	0.16	1.63	0.14	0.84	0.61	0.48	0.06	1.92	0.07	640000
Benzo (k) fluoranthene	ng/m^3	1.67	0.44	1.58	1.06	0.32	3.74	2.75	1.32	0.38	1.10	0.39	0.13	1.45	0.10	0.64	0.47	0.43	0.04	1.46	0.05	64000
Chloroform	$\mu g/m^3$	0.12	ND	ND	0.09	ND	ND	ND	0.11	0.18	0.13	0.25	0.11	0.40	0.24	ND	0.30	0.27	0.13	ND	ND	500
Beryllium (PM_{10})	ng/m^3	0.02	I	0.01	0.01	0.01	0.03	0.02	0.01	0.02	0.03	I	I	0.02	0.01	0.02	0.01	0.01	0.03	0.03	0.03	20
Toluene	$\mu g/m^3$	5.05	1.03	2.56	2.08	1.87	4.71	9.20	2.45	1.71	2.70	1.44	0.66	13.94	1.70	2.39	2.97	2.33	1.04	3.05	0.95	4000
Chrysene	ng/m^3	5.27	1.29	5.33	3.05	1.08	10.1	10.7	3.95	1.23	4.13	1.63	0.67	5.10	1.19	2.41	2.19	1.41	0.42	4.19	0.53	640000
Styrene	$\mu g/m^3$	0.69	0.17	0.29	0.22	0.17	0.60	1.05	0.34	0.23	0.55	0.20	ND	0.89	0.28	0.32	0.32	0.32	0.23	0.45	0.18	9000
Carbon Disulfide	$\mu g/m^3$	0.20	0.07	0.07	0.06	0.07	0.10	0.21	0.10	0.07	0.12	0.11	0.12	0.35	0.54	0.22	0.20	0.48	0.12	0.38	0.24	7000

Appendix D. Follansbee Middle School - Pollutant Concentrations (3/21/12-8/9/12).

Parameter	Units	3/21/2012	3/27/2012	4/2/2012	4/12/2012	4/18/2012	4/24/2012	4/30/2012	5/10/2012	5/16/2012	5/22/2012	5/29/2012	6/4/2012	6/14/2012	6/21/2012	6/27/2012	7/2/2012	7/9/2012	7/23/2012	8/2/2012	8/9/2012	Sample Screening Level[a]
Selenium (PM_{10})	ng/m^3	2.46	I	1.92	0.89	1.18	0.95	1.61	0.77	1.36	2.63	I	I	1.20	1.38	0.99	2.09	0.77	2.64	1.68	1.89	20000
Mercury (PM_{10})	ng/m^3	0.02	I	0.03	0.01	0.02	0.03	0.02	0.02	0.02	0.02	I	I	0.01	ND	ND	ND	ND	0.02	0.02	0.01	3000[c]
Methyl isobutyl ketone	$\mu g/m^3$	0.15	0.10	0.14	0.15	0.07	0.11	0.15	0.14	0.14	0.22	0.18	0.13	0.27	0.29	0.21	0.18	0.32	0.23	0.23	0.09	30000
Methyl Chloroform	$\mu g/m^3$	0.09	0.10	0.05	0.06	0.08	0.08	0.09	0.05	0.11	0.04	0.05	ND	0.11	0.05	0.10	0.08	0.04	0.04	0.04	0.04	10000
Acrylonitrile	$\mu g/m^3$	ND	ND	0.35	ND	ND	ND	4.28	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.35	0.28	200
Ethylene dibromide	$\mu g/m^3$	0.05	0.05	ND	ND	ND	ND	ND	ND	0.05	ND	ND	ND	ND	ND	0.08	0.05	ND	ND	ND	ND	12
Tetrachloroethane, 1,1,2,2-	$\mu g/m^3$	0.05	0.05	ND	ND	ND	0.04	0.06	ND	0.05	ND	ND	ND	ND	ND	0.09	0.05	ND	ND	ND	ND	120
Hexachloro-1,3-butadiene	$\mu g/m^3$	0.06	0.06	ND	ND	ND	0.04	0.07	ND	0.05	ND	ND	ND	ND	ND	0.09	0.05	ND	ND	ND	ND	320
Trichloroethylene	$\mu g/m^3$	0.06	0.05	ND	ND	ND	ND	0.06	ND	0.07	0.06	ND	ND	0.05	ND	0.08	0.05	ND	ND	ND	ND	10000
Trichloroethane, 1,1,2-	$\mu g/m^3$	ND	0.05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.07	0.04	ND	ND	ND	ND	440
Bromoform	$\mu g/m^3$	0.10	0.08	ND	ND	ND	0.07	0.10	ND	0.08	ND	ND	ND	ND	ND	0.12	0.07	ND	ND	ND	ND	6400
Vinyl chloride	$\mu g/m^3$	0.01	0.02	ND	ND	ND	ND	ND	ND	0.02	ND	ND	ND	ND	ND	0.02	0.01	ND	ND	ND	ND	1000
Trichlorobenzene, 1,2,4-	$\mu g/m^3$	ND	0.04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.04	ND	ND	ND	ND	ND	2000
Chlorobenzene	$\mu g/m^3$	0.04	ND	ND	ND	ND	ND	0.04	ND	0.04	ND	0.04	ND	ND	ND	0.08	0.05	ND	ND	ND	ND	10000
Methyl Methacrylate	$\mu g/m^3$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.09	ND	0.10	ND	ND	ND	ND	ND	7000
Dichloroethylene, 1,1-	$\mu g/m^3$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.03	ND	ND	ND	ND	ND	80
Chloroethane	$\mu g/m^3$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	40000
Benzyl Chloride	$\mu g/m^3$	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	140
Chloroprene	$\mu g/m^3$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	70
Dichloroethane, 1,1-	$\mu g/m^3$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4400
Dichloropropane, 1,2-	$\mu g/m^3$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	200
Dichloropropylene, cis-1,3-	$\mu g/m^3$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	14
Dichloropropylene, trans-1,3-	$\mu g/m^3$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	14
Ethyl Acrylate	$\mu g/m^3$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	20000
Methyl tert-Butyl Ether	$\mu g/m^3$	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7000

