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March 17, 2023

The Honorable John E McCormac
Mayor of Woodbridge
Municipal Building
1 Main Street
Woodbridge, NJ 07095

Dear Mayor McCormac:

The New Jersey Department of Health (NJDOH) has prepared this Letter Health Consultation (LHC) to address health concerns from potential indoor air exposures to polychlorinated biphenyls (PCBs) and pesticides at Colonia High School. This LHC was prepared under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR) and evaluates indoor air data collected in December 2022 by an environmental consultant retained by the high school. The sampling report was received by the NJDOH in January 2023.

The NJDOH evaluated the indoor air results utilizing federal guidance to evaluate the potential for health effects from exposures. **Based on the indoor air data provided to the NJDOH, harmful health effects are not likely for students and staff at Colonia High School from indoor air exposures to PCBs and pesticides.** To evaluate the PCB exposures that occur in school buildings, we used the U.S. Environmental Protection Agency's (USEPA) PCB Exposure Estimation Tool. This tool estimates and combines background exposures and calculates the level of PCBs in school air that would be below a level that is likely to be without an appreciable risk of harmful effects during a lifetime (USEPA 2020). For the other contaminants, we used the ATSDR evaluation process described more in detail below (ATSDR 2022a).

ATSDR's process for evaluating the potential of health impacts follows a two-tiered approach:

1. <u>Screening analysis</u>
   First, maximum concentrations of detected substances are compared to environmental media-specific comparison values. If contaminant concentrations exceed the environmental comparison value, these substances are selected for further evaluation. These are considered contaminants of concern.

2. <u>In-depth analysis</u>

If contaminant concentrations are above these comparison values, NJDOH reviews exposure scenarios (such as duration and frequency), the toxicology of the contaminant, and epidemiology studies to determine likelihood of harmful health effects. During this part of the evaluation process, NJDOH estimates site-specific exposure doses and compares those to health guideline values, which are developed based on data drawn from the epidemiologic and toxicological literature. Many uncertainty factors, sometimes known as safety factors, are applied to ensure that the health-based comparison values amply protect human health.

Screening analysis

In December 2022, a total of 20 indoor air samples were collected from various locations within the school building and were analyzed for PCBs and pesticides. These locations included the front entrance, boys team room, main office, women's restroom, music room, classrooms (104, 136, 128, 118, 234, 228, 214, 281), stairwell 9, faculty lounge, media center, food service, auditorium, gym, and cafeteria. **Table 1** summarizes the contaminants identified in these samples. As noted in the table, PCBs, chlordane and heptachlor were detected above their respective comparison values and therefore are identified as contaminants of concern to be evaluated further for potential health effects. PCBs, which can also be known by the tradename Aroclor, are mixtures of individual chlorinated compounds (known as congeners). Aroclors are named by their average chlorine concentration; for example, the name Aroclor 1254 means that the mixture contains approximately 54% chlorine by weight, as indicated by the second two digits in the name.

Table 1. Summary of Indoor Air Contaminants - Colonia High School

Contaminant	Number of Samples	Number of Detections	Minimum (ng/m^3)	Maximum (ng/m^3)	Comparison Value (ng/m^3) **	Contaminant of Concern
Total PCBs *	20	6	44	244	10 (CREG)	**Yes**
Chlordane	20	19	95	680	10 (CREG)	**Yes**
Heptachlor	20	12	11	23	0.77 (CREG)	**Yes**

*Total PCBs represents the combined Aroclor 1248 and 1254 which were the only PCBs detected in the indoor air of the school; **represents the most conservative comparison value.
ng/m^3 = nanogram of contaminant per cubic meter of air; CREG = ATSDR Cancer Risk Evaluation Guide

In-depth analysis

The NJDOH evaluated the indoor air data to determine whether the detected concentrations of PCBs, chlordane and heptachlor pose a health concern. In order for any contaminant to be a health concern, the contaminant must be present at a high enough concentration to cause potential harm and an exposure pathway must be present.

An exposure pathway is a series of steps starting with the release of a contaminant in environmental media and ending at the interface with the human body. A completed exposure pathway consists of five elements:

1. Source of contamination (historic pesticide application, building materials)

2. Environmental media and transport mechanisms (indoor air)
3. Point of exposure (school)
4. Route of exposure (inhalation)
5. Exposed population (students and staff)

There is a completed exposure pathway for students and staff breathing contaminated indoor air at Colonia High School as all five elements are present.

