**INDOOR AIR QUALITY**

**WATER DAMAGE ASSESSMENT**

**Brayton Elementary School**

**20 Brayton Hill Terrace**

**North Adams, MA**

Exterior view of Brayton Elementary School
20 Brayton Hill Terrace
North Adams, MA


Prepared by:

Massachusetts Department of Public Health

Bureau of Climate and Environmental Health

Indoor Air Quality Program

September 2024

# BACKGROUND

|  |  |
| --- | --- |
| Building: | Brayton Elementary School (BES) |
| Address: | 20 Brayton Hill Terrace, North Adams, MA |
| Requestor: | Barbara Malkas, Superintendent of Schools, City of North Adams |
| Reason for Request: | Water damage/mold growth |
| Date of Assessment: | August 30, 2024 |
| Massachusetts Department of Public Health/Bureau of Environmental Health (MDPH/BCEH) Staff Conducting Assessment: | Michael Feeney, Director, Indoor Air Quality (IAQ) Program |
| Building Description: | The BES is a variable-story, red brick building constructed in 1993. The ground floor consists of classrooms, an art room, special needs classrooms, music rooms, a computer room, and various storage rooms. |
| Windows: | Openable |

# EXECUTIVE SUMMARY

The MDPH/IAQ Program was asked to examine the BES for the presence of water damage/mold growth resulting from high relative humidity conditions that occurred during August 2024. The BES experienced water damage in the ground level of the building, which has classrooms that exist below grade and have no windows. IAQ staff visited the BES while water damage remediation efforts were being completed, with a focus on areas that were damaged by condensation (i.e., ceilings, insulation, carpeting, and classroom materials). Contractors used the US EPA guidelines *Mold Remediation in Schools and Commercial Buildings* to conduct water damage remediation, which include:

* Identifying the source of moisture causing water damage.
* Removing water-damaged porous materials capable of supporting mold growth (ceiling tiles, carpeting, and various stored materials), and
* Cleaning of non-porous surfaces areas (e.g., painted cement walls, laminated counters, floor tile).

Based on observations by IAQ staff, the source of water vapor causing the damage was a combination of high relative humidity weather that occurred in August 2024, combined with water vapor migration from classroom sink drains with dry drain traps. Heavy rain entering the North Adams storm/sewer system likely forced water vapor and air to back up the sink drain system, which then caused condensation on stored materials and building components.

Once water damage remediation is completed, the following recommendations are made:

* Continue to use vacuum cleaners equipped with high efficiency particle air (HEPA) filters which will remove residues of mold and mold spores from the environment.
* Use air cleaners equipped with HEPA filters in rooms to provide additional filtration of air in below-grade space.
* Ensure that all sink drain traps are wetted regularly (once a week) to prevent water vapor backup into classrooms.

In addition, the IAQ Program has offered to conduct a general IAQ assessment of the BES to identify any other conditions that impact the indoor environment.

# METHODS

IAQ staff conducted a visual inspection of ground floor areas. Air temperature and relative humidity were measured in each room. Surface temperatures of floors and walls were measured to determine if building components were at or below the dew point (temperature where condensation will gather on a cold surface). Please refer to the IAQ Manual for methods, equipment, sampling procedures, and interpretation of results (MDPH, 2015).

**RESULTS AND DISCUSSION**

The following is a summary of indoor air testing results (Table 1):

* ***Air Temperature*** was within the MDPH recommended range of 70°F to 78°F in areas tested during the assessment.
* ***Relative Humidity*** was within the MDPH recommended comfort range of 40 to 60% in all areas tested the day of assessment. If relative humidity exceeds 70%, for extended periods of time, mold growth may occur due to wetting of building materials even in the absence of liquid water (ASHRAE, 2019). Relative humidity outdoors was 53% on the day of the assessment. Relative humidity measurements inside were all below outdoor measurements.
* ***Dew Point*** was within a range of 53°F to 57°F in areas tested during the assessment***.***
* ***Floor and Wall Surface Temperatures*** were within a range of 65°F to 75°F. All floors and walls were above the dew point and were not wet by condensation.

Based on these observations, conditions that could result in water vapor moistening building components or stored equipment/materials were not present at the time of this assessment.

As mentioned, a water damage/flooding restoration firm was present during this visit. Remediation activities included:

* Carpeting was removed from classrooms in below grade spaces.
* Non-porous materials that had surface mold (painted walls, laminated countertops, metal) were cleaned.
* Fans and dehumidifiers were in use to accelerate drying of carpeting in hallways and classroom materials.
* Exhaust vents were in use to vent water vapor outdoors.
* Water-damaged ceiling tiles were removed and replaced.
* Non-porous classroom materials were cleaned.
* Items such as cabinets floor mats, and area rugs were removed to allow the floor to dry.

