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HETA 2026-0018

Dr. Karen Nell
Superintendent
Elizabethtown Area School District
600 E. High Street
Elizabethtown, PA 17022

Dear Dr. Nell:

This letter is in response to a union request, received on November 11, 2025, for the National Institute for Occupational Safety and Health (NIOSH) to conduct a health hazard evaluation of the Elizabethtown Area High School/Middle School Complex located at 600 E. High Street in Elizabethtown, PA. The request expressed concerns about peeling paint, mold, sewer backups, and odd odors including natural gas-like and sewer methane type smells throughout the building. Health concerns included respiratory infections, chronic sinus issues, asthma exacerbations, migraines, nausea, skin rashes, and eye irritations.

Background

On December 2, 2025, I spoke with the union representative to collect information regarding reported concerns pertaining to the building conditions, mold exposure, and potential health effects. During the call, we discussed the reoccurring sewage backups, mold, and odors of natural and methane gas.

The current structure was built in 1955 and houses the high school and middle school. Sixth through twelfth grade students attend the school. Additions to the school were completed in 1962, 1973, and 1996. The building is 433,150 square feet with 254,075 square feet dedicated to educational areas. The school has some carpeted areas throughout the building.

Approximately 5 to 6 years ago, the air conditioning was turned off during the summer months. When staff returned for the next school year, they discovered mold growing on cork boards and carpeting. The moldy carpeting and cork boards were removed.

In the high school lobby, the roof leaks when it rains, requiring buckets to be used to catch the water. Water stains and mold have been identified on drop ceiling tiles in multiple rooms. While damaged ceiling tiles are replaced, it can sometimes take a considerable amount of time. On one occasion, spray paint was reportedly used to cover water stains and mold on a ceiling tile.

Teachers reported having moldy books and mold spots on classroom walls. When returning for this school year, the union representative noted that the art room closet was covered in mold. The air conditioning did not seem to be set to an adequate temperature during the summer months. At the start of the school year in August 2025, the classrooms were equipped with dehumidifiers; they were removed in October 2025.

The union representative discussed the reoccurring sewage backups, noting that on one occasion the sewage backup flowed across the cafeteria floor in the high school. The main sewage line runs through the Social Studies wing. If a pipe breaks, students and staff are relocated to other areas at the school.

On December 10, 2025, I spoke with you about reported exposures and health concerns. The School Board was aware of these issues and has been trying to address concerns as they arise. Architects visited the building on multiple occasions and have deemed the building safe to occupy but beyond repair. The School Board is in the process of deciding next steps, such as maintenance and repairs, additions and renovations, constructing a new middle school/high school near the stadium or at the fairgrounds.

Several meetings have occurred to discuss the school complex project. During a financial planning meeting on February 3, 2026, board members received an overview of key financial considerations and long-term planning strategies. A building project type was not selected at that time. Throughout February and March, the school board planned to further discuss financial options such as choosing a tax rate for the district to cover the district's operational expenses and renovation or rebuilding. The Board planned to establish the tax rate by the end of March and select the building project type by the end of April. Recordings of past school board meetings are available on the [Elizabethtown Area School District's YouTube channel](#).

The School Board developed a [Secondary School Complex Building Project](#) webpage which serves as a central resource for information regarding the district's ongoing efforts to address facility needs and building options. In November 2025, the district launched a [Building Concerns Information Hub](#) to promote transparency and clarity on the challenges and next steps related to addressing building concerns.

We discussed the sewage issues, and you stated that when a backup occurs, the affected part of the building is closed while clean-up efforts are underway. Last year, you noted sewage overflowed into a classroom, and students were immediately relocated. The classroom was not reoccupied until it had been cleaned, sanitized, and damaged materials removed. You noted that more recently, the male and female restrooms near the cafeteria overflowed, and the overflow was cleaned up immediately.

The sewage system was built to accommodate the number of students and employees present in 1955, and it is not equipped to handle the current population. You noted that the pipes are cracking, corroding, and rusting. Clogs are often caused by students flushing feminine products and other inappropriate items. Corrosion is a major issue, as the pipes are made of carbon steel, which creates shards on the inside of the pipe that can snag items flowing through, causing clogs and backups. Custodial staff attempt to fix clogs using a snake, if they are unable to clear the clog, professionals are called in to flush the system and clear the blockage. Environmentally friendly cleaning products are used to clean up overflowing sewage.

Regarding natural gas odors, the school is located in a rural area, the odors are believed to be caused by the manure outside or possibly from the school's sewage system.

Air testing (spot checks) is performed quarterly in the building to check for mold. Classrooms are cleaned if mold is suspected. Indoor air quality inspections are conducted frequently, and any findings are addressed immediately. Multiple air quality tests were conducted in 2025, with the testing results available on the Buildings Concerns Information Hub. The most recent air testing occurred on December 19, 2025, in room 1930 at the high school. Indoor spore counts (133 spores per cubic meter of air (spores/m³)) were lower than outdoor spore counts (653 spores/m³). On November 20, 2025, a more comprehensive air quality test was performed at the middle school (in rooms IMC, M2335, M2745, M1745, M0115) and high school (in the tunnel, tunnel upper, H1605, H2705, H2615). The middle school results showed high carbon dioxide (CO₂) levels in rooms M2745 (1230 parts per million [ppm]) and M0115 (1468 ppm). The high school's upper tunnel revealed high indoor counts of 853 spore/m³ for *Penicillium/Aspergillus* compared to the outside sample of 267 spores/m³. Additional air quality reports from August and October 2025 are available on the Buildings Concerns Information Hub.

