INDOOR AIR QUALITY ASSESSMENT

Sherwood Middle School
30 Sherwood Ave
Shrewsbury, MA 01545

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 the Shrewsbury Board of Health (SBOH), Shrewsbury School Department (SSD) and Sherwood Middle School (SMS) faculty, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health (BEH) provided assistance and consultation regarding indoor air quality (IAQ) concerns at the SMS located at 30 Sherwood Avenue, Shrewsbury, Massachusetts. Specific concerns related to water damage/microbial growth, the possible presence of asbestos containing materials (ACM), and the presence of polychlorinated biphenyls (PCBs) at levels that may pose a health threat prompted the request. It should be noted that this general IAQ assessment is a component of a larger BEH evaluation of cancer and indoor environmental concerns. The larger evaluation is being led by BEH's Community Assessment Program (CAP).

On April 9, 2009, a visit was made to this building by Cory Holmes, Environmental Analysts/Inspector in BEH's IAQ Program. Mr. Holmes was accompanied by Robert Moore, SBOH; Sheila Gerardi, Assistant Superintendent of Custodians; and Principal Jane Lizotte, during the assessment. Mr. Holmes and Ms. Christine Gorwood, a Risk Communication Specialist in BEH's CAP, returned to the SMS on June 12, 2009, to coordinate testing for polychlorinated biphenyls (PCBs). Samples of air and wipe tests were collected and analyzed by an environmental consultant, Weston & Sampson. Results of PCB testing were the subject of a separate report issued previously (MDPH, 2009). On August 18, 2009, Suzanne Condon, Associate Commissioner, Director, BEH and other BEH staff met with SMS faculty, staff, SSD and Town Officials to discuss findings of the aforementioned report.

The building was previously visited by BEH staff in November, 2005 and a report detailing conditions observed with recommendations for improving indoor air quality was issued in January of 2006 (MDPH, 2006). The 2006 assessment was prompted by a parent concerned about the presence of rodents in the building.

Methods

BEH staff performed a visual inspection of building materials for water damage and/or microbial growth. BEH staff also examined the Shrewsbury Public Building Department's (SPBD) asbestos management plan for the SMS, which details the presence/condition of ACM throughout the building.

Discussion

Microbial/Moisture Concerns

In order for building materials to support mold growth, a source of water exposure is necessary. The SMS appears to have had chronic building envelope leaks as evidenced by water damaged materials throughout the building, including:

- Water damaged plaster around window frames (Pictures 1 and 2);
- Water damaged ceiling plaster and efflorescence (Pictures 3 through 5); and
- Water stained ceiling tiles (Picture 6).

Efflorescence is a characteristic sign of water damage but it is not mold growth. As moisture penetrates and works its way through mortar, brick or plaster, water-soluble compounds dissolve, creating a solution. As the solution moves to the surface of the material, the water evaporates, leaving behind white, powdery mineral deposits.

Repeated water damage to porous building materials (e.g., gypsum wallboard, ceiling tiles, carpeting) can result in microbial growth. 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.

A chronic roof leak was reported in the main office where water damaged ceiling plaster was noted (Picture 3). Office staff reported that buckets are commonly placed beneath areas of known water leaks during rainstorms. Leaks were also reported in 1st floor classrooms 120/121, where again water damaged ceiling plaster was also noted. BEH staff examined the classroom above this area and found a clogged drain (Picture 7), which may be the source of previous water leaks.

Active leaks were also reported in modular classroom 109. At the time of the April 9, 2009 visit, visible mold growth was observed on the gypsum wallboard (GW) ceiling above ceiling tiles in the corner of the classroom (Picture 8). SPBD staff reported that a roof drain above this modular classroom had frozen, causing damage to the integrity of the drainpipe, which caused the water leak and subsequently damaged the ceiling tiles. In order to prevent future pipe freezing, the SPBD installed heated coils in roof drains to melt ice (Picture 9). As mentioned, BEH staff visited the SMS on June 12, 2009, subsequent to the pipe heating system installation, which was after several days of rain. BEH staff found that the ceiling tile below the in this area was saturated (Pictures 10 and 11), indicating that the damaged drainpipe was unlikely to be the sole cause of water penetration. In subsequent

correspondence with Mr. Cox it was reported that the roof drain was planned to be removed and repaired and that the water damaged ceiling materials would be replaced during the summer 2009 break. This work was in progress during the August 18, 2009 visit, as evidenced by roofing contractors working on top of the modular classroom wing.

Other potential water penetration sources were noted around the exterior of the building, including:

- Missing/damaged exterior window caulking (Pictures 12 through 14);
- Missing/damaged mortar and exterior brick (Picture 15);
- A clogged exterior drain at the rear of the building (Pictures 16 and 17);
- Missing elbow extensions on downspouts (Picture 18); and
- Spaces under exterior doors (Picture 19).

