SAT Initiative: Sto-Rox Elementary School and Sto-Rox Middle School (McKees Rocks, PA)

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 has been conducted at Sto-Rox Elementary 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. For the purposes of this study, results from the air monitoring at Sto-Rox Elementary School are considered to be indicative of conditions at the nearby Sto-Rox Middle School (located less than one-fifth of a mile from Sto-Rox Elementary School).
- This school was selected for monitoring based on information indicating the potential for elevated ambient concentrations of hexavalent chromium and pollutants associated with coke oven operations, including benzene, arsenic, and benzo(a)pyrene, in air outside the school. Information evaluated included EPA's completed 2002 National-Scale Air Toxics Assessment (NATA). Additionally, the Allegheny County Health Department (ACHD) recommended this school because it is closest to the sources of interest (two chemical manufacturing facilities and a coke oven). Indoor air monitoring was also conducted by ACHD inside the school.
- Ambient air monitoring was performed from August 5, 2009 to January 6, 2010 for the following pollutants: hexavalent chromium; benzene and other volatile organic compounds (VOCs); arsenic and other metals in particulate matter less than 10 microns in diameter (PM_{10}); and benzo(a)pyrene and other polycyclic aromatic hydrocarbons (PAH).
- Levels of hexavalent chromium and associated longer-term concentration estimates are below levels of concern. They are not as high as suggested by the information available prior to monitoring.
- Levels of pollutants associated with coke oven emissions, including benzene, arsenic (PM_{10}), and benzo(a)pyrene measured in the outdoor air at this school indicate influence of several nearby sources. However, the measured levels and associated longer-term concentration estimates for these pollutants associated with coke oven emissions are not as high as was suggested by the information available prior to monitoring and are below levels of concern for long-term exposures.
- Based on the analysis described here, EPA will not extend air toxics 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 ACHD will continue to oversee industrial facilities in the area through air permits and other programs.

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 monitored 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 included 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 were placed at each school for approximately 60 days, and took air samples on at least 10 different days during that time. The samples were 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 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.

[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.

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*
- *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 website.

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

Sto-Rox Elementary School was selected for monitoring in consultation with the local county air agency, the Allegheny County Health Department (ACHD). For the purposes of this study, results from the air monitoring at Sto-Rox Elementary School are considered to be indicative of conditions at the nearby Sto-Rox Middle School (located less than one-fifth of a mile from Sto-Rox Elementary) (Figure 1). We were interested in evaluating the ambient concentrations of hexavalent chromium and of pollutants associated with coke oven operations, including benzene, arsenic, and benzo(a)pyrene, in air outside Sto-Rox Elementary School based on information in EPA's 2002 NATA modeling results for both a nearby coke oven facility and two chemical manufacturing facilities. Additionally, the ACHD recommended this school because it is closest to the sources of interest. Indoor air monitoring was conducted by ACHD inside the school (see Section V for additional information).

Outdoor monitoring commenced at this school on August 5, 2009 and continued through January 6, 2010. During this period, fifteen valid samples were also collected and analyzed for hexavalent chromium. Ten valid samples of VOCs were collected and analyzed for benzene and a standardized set of additional VOCs. Additionally, thirteen valid samples of airborne particles were collected using a PM_{10} sampler[4] and analyzed for arsenic and a small standardized set of additional metals. Finally, fifteen valid samples of PAHs were collected and analyzed for benzo(a)pyrene and a small standardized set of additional PAHs. Due to an issue with VOC monitoring equipment, three VOC results were invalidated (see EPA's technical document, Investigation and Resolution of Contamination Problems in the Collection of Volatile Organic Compounds, at http://www.epa.gov/schoolair/pdfs/VocTechdocwithappendix1209.pdf).

[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 arsenic is based on.

Additional VOC samples were collected to ensure that ten valid samples were available for analysis.

All VOC results with the exception of acrolein were evaluated for health concerns. Results of a recent short-term laboratory study have raised questions about the consistency and reliability of monitoring results of acrolein. As a result, EPA will not use these acrolein data in evaluating the potential for health concerns from exposure to air toxics in outdoor air as part of the School Air Toxics Monitoring project (SAT) (http://www.epa.gov/schoolair/acrolein.html). All sampling methodologies are described in EPA's schools air toxics monitoring plan (http://www.epa.gov/schoolair/techinfo.html).[5]

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) hazardous air pollutants (HAPs or air toxics)[6] 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 were 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[7] and, in the case of cancer

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

[6] 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.

