

Summary of Environmental Sampling Conducted at PS 234

A. Sampling Conducted Independently by the New York City Board of Education

Initial Asbestos Testing (October 2, 2001)

ATC performed the initial asbestos testing in and around the school on October 2, 2001. That testing included collection of 50 dust samples and 20 ambient air samples from inside the school, and three debris samples from the roof of the school. ATC reported that none of the 50 dust samples contained any detectable asbestos fibers, and none of the 20 air samples contained any asbestos structures. Two of the three debris samples from the roof contained traces of asbestos, at less than 1 percent.

Follow-up Testing for Asbestos (October 4-16, 2001)

Aggressive air sampling (sampling conducted with ventilation systems operating and using a leaf blower to mobilize dust from surfaces into the air) was conducted for asbestos on October 4, prior to the beginning of cleaning operations at the school, and October 16, following the cleanup activities. The October 4 sampling included the analysis of five samples from inside the school. Three of those five samples contained no asbestos structures, while the other two samples contained 3 and 14.8 structures/mm², respectively, less than the AHERA clearance level of 70 structures/mm². The October 16 testing included the collection of eight air samples from inside the school for analysis of asbestos. All eight of the air samples were found to contain no asbestos structures. In addition to the air testing, four wipe samples were collected from lockers around the school on October 14. All four of those samples were reported to have no asbestos detected.

Debris and Soil Sampling for Asbestos (October 30, 2001)

Following a site inspection involving the Board of Education, School Construction Authority, ENVIRON and PTA representatives, ATC performed additional testing of debris from the roof and under the rubber padding in the playground, as well as soils from planters located in the school yard. ENVIRON had recommended the cleanup of the debris in all these areas based on visual observations made during an initial inspection of the school. One sample of debris from the roof was found to contain 1.5 percent asbestos, which is above the 1 percent limit used to define an asbestos-containing material. Most of the other roof debris samples contained between a trace of asbestos and 0.75 percent asbestos. Based on these results, the School Construction Authority (SCA) contracted for the removal of all the stone ballast and debris from the roof.

Three samples of debris from beneath the rubber mats in the playground were all found to contain between a trace and 0.25 percent asbestos. Based on these results, the SCA contracted for the removal and cleaning of the rubber mats and the playground surfaces.

There were a total of 13 soil samples collected from planters for analysis of asbestos. Nine surface soil samples were found to contain either no detectable asbestos or trace levels of asbestos. Four samples collected from a depth of six inches below the ground surface were all found to contain no detectable asbestos. Based on these results, the SCA Contracted for the removal and replacement of the surficial soils in all the planters around the school.

School-Wide Lead Dust Sampling (November 29, 2001)

To evaluate the adequacy of cleaning, an extensive dust sampling program was implemented for analysis of lead. On November 29, forty dust samples were collected from throughout the school for lead analysis. Of the forty samples, 37 contained no detectable lead. The remaining three samples contained between 4.8 and 17.9 ug/ft², which are all less than the most-stringent acceptable level established for lead abatement projects, 40 ug/ft².

Follow-Up Air Monitoring for Asbestos (November 29-December 2, 2001)

Eighteen air samples were collected on each day during the period November 29 to December 2. Samples were taken from various locations throughout the school. No asbestos structures were detected in any of the samples collected on those four days.

Initial Indoor Air Quality Assessment (November 29-December 2, 2001)

Independent of the sampling requested by ENVIRON on behalf of the PS 234 Parent Teacher Association, the Board of Education retained ATC Associates Inc. to perform air testing during the period November 29 through December 2, 2001. This testing included the collection of four air samples (three inside the school and one outside the school) per day for analysis of eleven metals and a number of hydrocarbon compounds, including benzene and other volatile organic compounds, as well as monitoring for other air quality parameters, such as carbon dioxide, carbon monoxide, total volatile organic compounds, and particulates (PM2.5). Sampling locations varied on each of the four days and included the following locations:

- November 29: cafeteria, library, Room 305, outside on the east side of PS 234.
- November 30: Room 111, Room 229, Room 329, outside on the north side of PS 234.
- December 1: Room 122, Room 222, Room 322, outside on the roof by the HVAC intake.