The aforementioned conditions represent potential moisture 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). In addition, these breaches may provide a means for pests/rodents into the building.

Asbestos Containing Materials (ACM)

In 1986, the Asbestos Hazard Emergency Response Act (AHERA) was enacted to address repair of friable ACM in schools (US EPA, 1986). AHERA outlines a detailed process aimed at ensuring the safe management of all ACM by a designated person for a local education agency and requires the following:

- *Identify any ACM in the building using a licensed asbestos inspector.* A building-wide asbestos inspection was initially conducted in 1989.
- *Re-inspect any ACM using an accredited asbestos inspector every three years to determine any changes in condition.* Three-year inspections were up to date based upon records available. The next three-year inspection is due January 2010.
- *Perform periodic surveillance every six months with the following information: name of person performing the surveillance; date of surveillance; and any changes in the condition of the material.* A review of records also indicated that six-month inspections were up to date, conducted by Robert Cox, SPBD Superintendent.
- *Prepare an asbestos management plan (AHERA plan) that is kept on-site, up to date and available without restriction.* Copies of the AHERA plans are kept both at the SMS and at the SPBD central office.
- *Maintain accurate records of relevant events (response actions, personnel training, surveillance, inspections, cleaning/maintenance activities, etc.) and regular updates of the asbestos management plan as required.* Removal activities and clearance testing were included in the AHERA plan, as were training certificates.

Unless specifically tested and confirmed by an accredited laboratory, a material cannot be completely ruled out as non-ACM. However, ACMs do not pose a health risk when they are intact and well-maintained.

During the April 2009 MDPH site visit, occupants expressed concern with the possible presence of asbestos in specific building materials:

- Lab benches/classroom countertops (Pictures 20 and 21);
- Damaged (vinyl/linoleum) countertop material adjacent to univents (Picture 22);

- Damaged acoustical wall tiles (Picture 23); and
- Damaged wall plaster along windows (Picture 24).

According to the initial 1989 AHERA report:

- Lab benches in several areas (rooms 122, 123, 124, 207, 208, and 209) are made of Transite, which is a hard, fireproof composite material made of cement and asbestos. Transite is characterized as non-friable ACM. It is unclear if this excludes other similar looking lab benches and countertop material in other classrooms.
- No direct reference was listed for vinyl/linoleum material adjacent to univents.
- Wall tiles were determined to be non ACM.
- Wall plaster tested negative for ACM, with the exception of plaster in room 129 behind an outlet. It is unclear why this room was unique.

Other IAQ Conditions

Other conditions that can affect indoor air quality were observed during the assessment. Occupants had complaints of dirt/dust accumulation in perimeter radiant heat vents along exterior walls and windowsills (Picture 25 and 26). Over time, dirt, dust and debris settle in these vents where they accumulate. When the heating system is activated and heat rises from these vents (or from pipes traversing the grates), it can create a source of airborne particulates and odors.

Scented oil was observed on the univent in classroom 137 (Picture 27). Air deodorizers contain chemicals that can be irritating to the eyes, nose and throat of sensitive

individuals. Furthermore, deodorizing agents do not remove materials causing odors, but rather mask odors that may be present in the area.

Several occupants questioned the presence of a plywood sheet covering a portion of the cinderblock wall in classroom 122 (Picture 28). BEH staff removed the panel to observe conditions of the wall and found that several of the cinderblocks had been removed to gain access to plumbing fixtures in the wall cavity (Picture 29).

An occupant of the room that was created behind the stage had complaints of asthma exacerbation. BEH noted holes in a wall panel that opened into the wall cavity, which could serve as a pathway for dirt, dusts and odors into the stage room (Picture 30). Located in close proximity to these holes was a portable air purifier (Picture 30). Air purifiers have an internal fan that draws air into them. The close proximity of the air purifier to the openings in the wall can actually draw dirt, dust and odors from the wall cavity into the stage room, where the teacher's desk is located. In addition, an access panel was missing from the air handling unit (AHU) that supplies ventilation for this area (Picture 31). The lack of an access panel will render the AHU casing non-airtight and draw air from the basement space into the unit. As air bypasses filters, the opportunity exists for airborne dirt, dust, odors and particulates to be drawn into the HVAC system and be distributed to occupied areas. Aerosolized dust, particulates and odors can provide a source of eye, skin and respiratory irritation.

Finally, occupants expressed concern about on-going issues with rodents. For people suffering with asthma, exposure to allergens may trigger asthma symptoms, which may include shortness of breath. Rodents and their urine can serve as triggers for asthma for some individuals. Staff informed BEH that a number of mice had been caught this year, particularly in lower level classroom 011. To penetrate the exterior of a building, rodents

require a minimal breach of ¼ inch (MDFA, 1996). Rodent infestation results from easy access to food and water in a building. Rodent infestation can result in indoor air quality related symptoms due to materials in their wastes. Mouse urine contains a protein that is a known sensitizer (US EPA, 1992). A three-step approach is necessary to eliminate rodent infestation:

1. Removal of the rodents;
2. Cleaning of waste products from the interior of the building; and
3. Reduction/elimination of pathways/food sources that are attracting rodents.

