

## **SAT Initiative: Riverside Elementary School (Reading, Pennsylvania)**

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](http://www.epa.gov/schoolair)).

### **I. Executive Summary**

- Air monitoring has been conducted at Riverside 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.
- This school was selected for monitoring based on information indicating the potential for elevated ambient concentrations of hexavalent chromium in air outside the school. That information included estimates of significant emissions of total chromium in EPA's 2002 National-Scale Air Toxics Assessment (NATA) for a nearby steel mill. In addition, the Pennsylvania Department of Environmental Protection recommended this school as it is closest to the source of interest.
- Air monitoring for hexavalent chromium was performed from August 5, 2009 through October 28, 2009.
- Measured levels of hexavalent chromium and associated longer-term concentration estimates are well below levels of concern for short- or long-term exposures. They are not as high as suggested by the information available prior to monitoring.
- The levels of hexavalent chromium measured in the outdoor air at this school indicate a low-level influence from a nearby source.
- Based on the analysis described here, EPA will not extend air toxics monitoring at this school.
- The Pennsylvania Department of Environmental Protection (PADEP) 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 are monitoring specific (key) air toxics in the outdoor air around priority schools in 22 states and 2 tribal areas (<http://www.epa.gov/schoolair/schools.html>).

- The schools selected for monitoring include some schools that are near large industries that are sources of air toxics, and some schools that are in urban areas, where emissions of air toxics come from a mix of large and small industries, cars, trucks, buses and other sources.

- EPA selected schools based on information available to us about air pollution in the vicinity of the school, including results of the 2002 National-Scale Air Toxics Assessment (NATA), results from a 2008 USA Today analysis on air toxics at schools, and information from state and local air agencies. The analysis by USA Today involved use of EPA's Risk Screening Environmental Indicators tool and Toxics Release Inventory (TRI) for 2005.
  - Available information had raised some questions about air quality near these schools that EPA concluded merited investigation. In many cases, the information indicated that estimated long-term average concentrations of one or more air toxics were above the upper end of the range that EPA generally considers as acceptable (e.g., above 1-in-10,000 cancer risk for carcinogens).
- Monitors are placed at each school for approximately 60 days, and take air samples on at least 10 different days during that time. The samples are analyzed for specific air toxics identified for monitoring at the school (i.e., key pollutants).<sup>1</sup>
- 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.

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](http://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*

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<sup>1</sup> 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.

Information on health effects of air toxics being monitored<sup>2</sup> and educational materials describing risk concepts<sup>3</sup> are also available from EPA's website.

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

This school was selected for monitoring in consultation with the State air agency, PADEP. We were interested in evaluating the ambient concentrations of hexavalent chromium in air outside the school because EPA's 2002 NATA analysis indicated the potential for levels of concern due to estimates of hexavalent chromium emissions in the 2002 National Emissions Inventory for a nearby steel mill.

Monitoring commenced at this school on August 5, 2009 and continued through October 28, 2009. During this period, thirteen valid samples of airborne particles were collected and analyzed for hexavalent chromium (the key pollutant at this school). All sampling methodologies are described in EPA's schools air toxics monitoring plan (<http://www.epa.gov/schoolair/schools.html>).<sup>4</sup>

### **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)<sup>5</sup> 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.

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<sup>2</sup> For example, <http://www.epa.gov/schoolair/pollutants.html>, [http://www.epa.gov/ttn/fera/risk\\_atoxic.html](http://www.epa.gov/ttn/fera/risk_atoxic.html).

<sup>3</sup> For example, [http://www.epa.gov/ttn/atw/3\\_90\\_022.html](http://www.epa.gov/ttn/atw/3_90_022.html), [http://www.epa.gov/ttn/atw/3\\_90\\_024.html](http://www.epa.gov/ttn/atw/3_90_024.html).

<sup>4</sup> PADEP staff operated the monitors and sent the sample filters to the analytical laboratory under contract to EPA.

<sup>5</sup> 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.

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<sup>6</sup> and, in the case of cancer risk, consistent with the implied level of risk considered in identifying schools for monitoring. Consistent with the long-term or chronic focus of the modeling analyses, based on which these schools were selected for monitoring, we have analyzed the full record of concentrations of air toxics measured at this school, using routine statistical tools, to derive a 95 percent confidence interval<sup>7</sup> 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).<sup>8</sup> 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.<sup>9</sup> 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

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<sup>6</sup> 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.