[7] 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.

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[8] 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 any values below method detection limit (MDL).[9] 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 levels. 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.[10] 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 the 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 datasets in order to better characterize pollutants near particular sources. The 2-3 month dataset developed

[8] 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 dataset (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 datasets 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.

[9] 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.

[10] 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).

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 programs 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 sources of interest, such as that obtained from public databases such as TRI and/or consultation with the local air pollution authority.

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.[11] 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 Figures 2a-2d) with regard to areas of interest identified below.

[11] The development of long-term comparison levels, as well as of individual sample screening levels, is described in detail in *Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results.*

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

- The air sampling data collected over the five-month sampling period indicate influence from nearby sources of hexavalent chromium, benzene, arsenic, and benzo(a)pyrene emissions.
- The air sampling data and related longer-term concentration estimates for hexavalent chromium were below concentrations of significant concern for short-term and long-term exposure.
- The air sampling data collected over the five-month sampling period for the monitored pollutants commonly associated with coke oven emissions, including benzene, arsenic and benzo(a)pyrene were below concentrations of significant concern at this location.

Hexavalent Chromium, key pollutant:

- Do the monitoring data indicate influence from a nearby source?
  → The monitoring data include one hexavalent chromium concentration that is higher than concentrations commonly observed in other locations nationally.[12]
- Do the monitoring data indicate elevated levels that pose significant long-term health concerns?
  → The monitoring data for hexavalent chromium do not indicate levels of significant health concern for long-term exposures.
    - The estimate of longer-term hexavalent chromium 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).[13] 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 estimate is below a continuous (24 hours a day, 7 days a week) 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

[12] For example, one of the concentrations at this site (Table 2a) 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 of indicating potential influence from a source nearby to the school.
[13] The upper end of the interval is 1.7 times the mean of the monitoring data and less than 1% of the long-term cancer-based comparison level.

hexavalent chromium (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).[11]

→ 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 significant concern for long-term exposures.

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

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

  → The monitoring data include one benzene,[14] several arsenic (PM_{10}),[15] and some benzo(a)pyrene[16] concentrations 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 do not indicate levels of significant health concern for long-term exposures at this location.

    - 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 below the long-term comparison levels (Table 1).[17] 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 a week) lifetime exposure concentration associated with 1-in-100,000 additional cancer risk.

      - We did not identify any concerns regarding short-term exposures as each individual measurement 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).[11]

[14] For example, one of the concentrations at this site (Table 2b) 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 of indicating potential influence from a source nearby to the school.
[15] For example six of the concentrations at this site (Table 2a) 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 of indicating potential influence from a source nearby to the school.
[16] For example, three of the concentrations at this site (Table 2a) 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 of indicating potential influence from a source nearby to the school.
[17] The upper end of the interval is 1.4 times the mean of the monitoring data and less than 8% of the long-term cancer-based comparison level.

- 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).[18] 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 a week) lifetime exposure concentration associated with 1-in-100,000 additional cancer risk.
    - We did not identify concerns regarding short-term exposures 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).[11]
- 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).[19] This comparison level is based on consideration of continuous exposure concentrations (24 hours a day, all year, over a lifetime).
    - The longer-term concentration estimate is more than one hundred-fold 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-1-million additional cancer risk.
    - We did not identify any concerns regarding short-term exposures 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).[11]

<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?
    → The monitoring data show low levels of the other HAPs monitored, in which the longer-term concentration estimates for these HAPs are below their long-term comparison levels (Appendix C). Additionally each individual measurement for these pollutants is below the individual sample screening level[11] for that pollutant (Appendix D).

[18] The upper end of the interval is 1.6 times the mean of the monitoring data and less than 10% of the long-term noncancer-based comparison level.
[19] The upper end of the interval is 1.7 times the mean of the monitoring data and less than 1% of the long-term cancer-based comparison level.

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 concentration estimates do not pose significant concerns for cumulative health risk from these pollutants at this location (Appendix C).[20]

C. Wind and Other Meteorological Data

At each school monitored as part of this initiative, we collected meteorological data, minimally for wind speed and direction, during the sampling period. Additionally, we 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 Sto-Rox Elementary School collected wind speed and wind direction measurements beginning June 24, 2009, continuing through the sampling period (August 5, 2009-January 6, 2010), and ending March 9, 2010. 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 nearly nine months of on-site meteorological data. The meteorological data collected at the school on sampling days are presented in Figures 3a-3d and Tables 2a-b.

