SAT Initiative: Concord Elementary School (Seattle, Washington)

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 Concord 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, benzene, 1,3-butadiene, and lead in air outside the school. That information included a recommendation by the Puget Sound Clean Air Agency to monitor hexavalent chromium due to several small chromium metal plating facilities near the school. Also, EPA's 2002 National-Scale Air Toxics Assessment (NATA) indicated elevated levels of benzene and 1,3-butadiene from nearby mobile sources and elevated levels of lead from a nearby airport. EPA's lead emission estimate for this airport does not exceed the inventory threshold that would have made it a candidate for lead monitoring to evaluate compliance with the NAAQS for lead (http://www.epa.gov/ttn/naaqs/standards/pb/s_pb_index.html). This school is located in an industrial area adjacent to an airport and surrounded by several interstate and state highways.
- Air monitoring was performed from August 20, 2009 to November 18, 2009 for the following pollutants: hexavalent chromium; benzene, 1,3-butadiene, and other volatile organic compounds (VOCs); lead in total suspended particles (TSP); and metals in particulate matter less than 10 microns (PM_{10}).
- Measured levels of hexavalent chromium and associated longer-term concentration estimates are below levels of concern for short- and long-term exposures.
- The levels of hexavalent chromium measured in the outdoor air at this school indicate influence of (a) nearby source(s).
- Measured levels of benzene and 1,3-butadiene and associated longer-term concentration estimates at this school were not as high as was suggested by the modeling information available prior to monitoring. Although they were below levels of significant concern that had been suggested by the modeling information, these results indicate the influence of mobile source pollutants of concern that are the focus of EPA actions nationwide.
- Benzene and 1,3-butadiene are common in the outdoor air in urban areas where many sources are located near one another, particularly mobile sources such as cars and other motor vehicles and off-road machinery. Levels of benzene and 1,3-butadiene in many urban areas can be elevated. EPA remains concerned about mobile source emissions and continues to work to reduce those emissions across the country, through national rules

and by providing information and suggestions to assist with reductions in local areas (http://www.epa.gov/schoolair/mobile.html).

- Measured levels of lead, a pollutant for which there are national standards for ambient air, are below the level of the national standard for protection of public health.
- The levels of lead (TSP) measured in the outdoor air at this school indicate influence of a nearby source.
- Leaded aviation gasoline is utilized in general aviation aircraft with piston engines, which are generally used for instructional flying, air taxi activities, and personal transportation. Lead is not used in jet fuel, the fuel utilized by most commercial aircraft. Information regarding lead emissions from piston-engine aircraft can be found at: www.epa.gov/otaq/aviation.htm.
- Based on the analysis described here, EPA will not extend air toxics monitoring at this school. However, EPA's ongoing research and national air toxics monitoring programs will continue to collect information on mobile source impacts on outdoor air nationally.
- 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 Puget Sound Clean Air Agency (PSCAA) will continue to oversee industrial facilities in the area through air permits and other programs, and will continue to implement reductions in mobile source emissions through implementation of national programs and its own 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.

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

This school was selected for monitoring in consultation with the local air agency, Puget Sound Clean Air Agency (PSCAA). We were interested in evaluating the ambient concentrations of hexavalent chromium in air outside the school because the PSCAA suggested the potential for elevated levels of hexavalent chromium from several small metal plating facilities near the

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[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.

[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.

school. We were also interested in evaluating the ambient concentrations of benzene and 1,3-butadiene, two key mobile source air toxics, in air outside this school because EPA's 2002 NATA analysis indicated the potential for levels of concern due to estimates of benzene and 1,3-butadiene emissions from nearby mobile sources. More information on mobile sources of air toxics can be found on EPA's website (http://www.epa.gov/schoolair/mobile.html). We were also interested in evaluating the ambient concentrations of lead (TSP) in air outside the school because EPA's 2002 NATA analysis indicated the potential for levels of concern due to estimates of lead (TSP) emissions from a nearby airport. Leaded aviation gasoline is utilized in general aviation aircraft with piston engines, which are generally used for instructional flying, air taxi activities, and personal transportation. Lead is not used in jet fuel, the fuel utilized by most commercial aircraft. This school is located in an industrial area adjacent to an airport and surrounded by several interstate and state highways (Figure 1).

Monitoring commenced at this school on August 20, 2009 and continued through November 18, 2009. During this period, thirteen VOC samples were collected and analyzed for benzene and 1,3-butadiene (two of the key pollutants at the school) and for a standardized set of additional VOCs that are routinely included in the analytical methods for the key pollutants. Additionally, sixteen samples of total suspended particles (TSP) were collected and analyzed for lead and twelve hexavalent chromium samples were collected and analyzed. In addition to these pollutants, 14 samples of airborne particles were collected using a PM_{10} sampler.[4]

All VOC results with the exception of acrolein were evaluated for health concerns. EPA will not use the acrolein data in evaluating the potential for health concerns from exposure to air toxics in outdoor air as part of the SAT Monitoring project. The Agency made this determination after results of a short-term laboratory study raised questions about the consistency and reliability of monitoring results of acrolein. (More information is available at http://www.epa.gov/schoolair/acrolein.html) 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

[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 is based on.
[5] PSCAA staff maintained the monitors and site, and EPA 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. Also, hexavalent chromium is listed collectively with other forms of chromium as "chromium compounds".

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 EPA 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 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

[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.

[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.

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 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

[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).

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.

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

- The air sampling data collected over the 3-month sampling period and the related longer-term concentration estimates, while indicating influence from nearby sources of hexavalent chromium and lead, are below levels of concern for hexavalent chromium and below the national ambient air standard for protection of public health for lead.
- Benzene and 1,3-butadiene levels measured over the 3-month sampling period and associated longer-term concentration estimated at this school were not as high as suggested by the modeling information available prior to monitoring. Although they were below the levels of significant concern that had been suggested by the modeling information, these results do indicate the influence of mobile source pollutants of concern that are the focus of EPA actions nationwide.

[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.*

Hexavalent Chromium, key pollutant:

- Do the monitoring data indicate influence from a nearby source?
  - → The monitoring data included several hexavalent chromium concentrations that are 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 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).[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 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 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]

Benzene, key pollutant:

Benzene is one of several air toxics that EPA recognizes as a key pollutant nationally. A large number of people live in areas across the U.S. with elevated ambient concentrations of this pollutant due to mobile sources.[14]

- Do the monitoring data indicate elevated levels that pose significant long-term health concerns?
  - → Measured benzene levels and associated longer-term concentration estimates at this school were not as high as suggested by the modeling information available prior to monitoring. Although they were below the levels of significant concern that had been suggested by the modeling information, these results indicate the ubiquitous nature and influence of mobile source pollutants of concern that are the focus of EPA actions nationwide.

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[12] For example, seven 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 for indicating potential influence from a source nearby to the school.
[13] The upper end of the interval is nearly 2.2 times the mean of the monitoring data and less than 4% of the long-term cancer-based comparison level.
[14] Additional information on mobile sources of air toxics is available at http://www.epa.gov/schoolair/mobile.html

  - 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 both of the long-term comparison levels (Table 1).[15] These comparison levels are 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 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]

<u>1,3-Butadiene, key pollutant:</u>

1,3-Butadiene is one of several air toxics that EPA recognizes as a key pollutant nationally. A large number of people live in areas across the U.S. with elevated ambient concentrations of this pollutant due to mobile sources.[14]

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

  → Measured 1,3-butadiene levels and associated longer-term concentration estimates at this school were not as high as suggested by the modeling information available prior to monitoring. Although they were below the levels of significant concern that had been suggested by the modeling information, these results indicate the ubiquitous nature and influence of mobile source pollutants of concern that are the focus of EPA actions nationwide.

  - The estimate of longer-term 1,3-butadiene 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).[16] These comparison levels are 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 1,3-butadiene (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]

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[15] The upper end of the interval is nearly 1.3 times the mean of the monitoring data and less than 10% of the long-term cancer-based comparison level.

[16] The upper end of the interval is nearly 1.4 times the mean of the monitoring data and less than 9% of the long-term noncancer-based comparison level.

Lead, key pollutant:

- Do the monitoring data indicate influence from a nearby source?
  - → The data collected include one lead (TSP) concentration that was several times higher than the other on-site measurements. Additionally, as discussed in section IV.C below, on the day in which the highest concentration was measured, the wind information indicated a significant portion of that day's winds came from the direction of a nearby source.
- Do the monitoring data indicate elevated levels that pose significant long-term health concerns?
  - → The monitoring levels of lead (TSP) are below the national ambient air quality standard for protection of public health for lead.
    - ▪ The estimate of longer-term lead (TSP) 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] This comparison level is the level of the national ambient air quality standard.
  - → Lead concentrations in air increase with proximity to airports where piston-engine aircraft operate. The monitor at Concord Elementary School was over one kilometer from the airport, a distance at which available studies suggest lead concentrations typically decrease to local background levels.[18,19] The monitoring data do not indicate concentrations above the national ambient air quality standard for protection of public health.

Other Air Toxics

- 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, with longer-term concentration estimates for these HAPs below their long-term comparison levels (Appendix C). Additionally each individual measurement for these pollutants is below the individual sample screening level[11] for that pollutant (Appendix D).

[17] The upper end of the interval is nearly 1.5 times the mean of the monitoring data and less than 7% of the long-term noncancer-based comparison level.
[18] U.S. EPA (2010) Development and Evaluation of an Air Quality Modeling Approach for Lead Emissions from Piston-Engine Aircraft Operating on Leaded Aviation Gasoline. EPA-420-R-10-007. February 2010.
[19] South Coast Air Quality Management District (2010) General Aviation Airport Air Monitoring Study Final Report.

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)?
  - → Although the multiple air toxics monitored at this site were below the levels of significant concern for multi-pollutant cumulative risk that had been suggested by the modeling information, these results indicate the influence of multiple mobile source pollutants of concern that are the focus of EPA actions nationwide (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.

Due to siting issues related to the on-site meteorological station at Concord Elementary School, wind speed and wind direction measurements from a nearby air toxics study site (Duwamish) was used as a surrogate during the sampling period, beginning on August 20, 2009 and continuing through the end of the sampling period, November 18, 2009. The Duwamish monitoring site has been operating since April 1, 2009 and surrogate data for these meteorological parameters are available for all dates of sample collection and also for intervening days, producing an approximately 90-day record. The data collected on sampling days are presented in Figures 3a-3c and Tables 2a-2b. .