Key Pollutant

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

ng/m^3 nanograms per cubic meter

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

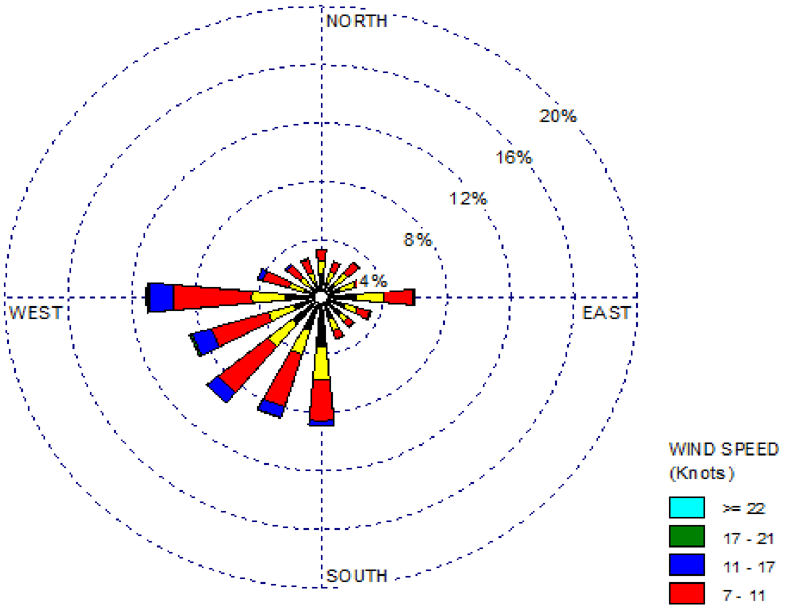
-- No sample was conducted for this pollutant on this day or the result was invalidated

[a] The individual sample screening 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", see http://www.epa.gov/schoolair/pdfs/UsesOfHealthEffectsInfoinEvalSampleResults.pdf. These screening levels are based on consideration of exposure all day, every day over a period ranging up to a couple of weeks, and longer for some pollutants.

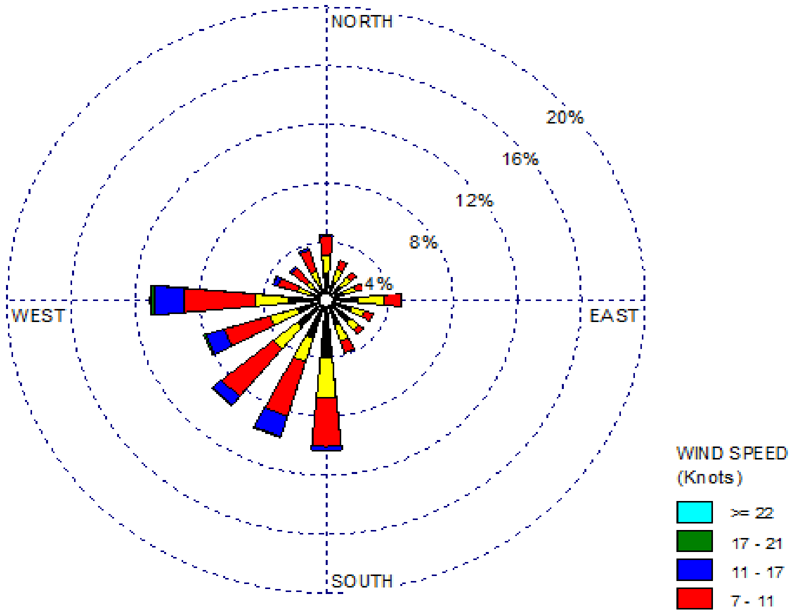
[b] The sample screening levels are specific to hexavalent chromium (recognized as the most toxic form) which is a fraction of the total chromium reported.

[c] 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. Windroses for Wheeling-Ohio County Airport NWS Station.



Wheeling-Ohio County Airport NWS Station
1/1/2002-8/9/2012[1]



Wheeling-Ohio County Airport NWS Staion
Across Sampling Period
October 27, 2011-August 9, 2012

[1] Wheeling-Ohio County Airport NWS Station (WBAN 14894) is 11.31 miles from Follansbee Middle School.