# INDOOR AIR QUALITY ASSESSMENT

**Mount Greylock Regional School**
**1781 Cold Spring Road**
**Williamstown, MA**

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
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## Background/Introduction

At the request of Rose Ellis, the Tri-district Superintendant of the Williamstown Lanesborough Public Schools, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health (BEH) conducted an indoor air quality (IAQ) assessment at the Mount Greylock Regional Middle/High School (MGRS) located at 1781 Cold Spring Road, Williamstown, MA. The request was prompted by general IAQ concerns. On December 2, 2011, a visit to conduct an IAQ assessment was made to the MGRS by Michael Feeney, Director of BEH's Indoor Air Quality Program. Mr. Feeney was accompanied by Ruth Alfasso and Kathleen Gilmore, Inspectors for BEH's IAQ Program and Christine Gorwood, Environmental Analyst/Risk Communication Specialist for BEH's Community Assessment Program.

The school is a single-story multiple wing building that was constructed in 1960 and renovated with an addition in 1968. Various areas have been repurposed from the original design. A new roof was reportedly installed in 2002. Windows are openable throughout the building.

## Methods

Air tests for carbon monoxide, carbon dioxide, temperature and relative humidity were conducted with the TSI, Q-Trak™, IAQ Monitor, Model 7565. Air tests for airborne particle matter with a diameter less than 2.5 micrometers were taken with the TSI, DUSTTRAK™ Aerosol Monitor, Model 8520. BEH staff also performed visual inspection of building materials for water damage and/or microbial growth.

## Results

The building houses both a middle school (grades 7 and 8) and a high school (grades 9-12), with a student population of approximately 625 and a staff of approximately 100. Tests were taken under normal operating conditions and results appear in Table 1.

## Discussion

### Ventilation

It can be seen from Table 1 that carbon dioxide levels were above 800 parts per million (ppm) in 20 of 71 areas surveyed. Elevated carbon dioxide levels measured in some areas of the school indicate poor air exchange in those rooms, possibly the result of deactivated/non-functioning/poorly functioning ventilation equipment. Some areas were empty/sparsely populated, which can result in greatly reduce carbon dioxide levels. Carbon dioxide levels would be expected to increase with higher occupancy.

Fresh air in most classrooms is supplied by a unit ventilator (univent) system (Picture 1). Univents draw air from outdoors through a fresh air intake located on the exterior walls of a building and return air through an air intake located at the base of each unit. The mixture of fresh and return air is drawn through a filter and a heating coil, and is then expelled from the univent by motorized fans through fresh air diffusers (Figure 1). Univents were found turned off in classrooms throughout the school. Obstructions to airflow, such as papers and books stored on univents and bookcases, carts and desks in front of univent returns were seen in some classrooms. Some univents also contained accumulated dirt/debris. These univents should be cleaned before operating to prevent aerosolization of this material.

In order for univents to provide fresh air as designed, intakes must remain free of obstructions. Importantly these units must remain “on” and allowed to operate while these rooms are occupied. Turning off the univent system effectively cuts off fresh air supply to the classroom. A univent was opened and examined. Louver systems appeared to be either altered or disconnected. Univent filters rest in a “pan” that has slots covered with a louver that slide beneath the “pan” to increase/decrease the size of the air intake aperture (Picture 2). The louvers that control intake of fresh air were closed in a number of univents examined putting the univents into a recirculating-only mode. Even when the louvers are fully open, the design of the louver system provides only about 50 percent of the available space for fresh air infiltration, which is highly inefficient for fresh air supply. These conditions can allow the build-up of normally occurring indoor pollutants and lead to IAQ/comfort complaints.

In general, univents are designed to draw air from fresh air supply vents that are at the same level as and within two feet of the rear of its cabinet. As an example, all classrooms in the MGRS with windows (perimeter classrooms) are configured in this manner. In some interior classrooms supply ductwork is approximately 15 feet in length and fresh air must make three 90º turns through ductwork prior to reaching the univent fans. As a general rule, each 90º bend in ductwork will reduce the draw of air by 50 percent. In the case of these rooms, the fresh air must make roughly 270º in turns. Assuming that the velocity of the draw of air at the univent fan equals 100 percent, the draw of air at the base of the vent is reduced to roughly 12.5 percent of the draw because of the three 90º bends in the ductwork.

Further, the age of the equipment makes service and repairs of these units difficult. According to the American Society of Heating, Refrigeration and Air-Conditioning Engineers

(ASHRAE), the service life[1] for a unit heater using hot water or steam is 20 years, assuming routine maintenance of the equipment (ASHRAE, 1991). Despite attempts to maintain the univents, the operational lifespan of the equipment from the 1960's has been exceeded. Maintaining the balance of fresh air to exhaust air will become more difficult as the equipment ages and as replacement parts become increasingly difficult to obtain.