[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). The 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

The nearest NWS station is at the Boeing Field, King County International Airport in Seattle, WA. This station is approximately 1.14 miles east of the school. Measurements taken at that station include wind, temperature, and precipitation. These are presented in Tables 2a-2b and Appendix E.

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

- Since any wind direction may be considered as the direction of a key source, all air samples were collected on days when the nearby key sources were contributing to conditions at the school location.
- The wind patterns at the Duwamish monitoring site across sampling dates are similar to those observed across the record of Duwamish 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 Boeing Field, King County International Airport does appear to represent the specific wind flow patterns at the nearby air toxics study site at Duwamish.
- Although we lack long-term wind data at the Duwamish 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. Therefore, the 3-month sampling period may be representative of year-round wind patterns.

- What are the directions of the key sources of hexavalent chromium, benzene, 1,3-butadiene, and lead emissions in relation to the school location?
  → The key source(s) of hexavalent chromium are not well defined at this time; therefore, no ZOI was identified.
  → The key sources of benzene and 1,3-butadiene were identified as nearby roadway mobile sources surrounding the school. Therefore, wind from any direction may be considered as from the direction of a key source, and is referred to as the expected zone of source influence A (ZOI A).
  → The key source of lead lies approximately 1 mile east-northeast of the school. Using the property boundaries of the source of interest (in lieu of information regarding the location of specific sources of lead), we have identified an approximate range of wind directions to use in considering the potential influence of this source on air concentrations at the school. This general range of wind directions, from approximately 20-120 degrees, is referred to here as the expected ZOI B.

- On days the air samples were collected, how often did wind come from direction of the key source?
  → For benzene and 1,3-butadiene sampling, since any wind direction may be considered as the direction of a key source, all sampling days for which Duwamish wind data are available were from the expected ZOI (Figures 3a-3b, Table 2b).

→ For lead sampling, there were eight of 16 sampling days in which the Duwamish wind data had a portion of winds from ZOI B (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 for benzene, 1,3-butadiene, and lead appear similar to those observed over the record of the Duwamish meteorological data during the sampling period.
  → We note that wind patterns at the nearest NWS station (at Boeing Field, King County 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 sampling 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 Boeing Field, King County International Airport (see below).

- How do wind patterns at the school compare to those at the Boeing Field, King County International Airport NWS station, particularly with regard to prevalent wind directions and the direction of the key source?
  → During the period for which data are available both at the nearby air toxics study site at the Duwamish location and at the reference NWS station (approximately 90 days), prevalent winds at the Duwamish location are predominantly from the south-southeast to south-southwest, while those at the NWS station are somewhat more from the southeast to south. The windroses for the two sites during the sampling period (Figures 3a-3c and Appendix E) show differences in wind flow patterns.

- Are there other meteorological patterns that may influence the measured concentrations at the school monitoring site?
  → We did not observe other meteorological patterns that may influence the measured concentrations at the school monitoring site.

V. Key Source Information

- There are a number of potential sources within a one mile radius, including sources involved in chrome plating, steel production, and other types of metal working. However, from this study it is not possible to discern direct emissions or the impact at the school from the individual sources as the sources' emissions are below required reporting thresholds and the total emissions per source is unclear.

- Was mobile source activity typical during the monitoring period?
  - The most recently available benzene and 1,3-butadiene emissions for mobile sources (NATA 2005) are lower than those relied upon previous modeling analysis for this area (2002 NATA).

- Was the lead source operating as usual during the monitoring period?

– The most recently available lead emissions for this source (NATA 2005) are lower than those relied upon previous modeling analysis for this area (2002 NATA).

VI. Integrated Summary and Next Steps

A. Summary of Key Findings

1. What are the key HAPs for this school?
   → Hexavalent chromium, benzene, 1,3-butadiene, and lead are the key HAPs for this school, identified based on the recommendation of the PSCAA and 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?
   → Measured hexavalent chromium levels and associated longer-term concentration estimates at this school are not at levels of concern as anticipated prior to monitoring.
   → Measured benzene and 1,3-butadiene levels and associated longer-term concentration estimates at this school were not as high as suggested by the modeling information available prior to monitoring. Although they were below the levels of significant concern that had been suggested by the modeling information, these results indicate the influence of mobile source pollutants of concern that are the focus of EPA actions nationwide.
   → Levels of lead, a pollutant for which there are national standards for ambient air, are below the level of the national standard for protection of public health.

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 Duwamish meteorological data that the sampling day conditions were inconsistent with conditions overall during this period.
   → Among the data collected for this site, we have none that would indicate generally higher (or lower) concentrations during other times of year. The wind flow patterns at the nearest NWS station during the sampling period appear to be representative of long-term wind flow at that station. 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 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 actions regarding emissions from aircraft engines can be found at: www.epa.gov/otaq/aviation.htm. EPA's ongoing research and national air toxics monitoring programs will continue to collect information on mobile source impacts on outdoor air nationally. EPA will also continue to work toward reductions in mobile source emissions nationally and to facilitate reductions in local areas (http://www.epa.gov/schoolair/mobile.html).
3. 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).
4. The PSCAA (as the local agency with primary permitting authority) will continue to oversee industrial facilities in the area through air permits and other program. PSCAA will also continue to implement reductions in mobile source emissions through implementation of national programs and its own programs.

VII. Figures and Tables

A. Tables

B. Figures

3c. Concord Elementary School (Seattle, WA) Lead (TSP) 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. Concord Elementary School Pollutant Concentrations.

E. Windroses for Boeing Field, King County International Airport.

Figure 1. Concord Elementary School and Sources of Interest.

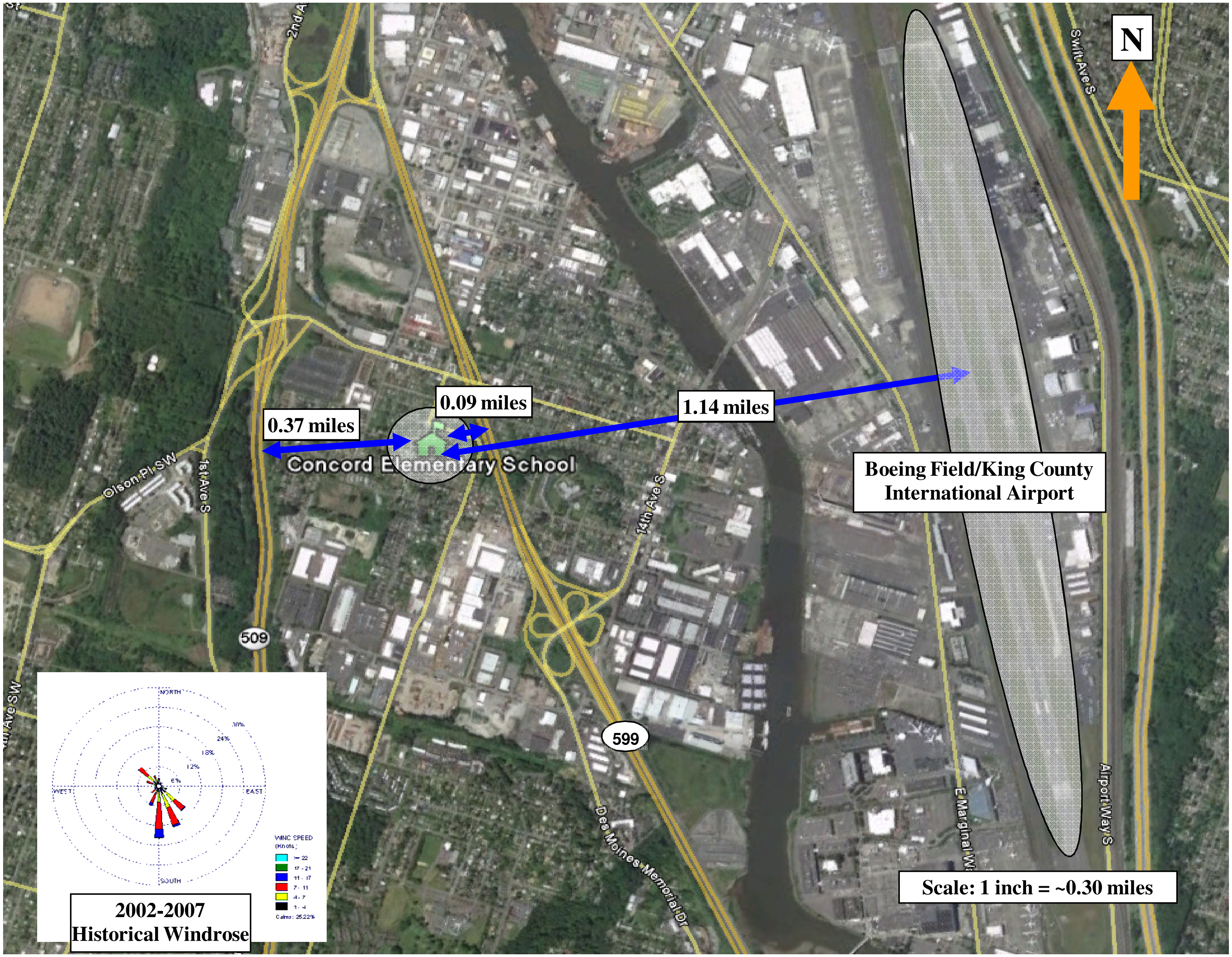


Table 1. Concord Elementary School - Key Pollutant Analysis.

Parameter		Units	Mean of Measurements	95% Confidence Interval on the Mean	Long-term Comparison Level[a]	
					Cancer-Based[b]	Noncancer-Based[c]
Hexavalent Chromium		ng/m^3	0.14 [d]	0 - 0.31	8.3[e]	100
Benzene		µg/m^3	1.03 [f]	0.76 - 1.29	13	30
Butadiene, 1,3-		µg/m^3	0.12 [g]	0.07 - 0.17	3.3	2
Lead (TSP)	Aug.-Oct.	ng/m^3	6.85 [h]	4.78 - 8.92	NA	150[j]
	Sept.-Nov.		6.61 [i]	4.55 - 8.68		

ng/m^3 nanograms per cubic meter
µg/m^3 micrograms per cubic meter
NA Not applicable

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

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

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

[d] The mean of measurements for hexavalent chromium is the average of all sample results, which include twelve detections that ranged from 0.0127 to 1.00 ng/m^3.

[e] 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^3, consistent with EPA's Supplemental Guidance for Assessing Susceptibility from Early-Life exposure.

