SAT Initiative: Stevens Creek Elementary School (Cupertino, California)

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

I. Executive Summary

- Air monitoring has been conducted at Stevens Creek Elementary School as part of the EPA initiative to monitor air toxics at schools in 22 states and 2 tribal areas.
- EPA selected this school based on reports from recent monitoring studies have raised concerns about the potential for elevated levels of hexavalent chromium near cement plants. This school was selected in consultation with Bay Area Air Quality Management District and input from the community.
- Air monitoring for hexavalent chromium was performed from June 30, 2009 through September 10, 2009. Thirteen air samples were collected over this period.
- Hexavalent chromium was below levels of concern, both for short-term and long-term continuous exposures. Levels were not as high as suggested by the information available prior to monitoring.
- Based on the analysis described here, EPA does not plan to extend air toxics monitoring at this school.
- The Bay Area Air Quality Management District (BAAQMD) will continue to monitor hexavalent chromium at this location to collect a full year's worth of monitoring data consistent with their monitoring policy. BAAQMD believes this will provide a more representative annual average that is used to determine health impacts. BAAQMD will be initiating a deposition/fallout study for several metals, and will be conducting mobile monitoring near this facility for a full suite of criteria pollutants. Results from these additional studies will be available through the BAAQMD website (http://www.baaqmd.gov/).

II. Background on this Initiative

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

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

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

[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.

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

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

This school was selected for monitoring hexavalent chromium[4] in consultation with the local air agency, Bay Area Air Quality Management District (BAAQMD) and interest in evaluating the ambient concentrations of hexavalent chromium which might relate to a nearby cement plant. Reports of recent monitoring studies have raised some concerns about the potential for unhealthy levels of hexavalent chromium near cement plants. This is a new and emerging issue which we would like to better understand. Stevens Creek Elementary School was selected for monitoring under EPA's new school air toxics monitoring initiative to see if hexavalent chromium is present in elevated levels in the air. We also considered input from the community in determining the location of the monitor.

We did receive several requests to consider other schools in the Cupertino area, however Stevens Creek Elementary School was selected based on an extensive analysis of wind patterns during the time of year the monitoring will be taking place and the route used by trucks transporting product from the plant.

EPA's monitoring was initiated at this school on June 30, 2009 and continued through September 10, 2009.[5] During this period 13 samples of airborne particles were collected using a low volume total suspended particulate (TSP) sampler specifically configured for collection of hexavalent chromium over a 24 hour period. The samples were analyzed for hexavalent chromium, the key pollutant at this school (www.epa.gov/schoolair/techinfo.html).

The BAAQMD has continued monitoring hexavalent chromium at this school since the EPA-initiated monitoring ended in September. The BAAQMD plans to continue monitoring until they obtain a minimum of a full year's worth of monitoring data at this site. This should provide a more complete understanding of any potential risks from hexavalent chromium at this site.

[2] For example, http://www.epa.gov/schoolair/pollutants.html, http://www.epa.gov/ttn/fera/risk_atoxic.html.
[3] For example, http://www.epa.gov/ttn/atw/3_90_022.html, http://www.epa.gov/ttn/atw/3_90_024.html.
[4] Chromium is a naturally occurring element found in rocks, animals, plants, and soil. It can exist in several different forms. Two common forms are trivalent (chromium 3+ or chromium III) and hexavalent chromium (chromium 6+, or chromium VI). Chromium III is an essential nutrient that helps the body use fat, sugars, and protein. Chromium VI is a toxic form that, when inhaled in large quantities, can cause damage to the respiratory system. Chromium VI can come from several sources, such as cement plants, ferrochrome production (an alloy used in making stainless steel), ore refining, chemical and refractory processing, automobile brake lining and catalytic converters for automobiles, leather tanneries, and chrome pigments.
[5] BAAQMD staff operated the monitors and sent the sample filters to the analytical laboratory under contract to EPA.