<sup>7</sup> 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.

<sup>8</sup> 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.

<sup>9</sup> 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).

- Evaluation of actions being taken or planned nationally, regionally or locally that may achieve emission and/or exposure reductions. An example of this would be actions taken to address the type of ubiquitous emissions that come from mobile sources.

We have further analyzed the dataset to describe what it indicates in light of some other criteria and information commonly used in prioritizing state, local and national air toxics program activities. State, local and national programs often develop long-term monitoring datasets in order to better characterize pollutants near particular sources. The 2-3 month dataset developed under this initiative will be helpful to those programs in setting priorities for longer-term monitoring projects. The intent of this analysis is to make this 2-3 month monitoring dataset as useful as possible to state, local and national air toxics 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 source(s) 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.<sup>10</sup> 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.

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<sup>10</sup> This is described in detail in *Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results*

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

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

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

- The air sampling data collected over the 2-month sampling period and the related longer-term concentration estimates are well below concentrations of significant concern for short- or long-term exposures, however these concentrations indicate a low-level influence from a nearby source of hexavalent chromium emissions.

#### Hexavalent Chromium, the key pollutant:

- Do the monitoring data indicate the influence from a nearby source?
  - The data collected include several hexavalent chromium concentrations that, while all well below any level of health concern, were higher than concentrations commonly observed in other locations nationally.<sup>11</sup>
- 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 both of the long-term comparison levels (Table 1).<sup>12</sup> These comparison levels reflect continuous exposure concentrations (24 hours a day, all year, over a lifetime).
    - Further, 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.
  - Additionally, we did not identify any concerns regarding short-term exposures as each individual measurement is below the individual sample screening level for

<sup>11</sup> For example, seven of the concentrations at this site (Table 2) were higher than 75 percent of samples collected at the National Air Toxics Trends Stations (NATTS) from 2004-2008 (Appendix B). Because the NATTS sites are generally sited so as not to be influenced by specific nearby sources, EPA is using the 75th percentile point of concentrations at these sites as a benchmark for indicating potential influence from a source nearby to this school.

<sup>12</sup> The upper end of the interval is nearly two times the mean of the monitoring data, but less than 5% of the cancer-based long-term comparison level.

hexavalent chromium (which is based on consideration of exposure all day, every day over a period ranging up to at least a couple of weeks, and longer for some pollutants).<sup>10</sup>

- 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 exposure.

### **C. Wind and Other Meteorological Data**

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

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

The meteorological station at Riverside Elementary School collected wind speed and wind direction measurements beginning July 8, 2009, continuing through the sampling period (July 30, 2009-October 28, 2009), and ending February 2, 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 approximately seven months of on-site meteorological data. The meteorological data collected at the school site on sampling days are presented in Figure 2 and Table 2.

The nearest NWS station is at Reading Regional/C. A. Spaatz Field Airport NWS Station in Reading, PA. This station is approximately 1.69 miles northwest of the school. Measurements taken at that station include wind, temperature and precipitation. These are presented in Table 2 and Appendix D.

**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 winds were coming from the nearby key source, and could therefore potentially contribute to conditions at the school location.
- The wind patterns at the monitoring site across sampling dates are generally 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 in Reading Regional/C. A. Spaatz Field Airport NWS Station does appear to represent the specific wind flow patterns at the school location during this time period.
- Although we lack long-term wind data at the monitoring site, the wind pattern at the NWS station during the sampling period is generally similar to the historical long-term wind flow pattern at that same NWS station. This suggests that, on a regional scale, the 3-month sampling period is generally representative of year-round wind patterns.

- What is the direction of the key source of hexavalent chromium emissions in relation to the school location?
  - The nearby industrial facility emitting the key pollutants into the air (described in section III, above) lies less than one mile north-northwest of the school.
  - Using the property boundaries of the full facility (in lieu of information regarding the location of specific sources of hexavalent chromium emissions at the facility), we have identified an approximate range of wind directions to use in considering the potential influence of this facility on air concentrations at the school.
  - This general range of wind directions, from approximately 300 to 350 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?
  - There were nine out of thirteen sampling days in which a portion of the winds were from the expected ZOI.
- 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 to be generally similar to those observed over the record of on-site meteorological data during the sampling period. Winds from the ZOI tend to be slightly higher during the full period when compared to the sampling period.