[f] The mean of measurements for benzene is the average of all sample results, which include thirteen detections that ranged from 0.492 to 1.74 µg/m^3.

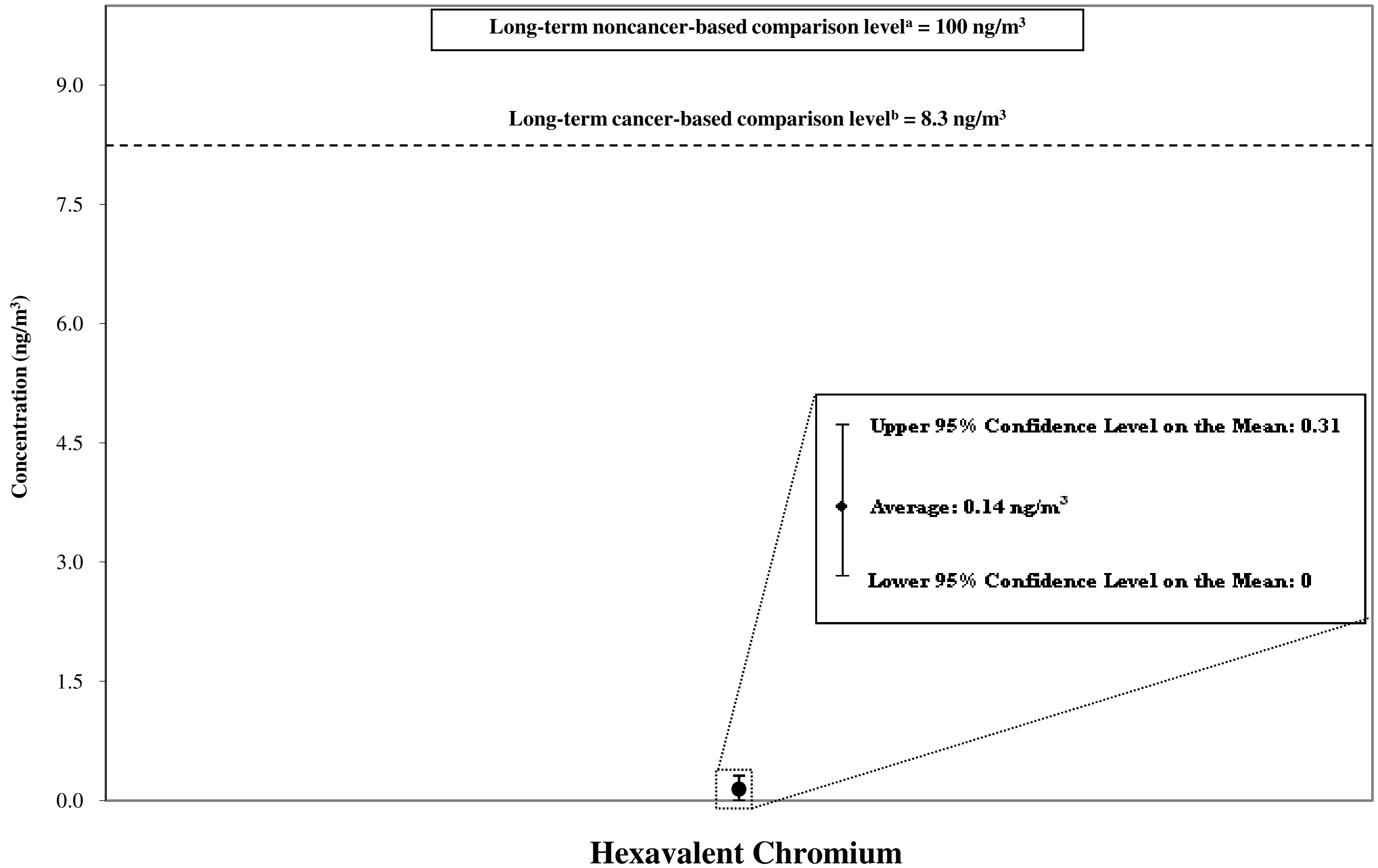
[g] The mean of measurements for 1,3-butadiene is the average of all sample results, which include thirteen detections that ranged from 0.031 to 0.281 µg/m^3.

[h] The mean of measurements for lead (TSP) is the average of all sample results, which include twelve detections that ranged from 3.11 to 27.9 ng/m^3.

[i] The mean of measurements for lead (TSP) is the average of all sample results, which include thirteen detections that ranged from 2.54 to 27.9 ng/m^3.

[j] This comparison value for lead is the level of the national ambient air quality standard, which is in terms of a rolling 3-month average level of lead in total suspended particles.

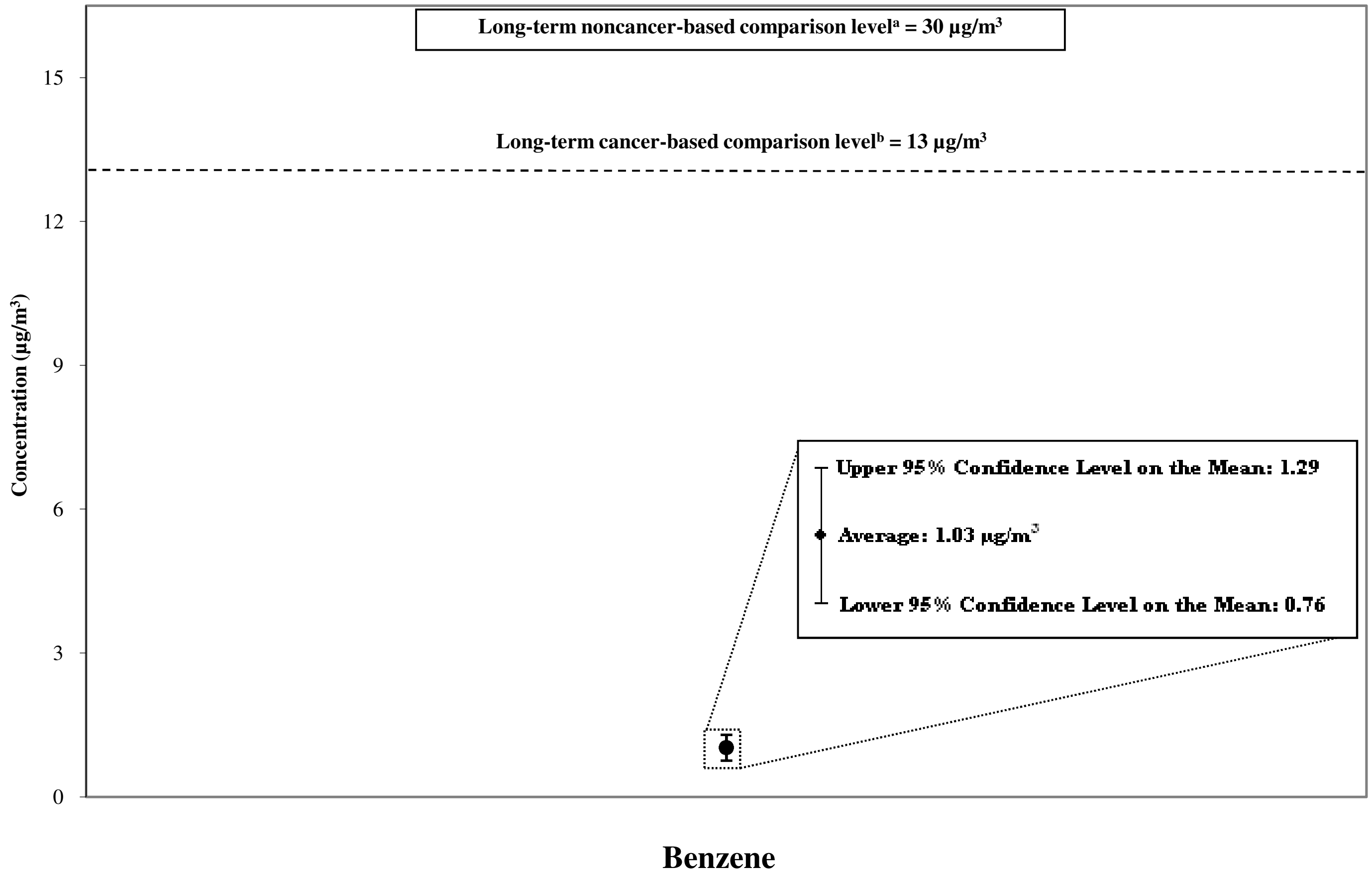
Figure 2a. Concord Elementary School - Key Pollutant (Hexavalent Chromium) Analysis.



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

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

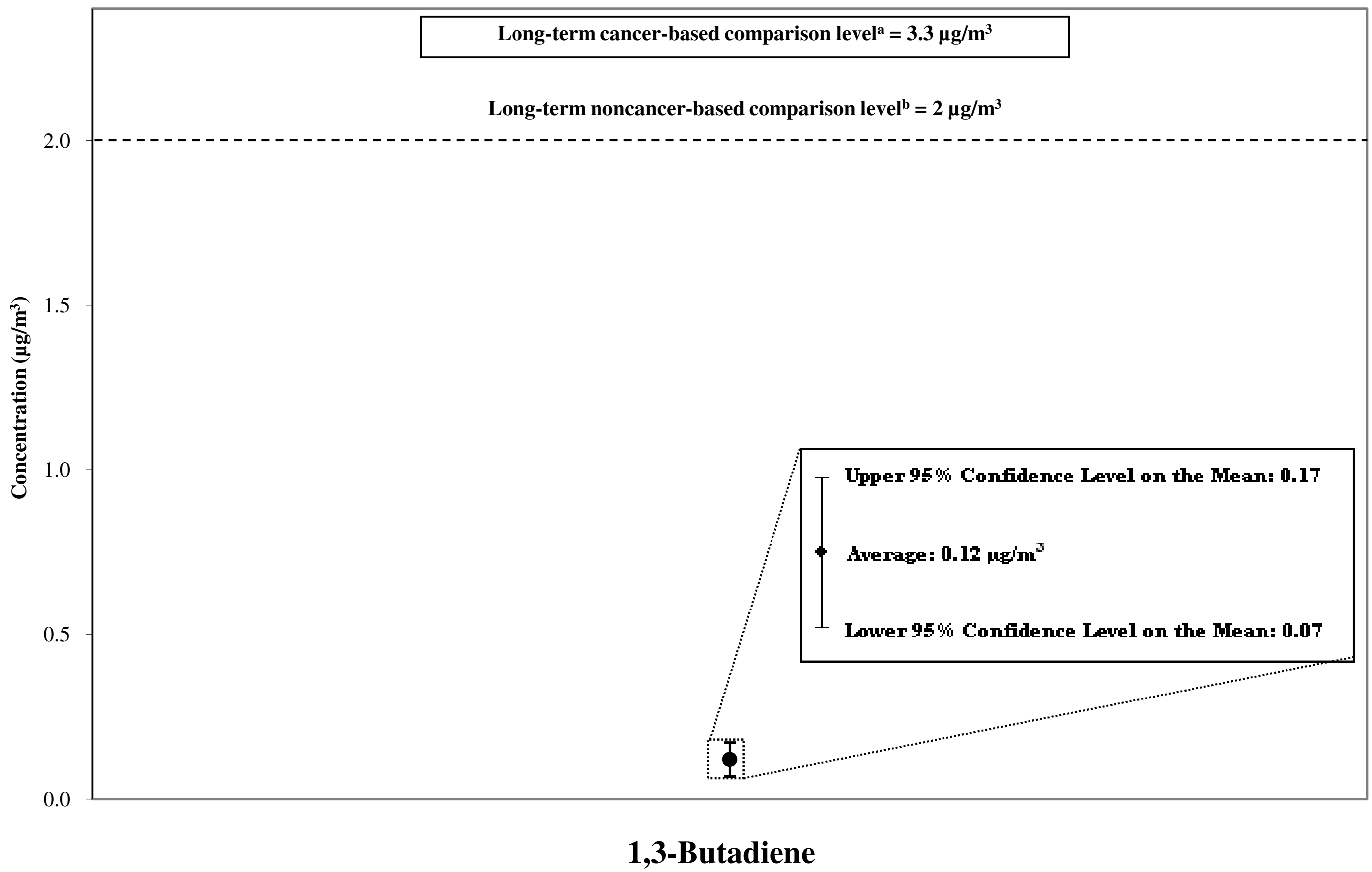
Figure 2b. Concord Elementary School - Key Pollutant (Benzene) Analysis.