IV. Monitoring Results and Analysis

A. Background for the SAT Analysis

The majority of schools being monitored in this initiative were selected based on modeling analyses that indicated the potential for annual average air concentrations of some specific (key) hazardous air pollutants (HAPs or air toxics)[6] to be of particular concern based on approaches that are commonly used in the air toxics program for considering potential for long-term risk. For example, such analyses suggested annual average concentrations of some air toxics greater than long-term risk-based concentrations associated with an additional cancer risk greater than 10-in-10,000 or a hazard index on the order of or above 10. To make projections of air concentrations, the modeling analyses combined estimates of air toxics emissions from industrial, motor vehicle and other sources, with past measurements of winds, and other meteorological factors that can influence air concentrations, from a weather station in the general area. In some cases, the weather station was very close (within a few miles), but in other cases, it was much further away (e.g., up to 60 miles) which may contribute to quite different conditions being modeled than actually exist at the school. The modeling analyses are intended to be used to prioritize locations for further investigation.

The primary objective of this initiative is to investigate - through monitoring air concentrations of key air toxics at each school over a 2-3 month period - whether levels measured and associated longer-term concentration estimates are of a magnitude, in light of health risk-based criteria, for which follow-up activities may need to be considered. To evaluate the monitoring results consistent with this objective, we developed health risk-based air concentrations (the long-term comparison levels summarized in Appendix A) for the monitored air toxics using established EPA methodology and practices for health risk assessment[7] and, in the case of cancer 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

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

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

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. Where multiple pollutants have been monitored at a school, the analysis of the air concentrations also includes a consideration of the potential for cumulative multiple pollutant impacts.[10] In general, where the monitoring results indicate estimates of longer-term average concentrations that are above the comparison levels - i.e., above the cancer-based comparison levels or notably above the noncancer-based comparison levels - we will consider the need for follow-up actions such as:

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

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

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[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 data set (i.e., the 'n') as well as the amount by which the individual data values vary from the dataset mean (i.e., the "standard deviation"). This calculation yields larger confidence intervals for smaller data sets as well as ones with more variable data points. For example, a dataset including {1.0, 3.0, and 5.0}, results in a mean of 3.0 and a 95% confidence interval of 3.0 +/- ~5 (or -2.0 to 8.0). For comparison purposes, a dataset including {2.5, 3 and 3.5} results in a mean of 3.0 and a 95% confidence interval of 3.0 +/- ~1.2 (or 1.8 to 4.2). The smaller variation within the data in the second set of values causes the second confidence interval to be smaller.

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

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

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

B. Chemical Concentrations

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

In developing or identifying these comparison levels, we have given priority to use of relevant and appropriate air standards and EPA risk assessment guidance and precedents.[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.

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

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

- The air sampling data collected over the 2-month sampling period are well below levels of health concern for short- and long-term exposures.

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

Hexavalent Chromium:

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

  → The data do not clearly indicate influence of a nearby source and none of the reported concentrations were higher than concentrations commonly observed in other locations nationally.[12] Of the thirteen samples taken at this site, six had detectable levels of hexavalent chromium, and seven had no detectable levels of hexavalent chromium (See Table 2).

  → On the six days when hexavalent chromium was detected, the wind was blowing from the direction of the source on three of those days.

  → Of the six days when hexavalent chromium was not detected, the wind was blowing from the direction of the source on two of those days.

  → Additional wind data collected by the BAAQMD during their monitoring effort will help us better understand any potential influence from nearby sources year-round.

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

  No. Hexavalent chromium was below levels of concern, both for short-term and long-term exposures, as well as for cancer and non-cancer health effects.[11]

  → The monitoring data for hexavalent chromium do not indicate levels of health concern for long-term exposures.

    - For the six sample results in which hexavalent chromium was detected, all concentrations were substantially below both the cancer-based and noncancer-based comparison levels (Table 1).[13] These comparison levels are developed based on an assumption that people would be exposed to those concentrations continuously (24 hours a day, all year, for a lifetime).