Several areas (e.g., the auditorium and library) have fresh air supplied by rooftop air handing units (AHUs). As with classroom univents, AHUs should be "on" and allowed to operate while these areas are occupied.

Mechanical exhaust ventilation in many of the classrooms with univents is supplied by a "univent exhaust" system. These units (Picture 3) are designed to exhaust air to the outside through vents in the lower portion of the unit. Both the univents and the univent exhausts are located along the same (outside) wall in each classroom. This means that even with the univent supply and exhaust operating optimally, the airflow in the classroom is concentrated in the area adjacent to the exterior wall, with little fresh air distributed to the interior side of the classroom, which may lead to airflow/comfort complaints. Some univent exhausts were found to be obstructed by items and many were found to be turned off or non-operable (Table 1).

As noted in a previous BEH IAQ assessment (MDPH, 2003), the manufacturer of the univents and univent exhausts [Schemennen (Picture 3)] appears to have ceased operations in the mid-1960s. Therefore, it is highly unlikely that replacement parts are available to restore univent fresh air intakes or univent exhausts to their original function.

In some rooms, exhaust is supplied by wall-mounted vents powered by rooftop motors. Exhaust vents were found off in many rooms and some were obstructed by equipment and items.

[1] The service life is the median time during which a particular system or component of …[an HVAC]… system remains in its original service application and then is replaced. Replacement may occur for any reason, including, but not limited to, failure, general obsolescence, reduced reliability, excessive maintenance cost, and changed system requirements due to such influences as building characteristics or energy prices (ASHRAE, 1991).

Exhaust vents must remain clear of obstruction in order to remove stale air and pollutants from classrooms.

To maximize air exchange, the MDPH recommends that both supply and exhaust ventilation operate continuously during periods of occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994). Since the manufacturer appears to have gone out of business in the 1960s and the likelihood of finding replacement parts is remote, it is highly unlikely that the univent and exhaust units can be repaired in order for the HVAC system to be balanced.

The Massachusetts Building Code requires that each room have a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or openable windows (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens, a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is

5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The MDPH uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, consult Appendix A.

Temperature measurements ranged from 66 °F to 74 °F, which were within or below the MDPH recommended comfort range at the time of the assessment (Table 1). The MDPH recommends that indoor air temperatures be maintained in a range of 70 °F to 78 °F in order to provide for the comfort of building occupants. Supplemental heating is provided by radiators (Picture 4). In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. As discussed, given the age, condition and operating status of ventilation equipment, temperature control would be expected to be difficult.

The relative humidity measured in the building ranged from 23 to 34 percent which was below the MDPH recommended comfort range at the time of the assessment (Table 1). The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

**Microbial/Moisture Concerns**

Water-damaged ceiling tiles were observed in a number of areas (Table 1, Pictures 5 and 6), which can indicate leaks from either the roof or plumbing system. The school has a ceiling tile system that is glued directly to the ceiling in some classrooms. Replacement of these tiles is difficult, since their removal appears to necessitate the destruction of the tile, which can result in the aerosolization of particulates. Water-damaged ceiling tiles may provide a medium for microbial growth and should be replaced after a water leak is discovered and repaired.

Sinks were noted in some classrooms, and many of them had items including paper and other porous materials stored underneath (Picture 7). Leaks from plumbing or condensation can moisten these materials. Porous items should be relocated and the spaces under the sinks should be examined periodically for leaks.

Condensation was reported on floor tiles and other surfaces during periods of high humidity. Based on discussion with building occupants, it was discovered that the building sits directly on a concrete slab with no basement or crawlspace underneath it. This means that the temperature of the floors in the building are being maintained close to the temperature of the ground, which does not change as much as air temperature over the seasons. Warm humid air in contact with the colder floor can lead to condensation. Because it is not possible to create a crawlspace beneath the floor, it is recommended that the impact of this condensation be reduced through: dehumidification in sensitive areas, not storing porous items directly in contact with the floor, and not using rugs or other floor coverings, particularly during the warm, humid times of year.

The US Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If not dried within this time frame, mold growth may occur. Once mold has colonized porous materials, they are difficult to clean and should be removed and discarded.

Plants were observed in a number of areas, including on classroom univents (Table 1). Plants can be a source of pollen and mold which can be respiratory irritants to some individuals. Plants should be properly maintained and equipped with drip pans and located away from univents to prevent the aerosolization of dirt, pollen and mold.

In classrooms that faced the courtyard, trees were noted to directly abut the windows (Picture 8). It was reported that plants and trees had recently been removed from the perimeter of the building. It is recommended that the remaining trees abutting the windoes be removed as well. Pollen and debris from trees can clog the ventilation system or enter classrooms where they can be a source of allergens and mold. The roots from trees and plants can also penetrate the building envelope leading to breaches. Additionally, a pile of mulch was noted in direct contact with the building (Picture 9); this should be removed as these materials can hold moisture against the side of the building and provide harborage for pests.