At the time of the MDPH/IAQ visit, remediation activities (removal and drying of water-damaged building materials) were fully active and were being conducted in accordance with US EPA guidance (US EPA, 2008). Water-damaged materials had been removed and/or dried and rooms were being cleaned. IAQ staff examined all accessible classrooms and other occupied spaces in the building and did not observe visible mold or associated odors during this visit. Materials cleaned were in the basement hallway, which were found free of visible mold and mold odor (Picture 1). Mold odors were found from guitars and instrument cases (Picture 2) which were discarded the day of this visit. One water-damaged ceiling tile to be replaced was noted in the basement hallway.

One sign of high relative humidity in the BES is the presence of bowed ceiling tiles. If a building experiences high relative humidity indoors over an extended period of time, moisture exposure may cause ceiling tiles to bow. According to American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), if relative humidity exceeds 70%, mold growth may occur due to wetting of building materials (ASHRAE, 2019). It is recommended that porous material be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2008).

Bowed ceiling tiles without discoloration or stains are not mold-colonized but are a sign of water vapor exposure. Bowing ceiling tiles are typically found in classrooms and cafeterias with sink or floor drains where the trap has dried. A trap is a section of pipe below the drain opening that fills with water to form an airtight seal. The airtight seal prevents combustible sewer gas, odors, and water vapor from the drain systems from backup up the drain to enter occupied space. Depending on various conditions, water evaporates from the trap if a plumbing device is not used for several days.

Wetting drain traps regularly to maintain the airtight water seal is particularly important when heavy rains occur. As large amounts of water enter storm/sewer pipes, air and other water vapor/odors/pollutants can be forced up drainpipes, which would be prevented from entering the occupied space by a wet drain trap.

Schools are particularly vulnerable to dry drain traps due to the extended summer vacation when the building is unoccupied, since water fountains as well as sinks in classrooms, the cafeteria and kitchens are not in use. School locations with bowed ceiling tiles are ones with multiple sinks that are not used during summer vacations, such as the cafeteria and science classrooms, as well as restrooms, when equipped with a suspended ceiling with cellulose ceiling tiles.

It is also important to note that the BES mechanical ventilation system is not equipped with chillers to provide cooling during hot weather. In addition to providing cooling, a heating, ventilation, and air conditioning (HVAC) system can reduce humidity during operation. Where air chilling is not available, use of dehumidifiers during hot, humid weather on the ground floor may reduce humidity.

A method to determine if areas in the BES are prone to condensation would be to measure air temperatures and compare them to building material temperatures. If a wide temperature range exists between measurements, the building materials at the colder end of the range may be prone to becoming moistened with condensation in hot, humid weather.

Using a laser thermometer, the surface temperature of the floors was measured (Table 1). Air temperature and relative humidity were also measured. Floor temperatures were measured in a range from 65°F to 75°F, while the indoor temperature was in a range of 73°F to 76°F. In general, the below grade floors and walls have temperatures that are below the measured air temperature (Table 1). This condition may indicate that soil in contact with below grade walls is transferring its cooler temperature to the floor and walls. This condition is called a thermal bridge. In this instance, the lower temperature of the floors and walls combined with presence of thermal bridges make the walls and floors vulnerable to subsequent moistening and mold growth under the extreme weather conditions experienced in Massachusetts over the past several summers.

Hot humid summers are becoming more frequent due to climate change. Massachusetts has experienced hot, humid, and rainy summers in 2018, 2021, and 2023. July of 2021 was the wettest ever recorded in Massachusetts, and the three-month period from June through August, known as the meteorological summer, was the fourth wettest on record, according to the National Oceanic and Atmospheric Administration’s (NOAA) Centers for Environmental Information (NOAA, 2021). The summer of 2023 was also hot, and wet, being measured as the second rainiest on record (WBUR, 2023). The summer of 2024 has also had significant stretches of hot, humid weather. These conditions are challenging for buildings, particularly those without central air conditioning.

Under these weather conditions, public buildings experienced extended periods of water vapor exposure from high relative humidity. When exposed to these conditions, porous materials such as gypsum wallboard, cardboard, carpeting and other materials may become moistened and colonized with mold, particularly if located in areas that are prone to developing condensation, such as floors and walls in contact with the ground (e.g., below grade space).

The guideline “Preventing Mold Growth In Schools During Hot, Humid Weather” <https://www.mass.gov/info-details/preventing-mold-growth-in-massachusetts-schools-during-hot-humid-weather> should be used to minimize the impact of such weather on classroom materials. This includes use of air conditioning and dehumidifiers, ensuring exhaust vents are on and operable, keeping windows closed, and ensuring air can circulate around porous materials.

# CONCLUSIONS AND RECOMMENDATIONS

Based on the observations made during the visit, it appears that most water-damaged materials were thoroughly dried and/or removed. The following recommendations are made:

1. Continue with restoration/reconstruction plans to replace all water-damaged building materials (ceilings, walls, floors, pipes, electrical, etc.).
2. Prior to re-occupancy:

* Operate/flush out the HVAC system for 24 hours and change filters. The MDPH recommends pleated filters with a Minimum Efficiency Reporting Value (MERV) of 8, which are adequate in filtering out pollen and mold spores (ASHRAE, 2012).
* Continue remediation activities which includes cleaning all items and surfaces with a high efficiency particulate air (HEPA) filter equipped vacuum cleaner combined with wet wiping and have carpets professionally cleaned.