  → Additionally, we did not identify any concerns regarding short-term exposures as each individual measurement is well below levels of concern for exposure all day, every day over a period ranging up to at least a couple of weeks.[11]

  → In summary, none of the individual measurements indicate concentrations of concern for short-term exposures and the combined contributions of all individual measurements in the estimate of longer-term concentration do not indicate a level of concern for long-term exposure.

  → Additional data collected by the BAAQMD during their monitoring effort will provide a more complete understanding of any potential risks from hexavalent chromium at this site.

[12] For example, none of the concentrations at this site (Table 2) were higher than 75 percent of samples collected at the National Air Toxics Trends Stations (NATTS) from 2004-2008 (Appendix B). Because the NATTS sites are generally sited so as not to be influenced by specific nearby sources, EPA is using the 75th percentile point of concentrations at these sites as a benchmark for indicating potential influence from a source nearby to this school.
[13] The upper end of the interval is nearly two times the mean of the monitoring data, but less than 0.1% of the cancer-based long-term comparison level.

C. Wind and Other Meteorological Data

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

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

The meteorological station at the Stevens Creek Elementary School collected wind speed and wind direction during the sampling period, beginning on July 2 (subsequent to the first sample collection on June 30) and continued through the end of the sampling period September 10, 2009. As a result, on-site data for these meteorological parameters are available for all but the first date of sample collection, producing a 70-day record. In a separate effort, BAAQMD is continuing on-site wind data collection, which will provide additional data to understand meteorological conditions at the site.

The nearest NWS station is at Moffett Federal Airfield Airport (Mountain View, CA). This station is approximately 6.1 miles north-northeast of the school. Measurements taken at that station include wind, temperature and precipitation. Wind speed and direction data collected at the school and at the Moffett Federal Airfield Airport NWS station have been summarized in Figure 2 and Appendix D, respectively. The data collected at the school are also presented in Table 2.

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

- Both the sampling results and the on-site wind data indicate that some of the air samples were collected on days when wind was blowing from the direction of the source, contributing to conditions at the school.

- The wind patterns at the monitoring site across sampling dates are generally similar to those observed across the full 70-day record of on-site meteorological data.

- Our ability to provide a confident characterization of the wind flow patterns at the monitoring site over the long-term is somewhat limited as the NWS site at Moffett Federal Airfield Airport does not appear to represent the specific wind flow patterns at the school location. Additional meteorological monitoring by BAAQMD at the school site during additional seasonal periods will assist in characterizing true long-term patterns.

- Although we lack long-term wind data at the monitoring site, the wind pattern at the Moffett Federal Airfield Airport NWS site during the 70-day record is generally similar to the historical long-term wind flow pattern at that same location. This suggests that, on a regional scale, the 2-month sampling period is generally representative of year-round wind patterns.

- What is the direction of the key source of hexavalent chromium emissions in relation to the school location?
  → The nearby cement facility emitting hexavalent chromium into the air lies generally to the west-southwest of the school.
  → Using the property boundaries of the full facility, we have identified an approximate range of wind directions to use in considering the potential influence of this facility on air concentrations at the school.
  → This general range of wind directions, from approximately 214 to 281 degrees, is referred to here as the expected zone of source influence (ZOI).

- On days the air samples were collected, how often did wind come from direction of the key source?
  → Over 20 percent of the hours on August 5, 12 and September 10, the wind was coming from the direction of the ZOI; however the levels of hexavalent chromium observed were very low. Two other days (July 18 and 24) wind was observed over 12 percent of the hours from the ZOI with higher levels of hexavalent chromium indicating a source influence (Figure 1, Table 2).