Exposure and Health Effects Other than Cancer

Since it was determined that there is a completed exposure pathway, the next step is the calculation of site-specific exposure doses. These calculated doses are then compared to health guidelines, which are based on data drawn from the epidemiologic and toxicologic literature and often include uncertainty or safety factors to ensure that they are amply protective of human health. When the calculated doses are below health guidelines, then health effects other than cancer are not likely.

For PCBs, the health guideline values are derived from the USEPA's PCB Exposure Estimation Tool, also known as PEET (USEPA 2020).

For indoor air exposures to chlordane and heptachlor, indoor air concentrations are compared to health guidelines known as a Minimal Risk Levels (MRLs). Chronic (exposure for more than 365 days) MRLs are based on toxicological studies in animals and on reports of human occupational (workplace) exposures. MRLs are usually extrapolated doses from observed effect levels in animal toxicological studies or occupational studies. They are adjusted by a series of uncertainty factors or through the use of statistical models. In toxicological literature, observations are typically reported as:

- **No-observed-adverse-effect level (NOAEL)** - A NOAEL is the ***highest*** tested dose of a substance that has been reported to have ***no*** harmful health effects on people or animals.
- **Lowest-observed-adverse-effect level (LOAEL)** - A LOAEL is the ***lowest*** tested dose of a substance that has been reported to ***cause*** harmful health effects in people or animals.

To provide perspective on the potential for health effects, a calculated exposure dose or air concentration is compared to the MRL and the applicable NOAEL or LOAEL. ***As the exposure dose increases beyond the MRL and approaches the level of the NOAEL and/or LOAEL, the likelihood of adverse health effects increases.***

To evaluate the potential for health effects, the NJDOH used USEPA Guidance for Exposure Levels for Evaluating PCBs in Indoor School Air and the ATSDR's Public Health Assessment Site Tool (PHAST) for evaluating exposures to Chlordane and Heptachlor.

PCBs

The most commonly observed health effects in people exposed to large amounts of PCBs are skin conditions such as acne and rashes. Studies in exposed workers have shown changes in blood and urine that may indicate liver damage. PCB exposures in the general population are not likely to result in skin and liver effects (ATSDR Tox FAQs 2014). More information on PCBs can be found in the attached factsheet.

To evaluate PCB exposures in schools, the USEPA developed the PCB Exposure Estimation Tool (PEET), which calculates exposure levels intended to maintain overall PCB exposures below the oral reference dose (RfD) of 20 nanograms of PCBs per kilogram body weight per day (expressed as ng/kg-day). An RfD is an estimate of a daily exposure to the human population (i.e., sensitive subgroups) that is likely to be without an appreciable risk of harmful effects during a lifetime (EPA 2020).

Exposure in schools is assumed to occur through incidental ingestion of dust and soil, inhalation of indoor and outdoor air and dermal (skin) absorption due to contact with indoor dust. The PEET default model inputs for these parameters are based on average exposures in a non-contaminated environment. PEET combines estimates of background exposures and calculates the level of PCBs in school air that will keep the total noncancer dose below the RfD.

Background exposure in the non-school setting is assumed to occur via similar routes with the addition of ingestion exposure via the diet. Using the total background dose for each age group (the sum of the contribution from each source and route of exposure), the PEET model calculates the maximum concentration of PCBs in school indoor air that would not exceed the RfD as shown in **Table 2**.

Table 2. USEPA Exposure Levels for Evaluating PCBs in School Indoor Air (ng/m^3)

Preschool			Elementary School	Middle School	High School	Adult/ Staff
Age: 1 to < 2 years	Age: 2 to < 3 years	Age: 3 to < 6 years	Age: 6 to < 12 years	Age: 12 to < 15 years	Age: 15 to < 19 years	Age: 19 years and older
100	100	200	300	500	600	500

ng/m^3 = nanograms of PCBs per cubic meter of air

The USEPA guidance values for PCBs, which vary by age, are based on the RfD of 20 ng/kg-day (the level at which adverse health effects other than cancer would not be expected). The RfD is derived from the LOAEL of 5,000 ng/kg-day. This is the actual level where health effects (eyelid swelling, fingernail bed malformation and immunological suppression) were observed in past studies.

The USEPA's health protective exposure level for PCBs in school indoor air is 500 ng/m^3 for staff and 600 ng/m^3 for high school students. The maximum level of PCBs detected in the indoor air of Colonia High School was 244 ng/m^3, which is below these USEPA guidance levels for high school students and staff. **Therefore, the NJDOH does not expect harmful noncancer health effects from exposure to PCBs detected in the school indoor air.**

Additionally, as noted in Table 2, the health protective indoor air concentration value for a high school scenario is 500 ng/m^3, based on the dose of 20 ng/kg-day. The indoor air concentration which corresponds with the actual level at which harmful health effects other than cancer would be observed based on toxicological studies in this population is 135,000 ng/m^3.