To eliminate exposure to allergens, rodents must be removed from the building. Please note that removal, even after cleaning, may not provide immediate relief since allergens can exist in the interior for several months after rodents are eliminated (Burge, 1995). A combination of cleaning, increase in ventilation and filtration should serve to reduce rodent associated allergens once the infestation is eliminated. Under current Massachusetts law that went into effect November 1, 2001, the principles of integrated pest management (IPM) must be used to remove pests in schools (Mass Act, 2000).

Conclusions/Recommendations

The BEH recommends that in order to prevent mold and related spore migration from entering occupied areas, recommendations outlined below should be implemented. MDPH guidance on mold remediation was previously provided to the SPBD and is provided in this report as (Appendix A). The MDPH prepared the mold remediation guidance document in order to reduce or minimize exposure opportunities to mold in buildings and to prevent/reduce

the migration of remediation-generated pollutants into occupied areas. The MDPH suggests that the following steps be taken on any remediation project within a public building.

Removal of Water Damaged/Mold-Colonized Materials

1. Conduct remediation activities in a manner consistent with provided MDPH Guidelines (Appendix A) as well as recommendations in "Mold Remediation in Schools and Commercial Buildings" published by the US Environmental Protection Agency (US EPA, 2001). This document can be downloaded from the US EPA website: http://www.epa.gov/iaq/molds/mold_remediation.html.
2. Remove water-damaged/mold-colonized gypsum wallboard in modular classroom 109. Consider replacing with a non-porous material. This measure will remove actively growing mold colonies that may be present.
3. Use local exhaust ventilation and isolation techniques to control remediation pollutants. Precautions should be taken to avoid the migration of these materials into adjacent/occupied areas of the building.
4. Ensure that during remediation/containment measures, the general mechanical ventilation system is deactivated and/or sealed (i.e., supply and return vents) in areas of remediation.
5. Seal discarded mold-colonized materials in plastic trash bags for transport to prevent cross-contamination during removal from building.
6. Clean non-porous surfaces (e.g., chairs, desks, tables) with a mild detergent, soap and water or an appropriate antimicrobial agent.

7. Vacuum carpets (and other surfaces) with a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner.
8. Establish communications between all parties involved with remediation efforts, to prevent potential IAQ problems and address related concerns.

Asbestos Concerns

1. Continue to conduct required 6-month and 3-year AHERA inspections and document in accordance with current asbestos management plan.
2. Coordinate efforts between building occupants, maintenance staff, building officials, and the school's licensed asbestos inspection firm to confirm that building materials (i.e., lab benches/countertops, linoleum/vinyl surfaces adjacent to univents and wall plaster) do not have ACM. Where asbestos-containing materials are found and/or damaged, these materials should be removed, remediated or maintained in a manner consistent with Massachusetts asbestos remediation laws (MDLI, 1993).

Other Recommendations

1. Operate all ventilation systems (univents, exhaust vents and air handling units) that are operable throughout the building continuously during periods of school occupancy.
2. Set thermostat controls in modular classrooms to the "on" position to provide constant supply and exhaust ventilation during periods of occupancy.
3. Remove all blockages from univents and exhaust vents to ensure adequate airflow.
4. Close classroom doors to maximize air exchange.

5. Use openable windows in conjunction with mechanical ventilation to increase air exchange. Care should be taken to ensure windows are properly closed at night and weekends to avoid the freezing of pipes and potential flooding.
6. Work with a roofing contractor to make repairs to chronic roof leaks in modular classroom wing. Replacing water damaged materials will remove mold growth; however, unless the source of moisture is repaired materials will continue to get wet and may lead to subsequent mold growth.
7. Seal utility holes/breaches in exterior walls and install weather stripping around exterior doors to prevent pest entry, water penetration and drafts.
8. Continue with IPM plans to control rodents. Consider working with a licensed pest control company if current plans are unsuccessful.
9. For additional advice regarding pest control contact the Massachusetts Department of Agricultural Resources, Pesticide/School IPM Program at (617) 626-1700 http://www.mass.gov/agr/
10. Replace missing elbows to downspouts in a manner to direct rainwater away from the building.
11. Ensure drain pipe in classroom 208 is unclogged.
12. Inspect/repair roof above main office and make repairs as needed.
13. Remove/replace water damaged ceiling tiles. Examine the areas above and around for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial.
14. Consider removing carpeting in areas of chronic leaks. If asbestos floor tiles are located beneath carpet and are damaged, these materials should be removed,

remediated or maintained in a manner consistent with Massachusetts asbestos remediation laws (MDLI, 1993).