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

→ Wind patterns across the air monitoring days appear to be generally similar to those observed over the full 70-day record of on-site meteorological data during the monitoring period, particularly with regard to the expected ZOI.
→ While wind data are not available at the school over the longer term, we note that wind patterns at the nearest NWS station (at Moffett Federal Airfield Airport) during the monitoring period are very similar to those recorded at the NWS station over the long-term (2002-2007 period; Appendix D), supporting the idea that regional meteorological patterns during the monitoring period were consistent with long-term patterns. However, there is some uncertainty as to whether this would also be the case at the school location as the general wind patterns at the Moffett Federal Airfield Airport station appear to differ from those at the school (see below).
→ Additional meteorological monitoring by BAAQMD at the school site during additional seasonal periods will assist in characterizing true long-term patterns.

- How do wind patterns at the school compare to those at the Moffett Federal Airfield Airport station, particularly with regard to prevalent wind directions and the direction of the key source?
  → During the period for which data are available both at the school site and at the reference NWS station (approximately 70 days), prevalent winds at the school site are predominantly from the north-northwest and south, while those at the NWS station are somewhat more from the north and north-northwest. The windroses for the two sites during the sampling period (Figure 1 and Appendix D) show differences in wind flow patterns, most likely resulting from nearby terrain and water influences.
  → Wind speeds at the school monitoring site are somewhat lower than those measured at the Moffett Federal Airfield Airport NWS most likely related to differences in the height of the wind sensors used.

- Are there other meteorological patterns that may influence the measured concentrations at the school monitoring site?
  → There does not appear to be any correlation between the other meteorological measurement taken at the school and the ambient levels of hexavalent chromium during the sampling period.

V. Key Source Information

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

  → The nearby source of hexavalent chromium (described in section III above) has operating permits issued by BAAQMD that includes operating requirements. [14]

[14] The operating permit issued for this facility by BAAQMD is described at: http://www.baaqmd.gov/Divisions/Engineering/Public-Notices-on-Permits/2009/081209-17947/Lehigh-Southwest-Cement-Company.aspx

→ Historical data from 1990 through 2006 shows that production peaked to near capacity in the year 2000. Average daily production for the year 2000 was 4188.5 short tons of clinker if you include days the kiln was shutdown, or 4731.4 short tons of clinker if you exclude days the kiln was shutdown. In comparison, production on days of sampling ranged from 0 to 4360.6 short tons of clinker, as shown in Table 2.

→ The nearby cement plant was operating at less than full capacity during a portion of the monitoring period, with the cement kiln shut down for 3 of the 13 days on which sampling occurred. The kiln was operating on the remaining 10 sampling days. Operations on these days varied from close to full capacity to ~35% of capacity.

VI. Integrated Summary and Next Steps

A. Summary of Key Findings

1. What are the key HAPs for this school?
   → Hexavalent chromium is the key HAP for this school, identified based on concerns about the potential for elevated levels of hexavalent chromium near cement plants.

2. Do the data collected at this school indicate an elevated level of concern?
   → No; the levels measured and associated longer-term concentration estimates are well below levels of concern for long-term exposures.

   → Additional data collected by the BAAQMD during their monitoring effort will provide a more complete understanding of any potential risks from hexavalent chromium at this site.

3. Are there indications, e.g., from the meteorological or other data, that the sample set may not be indicative of longer-term air concentrations? Would we expect higher (or lower) concentrations at other times of year?
   → The data we have collected appear to reflect air concentrations during the entire monitoring period, with no indications from the on-site meteorological data that the sampling day conditions were inconsistent with conditions overall during this period.
   → Among the data collected for this site, we have none that would indicate generally higher (or lower) concentrations during other times of year. Additional meteorological monitoring by BAAQMD at the school site during additional seasonal periods will assist in characterizing true long-term patterns.