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

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

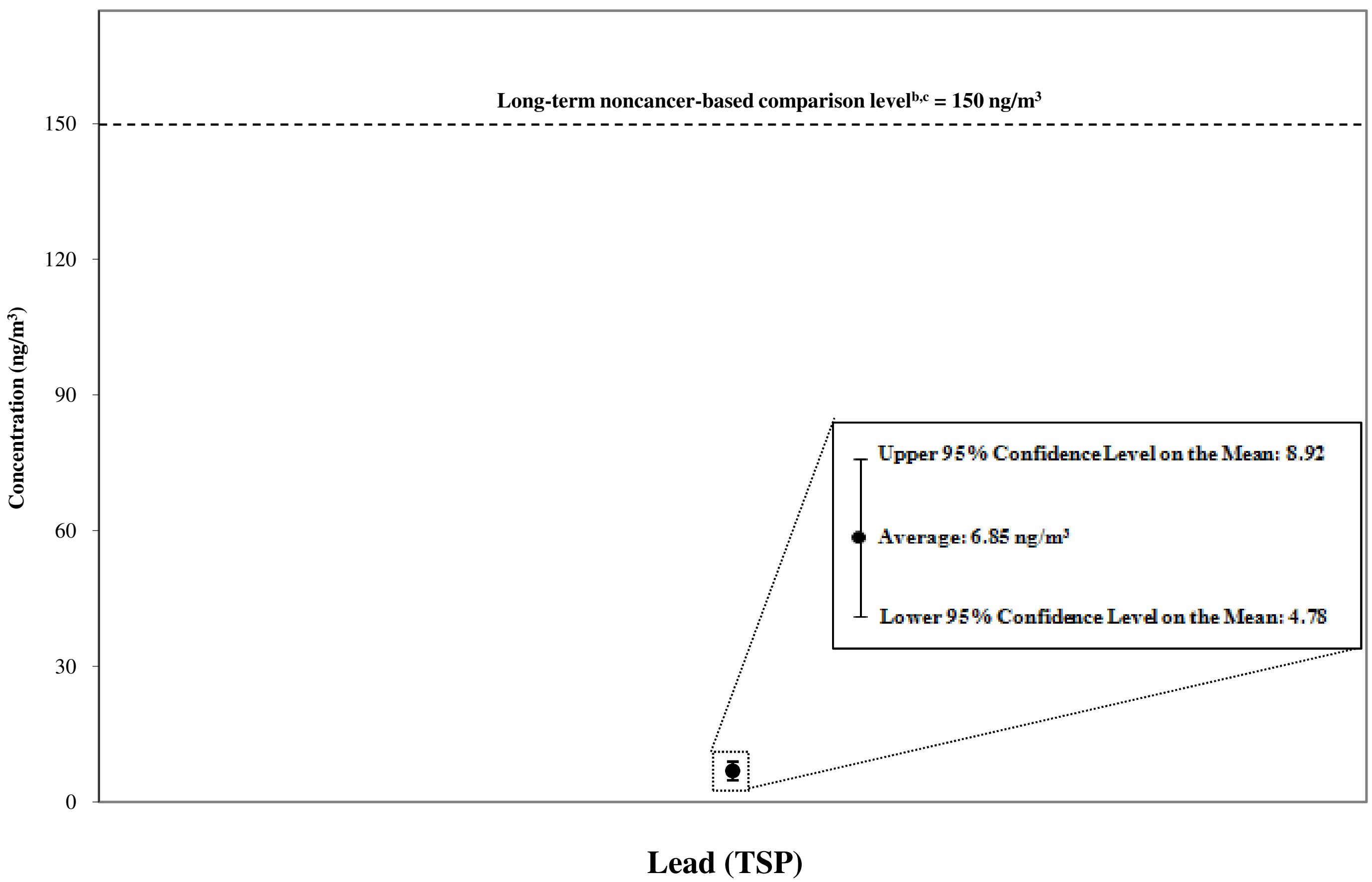
Figure 2c. Concord Elementary School - Key Pollutant (1,3-Butadiene) Analysis.



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

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

Figure 2d. Concord Elementary School - Key Pollutant (Lead (TSP)) Analysis.[a]



[a] Three-month rolling averages were calculated at each school for the August-October and September-November time periods. For presentation purposes, the higher of the two ranges is presented.

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

[c] This comparison value for lead is the level of the national ambient air quality standard, which is in terms of a rolling 3-month average level of lead in total suspended particles.

Table 2a. Concord Elementary School Key Pollutant Concentrations (Hexavalent Chromium and Lead (TSP)) and Meteorological Data.[a]

Parameter	Units	8/20/2009	8/24/2009	8/29/2009	9/4/2009	9/10/2009	9/16/2009	9/22/2009	9/28/2009	10/4/2009	10/10/2009	10/16/2009	10/22/2009	10/28/2009	11/3/2009	11/9/2009	11/12/2009	11/18/2009
Hexavalent Chromium	ng/m^3	--	--	--	--	--	0.0322	1.00	0.135	0.0310	0.0127	0.0757	0.0714	0.103	0.111	0.0357	0.0840	0.0221
Lead (TSP)	ng/m^3	7.24	3.11	3.14	6.42	8.59	4.63	--	4.71	27.9	4.74	6.30	4.61	6.24	5.62	2.54	3.72	3.31
% Hours w/Wind Direction from Expected ZOI B (20-120°)[b]	%	0.0	12.5	0.0	0.0	8.3	0.0	0.0	0.0	20.8	0.0	8.3	8.3	4.2	8.3	0.0	16.7	0.0
Wind Speed (avg. of hourly speeds)	mph	6.3	3.2	2.6	2.8	5.7	3.3	2.5	6.0	5.0	1.9	1.6	2.1	2.2	4.8	4.3	2.5	8.2
Wind Direction (avg. of unitized vector)[c]	deg.	186.3	238.3	273.1	206.5	326.1	181.8	6.1	230.3	155.5	181.6	161.2	327.9	172.9	196.7	173.8	186.3	317.9
% of Hours with Speed below 2 knots	%	8.3	29.2	45.8	50.0	8.3	33.3	41.7	20.8	20.8	75.0	83.3	66.7	66.7	20.8	20.8	54.2	0.0
Daily Average Temperature	° F	69.3	65.5	66.8	64.9	67.2	54.5	56.2	51.9	59.0	53.7	44.4	48.0	49.3	44.3	45.6	44.3	45.6
Daily Precipitation	inches	0.00	0.00	0.21	0.03	0.00	0.04	0.00	0.02	0.00	0.00	0.94	0.05	0.08	0.00	0.27	0.01	0.22

(Highlighted) All precipitation and temperature data were from the Boeing Field/King County International Airport NWS Station.

[a] Due to siting issues at Concord Elementary School, meteorological data from a nearby air toxics station at Duwamish was used for this analysis.

[b] Based on count of hours for which vector wind direction is from expected zone of influence B (20-120°), and refers to the lead source of interest.

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

-- No sample was collected for this pollutant on this day, or the sample was invalidated.

Table 2b. Concord Elementary School Key Pollutant Concentrations (Benzene and 1,3-Butadiene) and Meteorological Data.[a]

Parameter	Units	8/20/2009	8/23/2009	9/4/2009	9/28/2009	10/4/2009	10/10/2009	10/16/2009	10/22/2009	10/28/2009	11/3/2009[b]	11/9/2009[b]	11/12/2009[b]	11/18/2009
Benzene	µg/m^3	0.633	0.492	1.54	0.674	0.572	0.774	1.74	1.47	1.52	1.42	0.988	0.908	0.591
Butadiene, 1,3-	µg/m^3	0.031	0.031	0.281	0.066	0.066	0.082	0.221	0.21	0.224	0.14	0.12	0.064	0.038
% Hours w/Wind Direction from Expected ZOI A (0-360°)[c]	%	100	100	100	100	100	100	100	100	100	100	100	100	100
Wind Speed (avg. of hourly speeds)	mph	6.27	4.20	2.77	6.01	5.03	1.88	1.63	2.05	2.15	4.52	5.92	4.60	8.16
Wind Direction (avg. of unitized vector)[d]	deg.	186.3	358.8	273.1	181.8	6.1	230.3	155.5	181.6	161.2	316.7	180.1	188.8	173.8
% of Hours with Speed below 2 knots	%	8.3	0.0	50.0	20.8	20.8	75.0	83.3	66.7	66.7	29.2	12.5	16.7	0.0
Daily Average Temperature	° F	69.3	63.7	66.8	54.5	56.2	51.9	59.0	53.7	44.4	47.3	48.9	45.1	45.6
Daily Precipitation	inches	0.00	0.00	0.03	0.02	0.00	0.00	0.94	0.05	0.08	0.00	0.20	0.30	0.22

(yellow shading) All precipitation and temperature data were from the Boeing Field/King County International Airport NWS Station.

