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MOUNT VIEW MIDDLE SCHOOL: MOLD INVESTIGATION PROGRESS REPORT

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Prepared for: Howard County Public School System

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY 3

2.0 PRELIMINARY FINDINGS..... 4

3.0 BACKGROUND 6

4.0 HISTORY OF MOLD INCIDENTS AND RESPONSE ACTIONS 6

 4.1 Spring, 2013..... 6

 4.2 June, 2014 6

 4.3 July 2015..... 7

 4.4 September, 2015 8

 4.5 October, 2015..... 8

5.0 BUILDING INSPECTION 8

6.0 MOLD SAMPLING DATA 9

7.0 HEALTH CONCERNS 9

8.0 HUMIDITY CONTROL 10

APPENDIX A: HEALTH EFFECTS OF MOLD 12

1.0 EXECUTIVE SUMMARY

Note: BDL drafted this Progress Report based on initial findings from their evaluation of mold concerns at Mount View Middle School (MVMS). Please send comments to Elight@Building-Dynamics.com. BDL will conduct further investigation based on additional information.

MVMS is in overall good condition, is safe to occupy, and no hazards were identified. Elevated humidity during the cooling season caused mold growth. While most surfaces are now free of mold growth, BDL identified localized suspect growth and this was remediated by HCPSS. Possible ongoing leaks were observed in G&T Resource, 23 Kiln Room and a Health Suite patient room and these were repaired. There were moderate to heavy dust accumulations on upper and difficult to access surfaces throughout the school and this was cleaned by HCPSS. There was suspect spotting above lower level suspended ceilings on chilled water pipe insulation and localized CWP sweating (mostly water stains with some suspect growth), and suspect growth on top of a few ceiling tiles under these pipes. Occupants are not directly exposed. This insulation will be replaced next summer.

HVAC controls are being modified to improve humidity control and prevent a reoccurrence of mold growth next summer. Some teachers have interfered with HVAC operation by shutting off classroom ventilators and re-setting thermostats to low temperatures which increases relative humidity. BDL's final report will include more detailed engineering and recommendations for operating the building to prevent future mold growth.

Although there are no accepted standards for mold growth and damp conditions in buildings and they do not affect the health of the majority of occupants, these conditions are a potential trigger of allergy symptoms in some individuals. Such reactions are temporary and generally minor. BDL reviewed available information with the school nurses and found no cases where student symptoms were consistent with mold-related illness. The excess of pneumonia and bronchitis cases at MVMS this fall was not associated with mold. BDL also interviewed staff. Several teachers reported aggravation of pre-existing allergies coinciding with time at MVMS. Building-related allergy symptoms are often caused by factors other than mold, such as dust, pet dander and insects and the specific cause of allergies at MVMS could not be established from available information. Elimination of mold growth, dampness and excessive dust at MVMS may be beneficial to these individuals.

2.0 FINDINGS

- 2.1 MVMS is in overall good condition, is safe to occupy, and no hazards were identified.
- 2.2 Elevated humidity during the cooling season caused mold growth. HVAC controls are being modified to improve humidity control and prevent a reoccurrence of mold growth next summer.
- 2.3 BDL reviewed available information with the school nurses and found no cases where student symptoms were consistent with mold-related illness. Increased pneumonia and bronchitis at MVMS this fall was not associated with mold.
- 2.4 BDL also interviewed staff. Several teachers reported aggravation of pre-existing allergies coinciding with time at MVMS. Building-related allergy symptoms are often caused by factors other than mold, such as dust, per dander and insects and the specific cause of allergies at MVMS could not be established from available information. Elimination of mold growth, dampness and excessive dust at MVMS may be beneficial to these individuals.
- 2.5 While most surfaces are free of mold growth, BDL identified localized suspect growth in the following locations and these were all subsequently resolved by HCPSS:
 - Cork strips above blackboards on the lower level (being replaced)
 - Carpets on the lower level (odor musty during the cooling season), These were subsequently sanitized by HCPSS and are scheduled to be replaced next summer.
 - Teacher's desks in 14, 17 and 18 (remediated)
 - Bookshelves under windows in 15, 16, 17, 19, 20, 21 (remediated)
 - Minor suspect spotting on a cork board in 10 (being replaced)
 - FACS sink cabinets (not related to humidity, remediated)
 - Band instrument closet shelves (remediated)
 - Portable 2 window sill (remediated)
- 2.6 There was widespread suspect spotting above lower level suspended ceilings on chilled water pipe insulation caused by elevated humidity. These chilled water pipes also had localized sweating (mostly water stains with minor suspect growth), and suspect growth on top of a few ceiling tiles under these pipes. Occupants are not directly exposed to chilled water pipes and the tops of ceiling tiles. This insulation is scheduled to be replaced next summer.
- 2.7 There are also water stained ceiling tiles in several rooms (without suspect growth). These sites were investigated by BDL and moisture sources generally appeared to be resolved. Possible ongoing leaks were observed in G&T Resource, 23 Kiln Room and the Health Suite right patient room. HCPSS has resolved all leaks and stained ceiling tiles have been replaced.
- 2.8 There are moderate to heavy dust accumulations on upper ledges and behind contents throughout the school. This was subsequently cleaned by HCPSS.
- 2.9 HVAC units were found to be clean and in good sanitary condition. Air conditioners in the