B. Next Steps for EPA Monitoring

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

C. Additional Activities for Maintaining and Improving Air Quality

1. The Bay Area Air Quality Management District (BAAQMD) will continue to monitor hexavalent chromium at this location to collect a full year of monitoring and meteorological data consistent with their monitoring policy.
2. The BAAQMD will also be initiating a deposition/fallout study for several metals, and will be conducting mobile monitoring near this facility for a full suite of criteria pollutants. Results from these additional studies will be available through the BAAQMD website (http://www.baaqmd.gov/).
3. The BAAQMD will continue to oversee industrial facilities in the area through air permits, inspection and enforcement, and other programs.

VII. Figures and Tables

A. Tables

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

B. Figures

1. Stevens Creek Elementary School – Concentration and Wind Information.

VIII. Appendices

A. Summary Description of Long-term Comparison Levels.

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

C. Stevens Creek Elementary School - Pollutant Concentrations.

D. Windrose for Moffett Federal Airfield Airport NWS Station.

Table 1. Stevens Creek 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	54% of results were ND[d]		8.3[e]	100

ng/m^3 nanograms per cubic meter

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

[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] Hexavalent chromium was detected in only 6 of 13 samples, ranging from 0.001 to 0.020 ng/m^3. The MDL is 0.0043 ng/m^3. The detected levels (as well as the method detection level) are well below the long-term comparison level. Therefore, had we estimated a mean and CI, they would be well below the long-term comparison level.

[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.

Table 2. Stevens Creek Elementary School Key Pollutant Concentrations and Meteorological Data.

Parameter	Units	6/30/2009	7/6/2009	7/12/2009	7/18/2009	7/24/2009	7/30/2009	8/5/2009	8/12/2009	8/18/2009	8/24/2009	8/29/2009	9/4/2009	9/10/2009
Hexavalent Chromium	ng/m^3	ND	ND	ND	0.015	0.020	0.017	0.007	0.001	ND	ND	ND	ND	0.005
Kiln Production on Day of Sampling	short tons	0.0	3,929.7	3,905.6	4,015.8	4,015.7	3,586.0	4,360.6	4,269.0	3,858.5	4,154.3	1,554.3	0.0	0.0
Percent of 2000 Daily Average Kiln Production, Including Days Kiln Was Shut Down	%	NA	94%	93%	96%	96%	86%	104%	102%	92%	99%	37%	NA	NA
Percent of 2000 Daily Average Kiln Production, Excluding Days Kiln Was Shut Down	%	NA	83%	83%	85%	85%	76%	92%	90%	82%	88%	33%	NA	NA
% Hours w/Wind Direction from Expected	%	0.0	4.2	12.5	12.5	12.5	0.0	20.8	25.0	16.7	4.2	8.3	16.7	25.0
Wind Speed (avg. of hourly speeds)	mph	7.3	3.2	2.7	2.7	3.3	3.2	3.6	2.9	3.0	2.9	2.6	2.7	2.3
Wind Direction (avg. of unitized vector)[b]	deg.	358.2	355.4	327.0	317.7	5.8	3.0	277.6	280.1	292.4	354.3	323.3	280.2	263.6
% of Hours with Speed below 2 knots	%	16.7	29.2	54.2	37.5	25.0	29.2	37.5	54.2	37.5	33.3	58.3	54.2	66.7
Daily Average Temperature	° F	66.8	62.4	66.6	68.9	62.7	64.5	66.5	70.9	65.3	62.6	78.1	64.1	71.9
Daily Precipitation	inches	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Although the on-site meteorological station was not available until after the first measurement was taken (June 30th), BAAQMD was interested in obtaining monitoring data on a day when the source was not operating . As such, hourly wind information was extracted from the Moffett Federal Airfield Airport NWS Station for this day, and used as a surrogate.

All precipitation and temperature data were from the Moffett Federal Airfield Airport NWS Station.