The temperature in the building was described as irregular, often either too hot or too cold. There are approximately 200 heating, ventilation, and air conditioning (HVAC) units across the building, each of varying ages. Breakdowns of the units occur frequently, and the controller is outdated with parts no longer available. The School Board has tried to mitigate these issues by using humidifiers and dehumidifiers. The HVAC systems are maintained daily, but the electronic monitoring system's software is outdated, no longer supporting the system. Currently, the only way to identify a problem is through staff reports. Filters and vents are cleaned regularly, and if maintenance staff cannot resolve an issue, contractors are called in for assistance. The HVAC system located above the main entrance and lobby area is scheduled for replacement.

Lastly, we discussed the reported health concerns. You have received complaints about allergies, headaches, wheezing, and difficulty breathing. The Human Resources Department follows standard procedures and instructs staff members to seek medical evaluation. All concerns are taken seriously, and attempts are made to relocate staff members experiencing symptoms.

Discussion

Below, I provide information about indoor environmental quality that may be helpful for the current school building and during future renovations or construction.

Dampness in Buildings

Research has found that damp building conditions can lead to respiratory illnesses in occupants. Dampness in buildings can occur for a variety of reasons such as high indoor humidity, condensation, or roof leaks. Damp building conditions promote the growth of mold, bacteria, other microbial agents, dust mites, and cockroaches. Dampness can also contribute to the breakdown of building materials and furniture. Musty odors are a sign of microbial contamination. Building occupants in damp buildings can be exposed to pollutants in the air from biological contaminants and the breakdown of building materials.

Building-related Symptoms and Illnesses

Comprehensive reviews have been conducted of previous scientific studies evaluating the development of health effects associated with exposures from damp indoor conditions. The findings include sufficient epidemiological evidence of associations with upper and lower

respiratory symptoms, asthma development and exacerbation, respiratory infections, allergic rhinitis, bronchitis, and eczema as well as clinical evidence of association with hypersensitivity pneumonitis [Mendell et al. 2011; WHO 2009]. There was limited or suggestive evidence of association with allergy/atopy [Mendell et al. 2011]. NIOSH has published an Alert, [Preventing Occupational Respiratory Disease from Exposures Caused by Dampness in Office Buildings, Schools, and Other Nonindustrial Buildings](#). The Alert provides information on respiratory disease related to indoor dampness and recommendations for preventing and remediating damp buildings [NIOSH 2012].

Air Sampling

NIOSH does not typically recommend air sampling for mold with building air quality evaluations. There are no U.S. health-based exposure limits for biological contamination set by the Occupational Safety and Health Administration (OSHA) or recommended by NIOSH. Measurements of mold in air are highly variable and dependent on the mold species' lifecycle stages (e.g., spore formation) [NIOSH 2012]. In many cases, short-term sampling for mold spores is conducted; however, the results of the short-term sampling might not be representative of actual exposures. Furthermore, spore counts and culture results, which tend to be what are included in indoor air quality reports, do not capture the full range of exposures.

Although interpreting airborne fungal counts for exposure—whether spores or colony-forming units—can be challenging, particularly when results are negative or low despite water-damaged conditions, air sampling can sometimes provide valuable insights. For example, if indoor fungal species differ significantly from those found outdoors on the same day, this may indicate an indoor source of fungal growth. In this case, the consultant's sampling identified certain fungal species that were either more abundant indoors than outdoors or absent from the outdoor sample altogether. This suggests the presence of indoor mold sources, further supported by visual inspection and the detection of musty odors—an indicator of active mold growth.

What building occupants react to is largely unknown. It can be mold, biochemical compounds produced by mold, something related to bacteria, or compounds that are released into the air when wet building materials break down. We have found that thorough visual inspections or detection of problem areas by musty odors are more reliable. These methods have been used in past NIOSH research and have shown a correlation with health risks in buildings that have indoor environmental complaints [Cox-Ganser et al. 2009; Park et al. 2004].

Routine Visual Inspections

Implementing periodic room inspections for dampness can help to identify trouble areas before they become major problems. For example, conducting observational inspections in buildings quarterly or two times per year (spring and fall) provides documentation of dry versus damp areas and helps to prioritize maintenance and repair. As a resource for monitoring dampness in buildings, NIOSH has developed a [Dampness and Mold Assessment Tool](#). The tool provides an inexpensive mechanism to track, record, and compare conditions over time [Park and Cox-Ganser 2022]. The assessment form and associated instructions for general buildings and schools can also be downloaded from the [NIOSH website](#) [NIOSH 2018a,b]. Using moisture meters and infrared cameras can also sometimes identify sources of dampness.

Remediation

Wetted materials need to be dried within 48 hours of getting wet to prevent mold growth, and necessary repairs need to be made to prevent further water entry into the building. If mold is identified on materials, appropriate remediation guidelines with proper containment are recommended to minimize exposure to building occupants. Inappropriate remediation (e.g., painting over water-damaged materials or moldy surfaces) can cause further problems with building degradation and symptoms in occupants.

NIOSH has evaluated numerous buildings and found that, if building dampness is addressed promptly, these problems can generally be corrected using standard remediation practices (with appropriate containment to minimize exposure of building occupants). The EPA has a [guide](#) on mold remediation in commercial buildings [EPA 2026a] and [guidance](#) on moisture control for building design, construction and maintenance [EPA 2013]. NIOSH has a [Workplace Solutions document](#) on maintaining acceptable indoor environmental quality during construction and renovation projects [NIOSH 2020]. For additional information, you may wish to visit the [NIOSH](#), [EPA](#), or [OSHA](#) websites.