two portables were not inspected.

- 2.10 While runoff appears to generally drain away from the building, water may pond against the building by Room 10, making it a possible source of interior moisture. This will be corrected next summer.
- 2.11 Mold growth during summer 2014 was primarily due to chiller problems, negative pressure and HVAC controls deficiencies. HCPSS inspected and repaired all pneumatic controls. Negative pressure issues will be resolved with modification of controls and air balancing.
- 2.12 Mold growth during summer 2015 appears to be primarily due to the air conditioning being off for periods for roof construction, exceptionally hot, humid weather, negative pressurization and equipment malfunctions.
- 2.13 In November, BDL found the building under negative pressure with HVAC on and strongly negative with HVAC off. During warmer months, this draws unconditioned, humid air into the building. Negative pressure issues will be resolved with modification of controls and air balancing.
- 2.14 These HVAC fans were observed running after hours: exhaust fans, electrical room exhausts F-22 and 234, RTU3, uninvent 17, VAV in 22A and Portable 2. These were corrected by HCPSS.
- 2.15 The HCPSS summer air conditioning schedule for all schools ventilates unoccupied areas for several hours a day, potentially increasing relative humidity. BDL is preparing additional recommendations to resolve this.
- 2.16 Many classrooms have been over-cooled (69-72 degrees) which increases relative humidity. HCPSS will adjust controls and set cooling set-points to specified temperature.
- 2.17 During BDL interviews, teachers report frequent overheating in Room 7, Room 3, G&T Resources, Computer Lab, Orchestra Room, Student Services. HVAC controls will be modified to maintain proper temperature and humidity levels.
- 2.18 Although unit ventilators and thermostats at MVMS are locked, some teachers have interfered with HVAC operation by shutting them off. Some teachers at MVMS interfere with this by breaking into thermostats and re-setting to low temperatures (which increases relative humidity). Although this may be in response to temperature control deficiencies, HCPSS Maintenance reports that they do not receive comfort complaints from MVMS and that they can generally resolve temperature concerns if made aware of them.

HCPSS staff are reminded not to manipulate unit ventilators and to report all comfort issues to the Building Services Department for resolution.

2.0 BACKGROUND

In October 2015, Building Dynamics, LLC (BDL) was requested by HCPSS to assess environmental conditions and health concerns at Mount View Middle School (MVMS), evaluate the ability of HVAC systems to prevent future mold issues and make recommendations for improving indoor air quality (IAQ).

BDL developed a work plan for this assessment consisting of:

1. Review related documentation (mold identification, testing and remediation, IAQ investigations, health concerns, etc.)
2. Evaluate mold growth episodes for cause, impact, effectiveness of corrective measures and the potential for future reoccurrence
3. Conduct a comprehensive building inspection, including above ceilings
4. Assess health risks by investigating reported cases of building related symptoms, reviewing Health Room documentation and interviewing staff
5. Complete an engineering review of HVAC design, operations and maintenance with a focus on system operation during past mold episodes and current humidity control by the new HVAC system
6. Recommend actions to correct observed deficiencies and ensure environmental conditions remain safe

This progress report summarizes BDL findings to date. Work items (1) – (4) have been completed. BDL will finalize remaining work items and conduct additional investigations where needed to resolve any outstanding concerns.