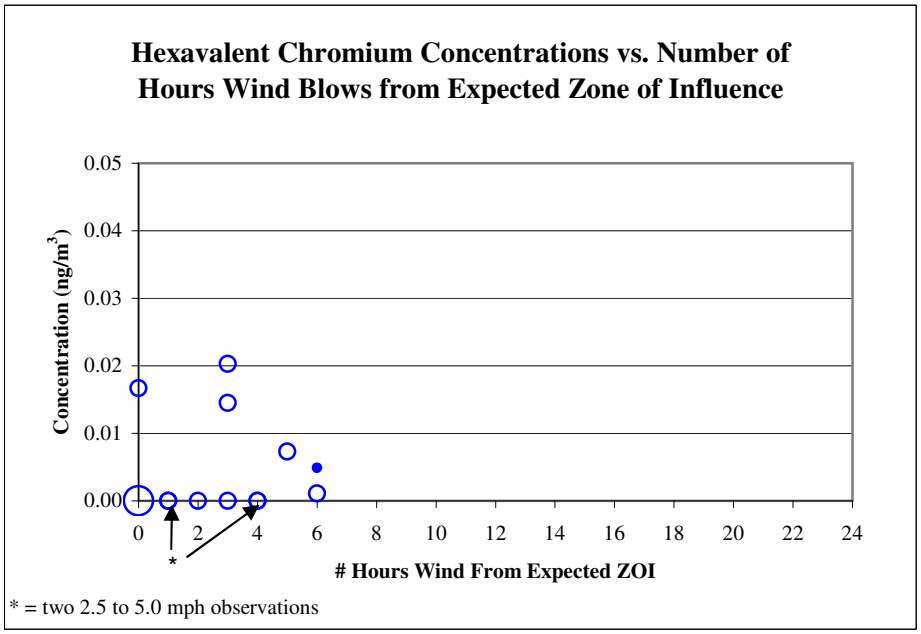
ng/m^3 nanograms per cubic meter

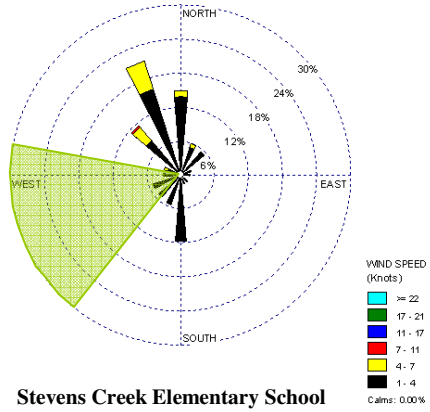
ND No detection of this chemical was registered by the laboratory analytical equipment. The method detection limit is 0.0043 ng/m^3.

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

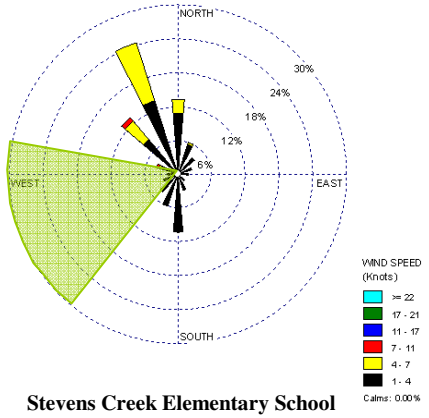
[b] Wind direction for each day is represented by values derived by scalar averaging of hourly estimates that were produced (by wind instrumentation's logger) as unitized vectors (specified as degrees from due north).

Figure 1. Stevens Creek Elementary School (Cupertino, CA) Hexavalent Chromium Concentration and Wind Information.





Stevens Creek Elementary School Composite Hourly Windrose on Sample Days (Beginning Jul. 6-Sep. 10, 2009)



Stevens Creek Elementary School Composite Hourly Windrose Across Sampling Period (Jul. 2-Sep. 10, 2009)

KEY

Pollutant: Hexavalent Chromium
Timeframe: June 30 - September 10, 2009

Note

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

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

Expected Zone of Source Influence

Appendix A. Summary Description of Long-term Comparison Levels

In addressing the primary objective identified above, to investigate through the monitoring data collected for key pollutants at the school whether levels are of a magnitude, in light of health risk-based criteria, to indicate that follow-up activities be considered, we developed two types of long-term health risk-related comparison levels. These two types of levels are summarized below.[15]

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.[16] 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.