After Remediation

After repairs and remediation are completed, employees and management often wish to know if the building is “safe.” Building consultants often recommend and perform “clearance” air sampling after remediation work has been completed in an attempt to demonstrate that the building is safe for occupants. However, there is no scientific basis for the use of air sampling for this purpose. Once remediation is completed (moldy and damaged materials removed; musty odors no longer evident), the best evidence that the building is safe may be that employees no longer experience building-related symptoms. In large populations of workers, using employee health questionnaires may be helpful to collect information on building-related symptoms, particularly among persons new to the building after remediation (i.e., those without “sensitizing” historical exposures during a period of water damage). Unfortunately, even if most employees experience improvement in their symptoms, and new employees remain free of building-related symptoms, some employees with allergic conditions may not notice an improvement because their immune systems may continue to react to very small amounts of allergens. Such individuals may have to avoid the building even after an otherwise successful remediation. An individualized management plan (such as assigning an affected employee to a different work location, perhaps at home or a remote site) is sometimes required, depending upon medical findings and recommendations of the individual’s healthcare provider.

Building Ventilation and Indoor Environmental Quality

Poor ventilation is common and frequently caused by lack of attention to the heating, ventilation, and air-conditioning (HVAC) system in a building. HVAC systems include equipment used to:

- Ventilate, heat, and cool
- Move air around (ductwork)
- Filter and clean the air

These systems have a significant impact on how pollutants are distributed in and removed from spaces. They can also be sources of pollutants such as microbial growth from stagnant water in drain pans or uncontrolled moisture inside air ducts.

Ventilation System Design

The amount of air an HVAC system needs to deliver depends on how many people will be in a space and how big that space is. It is important to make sure that fresh air is evenly spread throughout all areas where people spend time. If rooms are used for different purposes than they were originally designed for, the HVAC system(s) might need to be changed to meet the new needs. For example, if a storage room is turned into an area where people will be, the HVAC system may need to be adjusted to provide enough comfortable air for everyone.

Outdoor Air Supply

Adequate outdoor air in indoor spaces is important to dilute pollutants from equipment, building materials, furnishings, products, and people. *ANSI/ASHRAE Standard 62.1-2025: Ventilation for Acceptable Indoor Air Quality* provides guidelines for minimum outdoor air ventilation rates needed for acceptable indoor environmental quality [ANSI/ASHRAE 2025a].

For office spaces, conference rooms, and reception areas, the standard advises providing 5 cubic feet per minute of outdoor air per person (cfm/person) plus an extra 0.06 cfm for every square foot (cfm/ft²) of occupied space to account for pollutants from the building itself. Information for other types of spaces is provided in Table 1 below. To find rates for other indoor spaces, refer to Table 6-1 in the ANSI/ASHRAE 62.1-2025 [ANSI/ASHRAE 2025a] listed on the [Preview ASHRAE Standards and Guidelines](#) webpage. ASHRAE standards are generally incorporated into legally enforceable building codes, including the International Mechanical Code which is adopted by many states, cities, and municipalities as part of their building codes. However, there are occasions when ASHRAE guidance may differ from state or local mechanical codes. Therefore, care should be taken to meet the ventilation requirements most appropriate for your locality and building type. A qualified ventilation system expert can help meet ASHRAE ventilation guidelines in the building.

Table 1. ANSI/ASHRAE Standard 62.1-2025 Minimum Ventilation Rates in Breathing Zone			
Occupant Category	People Outdoor Air Rate cfm/person	Area Outdoor Air Rate cfm/ft ²	Maximum CO ₂ Above Ambient†‡ ppm
General			
Break rooms	5	0.06	1500
Coffee stations	5	0.06	1200
Conference room/meeting	5	0.06	1500
Corridors	—	0.06	NA
Occupied storage rooms for liquids or gels	5	0.12	NA
Office Buildings			
Main entry lobbies	5	0.06	1200
Occupiable storage rooms for dry materials	5	0.06	700
Office space	5	0.06	600
Reception areas	5	0.06	2100
Telephone/data entry	5	0.06	1800
Food and Beverage Service			
Cafeteria/fast-food dining	7.5	0.18	900

Kitchen (cooking)	7.5	0.12	NA
Educational Facilities			
Art classroom	10	0.18	NA
Assembly without fixed seats— concentrated (chairs only—fixed)	7.5	0.06	1200
Classrooms (ages 5 to 8)	10	0.12	600
Classrooms (age 9 plus)	10	0.12	600
Corridors (age 5 plus)	—	0.12	NA
Daycare sickroom	10	0.18	NA
Daycare (through age 4)	10	0.18	NA
Information technology equipment facilities (occupiable)	10	0.12	600
Lecture hall (fixed seats)	7.5	0.06	1200
Libraries	5	0.12	600
Media center	10	0.12	600
Multiuse assembly (tables and chairs)	7.5	0.06	1200
Music/theater/dance	10	0.06	2100
Science laboratories	10	0.18	NA
University/college laboratories	10	0.18	NA
Wood/metal shop	10	0.18	NA

Notes:

- cfm/person: cubic feet per minute of outdoor air per person in the occupied space
- cfm/ft²: cubic feet per minute of outdoor air per square foot of occupied floor space
- CO₂: carbon dioxide
- ppm: parts per million
- NA: not applicable

†It is important to be careful when interpreting indoor CO₂ measurements. If a space is not occupied with the usual number of people when taking a measurement, the results might not accurately reflect how well the ventilation system is working.