- December 2: first floor hall by exit 1; second floor hall by exit 1; third floor hall by exit 1; roof.

The results of this sampling are as follows:

- **Metals:** The results of the metals analyses showed that most metals were not detected either inside or outside of the school in any of the samples. Chromium was detected at trace levels in all samples but at similar levels to the method blank. Traces of iron were detected in two of the samples.
- **Hydrocarbons:** The results of the hydrocarbon analyses showed that most samples had low to non-detectable levels of most of the hydrocarbon compounds that were tested, although most samples also showed some level of undifferentiated hydrocarbons, which could represent a material such as mineral spirits. A few hydrocarbon compounds were detected in one or two sample each at concentrations above the method detection limit, including xylenes (maximum concentration of 0.294 ppm), ethylbenzene (0.154 ppm), tetrachloroethene (0.346 ppm), and chlorobenzene (0.129). There was extensive painting being conducted inside the school during the sampling period, as well as cleaning. The targeted hydrocarbon compounds detected in a few samples, which included ethylbenzene and toluene, are often present in certain paints or products used in painting. It is significant to note that the samples collected on December 2 contained no specific hydrocarbon compounds and only trace levels of unspecified hydrocarbon compounds. It is stated in the ATC report that the paint odors, which had been strong inside the school during the earlier sampling dates, had largely dissipated by December 2. Follow-up sampling for hydrocarbons and other volatile organic compounds is discussed later.
- **Particulates and Other Air Quality Parameters:** Levels of carbon dioxide, carbon monoxide, and relative humidity were within guideline ranges. Levels of particulates (PM_{2.5}) varied significantly during the period and appeared to generally correlate with outdoor levels. On one of the days, November 30, the particulate levels also exceeded the 65 ug/m³ standard for normal populations. It should be noted that 65 ug/m³ limit is established for outdoor conditions as an average concentration over 24 hours. On three of the four dates, some particulate measurements exceeded the guidance level of 40 ug/m³ established by USEPA for sensitive receptors. It should be noted that there has been some discussion that the method used to measure particulate levels may register higher particulate levels than would be measured by performing a gravimetric analysis of total particulates. ENVIRON has requested that the Board of Education's consultant perform a comparative analyses using the particulate meter and gravimetric analysis to determine the comparability between the two methods. The results of that comparison has not yet been received.

Total volatile organic compound concentrations varied widely during the period and seemed to correlate with painting being conducted within the school. ATC reported that the highest total VOC levels were in areas where strong paint odors were noted.

B. Sampling Conducted at Request of PS 234 PTA

In addition to the sampling being performed by the Board of Education, ENVIRON provided a recommendation for conducting additional sampling at PS 234 to address potential air quality issues in and around the school as well as evaluate the adequacy of the cleanup operation conducted at the school. Following discussions with the New York City Board of Education, a final scope of sampling was developed, which included:

- Conducting air monitoring at four locations inside the school, two locations outside the school within the play areas, one location on the school roof, one location outside the main entrance to the school. The samples were to be analyzed for volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), PCBs, dioxins and dibenzofurans, metals, cyanide, and particulates. In addition, measurements of other potential air pollutants were to be performed, including carbon dioxide, carbon monoxide, hydrogen sulfide, chlorine gas, nitrous oxides and sulfur dioxide. The parameter list was developed based upon a review of air quality data for the vicinity of ground zero.
- Conducting one round of wipe sampling from surfaces throughout the school for analysis of PAHs, PCBs, dioxins and dibenzofurans, metals, and asbestos.
- Conducting air sampling for fungal spores to assess potential impacts to indoor air quality from minor flooding that occurred in the school basement in the days immediately after September 11.

The results of the sampling are summarized below.

Air Monitoring

Asbestos (December 5, 9, and 12, 2001)

A total of 18 air samples per day were collected on each of three days from a variety of locations inside and outside the school and analyzed for asbestos using transmission electron microscopy (TEM). ATC reported that none of the 54 air samples collected was found to contain any measurable asbestos structures.