The nearest NWS station is at Pittsburgh International Airport in Pittsburgh, Pennsylvania. This station is approximately 7 miles west of the school. Measurements taken at that station include wind, temperature, and precipitation. These are presented in Tables 2a-2b and Appendix E.

[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.

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 source was contributing to conditions at the school location.
- The wind patterns at the monitoring site on sampling days are similar to those observed across the record of on-site meteorological data during the sampling period.
- Our ability to provide a confident characterization of the wind flow patterns at the monitoring site over the long-term is somewhat limited. However, the NWS station at Pittsburgh International Airport does 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 station during the sampling period is similar to the historical long-term wind flow pattern at that same NWS station. This suggests that, on a regional scale, the 5-month sampling period may be representative of year-round wind patterns.

- What are the directions of the key sources of hexavalent chromium, benzene, arsenic, and benzo(a)pyrene emissions in relation to the school location?
  - → The nearby industrial facilities emitting the hexavalent chromium, benzene, arsenic, and benzo(a)pyrene into the air (described in section III above) lie less than 1 mile north to 1 mile east of the school.
  - → Using the property boundaries of the full facilities (in lieu of information regarding the location of specific sources of hexavalent chromium, benzene, arsenic, and benzo(a)pyrene emissions at the facilities), 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 304-101 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 hexavalent chromium and benzo(a)pyrene sampling, there were 9 out of 15 sampling days in which the on-site wind data had a portion of the winds from the ZOI (Figures 3a and3d, Table 2a).
  - → For benzene sampling, there were 4 out of 10 sampling days in which on-site wind data had a portion of the winds from the ZOI (Figure 3b, Table 2b).
  - → For arsenic sampling, there were 7 out of 13 sampling days in which the on-site wind data had a portion of the winds from the ZOI (Figure 3c, Table 2a).

- 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 appear similar to those observed over the record of on-site meteorological data during the sampling period.

  → We note that wind patterns at the nearest NWS station (at Pittsburgh International Airport) during the sampling period are 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. There is some uncertainty as to whether the general wind patterns at the school location for longer periods would be similar to the general wind patterns at the Pittsburgh International Airport (see below).

- How do wind patterns at the school compare to those at the Pittsburgh International 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 5 months), prevalent winds at the school site are predominantly from the east-southeast and south-southwest to west-northwest, while those at the NWS station are somewhat more from the west-southwest to west-northwest. The windroses for the two sites during the sampling period (Figures 3a-3d and Appendix E) show some similarities in wind flow patterns.

- 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 sources of hexavalent chromium, benzene, arsenic, and benzo(a)pyrene have operating permits issued by ACHD that includes operating requirements.[21]

  – The nearby coke oven facility was operating at 80% of full capacity during the sample period. The average operating rate for 2009 was 76%. The average operating rate for January through September 2010 was 97%, which is typical when they are producing as much product as possible. Operating rates normally depend on the state of the economy and tend to vary accordingly.

[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.

- Operations at the two nearby chemical companies were 40% and 55% of full capacity during the sampling period which is normal average operating rate for both facilities.
- The most recently available benzene emissions data for the coke oven facility (2008 TRI and 2005 NATA) are higher than those relied upon in previous modeling analysis for this area (2002 NATA), whereas the benzene emissions estimate from one of the chemical manufacturing facilities was lower (2005 NATA vs. 2002 NATA). For the coke oven facility, total chromium emissions (2005 NATA) were lower than previously reported (2002 NATA), while benzo(a)pyrene emissions were higher than previously reported. Neither source has reported arsenic emissions data since the 2005 NATA.

V. Other Monitoring in This Community

The ACHD conducted air monitoring inside Sto-Rox Elementary and Middle Schools by the request of the school district based on concerns from a USA Today article which suggested that air at the school contained dicyclopentadiene (DCPD), a chemical that is harmful at high concentrations. Indoor air sampling was conducted using charcoal tube sorbent tubes attached to small personal pumps at two locations in the elementary school over four days in February, 2009 with additional samples taken at both schools in March, 2009. Sampling was conducted for DCPD and all BTEX compound (benzene, ethyl benzene, toluene and xylenes) which were known to be emitted by nearby industrial and mobile sources. Outdoor air sampling was also performed at the same time at existing air monitoring sites in Stowe and Avalon (Figure 1). Sampling results showed no detectable concentrations of DCPD, benzene, ethyl benzene or xylene in the indoor air. Small concentrations of toluene were found but at levels which would not create any long term health concern. More information may be found at their website: http://www.achd.net/air/index.html.