‡ This is an example of how to use the CO₂ information in the table. In an office space, if the CO₂ concentration is 600 ppm above ambient CO₂ (outdoor CO₂ level) then this may indicate insufficient ventilation. For instance, if the ambient or outdoor CO₂ concentration is measured at 400 ppm then CO₂ measurements in office spaces above 1000 ppm (400 outdoor CO₂ measurement + 600 indoor CO₂ level from row labeled 'office space' in table) may indicate insufficient ventilation.

See ANSI/ASHRAE 62.1-2025 for more detailed information, including Table 6-1, which can be found at the [Preview ASHRAE Standards and Guidelines webpage](#).

Carbon dioxide (CO₂) is a normal part of the air we breathe out, so when more people are in a building, CO₂ levels will go up. These levels are routinely measured in air quality studies because they indicate whether enough fresh outdoor air is being brought into a space to control odors and pollutants.

It is important to be careful when interpreting indoor CO₂ measurements. If a space is not occupied with the usual number of people when taking a measurement, the results might not accurately reflect how well the ventilation system is working. Similarly, open doors and windows that are not usually open will also impact CO₂ levels.

If multiple rooms share the same HVAC system, CO₂ concentrations in one space can impact what is happening in other spaces. High CO₂ levels can also suggest other indoor contaminants may be higher. With that understanding, if CO₂ levels are higher or if they rise significantly during the day, it may be necessary to increase the amount of outdoor air being brought into the space.

CO₂ measurements can be made using a calibrated, continuous fixed monitor or spot checks can be taken using a calibrated portable meter. Fixed CO₂ monitoring systems are typically expensive, require extensive knowledge to install, and require sophisticated control programs to interact with HVAC systems. They were generally not made to provide appropriate ventilation for people in a building. Instead, they were designed to maximize energy efficiency by reducing outdoor air, when possible. Fixed-position CO₂ monitors measure the level of CO₂ in a space to estimate how many people are in an area. As the CO₂ level increases, the HVAC system increases the outdoor air ventilation to dilute CO₂ (and vice versa). This is known as demand-controlled ventilation (DCV).

The number of CO₂ sensors, where they are placed, and how they are calibrated and maintained are important and should not be overlooked. For example, a wall-mounted monitor might not always show true levels of CO₂ in a room. If air from the room, the HVAC system, or open windows flow directly over the monitor, it can make readings seem lower than they really are.

If air in a room mixes well, the CO₂ levels measured should be close to the actual levels. However, many rooms do not mix air well, especially in older buildings with outdated ventilation systems or no systems at all. Additionally, if one room gets more outdoor air due to high CO₂ levels, that air might be taken from other rooms connected to the same HVAC system. This can lead to higher CO₂ levels in those other rooms which the HVAC system may not be able to manage effectively.

A simpler and more cost-effective way to monitor levels is to use portable CO₂ monitors with HVAC systems that do not adjust ventilation based on CO₂ levels. Some good, portable CO₂ meters cost less than \$300, and measurements can be taken near breathing zones of occupied areas in each room. It is important to choose reliable and accurate meters to get useful information from readings.

Under this approach, check that the HVAC system is working properly and meets the minimum outdoor air requirements based on the space being used currently and how many people are in it. Then, use a handheld portable CO₂ meter to measure CO₂ levels in rooms as they are being used. These measurements will give a baseline of CO₂ levels for each room based on how the HVAC system is running and the number of people present.

To ensure good ventilation, a common goal is to keep CO₂ levels below 800 parts per million (ppm) [Seppänen et al. 1999]. The Centers for Disease Control and Prevention (CDC) recommends this level to help protect people in buildings from respiratory viruses [NIOSH 2024, [See FAQ #3](#)]. For regular building use (not during a pandemic), Addendum ab to ANSI/ASHRAE Standard 62.1-2025 suggest maximum CO₂ concentrations or levels for different spaces (see Table 1) [ANSI/ASHRAE 2023a]. These guidelines are based on complex models and might not fit every type of space or situation [ANSI/ASHRAE 2025b]. Once a target CO₂ level is identified, current measurements can be checked against this target. If these measurements are higher than the target, consider the conditions when the measurement was taken. If necessary, investigate ways to bring in more outdoor air. If CO₂ levels cannot be lowered to the target, bigger changes to the ventilation system might be needed.

After establishing baseline CO₂ levels, regular measurements should be taken in each area and then compare them to the initial readings. If the airflow and the number of people in the space

remain the same, future CO₂ measurements above 110% of baseline level, indicate a potential problem needing further investigation.

In some cases, building owners/managers or occupants will open doors or windows to increase outdoor air into their building. However, relying on open doors and windows can cause problems. For example, air coming into a building through doors and windows may not reach everyone in the building. Outdoor air is unfiltered and may contain pollutants like pollen and dust. Open doors and windows can also affect the HVAC system's ability to control temperatures and humidity.

Exhaust Rates

ANSI/ASHRAE 62.1-2025 offers exhaust rates for spaces where airborne contaminants and odors are. Exhaust rates of at least 0.5 cfm/ft² directly outdoors is recommended for copy and printing rooms. Makeup air can consist of any combination of outdoor air, recirculated air, or air transferred from adjacent spaces.

When regular ventilation does not lower the amount of harmful emissions from office equipment to safe levels, it is important to think about using local exhaust ventilation. This type of system helps remove pollutants right at the source before they can spread throughout the room. However, little scientific research has been done to develop or test the performance of local exhaust systems for common office equipment.

Restrooms

Restrooms should exhaust or remove more air than is supplied to the space to control humidity and odors. This helps keep these areas under negative pressure, which means air flows in from outside the restroom. It is important to use separate exhaust fans to push air directly outside at least 10 feet from any air intakes, operable windows, or other building openings.