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

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

[16] 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).

adverse effect over a lifetime.[17] 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.

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

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

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

Key Pollutant

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

[b] No results of this chemical were registered by the laboratory analytical equipment. In calculations performed with the result, a value of zero is used.

Appendix C. Stevens Creek Elementary School Pollutant Concentrations.

Parameter	Units	6/30/2009	7/6/2009	7/12/2009	7/18/2009	7/24/2009	7/30/2009	8/5/2009	8/12/2009	8/18/2009	8/24/2009	8/29/2009	9/4/2009	9/10/2009	Sample Screening Level[a]
Hexavalent Chromium	ng/m^3	ND	ND	ND	0.015	0.020	0.017	0.007	0.001	ND	ND	ND	ND	0.005	580

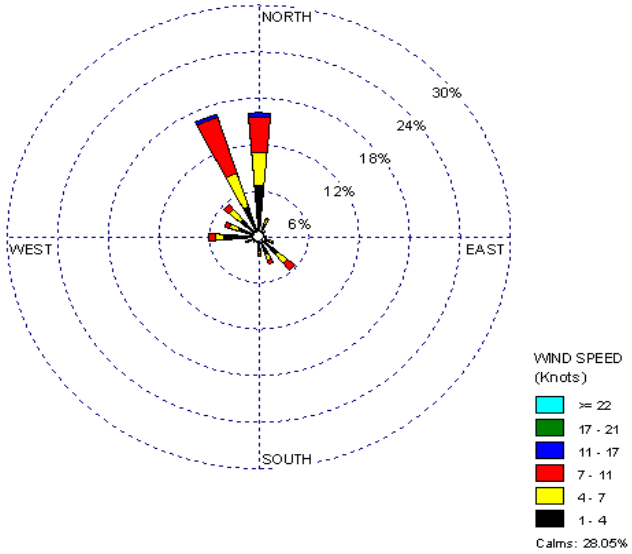
Key Pollutant

ng/m^3 nanograms per cubic meter

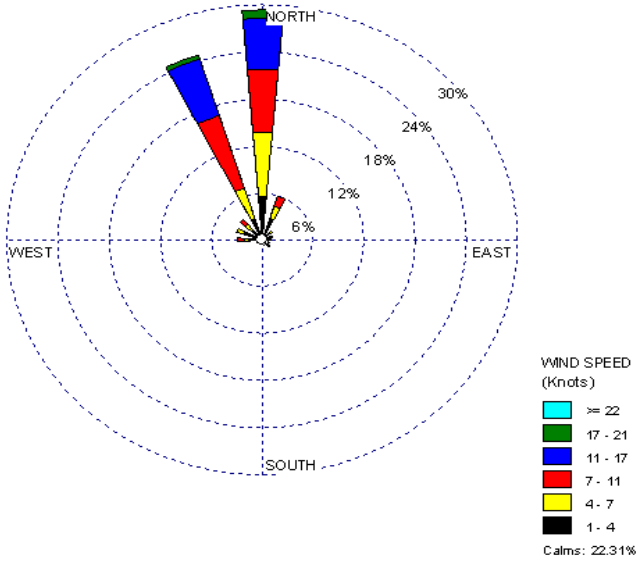
ND No detection of this chemical was registered by the laboratory analytical equipment. The method detection limit is 0.0043 ng/m^3.

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

Appendix D. Windrose for Moffett Federal Airfield Airport NWS Station.



Moffett Federal Airfield Airport NWS Station
2002-2007



Moffett Federal Airfield Airport NWS Station
Across Sampling Period
(Jul. 2-Sep. 10, 2009)[1]

[1] Moffett Federal Airfield Airport NWS Station is 6.09 miles from Stevens Creek Elementary School.