→ We note that wind patterns at the nearest NWS station (at Reading Regional/C. A. Spaatz Field Airport) were somewhat similar to monitoring site during the same sampling period. Wind patterns were also somewhat similar to those recorded at the NWS station over the long-term (2002-2007 period; Appendix D), supporting the idea that regional meteorological patterns during the monitoring period were consistent with long-term patterns. However, 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 Reading Regional/C. A. Spaatz Field Airport (see below).

- How do wind patterns at the school compare to those at the Reading Regional/C. A. Spaatz Field Airport 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 3 months), prevalent winds at the school site and the NWS station are predominantly from the west to northeast. The windroses for the two sites during the sampling period (Figure 2 and Appendix D) show little differences in wind flow patterns.
- Are there other meteorological patterns that may influence the measured concentrations at the school monitoring site?
  - We did observe that the highest concentration of hexavalent chromium was recorded on a day in which average daily wind speed was greater than 5 mph.

## V. Key Source Information

- Was the source operating as usual during the monitoring period?
  - The nearby source of hexavalent chromium (described in section III above) has a Title V operating permit, and subsequent Plan Approvals, issued by PADEP that include operating requirements.<sup>13</sup>
  - Information from the nearby source indicates that this facility was operating at a rate of 13% during the sampling period, in comparison to its usual conditions of 18-20% capacity.
  - The most recently available chromium emissions for this source (2008 TRI) are lower than those relied upon in previous modeling analysis for this area (e.g., 2002 NATA).

## VI. Integrated Summary and Next Steps

### A. Summary of Key Findings

1. What are the key HAPs for this school?

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<sup>13</sup> Operating permits, which are issued to air pollution sources under the Clean Air Act, are described at: <http://www.epa.gov/air/oaqps/permits/>

- Hexavalent chromium is the key HAP for this school, identified based on emissions information considered in identifying the school for monitoring.
2. Do the data collected at this school indicate an elevated level of concern, as implied by information that led to identifying this school for monitoring?
    - No; the levels measured and associated longer-term concentration estimates are not as high as that suggested by the information available prior to monitoring and are well below levels of concern for long-term exposures.
  3. Are there indications, e.g., from the meteorological or other data, that the sample set may not be indicative of longer-term air concentrations? Would we expect higher (or lower) concentrations at other times of year?
    - The data we have collected 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.

#### **B. Next Steps for Key Pollutants**

1. Based on the analysis described here, EPA will not extend air toxics monitoring at this school.
2. PADEP will continue to oversee industrial facilities in the area through air permits and other programs.

### **VII. Figures and Tables**

#### **A. Tables**

1. Riverside Elementary School – Key Pollutant Analysis.
2. Riverside Elementary School Key Pollutant Concentrations and Meteorological Data.

#### **B. Figures**

1. Riverside Elementary School – Key Pollutant (Hexavalent Chromium) Analysis.
2. Riverside Elementary School (Reading, PA) Hexavalent Chromium Concentration and Wind Information.

### **VIII. Appendices**

- A. Summary Description of Long-term Comparison Levels.
- B. National Air Toxics Trends Stations Measurements (2004-2008).