1. Discard mold-colonized guitars and cases. If mold odors are found in other music instrument cases, storage cases or other equipment located on the ground floor, discard and replace.
2. Continue to examine equipment and supplies for either visible mold growth or odors. If found, discard and replace these materials.
3. Ensure that sinks have drain traps wet during summer months. Pouring water down sink drains once a week is recommended to maintain water trap airtight seal.
4. For more information on mold refer to the US EPA’s “Mold Remediation in Schools and Commercial Buildings,” available at: <http://www.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide>.
5. Management of buildings in extreme relative humidity and rain can be challenging. The following documents can provide guidance that can be used to reduce the impact of hot, humid weather in buildings:
   1. Mold Growth Prevention During Hot, Humid Weather <https://www.mass.gov/service-details/preventing-mold-growth-in-massachusetts-schools-during-hot-humid-weather> and
   2. Remediation and Prevention of Mold Growth and Water Damage in Public Schools <https://www.mass.gov/service-details/remediation-and-prevention-of-mold-growth-and-water-damage-in-public-schools-and>.
6. Contact the IAQ Program for a general indoor air quality assessment following the completion of remediation and reconstruction work when school is in session.
7. Refer to resource manuals and other related IAQ documents for further building-wide evaluations and advice on maintaining public buildings. Copies of these materials are located on the MDPH’s website: <http://mass.gov/dph/iaq>.

# REFERENCES

ASHRAE. 2012. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Standard 52.2-2012 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size (ANSI Approved).

ASHRAE. 2019. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Ventilation for Acceptable Indoor Air Quality. ANSI/ASHRAE Standard 62.1-2019. Atlanta, GA.

MDPH. 2015. Massachusetts Department of Public Health. Indoor Air Quality Manual: Chapters I-III. Available at: <https://www.mass.gov/lists/indoor-air-quality-manual-and-appendices#indoor-air-quality-manual->.

NOAA. 2021. Summer 2021 neck and neck with Dust Bowl summer for hottest on record. National Oceanic and Atmospheric Administration, 1401 Constitution Avenue NW, Room 5128, Washington, DC 20230 <https://www.noaa.gov/news/summer-2021-neck-and-neck-with-dust-bowl-summer-for-hottest-on-record>.

US EPA. 2008. “Mold Remediation in Schools and Commercial Buildings”. Office of Air and Radiation, Indoor Environments Division, Washington, DC. EPA 402-K-01-001. September 2008. Available at: <http://www.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide>.

WBUR. 2023. “It's been a summer of rain and flooding misery in Mass.” WBUR local news. September 12, 2023. <https://www.wbur.org/news/2023/09/12/summer-flooding-rain-massachusetts>.

**Picture 1**

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**With exception of guitar case and paper, examples of non-porous materials that are cleanable**

**Picture 2**

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**Guitars with mold odors**

| **Location** | **Temp**  **(°F)** | **Relative**  **Humidity**  **(%)** | **Dew Pt.**  **(°F)** | **Floor Temp**  **(°F)** | **Difference between Floor and Air Temp** | **Remarks** |
| --- | --- | --- | --- | --- | --- | --- |
| Background (outside) | 73 | 53 | 54 |  |  |  |
| 111 | 75 | 48 | 54 | 71 | -4 |  |
| 108 | 76 | 47 | 54 | 71 | -5 |  |
| 104 | 76 | 44 | 53 | 72 | -4 |  |
| 108 storage | 75 | 46 | 53 | 68 | -7 |  |
| Hallway | 75 | 47 | 53 | 68 | -7 |  |
| 102 storage | 75 | 47 | 57 | 65 | -10 |  |
| 100 | 74 | 52 | 54 | 65 | -9 |  |
| Art room | 73 | 51 | 54 | 68 | -5 |  |
| Computer room | 74 | 51 | 55 | 70 | -4 |  |
| 106 | 74 | 51 | 55 | 71 | -3 |  |
| 101 | 75 | 49 | 55 | 71 | -4 |  |
| 107 | 74 | 50 | 54 | 71 | -3 |  |
| 111 | 74 | 51 | 54 | 70 | -4 |  |
| 109 | 74 | 51 | 55 | 73 | -1 |  |
| 116 | 75 | 50 | 53 | 73 | -2 |  |
| 118 | 75 | 50 | 55 | 73 | -2 |  |
| 120 | 75 | 49 | 55 | 73 | -2 |  |
| 123 | 76 | 49 | 55 | 73 | -3 |  |
| 121 | 76 | 49 | 55 | 73 | -3 |  |
| 119 | 76 | 48 | 56 | 75 | -1 |  |
| 117 | 76 | 50 | 56 | 75 | -1 |  |
| 115 | 76 | 50 | 56 | 75 | -1 |  |