3.0 HISTORY OF MOLD INCIDENTS AND RESPONSE ACTIONS

BDL reviewed HCPSS documentation of MVMS mold incidents and maintenance response. Similar to most schools, there have been occasional incidents involving minor mold growth and reports of occupant symptoms attributed to the building. Humidity control during the cooling season is a concern at MVMS and there has been mold growth on lower level classroom surface during some hot, humid periods. This is not uncommon for vacant areas during summer break, and this growth has been remediated by custodial personnel and specialized contractors by treatment with a sanitizing solution and HEPA-vacuuming. Reported contributing factors to excessive humidity included HVAC fans not shutting off at night, chiller operating problems and HVAC components requiring repair.

4.1 Spring, 2013

HCPSS evaluated classroom ventilators and identified that some valves did not open fully, reducing dehumidification, and some outdoor air dampers had been disconnected to reduce humid outdoor air which was entering the space. Humidity control was also impacted by the lack of pressure in pneumatic lines controlling the operation of the night thermostat. These were resolved by the end summer 2013.

4.2 June, 2014

HCPSS evaluated classrooms in response to staff dampness and mold concerns.

Findings:

- In lower level classrooms, ceiling tiles were significantly bowed due to high humidity and were damp in some areas; Carpet and desks were moist at times; Upper levels had slightly bowed ceiling tiles and were dry. Relative humidity was measured up to 93%.
- Slight mold growth was observed on the underside of a wooden rocker, wood above chalkboards, cork bulletin boards and on fiberglass pipe insulation above ceiling tiles. Other surfaces did not have visible mold growth.
- Musty odor was detected on the lower level.
- Some unit ventilators were turned off and two rooms were cold.
- The pneumatic system (air pressure) controlling the HVAC system may be deficient.
- The chiller system was down 50% during the spring and the air conditioning failed completely on June 19th. Chiller operation was restored that summer.
- The entire building was under strong negative pressure.

Response Actions:

- Ensured proper operation of outdoor air dampers and thermostats and that systems did not operate beyond scheduled hours
- Ensured exhaust fans were operating properly
- Evaluated building pressurization
- Sanitized the wooden rocker and wood above a chalk board.

4.3 July 2015

HCPSS re-evaluated classrooms in response to staff mold concerns.

Findings:

- Some classrooms on both levels were impacted by periods of sustained relative humidity exceeding 70%.
- There was localized mold growth in some rooms on the bottom of wood rocking chairs, student desks, bulletin boards, student chairs, student plastic chairs, and fabric teacher chairs.
- There was a musty odor.
- The cause of the increased humidity was found to be a combination of factors including unoccupied rooms without a heat load to cycle on dehumidification, exceptionally hot, humid weather, pneumatic controls leaking, causing certain unit ventilators to operate 24/7, and roof replacement activities.
- Unit ventilators were clean but were shut off by staff in rooms 10, 13, and art.
- A few unit ventilators were operating 24/7 due to pneumatic air leaks within controls.
- Pipe insulation above drop ceiling of lower level classrooms had faint mold spotting and some smaller pipe insulation had readily visible mold growth.

Response Actions:

- A restoration company cleaned and sanitized identified mold and HEPA-vacuumed carpets.

- Depending on how extensively bulletin boards were impacted, they were either disinfected or replaced.
- Dehumidifiers were brought in for a few days.
- Classroom ventilators were cleaned and checked for control deficiencies, which were repaired.
- Hallway carpeting was removed and replaced with floor tile (already scheduled before incident).
- An engineering review of HVAC systems was initiated.
- Exhaust system(s) serving rooms 10, 12, 13, and 16 were restored.
- Supply air diffusers were replaced and thermostat, adjusted in Portable 2.

Also during the summer of 2015, water infiltration occurred while the roof was open for replacement during one rainstorm in the Main Office area. No mold growth was observed and this area was restored by a water damage contractor.