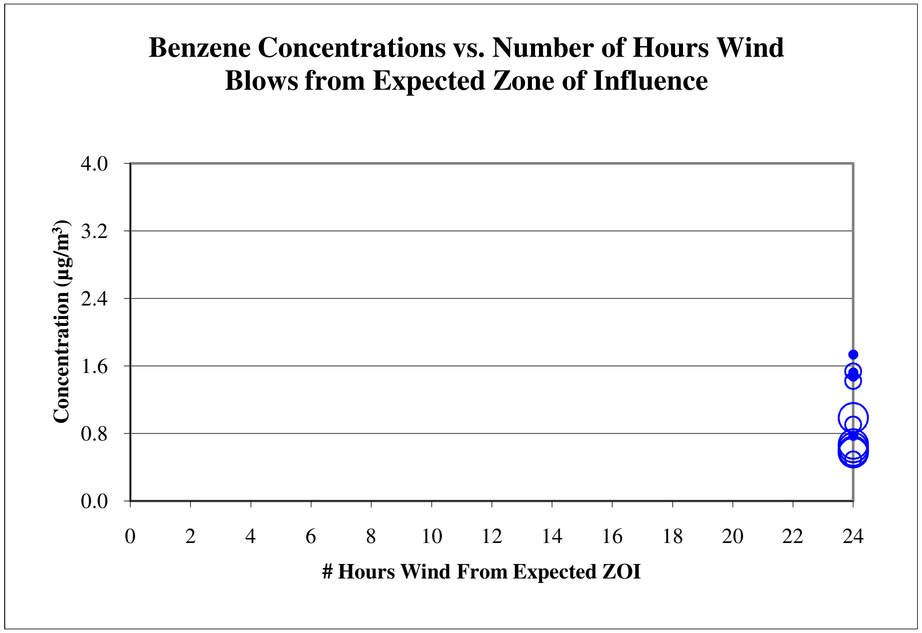
[a] Due to siting issues at Concord Elementary School, meteorological data from a nearby air toxics station at Duwamish was used for this analysis.

[b] Due to timer issues, manual samples were taken on these days, beginning after 9am and extending for 24 hours into the next day. As such, the hourly meteorological measurements correlating to the 24 hour sample were adjusted.

[c] Based on count of hours for which vector wind direction is from expected zone of influence A (0-360°).

[d] 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 3a. Concord Elementary School (Seattle, WA) Benzene Concentration and Wind Information.



KEY

Pollutant: Benzene
Timeframe: August 20, 2009 - November 18, 2009

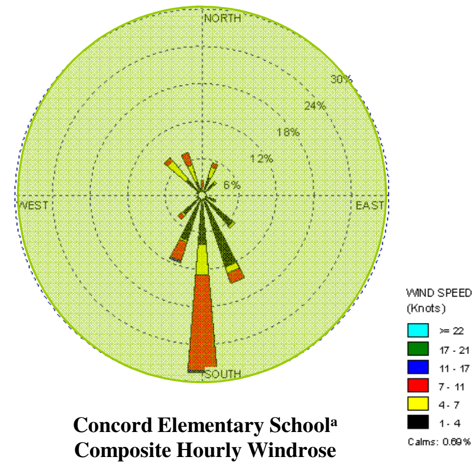
Wind Speed: 0.1-2.5 mph

Wind Speed: 2.5-5.0 mph

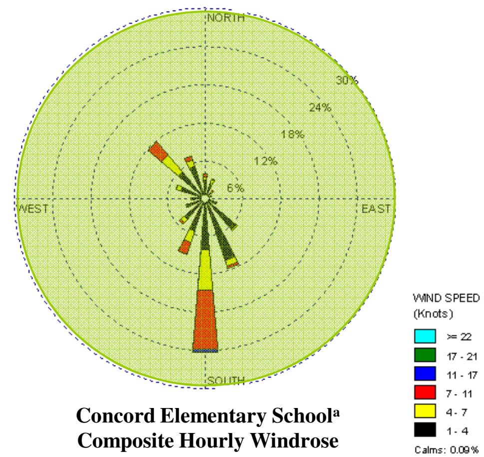
Wind Speed: > 5.0 mph

Note

Each circle denotes a 24-hour collection of air for chemical analysis. The size of the circle indicates the magnitude of the wind speed for that day (wind data shown in Table 2b). 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.



Concord Elementary School[a] Composite Hourly Windrose on Sample Days (Aug. 20, 2009-Nov. 18, 2009)

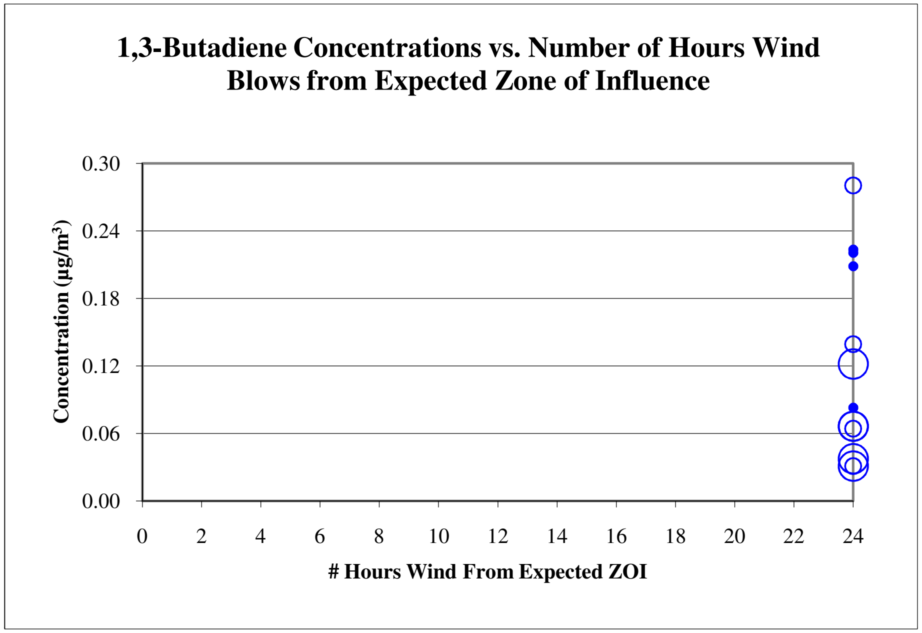


Concord Elementary School[a] Composite Hourly Windrose Across Sampling Period (Aug. 20, 2009-Nov. 18, 2009)

Expected Zone of Source Influence A

[a] Wind information from the Duwamish Monitoring Site

Figure 3b. Concord Elementary School (Seattle, WA) 1,3-Butadiene Concentration and Wind Information.



KEY

Pollutant: 1,3-Butadiene
Timeframe: August 20, 2009 - November 18, 2009

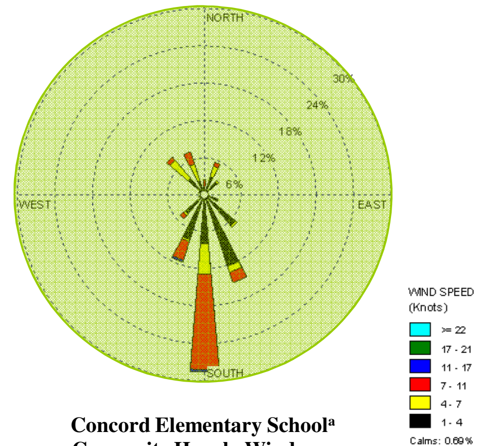
Wind Speed: 0.1-2.5 mph

Wind Speed: 2.5-5.0 mph

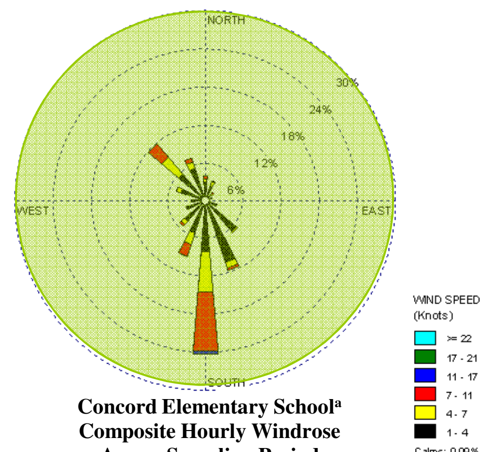
Wind Speed: > 5.0 mph

Note

Each circle denotes a 24-hour collection of air for chemical analysis. The size of the circle indicates the magnitude of the wind speed for that day (wind data shown in Table 2b). 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.



Concord Elementary School[a]
Composite Hourly Windrose
on Sample Days
(Aug. 20, 2009-Nov. 18, 2009)

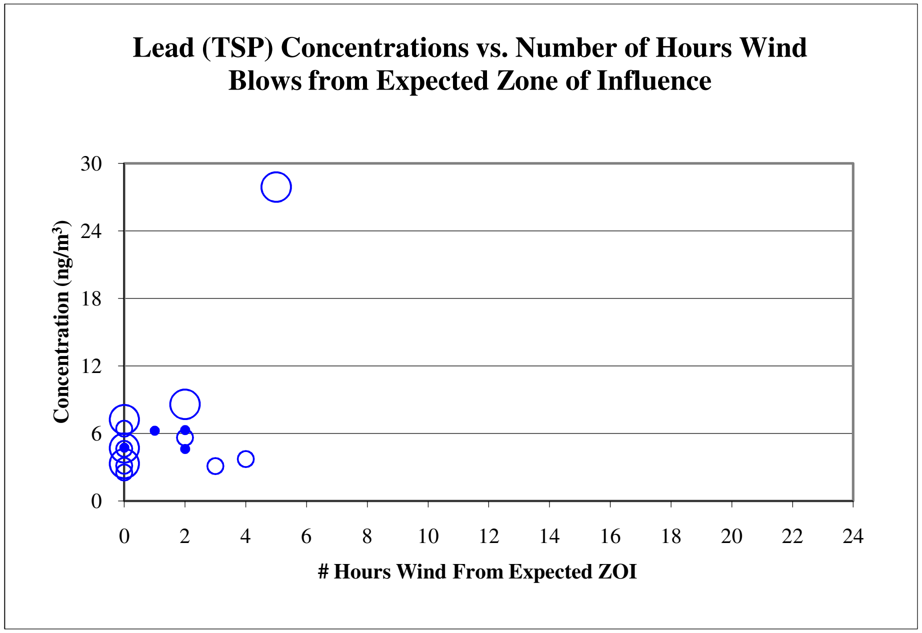


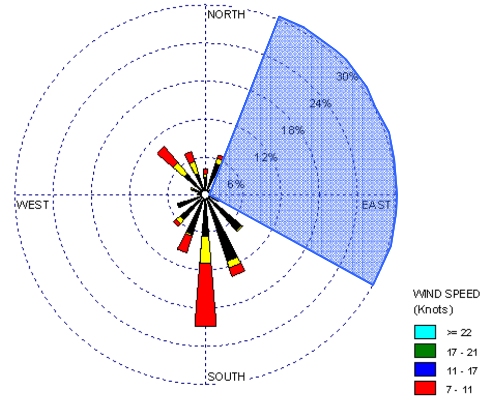
Concord Elementary School[a]
Composite Hourly Windrose
Across Sampling Period
(Aug. 20, 2009-Nov. 18, 2009)