Polychlorinated Biphenyls (PCBs) (December 6, 8, and 11, 2001)

Eight air samples were analyzed from inside and outside PS 234 on December 6, 8 and 11, 2001. PCBs were not detected in any of the 8 samples collected on any of the three days.

Polycyclic Aromatic Hydrocarbons (PAHs) (December 6, 8, and 11, 2001)

The only PAH compound detected in the samples from outside the school was naphthalene, at concentrations from below the detection limit to 0.32 ug/m^3 , while inside the school, naphthalene (ND to 0.69 ug/m^3), 1-methylnaphthalene (ND to 0.49 ug/m^3), and 2-methylnaphthalene (ND to 0.92 ug/m^3) were detected. Naphthalene is the major constituent of mothballs, and all three compounds are found in cigarette smoke. The detected concentrations are all within documented urban background levels. While there are no relevant standards for these compounds, the USEPA Region 9 preliminary remediation goal (PRG) for naphthalene in air, adjusted for a school exposure scenario, is 8.7 ug/m^3 for naphthalene. There is no PRG for either 1-methylnaphthalene or 2-methylnaphthalene. Naphthalene concentrations in all samples were well below the adjusted Region 9 PRG.

Dioxin and Dibenzofurans (December 6, 9, and 12, 2001)

Trace levels of dioxins were detected in all the indoor and outdoor samples collected on all three days. Reported TCDD Equivalents (a measure of the toxicity of the dioxin and dibenzofuran constituents detected in the sample expressed in terms of the toxicity of 2,3,7,8-tetrachloro-dibenzo-p-dioxin, the most potent of the dioxin isomers) were as follows (in picograms per cubic meter, pg/m^3):

<u>Date</u>	<u>Indoor Concentration</u>	<u>Outdoor Concentration</u>
December 6	0.0078-0.028 pg/m^3	0.038-0.073 pg/m^3
December 9	0.0079-0.022 pg/m^3	0.028-0.037 pg/m^3
December 12	0.0013-0.0035 pg/m^3	0.0014-0.0022 pg/m^3

There are no relevant standards for dioxins in air in a school setting. USEPA is utilizing a screening level of 160 pg/m^3 , assuming a one-year exposure, and 5.4 pg/m^3 , assuming a 30-year exposure. The USEPA Region 9 preliminary remediation goal (PRG) for dioxin in air adjusted for a school exposure scenario is 0.126 pg/m^3 . The dioxin levels were all well below any of these screening levels.

Mercury (December 7, 9, and 12, 2001)

Mercury was not detected in any of 8 samples collected on December 7, 9, and 12, 2001 above the level detected in the method blank.

Metals (December 5, 8, and 12, 2001)

Several metals were not detected in 8 samples collected inside and outside of the school. For the metals detected, indoor concentrations were generally lower than outdoor levels. Metals concentrations were generally higher in the samples collected on December 5 and decreased in the December 8 and December 11 samples. In the December 5 samples, common metals such as iron and aluminum were detected both inside and outside the school. In addition, copper and chromium were also detected both inside and outside of the schools, with chromium detected at up to 0.442 ug/m³ outside and 0.348 ug/m³ inside, and copper at up to 0.692 ug/m³ outside and 0.41 ug/m³ inside. These levels are within the range of urban background levels published by the U.S Department of Health and Human Services. For the samples collected on December 5, chromium was also detected in the blank sample at a level (0.383 ug) similar to those detected in the air samples (0.309 ug to 0.54 ug), indicating that the actual chromium concentrations in air may be significantly lower than indicated by the analyses. ATC, the firm that performed the sampling for the Board of Education, estimated that actual chromium concentrations in the samples would decrease by 80 to 90 percent when the blank concentrations were removed. On December 8 and 11, only copper and chromium were detected in any of the air samples inside or outside of the school. Chromium concentrations on December ranged up to 0.262 ug/m³ outside the school and 0.270 inside the school. On December 12, chromium was only detected in one of the four indoor samples and two of four outdoor samples at maximum concentrations slightly lower than on December 8. The USEPA is utilizing a screening level for hexavalent chromium of 0.6 ug/m³. These samples were analyzed for total chromium, which includes both the hexavalent and trivalent species. The total chromium concentrations in all the samples were below this USEPA screening level.