The International Mechanical Code, which is adopted by many states, cities, and municipalities as part of their building codes, states that if the exhaust fans are run continuously, 50 cubic feet of air per minute (cfm) per toilet or urinal should be exhausted. If fans are only run when turned on by a switch (like when the lights are on), they should remove 70 cfm for each toilet or urinal [ICC 2024]. The ANSI/ASHRAE Standard 62.1-2025 gives the same minimum exhaust airflow rates for public restrooms: 50 cfm per water closet or urinal for continuous operation and 70 cfm per water closet or urinal for intermittent operation.

For private restrooms meant for one person at time, both codes say if the exhaust fan only runs when someone is using the restroom, the exhaust ventilation should be 50 cfm. If the fan runs all the time, both the International Mechanical Code and ASHRAE Standard 62.1-2025 recommend 25 cfm of exhaust air [ANSI/ASHRAE 2025a; ICC 2024]. Overall, air from restrooms and shower rooms should not be recycled or brought back into the space but exhausted directly outdoors.

Basements

Basements in commercial buildings often have poor air quality if they are not properly ventilated. Typical ASHRAE Standard 62.1-2025 ventilation requirements for occupied spaces applies to those spaces in basements. Because they are located below ground, basements are prone to moisture buildup, musty odors, and mold growth. These problems can come from water leaks, damp soil, or condensation on cool surfaces. Some basements are used for storage,

mechanical equipment, or even offices, gyms, or meeting rooms. However, they commonly do not get enough fresh, outdoor air. Without good airflow, carbon dioxide, dust, or even radon gas can build up, especially if the space is sealed off or not frequently occupied. If fuel-burning appliances like boilers or water heaters are installed in the basement, poor ventilation can lead to carbon monoxide (CO) buildup or back drafting, where dangerous gases are pulled back into the room instead of going up the vent. Even unoccupied basements can cause problems if the stale, damp air rises into the floors above, spreading odors or contaminants throughout the building.

To help deal with moisture issues typical of many basements, consider installing continuous or intermittent exhaust ventilation, using dehumidifiers to keep humidity below 60%, and including vapor barriers to reduce moisture infiltration. If combustion appliances are present, dedicated combustion air intakes and CO detectors are essential for safety. The use of dedicated outdoor air systems (DOAS), small-ducted HVAC systems to deliver fresh air to tight or compartmentalized spaces, can also be very helpful. For basements located in areas with high radon levels, it is encouraged to include soil gas mitigation systems, such as sub-slab depressurization. Together, these strategies help turn damp, stagnant basement spaces into safe and usable parts of a building.

Crawl Spaces

Crawl spaces are shallow areas between the ground and the first floor of a building, and they often cause problems if not properly ventilated or sealed. Because they are close to the soil and usually dark and cool, crawl spaces tend to collect moisture, especially if there is no vapor barrier or if the area is vented to the outside in humid climates. That moisture can lead to mold, wood rot, and musty smells, which may spread into the building above. Crawl spaces can also pull in soil gases like radon or methane, which can be hazardous to health. In winter, crawl spaces that are not insulated or sealed can lead to cold floors, frozen pipes, and higher heating costs. In summer, humid outdoor air can enter through vents and condense on cooler surfaces, making the moisture problem even worse. These issues are especially common in older buildings with traditional vented crawl spaces, which often fail to control humidity and air quality effectively.

ASHRAE and other building science groups now recommend unvented (sealed) and conditioned crawl spaces instead of traditional vented designs, especially in humid or cold climates. This includes tightly sealing the space and installing a continuous ground vapor barrier to prevent uncontrolled moisture in the space. If soil gases are a concern, especially radon, sub-membrane depressurization systems (similar to those used in radon mitigation) may be needed. Properly designed crawl spaces help protect the building structure, improve indoor air quality, and reduce energy use, which makes them a key part of the overall ventilation and building envelope strategy.

Outdoor Air Quality

Outdoor air pollutants like carbon monoxide, pollen, and dust can affect indoor conditions when outside air enters a building's ventilation system. Properly installed and maintained filters can effectively collect particles from outdoor supply air, but they provide no protection against outdoor gases and vapors, like CO.

Controlling harmful gases or chemical pollutants might require special filtration equipment or relocation of outdoor air intakes. Section 4 of ANSI/ASHRAE Standard 62.1 specifies that any outdoor air brought into occupied spaces must meet the EPA's [National Ambient Air Quality](#)

[Standards \(NAAQS\)](#) [EPA 2026b]. The standard also says that a local outdoor air quality check should be done around the building where people are likely to be to identify harmful pollutants. If any outdoor contaminants exceed the NAAQS limits, the outdoor air must be treated before it enters occupied spaces. This will generally require assistance from a trained HVAC professional.

Maintenance of HVAC Equipment

Diligent maintenance of HVAC equipment is essential for providing clean and comfortable air in buildings. Well-managed buildings have regular maintenance programs to keep their HVAC systems working properly.

HVAC Duct Cleaning

We do not recommend duct cleaning unless there is mold or other harmful particles affecting the employees' health. Cleaning ducts the wrong way can spread dust and other pollutants into work spaces. Fiberglass ductwork with mold growth cannot be cleaned and should be replaced. If metal ducts need cleaned, it should only be performed by contractors who are certified members of the National Air Duct Cleaners Association. The National Institutes of Health's [HVAC Duct Cleaning](#) fact sheet provides additional information on cleaning strategies [NIH 2015].