Expected Zone of Source Influence A

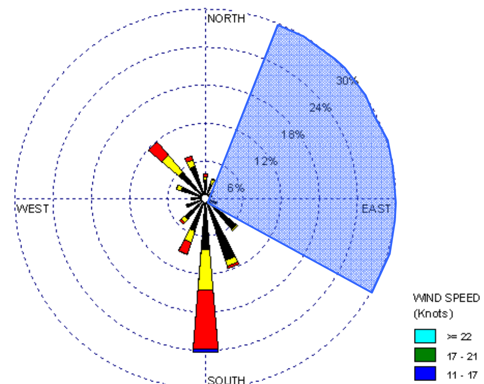
[a] Wind information from the Duwamish Monitoring Site

Figure 3c. Concord Elementary School (Seattle, WA) Lead (TSP) Concentration and Wind Information.





Concord Elementary School[a]
Composite Hourly Windrose
on Sample Days
(Aug. 20, 2009-Nov. 18, 2009)



Concord Elementary School[a]
Composite Hourly Windrose
Across Sampling Period
(Aug. 20, 2009-Nov. 18, 2009)

KEY

Pollutant: Lead (TSP)
Timeframe: August 20, 2009 - November 18, 2009

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

Note

Each circle denotes a 24-hour collection of air for chemical analysis. The size of the circle indicates the magnitude of the wind speed for that day (wind data shown in Table 2a). 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 B

[a] Wind information from the Duwamish Monitoring Site

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.[21]

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.[22] 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.

[21] These comparison levels are described in more detail *Schools Air Toxics Monitoring Activity (2009), Uses of Health Effects Information in Evaluating Sample Results*.
[22] 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.[23] 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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[23] EPA defines the RfC as "an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a NOAEL, LOAEL, or benchmark concentration, with uncertainty factors generally applied to reflect limitations of the data used. Generally used in EPA's noncancer health assessments." http://www.epa.gov/ncea/iris/help_gloss.htm#r

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

Pollutant	Units	# Samples Analyzed	% Detections	Maximum	Arithmetic Mean[b]	Geometric Mean	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
Hexavalent Chromium	ng/m^3	4,233	66%	2.97	0.03	0.03	ND	ND	0.01	0.04	0.13
Antimony (PM$_{10}$)	ng/m^3	2,372	94%	43.30	1.71	1.21	ND	0.60	1.13	2.17	4.33
Arsenic (PM$_{10}$)	ng/m^3	5,076	86%	47.70	0.93	0.70	ND	0.29	0.56	1.02	2.89
Beryllium (PM$_{10}$)	ng/m^3	4,771	64%	1.97	0.05	0.02	ND	ND	<0.01	0.02	0.50
Cadmium (PM$_{10}$)	ng/m^3	4,793	85%	15.30	0.27	0.17	ND	0.05	0.13	0.29	0.94
Chromium (PM$_{10}$)	ng/m^3	5,094	92%	172.06	2.71	1.66	ND	0.93	1.98	2.85	7.10
Cobalt (PM$_{10}$)	ng/m^3	2,614	91%	20.30	0.28	0.18	ND	0.08	0.15	0.27	1.00
Manganese (PM$_{10}$)	ng/m^3	4,793	99%	734.00	10.39	5.20	<0.01	2.41	4.49	9.96	33.78
Mercury (PM$_{10}$)	ng/m^3	1,167	81%	2.07	0.07	0.04	ND	0.01	0.02	0.06	0.32
Nickel (PM$_{10}$)	ng/m^3	4,815	90%	110.10	2.05	1.49	ND	0.74	1.44	2.50	5.74
Selenium (PM$_{10}$)	ng/m^3	2,382	96%	13.00	1.10	0.53	<0.01	0.24	0.53	1.07	5.50
Acetonitrile	µg/m^3	1,804	69%	542.30	3.55	0.72	ND	ND	0.27	0.76	8.60
Acrylonitrile	µg/m^3	3,673	31%	5.51	0.06	0.10	ND	ND	ND	0.03	0.33
Benzene	µg/m^3	6,313	94%	10.19	1.03	0.84	ND	0.48	0.80	1.31	2.81
Benzyl chloride	µg/m^3	3,046	9%	2.49	0.01	0.05	ND	ND	ND	ND	0.05
Bromoform	µg/m^3	2,946	4%	1.18	0.01	0.16	ND	ND	ND	ND	ND
Bromomethane	µg/m^3	5,376	61%	120.76	0.11	0.05	ND	ND	0.03	0.05	0.12
Butadiene, 1,3-	µg/m^3	6,427	67%	15.55	0.10	0.09	ND	ND	0.05	0.13	0.38
Carbon disulfide	µg/m^3	1,925	91%	46.71	2.32	0.25	ND	0.03	0.09	0.96	12.65
Carbon tetrachloride	µg/m^3	6,218	86%	1.76	0.52	0.58	ND	0.47	0.57	0.65	0.87
Chlorobenzene	µg/m^3	5,763	30%	1.10	0.02	0.04	ND	ND	ND	0.01	0.11
Chloroethane	µg/m^3	4,625	37%	0.58	0.02	0.04	ND	ND	ND	0.03	0.08
Chloroform	µg/m^3	6,432	73%	48.05	0.17	0.14	ND	ND	0.10	0.17	0.61
Chloromethane	µg/m^3	5,573	95%	19.70	1.17	1.20	ND	1.03	1.18	1.36	1.68
Chloroprene	µg/m^3	2,341	11%	0.17	<0.01	0.03	ND	ND	ND	ND	0.02
Dichlorobenzene, *p-*	µg/m^3	5,409	60%	13.65	0.19	0.16	ND	ND	ND	0.18	0.90
Dichloroethane, 1,1-	µg/m^3	5,670	16%	0.36	0.01	0.02	ND	ND	ND	ND	0.02
Dichloroethylene, 1,1-	µg/m^3	5,480	19%	0.44	0.01	0.02	ND	ND	ND	ND	0.04
Dichloromethane	µg/m^3	6,206	82%	214.67	0.59	0.34	ND	0.14	0.28	0.49	1.35
Dichloropropane,1,2-	µg/m^3	6,225	17%	1.80	0.01	0.03	ND	ND	ND	ND	0.04
Dichloropropylene, c*is* -1,3-	µg/m^3	4,705	18%	0.80	0.01	0.05	ND	ND	ND	ND	0.11
Dichloropropylene, *trans* -1,3-	µg/m^3	4,678	18%	1.13	0.02	0.05	ND	ND	ND	ND	0.11

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

Pollutant	Units	# Samples Analyzed	% Detections	Maximum	Arithmetic Mean[b]	Geometric Mean	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
Ethyl acrylate	$\mu g/m^3$	1,917	1%	0.08	<0.01	0.04	ND	ND	ND	ND	ND
Ethylbenzene	$\mu g/m^3$	6,120	84%	8.84	0.42	0.32	ND	0.10	0.29	0.53	1.33
Ethylene dibromide	$\mu g/m^3$	5,646	19%	4.15	0.01	0.05	ND	ND	ND	ND	0.05
Ethylene dichloride	$\mu g/m^3$	6,143	38%	4.49	0.03	0.05	ND	ND	ND	0.04	0.09
Hexachlorobutadiene	$\mu g/m^3$	3,727	20%	0.97	0.03	0.10	ND	ND	ND	ND	0.18
Methyl chloroform	$\mu g/m^3$	5,944	73%	3.17	0.09	0.10	ND	ND	0.08	0.11	0.20
Methyl isobutyl ketone	$\mu g/m^3$	2,936	60%	2.95	0.11	0.09	ND	ND	0.02	0.12	0.49
Methyl methacrylate	$\mu g/m^3$	1,917	9%	14.05	0.13	0.49	ND	ND	ND	ND	0.53
Methyl *tert-* butyl ether	$\mu g/m^3$	4,370	41%	20.50	0.28	0.12	ND	ND	ND	0.04	1.53
Styrene	$\mu g/m^3$	6,080	70%	27.22	0.16	0.11	ND	ND	0.05	0.16	0.60
Tetrachloroethane, 1,1,2,2-	$\mu g/m^3$	5,952	20%	2.47	0.02	0.04	ND	ND	ND	ND	0.07
Tetrachloroethylene	$\mu g/m^3$	6,423	71%	42.12	0.28	0.20	ND	ND	0.13	0.27	0.88
Toluene	$\mu g/m^3$	5,947	95%	482.53	2.46	1.54	0.01	0.70	1.51	3.05	7.42
Trichlorobenzene, 1,2,4-	$\mu g/m^3$	4,301	21%	45.27	0.07	0.10	ND	ND	ND	ND	0.16
Trichloroethane,1,1,2-	$\mu g/m^3$	5,210	19%	5.89	0.01	0.04	ND	ND	ND	ND	0.05
Trichloroethylene	$\mu g/m^3$	6,410	46%	6.50	0.05	0.07	ND	ND	ND	0.05	0.22
Vinyl chloride	$\mu g/m^3$	6,284	18%	1.61	0.01	0.02	ND	ND	ND	ND	0.03
Xylene, *m/p-*	$\mu g/m^3$	4,260	90%	21.41	1.12	0.71	ND	0.26	0.69	1.43	3.65
Xylene, *o-*	$\mu g/m^3$	6,108	83%	9.21	0.41	0.30	ND	0.09	0.24	0.52	1.39

Key Pollutant

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

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

[b] In calculations involving non-detects (ND), a value of zero is used.