BEH staff examined the outside perimeter of the building to identify breaches in the building envelope and/or other conditions that could provide a source of water penetration. Pieces of the outer layer of brick are flaking and falling off, a condition known as spalling (Picture 10). It is believed that the spalling may be attributable in part to subflorescence. Subflorescence is indicative of moisture penetration through masonry. As moisture penetrates the brick surface, mineral salts are deposited on the interior of the brick. In the winter months, through the actions of freezing and thawing, the expansion within the brick creates spalling. Based on examination of the brick, it is believed that a weatherproofing sealant may have been applied to the exterior, which would prevent moisture from the interior of the wall from exiting; this would create conditions resulting in subflorescence rather than efflorescence (a condition resulting in the mineral deposits occurring on the outside of the brick). Spalling was particularly notable on pilasters, which are decorative protrusions along the side of the building. Falling masonry can be a physical hazard.

The aforementioned conditions represent potential water penetration sources. Over time, these conditions can undermine the integrity of the building envelope and provide a means of water entry into the building via capillary action through foundation concrete and masonry (Lstiburek & Brennan, 2001). The freezing and thawing action of water during the winter months can create cracks and fissures in the foundation. In addition, these breaches may provide a means for pests/rodents to enter the building.

**Other Indoor Air Evaluations**

Indoor air quality can be negatively influenced by the presence of respiratory irritants, such as products of combustion. The process of combustion produces a number of pollutants. Common combustion emissions include carbon monoxide, carbon dioxide, water vapor, and smoke (fine airborne particle material). Of these materials, exposure to carbon monoxide and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5) can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the indoor environment, BEH staff obtained measurements for carbon monoxide and PM2.5.

*Carbon Monoxide*

Carbon monoxide is a by-product of incomplete combustion of organic matter (e.g., gasoline, wood and tobacco). Exposure to carbon monoxide can produce immediate and acute health affects. Several air quality standards have been established to address carbon monoxide and prevent symptoms from exposure to these substances. The MDPH established a corrective action level concerning carbon monoxide in ice skating rinks that use fossil-fueled ice resurfacing equipment. If an operator of an indoor ice rink measures a carbon monoxide level over 30 ppm, taken 20 minutes after resurfacing within a rink, that operator must take actions to reduce carbon monoxide levels (MDPH, 1997).

The American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE) has adopted the National Ambient Air Quality Standards (NAAQS) as one set of criteria for assessing indoor air quality and monitoring of fresh air introduced by HVAC systems (ASHRAE, 1989). The NAAQS are standards established by the US EPA to protect the public health from six criteria pollutants, including carbon monoxide and particulate matter (US EPA, 2006). As recommended by ASHRAE, pollutant levels of fresh air introduced to a building should not exceed the NAAQS levels (ASHRAE, 1989). The NAAQS were adopted by reference in the Building Officials & Code Administrators (BOCA) National Mechanical Code of 1993 (BOCA, 1993), which is now an HVAC standard included in the Massachusetts State Building Code (SBBRS, 1997). According to the NAAQS, carbon monoxide levels in outdoor air should not exceed 9 ppm in an eight-hour average (US EPA, 2006).

*Carbon monoxide should not be present in a typical, indoor environment*. If it *is* present, indoor carbon monoxide levels should be less than or equal to outdoor levels. Outdoor carbon monoxide concentrations were non-detect (ND) at the time of the assessment (Table 1). No measurable levels of carbon monoxide were detected inside the building during the assessment (Table 1).

*Particulate Matter*

The US EPA has established NAAQS limits for exposure to particulate matter. Particulate matter is airborne solids that can be irritating to the eyes, nose and throat. The NAAQS originally established exposure limits to particulate matter with a diameter of 10 μm or less (PM10). According to the NAAQS, PM10 levels should not exceed 150 micrograms per cubic meter ($\mu g/m^3$) in a 24-hour average (US EPA, 2006). These standards were adopted by both ASHRAE and BOCA. Since the issuance of the ASHRAE standard and BOCA Code, US EPA established a more protective standard for fine airborne particles. This more stringent PM2.5 standard requires outdoor air particle levels be maintained below 35 $\mu g/m^3$ over a 24-hour average (US EPA, 2006). Although both the ASHRAE standard and BOCA Code adopted the PM10 standard for evaluating air quality, MDPH uses the more protective PM2.5 standard for evaluating airborne particulate matter concentrations in the indoor environment.

Outdoor PM2.5 was measured at 8 $\mu g/m^3$ (Table 1). PM2.5 levels measured indoors ranged from 2 to 17 $\mu g/m^3$ (Table 1), which were below the NAAQS PM2.5 level of 35 $\mu g/m^3$ apart from room W417, which had a PM2.5 level of 70 $\mu g/m^3$. This room also had a notable sulfur-like odor, most likely from science experiments. It was reported that the classroom had been vacated for some time before the testing was done, indicating that exhaust ventilation may not be sufficient to remove lingering pollutants. Proper ventilation is particularly important in areas where contaminants (such as smoke and other science-related materials) may be present.