C. Riverside Elementary School Pollutant Concentrations.

D. Windroses for Reading Regional/C. A. Spaatz Field Airport NWS Station.

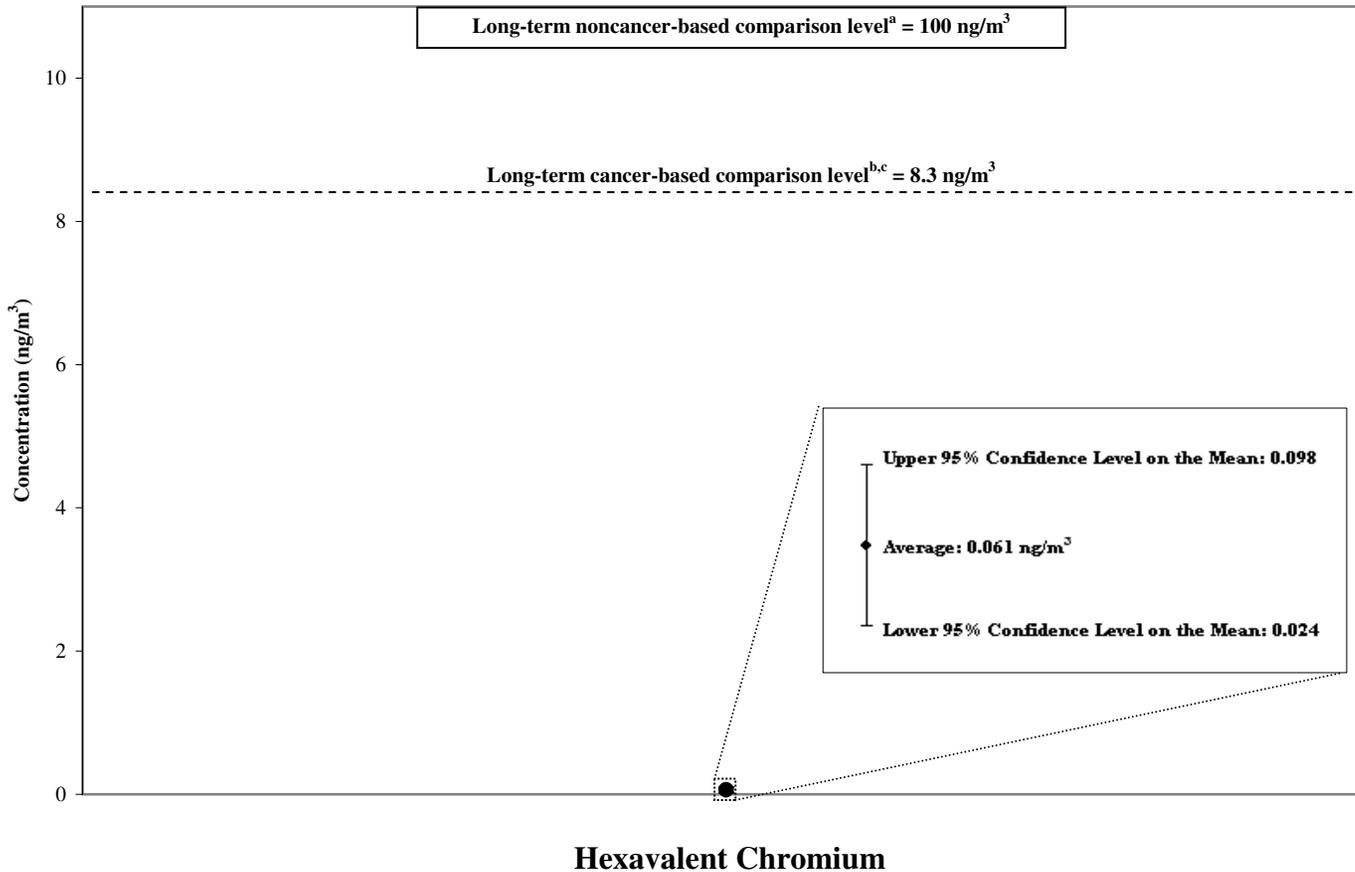
**Table 1. Riverside Elementary School - Key Pollutant Analysis.**

Parameter	Units	Mean of Measurements	95% Confidence Interval on the Mean	Long-term Comparison Level <sup>a</sup>	
				Cancer-Based <sup>b</sup>	Noncancer-Based <sup>c</sup>
Hexavalent Chromium	ng/m <sup>3</sup>	0.061 <sup>d</sup>	0.024 - 0.098	8.3 <sup>e</sup>	100