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

At each school, monitoring has been targeted to get information on a limited set of key hazardous air pollutants (HAPs).[24] These pollutants are the primary focus of the monitoring activities at a school and a priority for us based on our emissions, modeling and other information. In analyzing air samples for these key pollutants, we have also obtained results for some other pollutants that are routinely included with the same test method. Our consideration of the data collected for these additional HAPs is described in the first section below. In addition to evaluating monitoring results for individual pollutants, we also considered the potential for cumulative impacts from multiple pollutants as described in the second section below (see Table C-1).

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

- Do the monitoring data indicate elevated levels of any other air toxics or hazardous air pollutant (HAPs) that pose significant long-term health concerns?
  - → Longer-term concentration estimates for the other HAPs monitored are below their long-term comparison levels. Further, for pollutants with cancer-based comparison levels, longer-term concentration estimates for all but one of these (arsenic) are more than tenfold lower and all but five (also carbon tetrachloride, ethylbenzene, tetrachloroethylene, and dichloromethane) are more than 100-fold lower.[25]
  - → 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.[26]

<u>Additional Information on Five HAPs:</u>

- The first HAP mentioned above is arsenic. The mean and 95 percent upper bound on the mean for arsenic (PM_{10}) are approximately 7-10% of the cancer-based comparison level. A review of information available at other sites nationally shows that the mean concentration of arsenic (PM_{10}) 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).

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[24] 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.

[25] 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, respectively.

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

- The second 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 75th and 95th 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 throughout the world as a result of its slow rate of degradation in the environment and global distribution in the atmosphere.

- The third HAP mentioned above is ethylbenzene. The mean and 95 percent upper bound on the mean for ethylbenzene are approximately 2% the cancer-based comparison level. A review of information available at other sites nationally shows that the mean concentration of ethylbenzene at this site is between the 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 tetrachloroethylene. The mean and 95 percent upper bound on the mean for tetrachloroethylene are approximately 1-2% the cancer-based comparison level. A review of information available at other sites nationally shows that the mean concentration of tetrachloroethylene at this site is 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 fifth HAP mentioned above is dichloromethane. The mean and 95 percent upper bound on the mean for dichloromethane are approximately 1-2% the cancer-based comparison level. A review of information available at other sites nationally shows that the mean concentration of dichloromethane at this site is greater than the 95th 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.[27]

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

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

HAPs are within an order of magnitude of their comparison levels even if these pollutant levels fall below the comparison levels. This analysis is summarized below.

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

  → The data collected for the key and other air toxics and the associated longer-term concentration estimates do not together pose significant concerns for cumulative health risk from these pollutants.

  - ▪ The only HAPs monitored whose longer-term concentration estimates are more than ten percent of their lowest comparison levels are manganese and arsenic. The lowest comparison levels for these pollutants are based on noncancer effects to the central nervous system for manganese and on noncancer effects to development for arsenic, reducing concerns for cumulative health risk from these pollutants.

Table C-1. Concord Elementary School - Other Monitored Pollutant Analysis.

Parameter	Units	Mean of Measurements[a]	95% Confidence Interval on the Mean	Long-term Comparison Level[b] Cancer-Based[c]	Long-term Comparison Level[b] Noncancer-Based[d]
Non-Key HAPs with mean greater than 10% of the lowest comparison level					
Manganese (PM_{10})	ng/m^3	8.39	3.51 - 13.3	NA	50
Arsenic (PM_{10})	ng/m^3	1.64	1.01 - 2.27	23	15
Non-Key HAPs with mean lower than 10% of the lowest comparison level					
Carbon Tetrachloride	$\mu g/m^3$	0.74	0.64 - 0.83	17	100
Nickel (PM_{10})	ng/m^3	2.02	0.93 - 3.10	420	90
Xylene, *m/p-*	$\mu g/m^3$	2.03	1.20 - 2.87	NA	100
Ethylbenzene	$\mu g/m^3$	0.65	0.41 - 0.88	40	1,000
Cadmium (PM_{10})	ng/m^3	0.14	0.06 - 0.21	56	10
Tetrachloroethylene	$\mu g/m^3$	0.22	0.14 - 0.30	17	270
Chloromethane	$\mu g/m^3$	1.16	0.98 - 1.34	NA	90
Antimony (PM_{10})	ng/m^3	1.87	1.10 - 2.65	NA	200
Bromomethane	$\mu g/m^3$	0.04	0.04 - 0.05	NA	5
Dichloromethane	$\mu g/m^3$	1.54	0 - 3.33	210	1,000
Xylene, *o-*	$\mu g/m^3$	0.64	0.40 - 0.88	NA	100
Dichlorobenzene, *p-*	$\mu g/m^3$	0.05	0.03 - 0.07	9.1	800
Acetonitrile	$\mu g/m^3$	0.21	0.15 - 0.26	NA	60
Cobalt (PM_{10})	ng/m^3	0.20	0.04 - 0.35	NA	100
Carbon Disulfide	$\mu g/m^3$	0.06	0.04 - 0.08	NA	700
Chloroform	$\mu g/m^3$	0.13	0.11 - 0.15	NA	98
Toluene	$\mu g/m^3$	3.75	2.18 - 5.32	NA	5,000
Selenium (PM_{10})	ng/m^3	0.82	0 - 1.80	NA	20,000
Mercury (PM_{10})	ng/m^3	0.13	0.08 - 0.18	NA	300 [e]
Methyl chloroform	µg/m3	0.09	0.07 - 0.10	NA	5,000
Methyl isobutyl ketone	$\mu g/m^3$	0.80	0.44 - 1.16	NA	3,000
Chloroethane	µg/m3	0.02	0.01 - 0.03	NA	10,000
Styrene	$\mu g/m^3$	0.16	0.08 - 0.25	NA	1,000
Trichloroethylene	$\mu g/m^3$	0.09 [f]	0.02 - 0.17 [f]	50	600
Non-Key HAPs with more than 50% ND Results					
Ethylene dichloride	$\mu g/m^3$	92% of the results were ND[g]		3.8	2,400
Bromoform	$\mu g/m^3$	92% of the results were ND[h]		91	NA
Methyl Methacrylate	µg/m3	92% of the results were ND[i]		NA	700
Hexachloro-1,3-butadiene	$\mu g/m^3$	92% of the results were ND[j]		4.5	90
Beryllium (PM_{10})	ng/m^3	57% of the results were ND[k]		42	20
Trichloroethane, 1,1,2-	$\mu g/m^3$	92% of the results were ND[l]		6.3	400
Chlorobenzene	µg/m3	92% of the results were ND[m]		NA	1,000
No other HAPs were detected in any other samples					

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

Table C-1. Concord Elementary School - Other Monitored Pollutant Analysis.

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

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

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

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

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

[f] Trichloroethylene was detected in 6 of 13 samples, ranging from 0.059 to 0.34 $\mu g/m^3$. The MDL is 0.011 $\mu g/m^3$.

[g] Ethylene dichloride was detected in only 1 of 13 samples, with a result of 0.081 $\mu g/m^3$. The MDL is 0.008 $\mu g/m^3$.

[h] Bromoform was detected in only 1 of 13 samples, with a result of 0.06 $\mu g/m^3$. The MDL is 0.021 $\mu g/m^3$.

[i] Methyl methacrylate was detected in only 1 of 13 samples, with a result of 0.02 $\mu g/m^3$. The MDL is 0.115 $\mu g/m^3$.

[j] Hexachloro-1,3-butadiene was detected in only 1 of 13 samples, with a result of 0.02 $\mu g/m^3$. The MDL is 0.128 $\mu g/m^3$.

[k] Beryllium PM_{10} was detected in only 6 of 14 samples, ranging from 0.001 to 0.03 ng/m^3. The MDL is 0.011 ng/m^3.

[l] 1,1,2-Trichloroethane was detected in only 1 of 13 samples, with a result of 0.02 $\mu g/m^3$. The MDL is 0.016 $\mu g/m^3$.

[m] Chlorobenzene was detected in only 1 of 13 samples, with a result of 0.005 $\mu g/m^3$. The MDL is 0.009 $\mu g/m^3$.

Appendix D. Concord Elementary School Pollutant Concentrations.