4.4 September, 2015

- HCPSS assessed lower level classrooms in response to a parent concern. The outdoor air louver found on the Portable 2 HVAC unit did not open, ceiling supply air diffusers had suspect growth and the thermostat was set too low.

4.5 October, 2015

HCPSS responded to teacher IAQ complaint on the lower level and detected musty odor.

4.0 BUILDING INSPECTION

MVMS surfaces were evaluated by BDL for indicators of excess moisture and suspect growth following procedures consistent with ASTM D7338-10, Standard Guide for Assessment of Fungal Growth in Buildings. In addition to occupied space, BDL inspected above suspended ceilings and inside HVAC equipment.

Ceiling tiles are sensitive to humidity and their appearance provides a good indicator of dampness over time. At MVMS, ceiling tiles are significantly bowed in lower level classrooms, suggesting excessive humidity over time. Ceiling tiles throughout the rest of the building are only slightly bowed

Surfaces were free of suspect growth and dry, with the following minor exceptions:

- Suspect growth on cork strips above blackboards on the lower level
- Although carpets did not smell musty at the time, those on the lower level are reported to still smell musty during cooling season
- Minor suspect spotting was observed on teacher's desks in 14, 17, 18,
- Minor suspect spotting was observed on exterior bookshelves in 15, 16, 17, 19, 20, 21
- Minor suspect spotting was observed on a cork board in 10
- Minor suspect growth unrelated to humidity in FACS sink cabinets, on some shelves in band instrument closet and a Portable 2 window sill.

Widespread suspect spotting was observed above lower level suspended ceilings on chilled water pipe insulation due to humidity, localized pipe sweating (mostly water stains with minor suspect growth and suspect growth on top of a few ceiling tiles. Occupants are not directly exposed these.

There were water stained ceiling tiles visible in several rooms (no suspect growth). These were investigated by BDL and moisture surfaces generally appeared to be resolved. Possible ongoing leaks were observed in G&T Resource, 23 Kiln Room and the Health Suite right patient room.

There was moderate to heavy dust accumulations on upper and difficult to access surfaces throughout school. High touch surfaces were sanitized during pneumonia outbreak Sept-Nov (now appears to be resolved). On December 14, HCPSS cleaned some upper level surfaces.

BDL accessed representative HVAC units to evaluate mechanical hygiene. Roof top units and wall ventilators were observed to be clean and in good sanitary condition. Air conditioners in the two portables were not inspected.

While runoff appears to generally drain away from the building, water may pond against the building by Room 10.

5.0 MOLD SAMPLING DATA

Mold spores are ubiquitous in both indoor and outdoor air and there are no accepted standards for measured concentrations. Interpretation of airborne mold measurements is must take into account natural variability and there are no accepted air quality standards for mold.

HCPSS had Aria Environmental test MVMS for airborne spores as part of this investigation and BDL reviewed these data. Aria interpreted these data by comparing indoor to outdoor mold concentrations. Outdoors, mold concentrations can range from non-detected during cold, dry weather to over 100,000 spores per cubic meter when conditions are hot and humid. Inside spore concentrations are also highly variable. They are primarily made up of spores infiltrating from the outside and those associated with indoor dust (spore counts increase with building activity). Spore counts are not a reliable predictor of mold growth and it cannot be conclusively determined whether elevated counts are due to water damage or are naturally occurring. Individual air samples only reflect one point in time and do not reflect variation over time. Occasional detection of elevated indoor spore concentrations does not necessarily identify a mold growth problem. Air sampling data cannot be related to health risks and there are no accepted standards for spore concentrations.

Spore concentrations measured at MVMS were less than outside concentrations. Total spore concentrations in Rooms 10 and 12 were an order of magnitude above baseline conditions in other areas. This coincided with the two rooms where univent OA dampers remained open, thus drawing in more outdoor mold spores.

6.0 HEALTH CONCERNS

Although there are no accepted standards for mold growth and damp conditions in buildings and they do not affect the health of the majority of occupants, these conditions are a potential trigger of allergy symptoms in some individuals. Such reactions are temporary and generally minor. BDL reviewed available information looking for symptom patterns suggesting mold-related illness.