Frequently, indoor air levels of particulates (including PM2.5) can be at higher levels than those measured outdoors. A number of mechanical devices and/or activities that occur indoors can generate particulate during normal operations. Sources of indoor airborne particulates may include but are not limited to particles generated during the operation of fan belts in the HVAC system, use of stoves and/or microwave ovens in kitchen areas; use of photocopiers, fax machines and computer printing devices; operation of an ordinary vacuum cleaner and heavy foot traffic indoors.

*Volatile Organic Compounds*

Indoor air concentrations can be greatly impacted by the use of products containing volatile organic compounds (VOCs). VOCs are carbon-containing substances that have the ability to evaporate at room temperature. Frequently, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, chemicals evaporating from a paint can stored at room temperature would most likely contain VOCs. In an effort to identify materials that can potentially increase VOC concentrations, BEH staff examined classrooms for products that may contain these respiratory irritants.

Most classrooms contained dry erase boards and dry erase board markers (Table 1, Picture 11). Materials such as permanent markers, dry erase markers and dry erase board cleaners may contain VOCs, such as methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve (Sanford, 1999), which can be irritating to the eyes, nose and throat.

Household cleaning products were observed in several areas (Picture 12). A Material Safety Data Sheet (MSDS) for each product used should be available at a central location for all school chemicals in the event of an emergency. Consideration should be given to providing teaching staff with school-issued cleaning products and supplies to prevent any potential for adverse chemical interactions between residues left from cleaners used by the facilities staff and those left by cleaners brought in by others.

Photocopiers were observed in many areas (Table 1) and a laminator was noted in the AV room inside the library. Local exhaust ventilation was not noted in the AV room or in most photocopier locations. Lamination machines melt plastic and produce odors and VOCs. VOCs and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, 1992). Local exhaust should be activated/repaired where available or added when feasible to remove excess heat, odors and particulates when equipment is operating.

*Chemistry Areas*

As mentioned above, an odor of sulfur was noted in room W417 even though the classroom had been vacated earlier indicating that insufficient exhaust ventilation was present in this room to remove odors from chemistry activities. Also noted in the chemistry storage area adjacent to this room were two fume hoods which were not active, but appeared to be used to store bottled chemicals labeled as "acids" (Picture 13). It was later reported by MGRS staff that none of the chemistry hoods were functional. Fume hoods should not be used for the storage of chemicals. Operable fume hoods are critical to providing control and removal of fumes and vapors from experiments that may product toxic airborne products. If the chemistry curriculum at the school requires the use of fume hoods, these fume hoods should be repaired or replaced.

The chemistry storage area was somewhat cluttered. General storage of chemicals and items in the chemistry storage area needs to be reviewed and revised. Appendix B contains guidance on chemical storage and use in schools.

*Stained Glass Workroom*

In the stained glass workroom, several items of concern were noted. The making of stained glass requires heating a metal flux or solder using a soldering iron, which can produce metal fumes and smoke. The room in which stained glass activities take place has no exhaust ventilation; one of the windows was open during the visit, providing a source of fresh air. Soldering activities need to be conducted with local exhaust ventilation and, in some cases, with the use of personal protective equipment including respirators. Use of a soldering table or hood that extracts the fumes and sends them outside will reduce the risks to students and staff from soldering fumes and smoke.

In addition, it was noted that the solder set out for use in this workshop was composed of 50 percent lead and 50 percent tin (Picture 14). Lead is toxic to people, particularly children; lead exposure in pregnant women can impact the development of the fetus and. Lead can be stored in the body for a lengthy period of time (ATSDR, 2007) and can be absorbed into the body through inhalation (breathing of dust or fumes) and through ingestion (eating or drinking lead-contaminated food or beverages). Use of lead-containing solder can expose users to both hazards, particularly with the lack of exhaust ventilation noted, and the potential for lead-containing dusts to persist on hands, clothing and other items in the classroom where they can later be transferred to food or other items placed into the mouth.

The use of lead-containing solder is not recommended in a secondary school-based program and should be eliminated. Only lead-free solders should be purchased and used. In addition, the stained glass room requires a thorough cleaning to remove accumulated lead dust and debris.

The stained glass workroom also contained two pottery kilns with no exhaust ventilation. If the kilns are used, the exhaust vents must be properly connected and free of breaches. In addition, it is important that any glazes used for pottery in a school setting be free of lead, cadmium and other toxic metals.

*Other Conditions*

Other conditions that can affect indoor air quality were observed during the assessment. In several classrooms, items were observed on the floor, windowsills, tabletops, counters, bookcases and desks. The large number of items stored in classrooms provides a source for dusts to accumulate. These items (e.g., papers, folders, boxes) make it difficult for custodial staff to clean. Items should be relocated and/or cleaned periodically to avoid excessive dust build up. A build up of pencil shavings was observed in several classrooms (Table 1, Picture 15). These materials can be aerosolized by air movement from the ventilation system, doors opening and closing, or foot traffic and may present an eye or respiratory irritant.