Parameter	Units	8/20/2009	8/23/2009	8/24/2009	8/29/2009	9/4/2009	9/10/2009	9/16/2009	9/22/2009	9/28/2009	10/4/2009	10/10/2009	10/16/2009	10/22/2009	10/28/2009	11/3/2009	11/9/2009	11/12/2009	11/18/2009	Sample Screening Level[a]
Hexavalent Chromium	ng/m^3	--	--	--	--	--	--	0.0322	1.00	0.135	0.0310	0.0127	0.0757	0.0714	0.103	0.111	0.0357	0.0840	0.0221	580
Benzene	$\mu g/m^3$	0.633	0.492	--	--	1.54	--	--	--	0.674	0.572	0.774	1.74	1.47	1.52	1.42	0.988	0.908	0.591	30
Butadiene, 1,3-	$\mu g/m^3$	0.031	0.031	--	--	0.281	--	--	--	0.066	0.066	0.082	0.221	0.21	0.224	0.14	0.12	0.064	0.038	20
Lead (TSP)	ng/m^3	7.24	--	3.11	3.14	6.42	8.59	4.63	--	4.71	27.9	4.74	6.30	4.61	6.24	5.62	2.54	3.72	3.31	150
Manganese (PM_{10})	ng/m^3	--	--	--	2.08	12.0	8.39	8.74	36.0	8.63	2.79	--	6.22	8.49	6.84	8.29	3.00	3.79	2.19	500
Arsenic (PM_{10})	ng/m^3	--	--	--	1.09	1.48	0.53	0.82	4.65	1.53	1.24	--	2.03	2.01	2.57	1.55	2.14	1.24	0.07	150
Carbon Tetrachloride	$\mu g/m^3$	0.642	0.730	--	--	0.913	--	--	--	0.799	0.749	0.831	0.62	0.705	0.774	0.57	1.11	0.61	0.54	200
Nickel (PM_{10})	ng/m^3	--	--	--	2.13	2.77	3.47	2.12	7.87	1.72	0.75	--	1.59	0.68	1.24	1.74	0.64	0.64	0.86	200
Xylene, *m/p-*	$\mu g/m^3$	1.06	0.26	--	--	2.29	--	--	--	1.46	0.52	0.85	4.92	3.41	3.53	2.92	2.73	1.06	1.43	9,000
Ethylbenzene	$\mu g/m^3$	0.33	0.11	--	--	0.686	--	--	--	0.456	0.19	0.31	1.36	1.06	1.09	0.956	0.860	0.40	0.578	40,000
Cadmium (PM_{10})	ng/m^3	--	--	--	0.06	0.18	0.06	0.07	0.56	0.09	0.16	--	0.11	0.16	0.20	0.11	0.06	0.09	0.01	30
Tetrachloroethylene	$\mu g/m^3$	0.10	0.05	--	--	0.42	--	--	--	0.16	0.081	0.15	0.49	0.32	0.24	0.29	0.29	0.14	0.11	1,400
Chloromethane	$\mu g/m^3$	1.42	1.43	--	--	1.57	--	--	--	1.24	1.11	0.934	0.818	1.05	1.11	0.843	1.76	0.926	0.886	1,000
Antimony (PM_{10})	ng/m^3	--	--	--	1.09	2.56	1.60	1.68	6.13	1.05	1.67	--	2.02	1.82	2.42	1.65	0.93	1.24	0.37	2,000
Bromomethane	$\mu g/m^3$	0.039	0.047	--	--	0.047	--	--	--	0.047	0.047	0.039	0.039	0.070	0.047	0.043	0.050	0.03	0.03	200
Dichloromethane	$\mu g/m^3$	0.619	0.542	--	--	0.907	--	--	--	0.518	0.400	11.3	2.35	0.726	0.709	0.792	0.511	0.31	0.355	2,000
Xylene, *o-*	$\mu g/m^3$	0.40	0.11	--	--	0.760	--	--	--	0.487	0.18	0.31	1.41	1.11	1.08	0.895	0.856	0.35	0.37	9,000
Dichlorobenzene, *p-*	$\mu g/m^3$	0.072	0.03	--	--	0.12	--	--	--	0.084	0.04	0.04	0.11	0.05	0.04	0.060	0.03	ND	0.02	10,000
Acetonitrile	$\mu g/m^3$	0.279	0.348	--	--	0.351	--	--	--	0.186	0.181	0.360	0.202	0.13	0.15	0.10	0.16	0.13	0.11	600
Cobalt (PM_{10})	ng/m^3	--	--	--	0.06	0.16	0.15	0.14	0.60	0.14	0.04	--	0.10	0.11	0.12	0.98	0.05	0.08	0.02	100
Carbon Disulfide	$\mu g/m^3$	0.084	0.056	--	--	0.14	--	--	--	0.03	0.031	0.044	0.062	0.087	0.03	0.069	0.037	0.041	0.02	7,000
Chloroform	$\mu g/m^3$	0.13	0.13	--	--	0.16	--	--	--	0.14	0.12	0.21	0.15	0.13	0.13	0.11	0.14	0.093	0.068	500
Toluene	$\mu g/m^3$	1.94	0.603	--	--	5.62	--	--	--	2.47	1.19	2.23	9.62	7.09	4.71	5.73	3.09	2.32	2.12	4,000
Selenium (PM_{10})	ng/m^3	--	--	--	0.17	0.61	0.36	0.94	6.71	0.54	0.48	--	0.54	ND	0.20	0.65	0.04	0.20	0.01	20,000
Mercury (PM_{10})	ng/m^3	--	--	--	0.18	0.05	0.17	0.34	0.16	0.10	0.22	--	0.16	0.05	0.05	0.18	0.02	0.10	0.03	3,000[b]
Methyl chloroform	µg/m3	0.072	0.080	--	--	0.11	--	--	--	0.098	0.14	0.11	0.093	0.076	0.093	0.071	0.098	0.055	0.055	10,000
Methyl isobutyl ketone	$\mu g/m^3$	2.28	0.979	--	--	1.81	--	--	--	0.500	0.16	0.20	0.656	0.795	0.594	0.664	0.754	0.582	0.442	30,000
Chloroethane	µg/m3	0.037	0.026	--	--	0.032	--	--	--	ND	ND	0.029	0.01	0.02	0.01	0.02	0.066	0.026	0.026	40,000
Styrene	$\mu g/m^3$	0.076	0.03	--	--	0.12	--	--	--	0.12	0.03	0.081	0.524	0.32	0.34	0.18	0.10	0.13	0.085	9,000
Trichloroethylene	$\mu g/m^3$	ND	ND	--	--	0.16	--	--	--	0.059	ND	--	0.34	--	0.15	0.20	0.075	ND	ND	10,000

Appendix D. Concord Elementary School Pollutant Concentrations.

Parameter	Units	8/20/2009	8/23/2009	8/24/2009	8/29/2009	9/4/2009	9/10/2009	9/16/2009	9/22/2009	9/28/2009	10/4/2009	10/10/2009	10/16/2009	10/22/2009	10/28/2009	11/3/2009	11/9/2009	11/12/2009	11/18/2009	Sample Screening Level[a]
Ethylene dichloride	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	0.081	ND	ND	ND	ND	270
Bromoform	µg/m^3	ND	ND	--	--	ND	--	--	--	0.06	ND	--	ND	--	ND	ND	ND	ND	ND	6,400
Methyl Methacrylate	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	0.02	ND	ND	ND	ND	7,000
Hexachloro-1,3-butadiene	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	0.02	ND	ND	ND	ND	320
Beryllium (PM_{10})	ng/m^3	--	--	--	0.001	ND	ND	0.003	ND	ND	0.009	--	ND	0.02	0.03	ND	ND	0.001	ND	20
Trichloroethane, 1,1,2-	µg/m^3	0.02	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	ND	ND	ND	ND	ND	440
Chlorobenzene	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	0.005	ND	ND	ND	ND	10,000
Acrylonitrile	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	ND	ND	ND	ND	ND	200
Benzyl Chloride	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	ND	ND	ND	ND	ND	140
Chloroprene	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	ND	ND	ND	ND	ND	200
Ethylene dibromide	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	ND	ND	ND	ND	ND	12
Dichloroethane, 1,1-	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	ND	ND	ND	ND	ND	4,400
Dichloroethylene, 1,1-	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	ND	ND	ND	ND	ND	80
Dichloropropane, 1,2-	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	ND	ND	ND	ND	ND	200
Dichloropropylene, *cis* -1,3-	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	ND	ND	ND	ND	ND	40
Dichloropropylene, *trans* -1,3-	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	ND	ND	ND	ND	ND	40
Ethyl Acrylate	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	ND	ND	ND	ND	ND	7,000
Methyl *tert* Butyl Ether	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	ND	ND	ND	ND	ND	7,000
Tetrachloroethane, 1,1,2,2-	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	ND	ND	ND	ND	ND	120
Trichlorobenzene, 1,2,4-	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	ND	ND	ND	ND	ND	2,000
Vinyl chloride	µg/m^3	ND	ND	--	--	ND	--	--	--	ND	ND	--	ND	--	ND	ND	ND	ND	ND	1,000

Key Pollutant

ng/m^3 nanograms per cubic meter

µg/m^3 micrograms per cubic meter

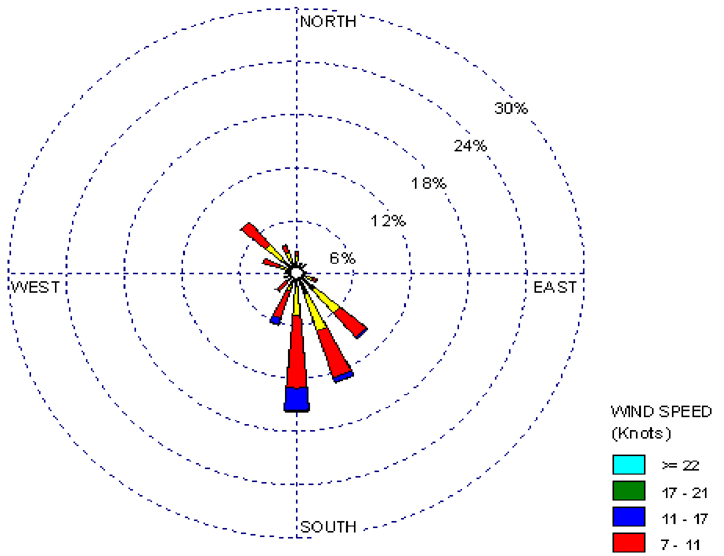
-- No sample was collected for this pollutant on this day or the pollutant was invalidated.

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

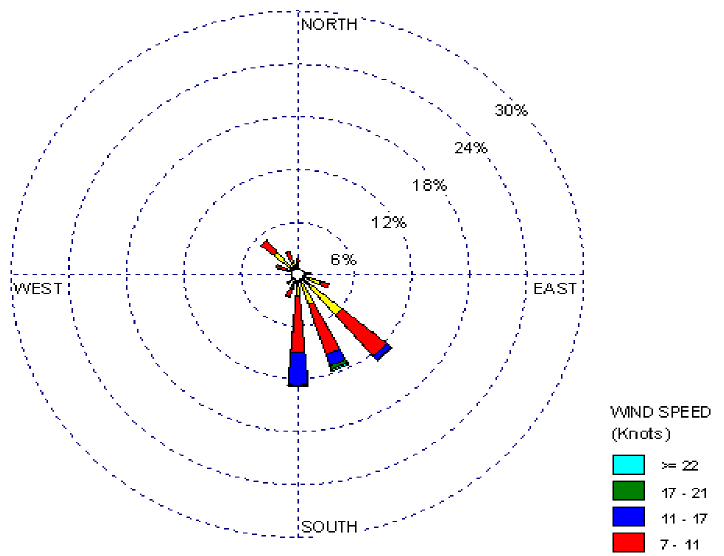
[a] The individual sample screening levels and their use is summarized on the web site and described in detail in Schools Air Toxics Monitoring Activity (2009), "Uses of Health Effects Information in Evaluating Sample Results", see http://www.epa.gov/schoolair/pdfs/UsesOfHealthEffectsInfoinEvalSampleResults.pdf. These screening levels are based on consideration of exposure all day, every day over a period ranging up to at least a couple of weeks and longer for some pollutants.

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

Appendix E. Windroses for Boeing Field/King County International Airport NWS Station.



Boeing Field/King County International Airport NWS Station 2002-2007[1]



Boeing Field/King County International Airport NWS Station Across Sampling Period (Aug. 20, 2009-Nov. 18, 2009)[1]

[1] Boeing Field/King County International Airport NWS Station (WBAN 24234) is 1.14 miles from Concord Elementary School.