15. Remove leaves and debris from exterior drain, examine for proper drainage. Make repairs as needed.

16. Seal windows to prevent water penetration and drafts.

17. Scrape/clean efflorescence from masonry walls/ceilings and monitor for further water penetration. Clean, prepare, and re-paint concrete/plaster ceilings and walls in water damaged areas once leaks are repaired.

18. Consider replacement of window systems throughout the building to prevent water penetration and drafts through window frames.

19. Consider having exterior brick re-pointed and waterproofed to prevent water intrusion.

20. Remove and conduct thorough cleaning of perimeter wall-mounted radiator units and window vents (Pictures 23 and 24) using a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner. Inspect periodically, clean as needed.

21. Refrain from scented oils, air fresheners and deodorizers to prevent exposure to VOCs.

22. 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 for 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).

23. Seal holes in wall panel in stage room.

24. Replace missing access panel for AHU in stage room to prevent filter bypass.

25. 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.

26. 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://www.mass.gov/dph/iaq.

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Picture 1

Water Damaged Plaster around Window Frames

Picture 2

Water Damaged Plaster around Window Frames

Picture 3

Water Stained Ceiling Plaster in Main Office, Note Bulge in Center

Picture 4

Water Damaged Ceiling Plaster and Efflorescence

Picture 5

Water Damaged Ceiling Plaster and Efflorescence

Picture 6

Water Damaged Ceiling Tiles in Modular Classroom 109, Note Bucket to Catch Leaks (April 9, 2009)

Picture 7

Clogged Drain in Classroom 208, Directly above Classroom 121

Picture 8

Water Damaged/Mold Colonized Gypsum Wallboard Ceiling in Modular Classroom 109

Picture 9

Heated Electrical Coils to Melt Ice in Rooftop Drains of Modular Wing

Picture 10

Water Damaged Ceiling Tiles in Modular Classroom 109, Note Dark Circular Stain Indicating Tile was Saturated (June 12, 2009)

Picture 11

Pooling Water on Roof of Modular Classroom Wing (June 12, 2009)

Picture 12

Missing/Damaged Exterior Window Caulking

Picture 13

Missing/Damaged Exterior Window Caulking

Picture 14

Missing/Damaged Caulking around Window Frame

Picture 15

Missing/Damaged Mortar around Exterior Brick

Picture 16

Clogged Drain at Bottom of Exterior Stairwell

Picture 17

Close-Up of Clogged Drain at Bottom of Exterior Stairwell, Note Tree Growing out of Dirt/Debris

Picture 18

Missing Elbow Extension on Downspout

Picture 19

Spaces under Exterior Doors

Picture 20

Sink Countertops

Picture 21

Classroom Countertop

Picture 22

Countertop Material Adjacent to Univent along Windows

Picture 23

Damaged Acoustical Wall Tile

Picture 24

Water Damaged Plaster around Window Frames

Picture 25

Perimeter Radiant Heat Vents along Window Sill

Picture 26

Perimeter Radiant Heat Vents along Exterior Wall

Picture 27

Scented Oil on Windowsill near Univent in Classroom 137

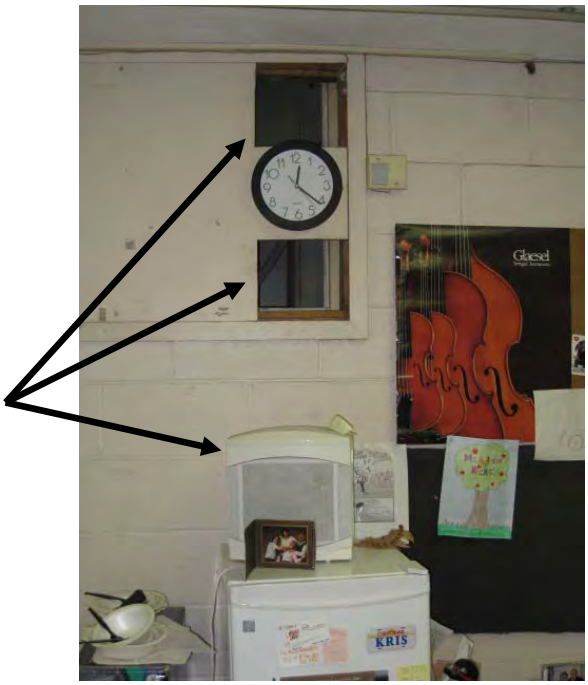
Picture 28

Plywood Panel on Wall in Classroom 122

Picture 29

Plumbing Fixture behind Plywood Panel on Wall in Classroom 122

Picture 30



Proximity of Air Purifier to Holes in Wall Panel in Stage Room

Picture 31

Missing Panel on HVAC Unit in Stage Room Allowing for Filter Bypass