ng/m<sup>3</sup> nanograms per cubic meter

- <sup>a</sup> Details regarding these values are in the technical report, Schools Air Toxics Monitoring Activity (2009) Uses of Health Effects Information.
- <sup>b</sup> Air toxics for which the upper 95% confidence limit on the mean concentration is above this level will be fully discussed in the text and may be considered a priority for potential follow-up activities, if indicated in light of the full set of information available for the site. Findings of the upper 95% confidence limit below 1% of the comparison level (i.e., where the upper 95% confidence limit is below the corresponding 1-in-1-million cancer risk based concentration) are generally considered a low priority for follow-up activity. Situations where the summary statistics for a pollutant are below this comparison level but above 1% of this level are fully discussed in the text of the report.
- <sup>c</sup> 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.
- <sup>d</sup> The mean of measurements for hexavalent chromium is the average of all sample results, which include eleven detections that ranged from 0.010 to 0.183 ng/m<sup>3</sup>, There were, as well, two samples in which no chemical was registered by the laboratory analytical equipment. For these samples, a value of zero was used when calculating the mean.
- <sup>e</sup> This comparison value is based on the EPA IRIS cancer assessment. It is noted that the EPA is currently updating this assessment with regard to the mode of action. If the update were to conclude that this chemical is carcinogenic by a mutagenic mode of action, this comparison level would be revised to a slightly lower value of 5.2 ng/m<sup>3</sup>, consistent with EPA's Supplemental Guidance for Assessing Susceptibility from Early-Life exposure.

**Figure 1. Riverside Elementary School - Key Pollutant (Hexavalent Chromium) Analysis.**



<sup>a</sup> 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.

<sup>b</sup> 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.

<sup>c</sup> This comparison value is based on the EPA IRIS cancer assessment. It is noted that the EPA is currently updating this assessment with regard to the mode of action. If the update were to conclude that this chemical is carcinogenic by a mutagenic mode of action, this comparison level would be revised to a slightly lower value of 5.2 ng/m<sup>3</sup>, consistent with EPA's Supplemental Guidance for Assessing Susceptibility from Early-Life exposure.

**Table 2. Riverside Elementary School Key Pollutant Concentrations and Meteorological Data.**

Parameter	Units	8/5/2009	8/11/2009	8/17/2009	8/23/2009	8/26/2009	9/8/2009	9/10/2009	9/16/2009	9/22/2009	9/28/2009	10/4/2009	10/22/2009	10/28/2009
Hexavalent Chromium	ng/m <sup>3</sup>	0.013	0.183	0.009	0.019	0.164	0.098	ND	0.051	0.010	0.088	ND	0.072	0.087
% Hours w/Wind Direction from Expected ZOI <sup>a</sup>	%	8.3	25.0	4.2	58.3	4.2	4.2	0.0	0.0	0.0	8.3	8.3	4.2	0.0
Wind Speed (avg. of hourly speeds)	mph	4.1	5.6	3.5	4.8	4.1	2.4	4.8	4.5	3.1	4.6	3.9	2.1	3.7
Wind Direction (avg. of unitized vector) <sup>b</sup>	deg.	300.1	286.8	222.8	322.5	263.5	35.4	43.0	34.0	186.0	195.4	291.3	159.3	37.6
% of Hours with Speed below 2 knots	%	25.0	0.0	41.7	12.5	29.2	58.3	4.2	0.0	29.2	20.8	45.8	75.0	8.3
Daily Average Temperature	° F	76.7	78.9	79.6	76.4	76.3	67.3	62.4	62.8	69.0	60.8	58.9	57.7	56.6
Daily Precipitation	inches	0.00	0.12	0.00	0.00	0.00	0.01	0.00	0.04	0.00	0.08	0.00	0.00	0.63