Cyanide(December 6, 8, and 11, 2001)

Cyanide was not detected in either of two samples collected on December 6, 2001 at levels above the method blank. On December 8, cyanide was detected in both samples outside of the school as well as in the method blank sample, at concentrations (corrected for blank levels) of 0.0042 and 0.0052 mg/m³, and on December 11, cyanide was detected in both outside samples at blank corrected concentrations of 0.0008 mg/m³ and 0.0048 mg/m³. All the measured cyanide concentrations are below the USEPA Region 9 PRG for cyanide in air, adjusted for a school exposure scenario, of 0.0087 mg/m³. Sources of cyanide in the environment include vehicle exhaust, industrial sources, and natural biogenic processes.

Hydrocarbons

On December 5, 2001, trace levels of one target compound, acetone, were detected in one outdoor sample (0.347 ppm) and two indoor samples (0.101 ppm and 0.116 ppm). In addition, undifferentiated hydrocarbons were also detected in two indoor samples. Painting and cleaning operations were being conducted on that day and these results are

consistent with either or both of those operations as the potential source of the trace levels detected.

None of the target hydrocarbons, including volatile organic compounds such as benzene, were not detected in any of 8 air samples collected from inside or outside the school on December 9 or 11, 2001.

Volatile Organic Compounds plus Library Search (December 15, 2001)

Five air samples were collected for analysis of volatile organic compounds with a 15-compound forward library search (VOC+15) on December 15, 2001. Sampling locations included three outdoor samples (main entrance, roof, and the rear playground) and two indoor samples (cafeteria and second floor hallway). A few targeted VOCs were detected at trace levels both outside and inside the school, including benzene (maximum 0.9 ppb outside, 0.8 ppb inside), ethylbenzene (0.3 ppb outside, 1.0 ppb inside), toluene (1.6 ppb outside, 2.8 ppb inside), and xylenes (1.5 ppb outside, 4.7 ppb inside). In addition, several non-target VOC compounds were detected both inside and outside of the school. Overall, the type and levels of VOCs detected are generally consistent with urban background concentrations documented by USEPA.

Particulates and Other Air Quality Parameters (December 8 to 14, 2001)

Levels of carbon dioxide, carbon monoxide, and relative humidity were within guideline ranges. Levels of particulates (PM_{2.5}) varied significantly during the period. Based on periodic measurements taken at several locations inside and outside of the school, the average particulate levels on all five days (indoor averages ranged from 22 to 36 ug/m³) were below the threshold level of 40 ug/m³ used by USEPA for sensitive receptors inside the school, although some instantaneous particulate measurements were higher, up to 68 ug/m³, which is slightly above the 65 ug/m³ guideline used by USEPA for normal populations. It should be noted that the 40 ug/m³ and 65 ug/m³ limits are established for outdoor conditions as an average concentration over 24 hours. Outdoor levels were approximately similar to indoor readings on December 8 and 9, but outdoor readings were higher than indoor readings on December 10 and 12, with average outdoor readings of 51 ug/m³ on December 10 and 52 ug/m³ on December 12.

In addition to the periodic particulate monitoring conducted, three locations were monitored continuously for approximately 24 hours during this period. One indoor location, the cafeteria, had average particulate levels of 30 ug/m³ on December 8-9, 44 ug/m³ on December 11-12, and 58 ug/m³ on December 13-14. Outdoor levels were somewhat higher, with average levels on the roof exceeding 65 ug/m³ during December 12-13 and 13-14, and outside the main entrance on December 12-13. These measurements were made with the school ventilation system shut down while improved filtration systems were installed. Further assessment of particulate levels is warranted with the upgraded ventilation systems operating. As previously discussed, an evaluation of the testing method being used for particulates is also underway, along with further particulate monitoring to assess current air quality. In general, particulate levels in the area of the school, including at a measurement station at the Borough of Manhattan Community College, have been well below 40 ug/m³ on most days in recent weeks.