BDL reviewed available information with the school nurses and found no cases where student symptoms were consistent with mold-related illness. The excess of pneumonia and bronchitis cases at MVMS this fall was not associated with mold.

HCPSS has received complaints from three MVMS teachers attributing symptoms to mold. Although HCPSS investigations were inconclusive as to association with building conditions, additional remediation and repairs were recommended as a precaution.

BDL interviewed 19 MVMS teachers regarding their health status and observations of environmental conditions. All report observing damp conditions on the lower level. Half stated that they had not experienced symptoms which they attributed to time spent in the building. Several teachers report aggravation of pre-existing allergies coinciding with time at MVMS. Building-related allergy symptoms are often caused by factors other than mold, such as dust, per dander and insects and the specific cause of allergies at MVMS could not be established from available information. Elimination of mold growth, dampness and excessive dust at MVMS may be beneficial to these individuals.

The remaining half of teachers attributing illness to the building described non-specific symptoms unlikely to be building-related (i.e., light-headed, fatigue). These individuals were told to consult their personal physician if these are an ongoing concern. Appendix A summarizes science-based findings on mold health effects in general.

7.0 HUMIDITY CONTROL

Summer mold growth generally does not occur in schools unless the HVAC is being operated in a manner allowing continuous high humidity levels over several weeks or there are equipment malfunctions. The primary cause of mold growth at MVMS has been sustained periods of elevated relative humidity. HCPSS and BDL are continuing to evaluate HVAC systems to identify specific causes of past mold growth incidents and to make recommendations for ongoing HVAC operations which will ensure that humidity-related mold growth does not reoccur. To date, BDL has reviewed some of the HVAC documentation, with these initial observations:

- Mold growth during summer 2014 was primarily due to chiller problems, negative pressure and HVAC controls deficiencies.
- Mold growth during summer 2015 appears to be primarily due to the air conditioning being off for periods due to roof construction, exceptionally hot humid weather, negative pressurization and control malfunctions.
- BDL found the building to still operate under negative pressure with the HVAC on and was strongly negative with HVAC off
- The following HVAC fans were observed running after hours: exhaust fans, electrical room exhausts F-22 and 234, RTU3, uninvent 17, VAV in 22A and Portable 2
- Unconditioned outside air was blowing into Rooms 10 and 12 when unit ventilators were off because dampers remained open.
- HCPSS summer air conditioning schedule for all schools ventilates unoccupied areas for several hours a day, potentially increasing relative humidity
- During BDL interviews, teachers report that overheating was not resolved by Maintenance in Room 7, Room 3, G&T Resources, Computer Lab, Orchestra Room, Student Services

Maintaining IAQ in occupied classrooms is dependent on classroom air units providing continuous ventilation and temperature controls remaining set within the specified range. Although unit ventilators and thermostats at MVMS are locked, some teachers have interfered with HVAC operation by shutting them off ventilation and lowering their thermostat to temperatures which increase relative humidity. Although this may be in response to temperature control deficiencies, HCPSS Maintenance reports that they do not receive comfort complaints from MVMS and that they can only resolve temperature concerns if made aware of them. It's also important for teachers to understand the limitations of school HVAC systems. Because equipment is set by season to provide either cooling or heating, rooms can be too warm on an unseasonably warm winter day. Also, since systems are generally off overnight, rooms can be uncomfortable first thing in the morning. Finally, because humidification is not typically provided in schools and portable humidifiers are not allowed, air can be very dry in the winter and contribute to irritation.

BDL reviewed environmental measurements made by HCPSS and their consultant, Aria, and found:

- Between Aug 17 and Sept 30, relative humidity (RH) wasn't sufficiently elevated on a sustained basis to grow mold, but was high enough at night to leave porous materials damp (responsible for ongoing musty carpet odor).
- Mold growth primarily occurred on the lower level where RH was higher (warmer temperature upstairs reduced RH)
- Although inside spore counts were below outside levels, total spore concentrations in Rooms 10 and 12 were an order of magnitude above baseline conditions in other areas. This coincided with the two rooms where uninvent OA dampers remained open, thus drawing in more outdoor mold.
- Many classrooms have been over-cooled (69-72 degrees). Resetting to 74-76 would reduce RH and save energy

The final phase of BDL's study will include a more detailed engineering review of HVAC systems and operating procedures.