Temperature and Relative Humidity

Maintaining proper indoor temperature and humidity levels is crucial for comfort, health, building integrity, energy efficiency, and indoor air quality. Proper temperature and humidity levels contribute to occupant comfort. High humidity can make a space feel warmer than it actually is, leading to discomfort. High humidity levels can also promote the growth of mold, mildew, and dust mites, and lead to the proliferation of pollutants and allergens, which can lead to respiratory issues and allergies. Excessive humidity can lead to condensation on surfaces, which can promote mold growth and cause damage to building materials, including wood, drywall, and insulation. This can result in structural issues and increased maintenance costs. Conversely, low humidity can cause dryness in the skin, eyes, and respiratory tract, which can exacerbate respiratory problems, increase susceptibility to infections, and cause general discomfort. Low humidity can also lead to an increase in particulate matter in the air. Maintaining a balanced environment helps ensure occupants feel comfortable.

ANSI/ASHRAE Standard 55-2023: Thermal Environmental Conditions for Human Occupancy provides indoor environmental and personal factors that produce acceptable thermal conditions within a space. Assuming slow air movement (around 20 feet per minute) and 50% indoor relative humidity, the temperatures recommended by ASHRAE are around 64.5°F to 74°F in the winter, and from 69.5°F to 77°F in the summer [ANSI/ASHRAE 2023b]. Seasonal temperature ranges are mostly influenced by the clothes we wear.

The EPA recommends maintaining indoor relative humidity below 60%, ideally between 30% and 50%, to reduce mold growth [EPA 2025a,b]. Relative humidity is the percentage of the total amount of moisture (water vapor) that could be held in the air the current temperature. ASHRAE Standard 62.1 recommends maintaining indoor humidity at a level that keeps the indoor dew point temperature below 60°F in buildings that are mechanically cooled, whether occupied or not [ANSI/ASHRAE 2025a]. The only exceptions are for rooms like showers, swimming pool areas, enclosures, kitchens, spa rooms, and certain warehouses where high humidity is expected and will not cause harm. Other exemptions include situations where the

outdoor air is typically cool and dry, reducing the likelihood of indoor moisture problems; spaces constructed with materials and furnishings that can tolerate high humidity without supporting mold growth or sustaining damage; and short-term increases in indoor humidity for up to about 60 hours, provided that humidity levels remain within acceptable limits on average over a 30-day period. Standard 62.1 has no humidity limits for spaces not served by mechanical systems.

The dew point is the temperature at which air can no longer hold all of its water vapor, and some of the water vapor condenses into liquid water, generally on cooler surfaces like air-conditioning supply vents and ductwork and uninsulated cold water pipes. As the air temperature approaches the dew point, the relative humidity increases. The higher the dew point temperature, the muggier it feels. Many people find the air comfortable when the dew point temperature is below 60°F [Helmenstine 2024]. When the dew point temperature is above 60 °F, it feels more humid, and when the dew point is below 40°F, it feels noticeably dry [Helmenstine 2024]. Controlling the indoor dew point temperature, much like controlling the relative humidity, involves removing excess moisture from the air. This is often accomplished with HVAC systems when cooling coils are cold enough to condense moisture from the air. One common strategy is to cool the air and condense moisture so the dew point temperature of the air leaving the cooling coil is below 60%. Then, the air flows through a reheat coil to warm it back up slightly (which does not change the dew point) before supplying it to occupied spaces. This helps improve occupant comfort. In room dehumidifiers can also be used to remove moisture from the air in occupied spaces. Another method is to use a dedicated outdoor air system (DOAS), which brings in fresh outdoor air and dries it before it mixes with the air inside occupied spaces. The goal is to keep the mixed air dew point below 60%.

It is also important to stop moisture from getting into the building through leaks or cracks. Sealing the building well and using vapor barriers in walls and floors can help. In wet areas like bathrooms or kitchens, exhaust fans should be used to exhaust moist air outside. Humidity sensors can be used to monitor indoor moisture levels and tell the HVAC system when to turn on, even if the thermostat setpoint is already met. Finally, keeping the air moving with fans and making sure the HVAC system runs even during unoccupied times, especially in the summer, can help avoid humidity spikes. These steps, alone or in combination, work together to control dew point and protect both people and buildings.

Occupied and Non-occupied Settings

Some buildings with HVAC systems run the ventilation systems during the day when people are in buildings and then turn them off at night or when buildings are empty. While this can save energy, it is not a good idea for buildings with air conditioning. Turning the system off can lead to problems with moisture building up on indoor surfaces when humid air gets inside during those off times.

Advanced HVAC systems with programmable thermostats can reduce ventilation during unoccupied times, allowing indoor temperature and humidity to vary but preventing extreme fluctuations. This “set back” method saves energy and helps keep indoor air dew point at or below 60°F, which prevents microbial growth. Regardless of whether the system runs continuously or is set back, it’s essential to ensure fresh outdoor air flow and indoor temperature and humidity meet the standards in ANSI/ASHRAE 62.1-2025 and ANSI/ASHRAE 55-2023 any time the building is occupied [ANSI/ASHRAE 2025a; ANSI/ASHRAE 2023a].