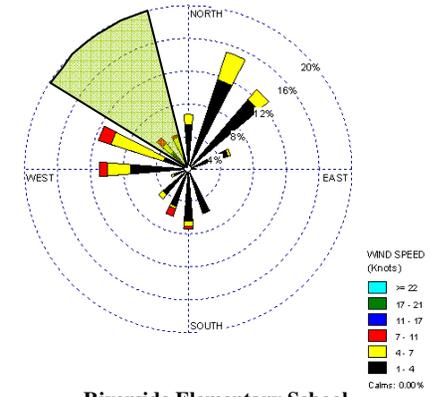
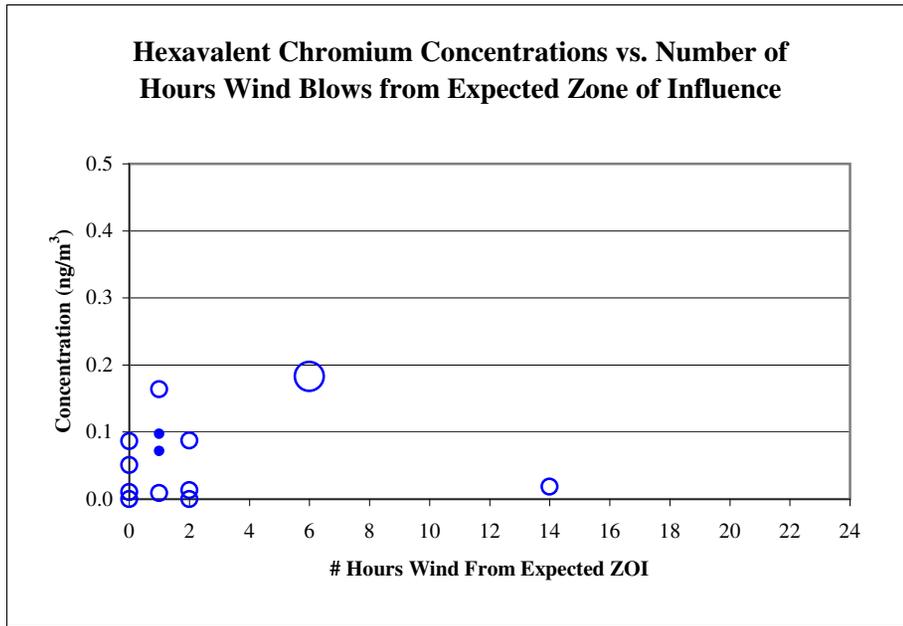
All precipitation and temperature data were from the Reading Regional/C.A. Spatz Field Airport NWS Station.

ND No detection of this chemical was registered by the laboratory analytical equipment. The method detection limit is 0.0043 ng/m<sup>3</sup>.

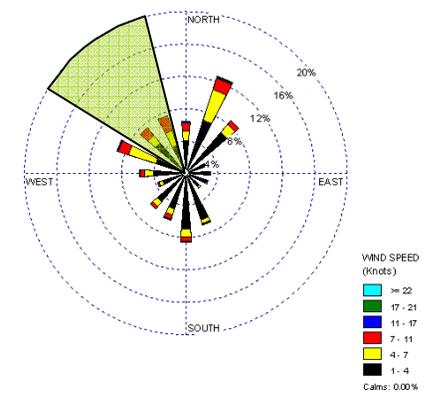
<sup>a</sup> Based on count of hours for which vector wind direction is from expected zone of influence.

<sup>b</sup> 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).

**Figure 2. Riverside Elementary School (Reading, PA) Hexavalent Chromium Concentration and Wind Information.**



**Riverside Elementary School  
Composite Hourly Windrose  
on Sample Days  
(Aug. 5, 2009-Oct. 28, 2009)**



**Riverside Elementary School  
Composite Hourly Windrose  
Across Sampling Period  
(Aug. 5, 2009-Oct. 28, 2009)**

**KEY**

**Pollutant: Hexavalent Chromium**  
**Timeframe: August 5, 2009 - October 28, 2009**

Note

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

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.

Expected Zone of Source Influence

## 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.<sup>14</sup>

### 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.<sup>15</sup> 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.

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<sup>14</sup> These comparison levels are described in more detail *Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results*.

<sup>15</sup> 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.<sup>16</sup> 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.

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<sup>16</sup> 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](http://www.epa.gov/ncea/iris/help_gloss.htm#r)

## Appendix B. National Air Toxics Trends Stations Measurements (2004-2008).<sup>a</sup>

Pollutant	Units	# Samples Analyzed	% Detections	Maximum	Arithmetic Mean <sup>b</sup>	Geometric Mean	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
Hexavalent Chromium	ng/m <sup>3</sup>	4,233	66%	2.97	0.03	0.03	ND	ND	0.01	0.04	0.13

Key Pollutant

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

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

<sup>b</sup> In calculations involving non-detects (ND), a value of zero is used.