BDL President, Ed Light, CIH, *holds degrees in Environmental Science from the University of Massachusetts (B.S.) and Marshall University (M.S.), is a Senior Fellow of the American Industrial Hygiene Association, has authored over 40 scientific publications on assessment and control of the indoor environment and chaired several national scientific committees. In the 1980s, Mr. Light established the West Virginia Department of Health IAQ Program, pioneering efforts to resolve exposure issues related to formaldehyde, asbestos, and termiticides. In the 1990's, he developed widely used protocols for addressing IEQ complaints (published by EPA, NIOSH and ISIAQ) and managing air quality in occupied buildings under construction (now an ANSI standard). As a consultant, Mr. Light has directed more than 1000 multi-disciplinary IEQ investigations, ranging from the White House to the South Pole Station.*

APPENDIX A: HEALTH EFFECTS OF MOLD

The majority of building occupants are not affected by dampness and mold growth (termed “dampness” in this document). Dampness is thus not a health hazard like asbestos or carbon monoxide, but it can cause symptoms in some sensitive individuals. There are many different types of mold, but all present similar health risks to building occupants.

1. Are allergy-type symptoms related to mold?

While 40% of the population is allergic to various environmental agents, only 5% experience allergy symptoms when exposed to mold. Allergy symptoms are generally minor (i.e., short-term congestion or watery eyes), although asthmatics may experience more severe reactions. Mold allergies can occur both inside buildings and outdoors. Building-related allergies are often triggered by substances other than mold (i.e., dust, animal dander, insect residues) and can be similar to those associated with other illness (i.e., colds and flu). Dampness-related symptoms generally resolve after leaving a problematic environment. The incidence and severity of symptoms related to mold exposure in the indoor environment depend on (a) the individual’s susceptibility; (b) the extent of dampness; and (c) the individual’s direct exposure to mold. Building dampness is generally of less concern where occupant exposure is brief or the condition is not open to occupied space.

Another potential reaction of the immune system to mold is hypersensitivity pneumonitis. This is a rare condition generally associated with heavy exposures in agricultural or industrial environments.

2. Are respiratory infections related to mold?

Although research suggests an association between dampness and some respiratory symptoms, the majority of occupant respiratory symptoms are unlikely to be mold-related. The average adult has two to three respiratory infections per year, and these typically spread person-to-person. Sinus infections are generally bacterial or viral in nature and occur in about 10% of the population.

Opportunistic fungal infections (i.e., aspergillosis) occur only in immune-compromised patients. These patients’ mold exposure has typically been limited to spores normally present in outdoor air or healthcare facilities. No studies link opportunistic infections to occupancy in damp buildings.

3. Are non-allergy symptoms related to mold?

The average adult experiences at least one common symptom per week (i.e., headache, fatigue, eye irritation). Non-specific symptoms have many potential causes, and a link to environmental exposure may be coincidental. For example, headaches can be associated with job stress and eye irritation with dry air.

Media reports attribute a variety of symptoms to “black mold” in buildings, including neurological effects such as “brain fog” dizziness and headache. While toxicity has been established from ingestion of food contaminated with mycotoxins (chemicals produced by some molds), evidence does not support toxic effects from exposure to mold growth in buildings.

4. Is mold associated with chronic disease or reproductive effects.

Mold growth in buildings has not been associated with cancer or other chronic diseases. It is not known to impact pregnancies.

5. How is mold-related illness diagnosed?

While research has established an association between dampness and some allergy symptoms, the majority of building-related allergies are caused by other factors. Mold-sensitive occupant typically test positive to mold (allergist evaluation) or consistently report similar symptoms in different damp environments. Establishing symptom causation requires medical diagnosis and consideration of all environmental exposures. Testing air or surfaces for mold cannot determine the cause of occupant-reported symptoms.

It is possible that highly susceptible individuals may experience dampness-related symptoms which have not been confirmed by research studies. Patient-specific evaluation by a qualified physician is necessary when considering such a possibility.

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