Chlordane

Chlordane affects mainly the nervous system and liver in people and animals. Headaches, irritability, confusion, dizziness, and tremors have occurred in people who breathed air containing high concentrations of chlordane or accidentally swallowed small amounts of chlordane. Chlordane was historically used in the United States as a pesticide on agricultural crops, lawns, building grounds, and homes. EPA banned all uses of chlordane in 1988 because of concerns about damage to the environment and harm to human health (ATSDR ToxFAQs 2018).

The chronic MRL for chlordane is 20 ng/m^3. The indoor air sample result with the highest concentration of chlordane (680 ng/m^3) exceeds this MRL. Therefore, the NJDOH reviewed the toxicological literature to review the level at which health effects were observed in toxicological studies. Liver damage and changes in blood cells were observed in an animal study at 1,000,000 ng/m^3. The maximum concentration of 680 ng/m^3 detected in the indoor air of Colonia High School is approximately 1,500 times lower than the LOAEL of 1,000,000 ng/m^3. **Therefore, the NJDOH does not expect harmful noncancer effects from exposure to chlordane in the school indoor air.**

Heptachlor

There is no reliable information on health effects in humans. Liver damage, excitability, and decreases in fertility have been observed in animals ingesting heptachlor. Heptachlor was used extensively in the past for killing insects in homes, buildings, and on food crops. These uses stopped in 1988 with the exception of use for fire ant control in underground power transformers (ATSDR Tox FAQs 2005).

There are no MRLs or other noncancer health guideline values available for heptachlor. Therefore, the NJDOH could not evaluate the potential for health effects other than cancer. This is because available toxicological literature does not identify any studies in humans or animals pertaining to inhalation exposures to heptachlor.

Exposure and Cancer Health Effects

NJDOH evaluates the potential for cancer health effects by assessing the excess cancer risk relating to exposure over the background cancer risk. In New Jersey, approximately 45% of women and 47% of men (about 46% overall) will be diagnosed with cancer in their lifetime (NJSCR 2023). This is referred to as the “background cancer risk.” The term “excess cancer risk” represents the risk on top of the background cancer risk and is referred to as the Lifetime Excess Cancer Risk, or LECR. An LECR of “one-in-a-million” (1/1,000,000 or 10^{-6} cancer risk) means that if 1,000,000 people are exposed to a cancer-causing substance at a certain level for a

period of time, then one cancer above the background number of cancers may develop in those one million people over the course of their lifetime (considered to be 78 years).

To put the LECR of 10^{-6} in context of New Jersey's background cancer risk, the number of cancers expected in one million people over their lifetime is 470,000 (47%) in New Jersey. If these one million people are all exposed to a cancer-causing substance for a specific duration, then 470,001 people may develop cancer instead of the expected 470,000 over the course of their lifetime (78 years).

The NJDOH follows ATSDR's guidelines to evaluate theoretical cancer risks from environmental exposures (ATSDR 2022b). A **concern for an increased risk** is categorized as an excess of one or more additional cancer cases per 10,000 people (expressed as risk in "the 10^{-4} range" or higher). This is a theoretical estimate of cancer risk that NJDOH and ATSDR use as a tool for deciding whether public health actions are needed to protect health. It is not an actual estimate of cancer cases in a community and is not a prediction that cancer will occur. NJDOH and ATSDR categorize **no concern for an increased risk** to include risks in the range between one and nine additional cancer cases per 100,000 people (expressed as "the 10^{-5} range") and *an even lower* risk is represented by the range between one and nine additional cancer cases per 1,000,000 people (expressed as "the 10^{-6} range"). Health guidelines are typically developed for carcinogens based on one excess cancer case per 1,000,000 individuals exposed. According to the U.S. Department of Health and Human Services (DHHS), possible cancer classes of contaminants detected at a site are as follows:

- Known human carcinogen
- Reasonably anticipated to be a carcinogen
- Not classified

PCBs

The DHHS has concluded that PCBs may reasonably be anticipated to be carcinogens. PCBs have been classified as probably carcinogenic, and carcinogenic to humans by the USEPA and International Agency for Research on Cancer (IARC), respectively. Some epidemiological studies of workers exposed to PCBs suggest that occupational exposures to PCBs were associated with cancer at several sites, particularly the liver, biliary tract, intestines, and skin (melanoma). In animal studies, rats that ate food containing high levels of PCBs for two years developed liver cancer. [ATSDR 2000].