### Appendix C. Riverside Elementary School Pollutant Concentrations.

Parameter	Units	8/5/2009	8/11/2009	8/17/2009	8/23/2009	8/26/2009	9/8/2009	9/10/2009	9/16/2009	9/22/2009	9/28/2009	10/4/2009	10/22/2009	10/28/2009	Sample Screening Level <sup>a</sup>
Hexavalent Chromium	ng/m <sup>3</sup>	0.013	0.183	0.009	0.019	0.164	0.098	ND	0.051	0.010	0.088	ND	0.072	0.087	580

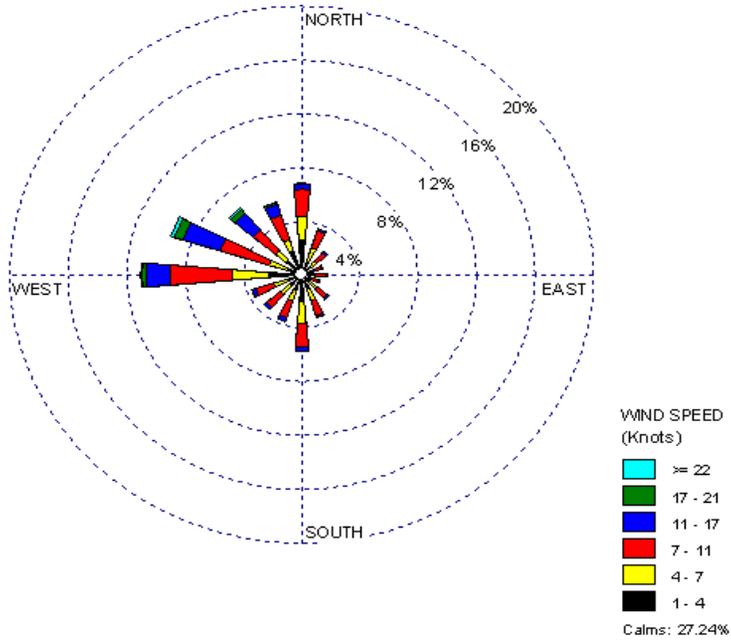
Key Pollutant

ng/m<sup>3</sup> nanograms per cubic meter

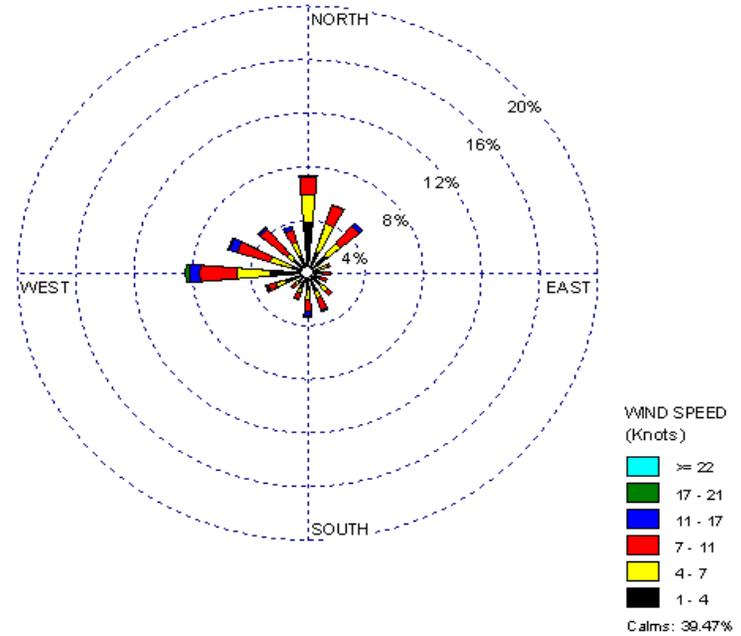
ND No detection of this chemical was registered by the laboratory analytical equipment. The method detection limit is 0.0043 ng/m<sup>3</sup>.

<sup>a</sup> 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 at least a couple of weeks, and longer for some pollutants.

**Appendix D. Windroses for Reading Regional/C.A. Spaatz Field Airport NWS Station.**



**Reading Regional/C A Spaatz Field  
Airport NWS Station  
2002-2007<sup>1</sup>**



**Reading Regional/C A Spaatz Field  
Airport NWS Station  
Across Sampling Period  
(Aug. 5, 2009-Oct. 28, 2009)<sup>1</sup>**

<sup>1</sup> Reading Regional/C. A. Spaatz Field Airport NWS Station (WBAN 14712) is 1.69 miles from Riverside Elementary School