Dust was observed accumulated in univent interiors, exhaust vents, and personal/ceiling fans (Picture 16). This equipment should be cleaned periodically in order to prevent dust/debris from being aerosolized and redistributed throughout the room.

Containers for recyclable cans and bottles were noted in several classrooms. Empty food containers can be attractive to pests. These containers should be rinsed before they are placed in a recycling receptacle and removed to a more secure location on a regular basis

## Conclusions/Recommendations

The capacity of mechanical ventilation equipment to provide adequate fresh air and exhaust to classrooms is limited, as evidenced by air testing (i.e., carbon dioxide levels above 800 ppm). Based on the condition of the univent and univent exhaust system in the building, repair of the existing ventilation system is not likely to be feasible. To remedy building problems, two sets of recommendations are made: **short-term** measures that may be implemented as soon as practicable and **long-term** measures that will require planning and resources to address overall IAQ concerns. In view of the findings at the time of the visit, the following recommendations are provided:

### Short Term Recommendations

1. Operate all functional ventilation systems throughout the building continuously during periods of occupancy. An increase in the percentage of fresh air supply and/or increased exhaust capabilities is recommended. Particular attention should be made to art and science rooms.
2. If possible, make repairs to exhaust system as needed. Ensure classroom exhaust vents are turned on at the start of school and are allowed to operate during occupancy.
3. Remove all blockages from univents and exhaust vents to ensure adequate airflow.
4. Consider adopting a balancing schedule of every 5 years for all mechanical ventilation systems, as recommended by ventilation industrial standards (SMACNA, 1994).
5. Use openable windows in conjunction with classroom univents and exhaust vents to facilitate air exchange until repairs that are more permanent can be made. Care should be

taken to ensure windows are properly closed at night and weekends to avoid the freezing of pipes and potential flooding.

6. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

7. Ensure leaks are repaired and replace any suspended water-damaged ceiling tiles. Examine the area above these tiles for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial, as needed. Make repairs to other water-damaged building materials throughout the building.

8. Remedy all exterior building envelope conditions that contribute to water infiltration into the building, such as:

   a Repair cracked masonry and broken, missing mortar in exterior brickwork;

   b Ensure all doors fit and close securely using weather-stripping as needed. Monitor for penetrations by looking for visible light or feeling for drafts;

   c Remove trees and other plants abutting the building in the courtyard. Refrain from storing mulch directly against the building.

9. Remove items, particularly porous paper and cardboard, from beneath sinks. Check sinks for leaks periodically, and repair promptly.

10. Reduce the impact of condensation on floors during the humid months by dehumidification in sensitive areas, not storing porous items directly in contact with the floor, not using rugs or other floor coverings, and dedicated cleaning of moistened areas.

11. Ensure plants are equipped with drip pans. Examine drip pans periodically for mold growth and disinfect with an appropriate antimicrobial, as needed. Move plants away from fresh air supply sources.

12. Ensure all cleaning products used at the facility are approved by the school department and kept out of the reach of children.

13. Consider adding additional exhaust ventilation to copier/laminator areas where feasible. Activate local exhaust ventilation when copiers and laminators are in use, make repairs as necessary.

14. Address the functioning of fume hoods by repairing or replacing the hoods, or determining that fume hoods are not necessary for the curriculum. Do not use fume hoods, active or deactivated, for storage of chemicals.

15. Prohibit the use of lead-containing solder in the stained glass workshop. Engage the services of an industrial hygiene consultant relative to cleaning of the room to remove built-up lead dusts and installation of appropriate soldering ventilation.

16. Ensure that operable kilns have appropriate exhaust ventilation. Check the composition of glazes and refrain from using/purchasing those containing lead and other toxic metals.

17. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning of classrooms.

18. Clean items, including chalk and dry erase marker trays regularly with a wet cloth or sponge to prevent excessive build-up.

19. Clean pencil shaving trays frequently to prevent a build-up of dusts.

20. Clean accumulated dust and debris periodically from the interior of univents, exhaust vents and blades of personal and ceiling fans.

21. Make sure recyclable food containers are clean and removed promptly to avoid attracting pests.

22. Consider adopting the US EPA (2000) document, "Tools for Schools", as an instrument for maintaining a good indoor air quality environment in the building. This document is available at: http://www.epa.gov/iaq/schools/index.html.

23. Refer to resource manual and other related indoor air quality documents located on the MDPH's website for further building-wide evaluations and advice on maintaining public buildings. These documents are available at: http://mass.gov/dph/iaq.

**Long Term Recommendations**

1. Contact an HVAC engineering firm for a building-wide ventilation systems assessment. Based on historical issues with air exchange/indoor air quality complaints, age, physical deterioration and availability of parts for ventilation components, such an evaluation is necessary to determine the operability and feasibility of replacing the equipment.