Instrument readings for total volatile organic compounds, nitrous oxide, sulfur dioxide, and hydrogen sulfide were all below the instrument detection limit. Nitrogen dioxide was measured at average concentrations ranging from 0.1 ppm to 0.3 ppm indoors, and 0.2 ppm to 0.4 ppm outdoors. These levels exceed the USEPA ambient air quality standard of 0.053 ppm. These readings are believed to be the result of instrument error. Re-testing using a more sensitive meter at a nearby school confirmed instrument error from the earlier readings at that school and re-testing of nitrogen dioxide levels at PS 234 have confirmed this conclusion, based on information received verbally from ATC.

Wipe Samples

Dust Sampling for Asbestos (December 5, 2001)

A total of 22 dust samples were collected from throughout the school on December 5 for analysis of asbestos. ATC reported that no asbestos was detected in any of the 22 dust samples.

Comprehensive Surface Sampling (December 5, 2001)

Ten wipe samples were collected from various locations inside PS 234 on December 6, 2001 for a variety of potential contaminants, including dioxins and dibenzofurans, metals, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs). The sample locations included:

- Cafeteria - windowsill
- Kitchen – serving windowsill
- Room 116 – table surface
- Room 120 – windowsill
- Room 211 – table surface
- Library – table surface
- Library – bookcase surface
- Room 305 – bookcase surface
- Room 316 – table surface
- Gymnasium – landing.

The results of the analyses of these samples are discussed below.

Polychlorinated Biphenyls and Polycyclic Aromatic Hydrocarbons

None of the ten surface samples contained PCBs at concentrations above the laboratory method reporting level (2 ug). None of the ten surface samples contained polycyclic aromatic hydrocarbons above the laboratory method reporting limit (5 ug).

Dioxin/Dibenzofurans

Trace levels of dioxins and dibenzofurans were detected in nine of the ten surface wipe samples collected, as expected. Only the sample collected from the gymnasium floor did not contain any measurable dioxin. TCDD equivalent concentrations were reported at highest concentrations in three wipe samples collected from windowsills (0.017 to 0.041 ng/m²) and lower in samples collected from tabletops and bookcases (0.00018 to 0.00074 ng/m²). There are no established standards for dioxins/dibenzofurans on surfaces. The National Research Council (1988) has published a recommended surface criterion for dioxins of 25 ng/m² for an office building setting, and cites recommended concentrations in several states ranging from 1 to 25 ng/m². ENVIRON developed a preliminary screening level of 0.055 ng/m² using a USEPA risk-based approach, reasonable exposure assumptions for a school setting, and very protective risk targets (10⁻⁶). All of the reported TCDD equivalent concentrations were less than the preliminary screening level, and well below the recommended criteria cited by the National Research Council.

Metals

Metals were detected in all samples, as expected. Common metals, such as iron, copper, manganese, and zinc were detected in all 10 samples. Trace metals, such as chromium, cadmium, and nickel, were detected in four or less of the samples. Only lead has regulatory levels for surface dust (lead was discussed above). ENVIRON developed preliminary screening levels for the analyzed metals utilizing a USEPA risk-based approach, with reasonable exposure assumptions for a school setting, and very protective risk targets (10⁻⁶). All of the detected metal concentrations were below the preliminary screening levels.

Mold Assessment

Because there was some minor flooding in the basement of the school in the few days immediately after September 11, an assessment was performed to determine if there were any issues related to mold growth or fungal spores in the school. An inspection was performed of the basement by ATC Associates on October 31 which found no evidence of microbial growth or mold growth evident. ENVIRON performed a follow-up inspection and made the same observations. To confirm those observations, sampling for fungal spore counts was performed inside and outside the school on December 18, 2001. That sampling found that spore counts inside the school were lower than outside the school, indicating no evidence of amplified fungal growth in the school.

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