Sewer Gas

Sewer gas is composed of many chemical components, including but not limited to hydrogen sulfide, nitrogen oxides, methane, ammonia, and sulfur dioxide [Namour 2022]. Hydrogen sulfide is a flammable, colorless gas that smells like rotten eggs. People can usually smell hydrogen sulfide at very low concentrations in the air [ATSDR 2024]. Hydrogen sulfide can enter buildings in a variety of ways including from sinks or floor drains (often because of dry or faulty traps), dried or leaky toilet wax seals, cracked or blocked pipes, or blocked plumbing gas vents. Repeated or prolonged exposure may cause headaches, eye irritation, fatigue, irritability, digestive disturbances, and weight loss [OSHA, 2005]. Exposure to high levels of hydrogen sulfide can cause loss of consciousness or possibly death [ATSDR 2024]. The OSHA website has a [table](#) of health symptoms/effects based on exposure concentrations of hydrogen sulfide [OSHA, no date(a)]. Air sampling can measure for sewer gas chemical components such as hydrogen sulfide and potentially detect sources of the sewage smell. This can be helpful to determine how to address sewer gas smells.

Additional information about hydrogen sulfide is provided in the links below.

- National Institute for Occupational Safety and Health (NIOSH)
[CDC - NIOSH Pocket Guide to Chemical Hazards - Hydrogen sulfide](#)
- Agency for Toxic Substance and Disease Registry (ATSDR)
[Hydrogen Sulfide | ToxFAQs™ | ATSDR](#)
- Occupational Safety and Health Administration (OSHA)
[Hydrogen Sulfide - Hazards | Occupational Safety and Health Administration](#)
[OSHA Fact Sheet – Hydrogen Sulfide \(H2S\)](#)

Lead-containing Paint

The health hazard evaluation noted concerns about peeling paint. Lead from paint, including lead-contaminated dust, is a common cause of lead poisoning [EPA 2025c]. In 1978, the federal government banned consumer uses of lead-containing paint. In buildings constructed before 1978, it is possible lead paint was used and might be under layers of newer paint. The EPA recommends that any peeling, chipping, chalking, cracking, damaged, or damp lead-based paint should be attended to immediately; however, lead-based paint that is in good condition is usually not a health hazard [EPA 2025c]. Renovation and remediation of buildings that may contain lead-based paint should be done by a contractor who is trained to perform lead-safe work practices. Additional information on lead can be found on the [NIOSH](#), [EPA](#) and [OSHA](#) webpages.

Lead exposure may cause a range of health effects including damage to the central nervous system, cardiovascular system, reproductive system, hematological (e.g., blood and bone marrow) system, and kidneys [NIOSH 2024b; CDC 2024]. While children are most at risk for lead poisoning, adults can also show symptoms, including cognitive and nerve disorders, high blood pressure, and reproductive problems [NIOSH 2024b; OSHA, no date(b)].

Communication

I commend the efforts to communicate with staff and the community by creating the [Buildings Concerns Info Hub](#) and [Secondary School Complex Building Project](#) webpages. OSHA has helpful [guidance](#) on recommended practices for safety and health programs [OSHA, no date(c)].

The EPA has an [Indoor Air Quality Tools for Schools Action Kit](#) which might be helpful. The Action Kit provides best practices, industry guidelines, sample policies, and a sample indoor air quality program management plan [EPA 2025d].

Recommendations

1. If peeling, chipping, chalking, cracking, damaged, or damp paint is lead-based, it needs to be attended to immediately. The EPA has information on [lead test kits](#), [Renovation](#) and remediation of buildings that may contain lead-based paint (that might be under layers of newer paint) should be done by a [contractor who is trained to perform lead-safe work practices](#). Additional information on lead can be found on the [NIOSH](#), [EPA](#) and [OSHA](#) webpages.
2. Check for possible sources of sewage gas, such as the following:
 - a. Dry or faulty traps in sinks or floor drains
 - b. Dried or leaky toilet wax seals
 - c. Cracked or blocked pipes
 - d. Blocked plumbing gas vents

Air sampling can measure for sewer gas chemical components such as hydrogen sulfide and potentially detect sources of the sewage smell. This can be helpful to determine how to address sewer gas smells.

3. Evaluate the roof for sources of leaks and repair or replace as needed and feasible.
4. Inspect the high school's tunnel to identify sources of moisture and correct any identified issues.
5. Any mold and moisture-damaged materials, such as damaged ceiling tiles, should be removed or cleaned with the appropriate containment to minimize exposure for remediation workers, building occupants, and unaffected sections of the building. Damp building conditions promote the growth of mold, bacteria, and other microbial agents. Moisture can also attract cockroaches, rodents, and dust mites. Dampness can contribute to the breakdown of building materials and furniture which can result in adverse health effects. The following resources have information on assessment and remediation of fungi in indoor environments and maintaining acceptable indoor environmental quality during construction and renovation projects.
 - a. NIOSH
 - [Workplace Mold and Your Health | Mold | CDC](#)
 - [Preventing Occupational Respiratory Disease from Exposures Caused by Dampness in Office Buildings, Schools, and Other Nonindustrial Buildings](#)
 - b. EPA
 - [Mold | US EPA](#)
 - [Mold Remediation in Schools and Commercial Buildings Guide](#)

6. Routinely inspect the building for water intrusion and damage and correct these upon discovery. During and after heavy rains, walk through the building and check for water incursion.
 - a. Identify any potential sources of dampness or mold through visual inspection and make proper repairs to prevent further problems from occurring.
 - Consider using the [NIOSH Dampness and Mold Assessment Tool](#) when inspecting the building for dampness and mold. The tool and instructions for use are on the NIOSH [website](#).
 - The below paper also provides detailed instructions on using the NIOSH tool and provides an example Excel file for data entry in the [supplementary materials](#).