2. Strong consideration should be given to replacing univents and exhaust units in classrooms.

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**Picture 1**

**Unit Ventilator (Univent)**

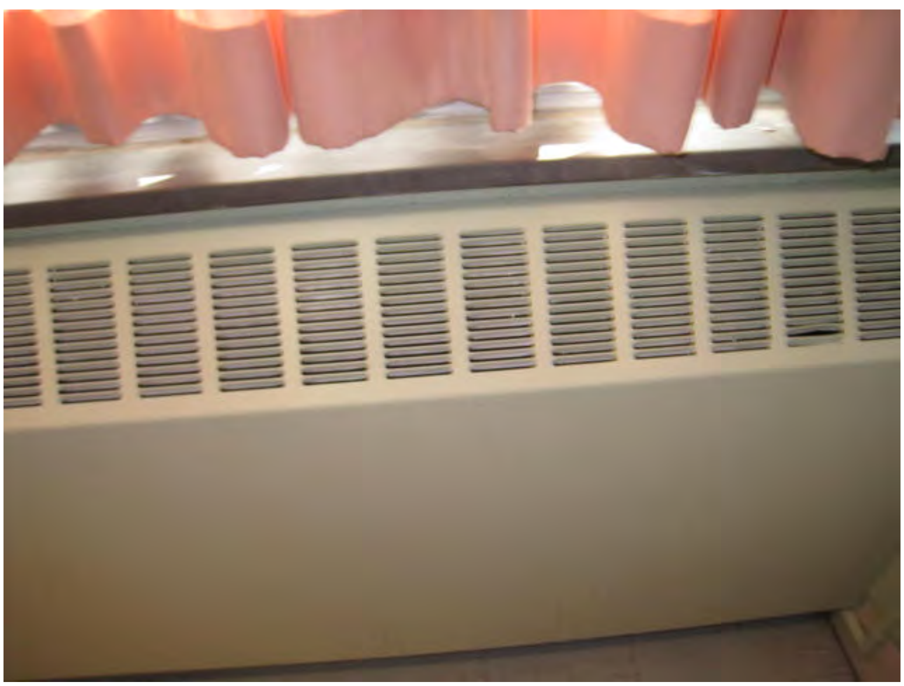
**Picture 2**

**Louver holes in univent**

**Picture 3**

**Univent Exhaust Unit (right side of picture)**
**Note materials on floor next to exhaust vent**

**Picture 4**



**One type of radiator found in MGRS**

**Picture 5**

**Water-damaged ceiling tile, type affixed to ceiling system**

**Picture 6**

**Water-damaged ceiling tile, suspended type**

**Picture 7**


**Items found under sink, including water-damaged cardboard and cleaning supplies**

**Picture 8**

**Plant in contact with window overlooking courtyard**

**Picture 9**

**Pile of mulch in contact with building**

**Picture 10**

**Brick spalling**

**Picture 11**

**Dry erase tray with dusts**

**Picture 12**


**Cleaning products under sink**

**Picture 13**


**Acids stored in non-operable fume hood**

**Picture 14**


**Spool of solder in the stained glass workshop, showing 50% lead 50% tin content**

**Picture 15**

**Pencil shavings**

**Picture 16**

**Dusty blades on personal fan**

**Location: Mount Greylock Regional High School** **Indoor Air Results**

**Address: 1781 Cold Spring Road, Williamstown MA** **Table 1** **Date: December 2, 2011**

| Location | Carbon Dioxide (ppm) | Carbon Monoxide (ppm) | Temp (°F) | Relative Humidity (%) | PM2.5 (µg/m3) | Occupants in Room | Windows Openable | Ventilation | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Supply | Exhaust | |
| Background | 431 | ND | 58 | 23 | 8 | | | | | Sunny, light wind |
| Administration | 914 | ND | 74 | 29 | 9 | 2 | Y | N | Y | Transom over door, radiator |
| Auditorium stage | 533 | ND | 67 | 26 | 4 | 1 | N | Y | Possibly | DO |
| Business manager's office | 707 | ND | 70 | 33 | 5 | 4 | Y | N | Y | Transom over door, DEM, radiators |
| C201 | 886 | ND | 72 | 27 | 8 | 19 | Y | Y | Y | DEM, computer and printer, UV on high, paper near UV exhaust |
| C202 | 544 | ND | 69 | 25 | 6 | 1 | Y | Y | Y | UV supply and UV exhaust |
| C203 | 764 | ND | 72 | 26 | 10 | 21 | Y | Y | Y | Computer lab with many computers, DEM, plants, WD CTs |
| C204 | 547 | ND | 70 | 23 | 4 | 0 | Y | Y | Y | Recyclable cans in room, DEM, UV supply on and UV exhaust |
| C205 | 768 | ND | 71 | 26 | 6 | 12 | Y | Y | Y | DEM, WD CTs |
| C206 | 941 | ND | 72 | 29 | 8 | 10 | Y | Y | Y | UV supply and UV exhaust, DEM, books and papers |