VI. Integrated Summary and Next Steps

A. Summary of Key Findings

1. What are the key HAPs for this school?

   → Hexavalent chromium, 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 of hexavalent chromium, benzene, arsenic (PM_{10}), and benzo(a)pyrene on several 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 measured levels and associated longer-term concentration estimates for hexavalent chromium are not as high as that suggested by the information available prior to monitoring and are below levels of concern for long-term exposures.

→ The measured levels and associated longer-term concentration estimates for pollutants associated with coke oven emissions, including benzene, arsenic and benzo(a)pyrene, and other monitored pollutants are not as high as was suggested by the information available prior to monitoring and are below levels of significant 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 appear to reflect air concentrations during the sampling 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 site. The lack of long-term meteorological data at the school location, along with our finding that the wind patterns from the nearest NWS station are similar to those at the school, 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 will not 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.
3. The ACHD will continue to oversee industrial facilities in the area through air permits and other programs.

VII. Figures and Tables

A. Tables

1. Sto-Rox Elementary School – Key Pollutant Analysis.

2a. Sto-Rox Elementary School Key Pollutant Concentrations (Hexavalent Chromium, Arsenic (PM_{10}), and Benzo(a)pyrene) and Meteorological Data.

2b. Sto-Rox Elementary School Key Pollutant Concentrations (Benzene) and Meteorological Data.

B. Figures

1. Sto-Rox Elementary School, Sto-Rox Middle School, and Sources of Interest.

2a. Sto-Rox Elementary School – Key Pollutant (Hexavalent Chromium) Analysis.

2b. Sto-Rox Elementary School – Key Pollutant (Benzene) Analysis.

2c. Sto-Rox Elementary School – Key Pollutant (Arsenic (PM_{10})) Analysis.

2d. Sto-Rox Elementary School – Key Pollutant (Benzo(a)pyrene) Analysis.

3a. Sto-Rox Elementary School (McKees Rocks, PA) Hexavalent Chromium Concentration and Wind Information.

3b. Sto-Rox Elementary School (McKees Rocks, PA) Benzene Concentration and Wind Information.

3c. Sto-Rox Elementary School (McKees Rocks, PA) Arsenic (PM_{10}) Concentration and Wind Information.

3d. Sto-Rox Elementary School (McKees Rocks, PA) Benzo(a)pyrene Concentration and Wind Information.

VIII. Appendices

A. Summary Description of Long-term Comparison Levels.

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

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

D. Sto-Rox Elementary School Pollutant Concentrations.

E. Windroses for Pittsburgh International Airport NWS Station.

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.[22]

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.[23] 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.

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

[23] 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.[24] 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.

[24] 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 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).[25] 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?

  → The longer-term concentration estimates for the other HAPs monitored are below their long-term comparison levels.

  → Further, for pollutants with cancer-based comparison levels, the longer-term concentration estimates for all but four of these (carbon tetrachloride, naphthalene, *p*-dichlorobenzene, and 1,3-butadiene) are more than 100-fold lower.[26]

  → 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.[27]

Additional Information on Four HAPs:

- The first HAP mentioned above is carbon tetrachloride. The mean and 95 percent upper bound on the mean for carbon tetrachloride are approximately 4-5% 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 75^{th} and 95^{th} percentile of samples collected from 2004 to 2008 (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

[25] 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.

[26] 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^{-6} excess cancer risk.

[27] 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.*

throughout the world as a result of its slow rate of degradation in the environment and global distribution in the atmosphere.

- The second HAP mentioned above is naphthalene. The mean and 95 percent upper bound on the mean for naphthalene are approximately 3-4% 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 between the 50th and 75th percentile of samples collected from 2004 to 2008 (the most recently compiled period) at the NATTS sites (Appendix B).

- The third HAP mentioned above is *p*-dichlorobenzene. The mean and 95 percent upper bound on the mean for *p*-dichlorobenzene are approximately 2-6% 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 75th and 95th percentile of samples collected from 2004 to 2008 (the most recently compiled period) at the NATTS sites (Appendix B).

- The fourth HAP mentioned above is 1,3-butadiene. The mean and 95 percent upper bound on the mean for 1,3-butadiene are approximately 1-2% 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 below the 50th percentile of samples collected from 2004 to 2008 (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.[28]

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.

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

- 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.

        - There are not multiple HAPs for which longer-term concentration estimates are more than ten percent of their lowest comparison levels.