Park J-H and Cox-Ganser JM [2022]. NIOSH dampness and mold assessment tool (DMAT): Documentation and data analysis of dampness and mold-related damage in buildings and its application. [Buildings 12\(8\):1075](#).
 - b. If dampness or mold is not identified during visual inspections but is suspected because of musty odors or continued health complaints, consider other methods to look for hidden problems such as under flooring or in wall cavities. Also, thermal imaging, with an infrared camera, after heavy rains can be used inside and outside buildings to look for leaks.
 - c. Keep a record of when and where mold or water-damaged materials are discovered and what has been done to promptly fix the underlying problem leading to the water damage.
 - d. Monitor repaired areas to ensure repairs and remedial actions are effective.
7. Prior to construction or renovation projects, review the following resources for information on maintaining acceptable indoor environmental quality during construction and renovation projects.
 - a. NIOSH
 - [Maintaining Acceptable Indoor Environmental Quality \(IEQ\) During Construction and Renovation Projects](#)
 - b. EPA
 - [Moisture Control Guidance for Building Design, Construction and Maintenance](#)
8. Evaluate your existing housekeeping program with attention to carpet cleanliness and keeping horizontal surfaces dust-free.
 - a. Vacuum the carpet regularly with a vacuum equipped with a HEPA filter. Ensure HEPA vacuums are well maintained, and the HEPA filters are changed according to the manufacturer's recommendations. If cleaning the carpet, consider dry steam cleaning instead of carpet shampooing. Sufficient drying of the carpet is vital after any cleaning process.
 - b. Avoid the use of biocides on the carpet, but if used, use minimally during unoccupied times and follow the manufacturer's recommendations for dilution, application, and worker protection (skin and respiratory protection).
 - c. HEPA filter equipped vacuums are also recommended for cleaning fabric covered chairs and dividers between desks or cubicles.

- d. Use a damp cloth or mop on nonporous surfaces rather than dry materials to clean up dust. This prevents dust from becoming airborne and resettling.
9. Maintain indoor temperature and humidity levels according to the guidelines discussed. The EPA recommends maintaining indoor relative humidity below 60%, ideally between 30% and 50%, to reduce mold growth. Assuming slow air movement (around 20 feet per minute) and 50% indoor relative humidity, the operative temperatures recommended by ASHRAE are around 64.5°F to 74°F in the winter, and from 69.5°F to 77°F in the summer. The difference in temperature ranges between the seasons is largely due to clothing selection. ASHRAE Standard 62.1 recommends that indoor humidity be maintained to provide a maximum indoor-air dew-point temperature of 60°F in buildings that are mechanically cooled, during occupied and unoccupied periods. Using indoor-air dew-point temperature to limit humidity limits the total mass of water vapor available for condensation and adsorption on surfaces indoors. Condensation and adsorption of water on surfaces is largely responsible for indoor microbial growth.
10. Ensure dehumidifiers, if used, are cleaned and maintained according to the manufacturer's recommendations.
11. Ensure humidifiers, if used, are cleaned and maintained according to the manufacturer's recommendations.
 - a. If portable in-room humidifiers are used for sensory comfort and to reduce excessively low relative humidity levels, it is recommended to use humidifiers with built-in humidistats and control the indoor relative humidity level near 40%. Higher humidity levels are not necessarily better, and they may lead to mold growth, mildew, and other long-lasting indoor air quality issues.
 - b. Maintenance and cleaning of portable humidifiers is very important. The water in the humidifier should be changed daily, and the humidifier should be well maintained and cleaned in accordance with manufacturer recommendations. Be sure to unplug the unit prior to cleaning.
 - c. The [EPA Use and Care of Home Humidifiers](#) website has helpful information.
12. Follow the manufacturer's recommended maintenance schedules for the ventilation system, including replacing air filters, checking drip pans, ensuring thermostats are in working order, and checking and cleaning ventilation system dampers to ensure proper functioning.
13. Investigate why the CO₂ levels were elevated in Rooms M2745 and M11. Ensure outdoor air supply and exhaust rates are consistent with ventilation requirements most appropriate for your locality and building type. ASHRAE provides solid guidance on outdoor air requirements, and their standards are generally incorporated into legally-enforceable building codes. However, there are occasions that the ASHRAE guidance may differ from state and/or local mechanical codes. Therefore, care should be taken to meet the ventilation requirements most appropriate for your locality and building type. Consult with a licensed ventilation engineer if assistance is needed determining outdoor air supply and exhaust rates.
14. Continue to maintain a communication system with employees for when building-related issues arise. If not already established, consider starting a health and safety committee, which consists of employees, management, and maintenance. OSHA has helpful [guidance](#) on recommended practices for safety and health programs. The EPA has an [Indoor Air Quality](#)

[Tools for Schools Action Kit](#) that provides best practices, industry guidelines, sample policies, and a sample indoor air quality program management plan.

15. Encourage building occupants to report new, persistent, or worsening symptoms, particularly those with a work-related pattern, to their personal healthcare providers and, as instructed by their employer, to a designated individual in their workplace.

This letter will serve to close this health hazard evaluation request. **NIOSH recommends that you post copies of this letter in a prominent place accessible to all employees for a period of 30 calendar days.** If you have questions or concerns, please contact me at (304) 285-5788 or ezi2@cdc.gov.

Sincerely,

A handwritten signature in blue ink, appearing to read 'Tia McClelland', is positioned above the typed name.

Tia McClelland, MPH, CPH
Respiratory Health Hazard Evaluation and
Technical Assistance Program
Respiratory Health Division

cc:

Union Representative

Mr. Jim Gilles, Vice President of the Elizabethtown School board

Dr. Lisa McHugh, State Epidemiologist, Pennsylvania Department of Health

Mr. Michael Rivera, Regional Administrator, U.S. DOL – OSHA, Philadelphia Region

Close-out file (2026-0018)

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