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**Location: Mount Greylock Regional High School** **Indoor Air Results**

**Address: 1781 Cold Spring Road, Williamstown MA** **Table 1 (Continued)** **Date: December 2, 2011**

| Location | Carbon Dioxide (ppm) | Carbon Monoxide (ppm) | Temp (°F) | Relative Humidity (%) | PM2.5 (μg/m3) | Occupants in Room | Windows Openable | Ventilation | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Supply | Exhaust | |
| C207 | 873 | ND | 71 | 28 | 9 | 15 | Y | Y | Y | UV supply and UV exhaust, DEM |
| C208 | 800 | ND | 70 | 27 | 9 | 12 | Y | Y | Y | UV supply and UV exhaust |
| C209 | 884 | ND | 70 | 29 | 9 | 21 | Y | Y | Y | UV supply and UV exhaust PF, PS, DEM |
| C210 | 708 | ND | 71 | 25 | 12 | 8 | Y | Y | Y | UV supply and UV exhaust, DEM, CD, clutter |
| C211 | 915 | ND | 70 | 28 | 9 | 7 | Y | Y | Y | UV supply and UV exhaust, chalk, DEM |
| C212 | 761 | ND | 69 | 28 | 8 | 14 | Y | Y | Y | UV supply and UV exhaust |
| C213 | 902 | ND | 69 | 27 | 9 | 15 | Y | Y | Y | UV supply and UV exhaust, DEM |
| Cafeteria | 815 | ND | 67 | 29 | 8 | >150 | Y | Y | Y | |
| E501 Music Room | 532 | ND | 70 | 28 | 8 | 13 | Y | Y | Y | DO, WD CTs, clutter |

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**Address: 1781 Cold Spring Road, Williamstown MA** **Table 1 (Continued)** **Date: December 2, 2011**

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|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Supply | Exhaust | |
| E504 | 595 | ND | 70 | 26 | 8 | 2 | Y | | | Plants |
| E504 (left) | 579 | ND | 70 | 28 | 8 | 1 | Y | Y | N | Tree and debris from courtyard abut window |
| E506 Guidance | 496 | ND | 69 | 27 | 5 | 1 | Y | N | N | DO, radiator, window open |
| E507 | 715 | ND | 67 | 27 | 7 | 1 | Y | Y | Y | UV supply and UV exhaust |
| E509 | 704 | ND | 68 | 27 | 7 | 13 | Y | Y | Y | UV supply and UV exhaust |
| E511Art Room | 544 | ND | 69 | 27 | 9 | 0 | Y | Y | Y | UV and UV exhaust, art materials, items under sink |
| E512A | 721 | ND | 74 | 26 | 4 | 0 | N | N | N | PC |
| E513 | 742 | ND | 69 | 31 | 8 | 15 | Y | Y | N | Art materials, DO |
| E515 | 520 | ND | 69 | 25 | 8 | 3 | Y | Y | Y | UV supply and UV exhaust, sink with cleaners and items underneath |
| E515 (Food Lab) | 526 | ND | 70 | 25 | 5 | 0 | Y | Y | Y | Open supplies under sink |

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|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Supply | Exhaust | |
| E516 Music room | 486 | ND | 69 | 34 | 6 | 2 | Y | Y | Y | Blinds down, UV, DEM, chalk, humidification in use to protect instruments |
| E517 | 487 | ND | 68 | 27 | 6 | 0 | Y | Y | Y | DEM, WD-CTs |
| Financial Assistance | 748 | ND | 74 | 26 | 7 | 2 | Y | N | N | Transom over door, radiator |
| Gym | 534 | ND | 67 | 27 | 7 | 6 | Y | Y | Y | Exhaust vents behind bleachers/blocked |
| Gym (left side) | 578 | ND | 68 | 26 | 7 | ~6 | N | Y | Y | |
| Library | 689 | ND | 70 | 27 | 6 | 11 | N | Y | Y | Large supply vent in ceiling, exhaust in floor and walls, DO, WD CTs, Computers |
| Library computer lab | 933 | ND | 70 | 30 | 9 | 20 | N | N | N | Computers, DO, WD CT, bowed CT |
| Library single computer room | 691 | ND | 70 | 27 | 8 | 1 | N | N | N | DO, very small room |
| Main principal office | 809 | ND | 70 | 28 | 9 | 1 | Y | Y | N | Clutter, paper storage |
| N302 | 824 | ND | 71 | 27 | 7 | 23 | Y | N | N | Radiators, DEM, plants |