Chlordane

The DHHS has not determined whether chlordane causes cancer in people. The USEPA has classified chlordane as a probable human carcinogen. The IARC has classified chlordane as a possible human carcinogen. Some studies on workers who made or used chlordane show that exposure is not related to cancer, while others show that there may be a link. There is not enough information to know for sure. Studies in animals show mice that ate low levels of chlordane developed liver cancer.

Heptachlor
Lifetime exposure to heptachlor resulted in liver tumors in animals. The IARC and the USEPA have classified heptachlor as a possible human carcinogen.

Cancer Risks for PCBs, Chlordane and Heptachlor

The NJDOH assumed a conservative exposure scenario for students and staff of Colonia High School of 9 hours/day for 5 days/week and 47 weeks per year. This is known as the "Exposure Factor" and is calculated as follows:

$$\text{Exposure Factor} = \frac{9 \text{ hours}}{24 \text{ hours per day}} \times \frac{5 \text{ days}}{7 \text{ days per week}} \times \frac{47 \text{ weeks}}{52 \text{ weeks per year}} = 0.24$$

The exposure factor for the school scenario is 0.24. This factor is multiplied by the maximum concentration of PCBs, chlordane and heptachlor to get the adjusted air concentration. The LECR is calculated by multiplying the adjusted air concentration for the school scenario by the exposure duration and the EPA inhalation unit risk (IUR) for cancer. The IUR is the incremental risk posed by a specific concentration unit in air (usually per 1 microgram per cubic meter ($\mu g/m^3$) of the pollutant in air).

The formula used to calculate the LECRs for PCBs, chlordane and heptachlor is as follows:

LECR = Adjusted Air Concentration (ng/m^3) x ED/AT x IUR (ng/m^3) $^{-1}$

Where:

Adjusted Air Concentration = Exposure factor multiplied by maximum air concentration (ng/m^3)
ED = Exposure Duration in years (4 years for students, 20 years for staff)
AT = Averaging Time (78-year lifetime)

Table 3 summarizes the calculated adjusted air concentrations and LECRs for students and staff of Colonia High School.

Table 3. LECR Calculations – PCBs and Pesticides in Indoor Air at Colonia High School

Contaminant	Maximum Concentration (ng/m^3)	Exposure Factor	Adjusted air concentration (ng/m^3)	Exposure Duration over 78-year Lifetime		IUR (ng/m^3) $^{-1}$	LECR	
				Students	Staff		Students	Staff
Total PCBs	244	0.24	60	4	20	0.0000001	3.1×10^{-7}	1.6×10^{-6}
Chlordane	680	0.24	170	4	20	0.0000001	8.7×10^{-7}	4.4×10^{-6}
Heptachlor	23	0.24	5.7	4	20	0.0000013	3.8×10^{-7}	1.9×10^{-6}
Total LECR	----------	---------	----------	-------	------	-------	**1.6×10^{-6}**	**7.9×10^{-6}**

These parameters are taken from ATSDR's PHAST tool for the school scenario; Example LECR calculation for students exposed to PCBs: 60 ng/m^3 x 4 years/78 years x 0.0000001 = 3.1×10^{-7}

As shown in **Table 3** the combined LECR for students is approximately two in one million similarly exposed people. The combined LECR for staff is approximately eight in one million similarly exposed people. **These LECRs indicate no concern for an increased theoretical cancer risk as they are in the 10^{-6} range.**

Conclusion

Based on the indoor air data provided to the NJDOH, harmful health effects are not likely for students and staff at Colonia High School from indoor air exposures to PCBs and pesticides. PCB levels were below the USEPA's health-based guidelines for PCBs in schools. Chlordane concentrations were below levels where no harmful health effects were observed in toxicological studies. Finally, there is no concern for increased theoretical cancer risks from exposures to PCBs and pesticides in the school.

The NJDOH will continue to review additional data if requested. Please feel free to contact me at 609-826-4984 or by email at Christa.Fontecchio@doh.nj.gov with any questions or concerns.

Sincerely,

Christa Fontecchio

Christa Fontecchio, M.P.H.
Environmental and Occupational Health Surveillance Program
New Jersey Department of Health

c: Leah Graziano, R.S. Regional Director, ATSDR Region 2

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