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|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Supply | Exhaust | |
| N304 | 478 | ND | 70 | 23 | 4 | 0 | Y | Y | Y | UV supply and UV exhaust, DEM, WD CTs |
| N306 | 709 | ND | 72 | 24 | 4 | 6 | Y | Y | Y | UV supply and UV exhaust, DEM, DO, fresh air blocked by plastic bins |
| N308 | 903 | ND | 70 | 26 | 4 | 16 | Y | Y | Y | UV supply and UV exhaust, DEM |
| N313 | 681 | ND | 71 | 26 | 7 | 5 | Y | Y | Y | Chalk and DEM, UV supply and UV exhaust |
| Nurses Office | 604 | ND | 67 | 29 | 7 | 5 | Y | Y | Y | |
| Principal's office | 595 | ND | 70 | 27 | 9 | 0 | Y | Y | N | Storage and clutter, UV |
| S101 (Principal's suite) | 745 | ND | 70 | 27 | 9 | 1 | N | N | N | No airflow, large PC |
| S103 Meeting Room | 341 | ND | 66 | 25 | 5 | 0 | N | Y | Y | PF, PCs |
| S107 | 1204 | ND | 70 | 31 | 6 | 27 | Y | Y | Y | WD CTs, DEM |
| S108 | 1404 | ND | 67 | 25 | 6 | 21 | | Y | Y | WD CTs, DEM |

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**Table 1 (Continued)**

**Indoor Air Results**

**Date: December 2, 2011**

| Location | Carbon Dioxide (ppm) | Carbon Monoxide (ppm) | Temp (°F) | Relative Humidity (%) | PM2.5 (µg/m3) | Occupants in Room | Windows Openable | Ventilation | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Supply | Exhaust | |
| S108 (AV) | 630 | ND | 71 | 25 | 9 | 0 | N | Y | ? | Laminator, dirty/stained carpet, other equipment/electronics, DEM |
| S109 | 1107 | ND | 69 | 26 | 7 | 18 | Y | Y | Y | Supply vent not on |
| S110 | 431 | ND | 67 | 30 | 5 | 1 | Y | Y | Y | DEM, WD CT |
| S112 | 578 | ND | 71 | 24 | 3 | 8 | Y | Y | Y on | UV supply blocked with books, 4 CT falling down, DEM, recyclable bottles (empty) |
| S113 | 899 | ND | 71 | 28 | 8 | 14 | Y | Y on | N | DEM, plants on/near UV, CD |
| S114 | 780 | ND | 72 | 26 | 2 | 13 | Y | Y | Y | DEM, WD CTs |
| Staff lounge | | | | | | | | | | Fridge, microwave, old vacuum cleaner |
| Stained glass room | 458 | ND | 69 | 27 | 8 | 0 | Y one ajar | Y | N | Dirty, lead/tin solder in use, no room exhaust or local exhaust for work |
| Theatre | 689 | ND | 72 | 26 | 7 | 0 | N | Y | | Carpet stained, DEM |
| Von Huttz office | 679 | ND | 70 | 26 | 8 | 1 | Y | Y | N | DEM, clutter |

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|---|---|---|---|---|---|---|---|---|---|---|
| W 402 (science) | 911 | ND | 69 | 30 | 17 | 9 | Y | Y | ? | DO, many items and chemicals |
| W403 plant room | 498 | ND | 69 | 30 | 7 | 0 | Y | Y | Y | Numerous plants, UV, sinks, outside door not sealed |
| W406 | 740 | ND | 69 | 27 | 6 | 12 | Y | Y | Y | DEM |
| W408 | 583 | ND | 70 | 28 | 5 | 1 | Y | Y | Y | UV supply blocked, WD-CTs |
| W409 | 694 | ND | 69 | 26 | 9 | 7 | Y | Y | Y | UV on, DEM, clutter, items, under sink |
| W410 | 583 | ND | 70 | 26 | 5 | 0 | Y | Y | Y | |
| W411 | 888 | ND | 69 | 29 | 6 | 19 | Y | Y | Y | DEM |
| W412 | 468 | ND | 69 | 24 | 5 | 0 | Y | Y | Y | DEM |
| W413B | 709 | ND | 71 | 23 | 9 | 0 | Y | Y | Y | UV, clutter, PC |
| W415 | 778 | ND | 71 | 26 | 10 | 18 | | | | Chalk, DEM, odors, items under sink |

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|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Supply | Exhaust | |
| W417 | 1079 | ND | 70 | 28 | 70 | 0 | Y | Y | Y on | Sulfur odor, 20+ WD CTs |
| W417 storage | | | | | | | | | | Chemical hood/storage room, hoods are off with acids inside, 28 WD CT |
| W419 | 610 | ND | 71 | 24 | 7 | 0 | Y | Y on | Y | Sink, UV supply and UV exhaust, DEM, tree against window |
| Weight room | 424 | ND | 66 | 27 | 6 | 0 | Y | Y | Y | |
| Women's staff restroom | | | | | | | | | | No WD |
| Wrestling | 527 | ND | 69 | 25 | 7 | 1 | Y | Y | Y | Large room, mats on floor with disinfectant odor, UV |

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