INDOOR AIR QUALITY ASSESSMENT

Goodell Hall
University of Massachusetts
140 Hicks Way
Amherst, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment

February 2010

Background/Introduction

In response to a request from Dr. Maureen O'Leary, Assistant Director, Academic Safety & Environmental Health Program, University of Massachusetts (UMASS), an indoor air quality assessment was conducted at Goodell Hall, 140 Hicks Way, Amherst, Massachusetts. The Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEH) conducted the assessment. BEH staff received complaints of general indoor air quality problems as well as health concerns that occupants attributed to the building. On October 9, 2009, a visit to conduct an assessment of Goodell Hall was made by Michael Feeney, Director of BEH's Indoor Air Quality (IAQ) Program. Mr. Feeney was accompanied by Lisa Hébert and James Tobin, Environmental Analysts/Indoor Air Inspectors in BEH's IAQ Program.

Goodell Hall was constructed in 1935 as a library and was converted into office space for the UMASS graduate admissions program. The original building is a three-story structure with a basement, which is now occupied. A four-story wing was added to the rear of the original building in the post World War II era. The addition included a rooftop penthouse that houses the entire building's heating, ventilating and air-conditioning (HVAC) system. Windows are openable in some areas of the building.

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken 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 offices at Goodell Hall have an employee population of approximately 405. Tests were taken under normal operating conditions and results appear in Table 1.

Discussion

Ventilation

It can be seen from Table 1 that the carbon dioxide levels were below 800 ppm in all but 1 of 83 areas surveyed (Table 1), indicating adequate ventilation exists in the majority of the building. The HVAC system consists of a series of large air-handling units (AHUs) located in the rooftop penthouse (Picture 1). Each AHU is connected to ceiling-mounted fresh air diffusers via ductwork. Air is returned to the AHUs by ceiling-mounted vents connected to ductwork. The original building has a set of AHUs in closets, which are connected to occupied space via ductwork (Picture 2). The HVAC system was operating during the assessment. Walls erected during the remodeling to create additional office space separated some supply vents from their corresponding return vents. As a result, some occupied areas do not have complete fresh air supply and return ventilation capacity. Occupied spaces need sufficient fresh air supply and return in order to create airflow. Ordinary indoor air pollutants can build up in an area if HVAC system components are missing.

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 HVAC systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994). The date of the last balancing of these systems was not available at the time of the assessment.

The Massachusetts Building Code requires that each room have a minimum ventilation rate of 20 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, please see Appendix A.

Temperature readings recorded during the assessment ranged from 69 °F to 79 °F, which were within the MDPH's recommended comfort range in most areas (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. 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.

Relative humidity measurements ranged from 41 to 53 percent, which were within the BEH comfort guidelines in all areas surveyed. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels would be expected to drop during the winter months due to heating and decreased outdoor relative humidity concentrations. 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

The lowest level of the building is used for record storage. This area has been subdivided using cyclone fencing, which allows for free air movement. A large number of paper records are stored in this area in filing cabinets constructed of heavy cardboard (Picture 3). A distinct, pungent odor of moistened cardboard was detected in this space. Located in this area are a fresh air supply and return vent that are likely connected to the general HVAC system (Picture 4). Odors from the stored materials in the lower level can be captured by the HVAC system and distributed into other areas of the building.

The likely source of moisture in this area is the building's mechanical room, which is located below the records storage room. The building does not contain a furnace. Steam is pumped into this mechanical room via piping from the UMass steam plant. The mechanical room has a number of sources for leaking water and/or steam, including a significant number of pipe breaches (Picture 5) and a sump pump cistern (Picture 6). Of note is the existence of a fan system (EB8) that appears to be an exhaust ventilation system dedicated to removing water vapor and air from the mechanical room. At the time of the IAQ assessment, this fan was found deactivated, likely due to its location with its electric exhaust vent motor in a pool of standing water (Picture 7). Without mechanical exhaust ventilation, water vapor can migrate from the mechanical room to the records storage room above.

Several conditions observed in the building indicate that water vapor and pollutants are migrating from the records storage area to occupied areas. Air may be drawn up the elevator shafts to upper floors. In addition, the building contains a number of abandoned dumbwaiters (Picture 8), which can allow for basement air to migrate to occupied spaces on upper floors. The following concepts concerning heated air and elevators/dumbwaiters should be understood in order to explain how basement air may be impacting the upper floors:

1. Heated air will create upward air movement (called the stack effect).
2. Cold air moves to hot air, which creates drafts.
3. Airflow is created, intended or otherwise, from items that produce heat (e.g., fluorescent light bulbs).
4. As heated air rises, negative pressure is created, drawing cold air back to equipment creating heat.

5. Airflow created by the stack effect, drafts or mechanical ventilation can draw particulate matter into the air stream.

Each of these concepts has influence on the movement of basement pollutants to the upper floors. As heated air rises in the stairwells, dumbwaiter and elevator shafts, basement air can enter each of these vertical shafts. In addition to the stack effect, elevators can draw pollutants into the elevator shaft while cars operate. This piston effect can serve to place the basement elevator lobby under negative pressure as the car moves upwards, enhancing the penetration of basement pollutants into occupied areas and hallways through doorframes and other holes in walls and ceilings.

Water-damaged cardboard was also observed in the air-handling room. Water-damaged paper products can serve as a source of mold growth and should be removed and discarded to prevent a source of respiratory irritation.

Water-damaged ceiling tiles were observed throughout the building (Picture 9). In some areas, water damage to ceilings and walls has caused large areas to exhibit peeling paint. Water-damaged walls and ceilings are an indication of leakage in the building, most likely from the roof. The roof should be examined and repaired/replaced to prevent additional leaks and damage to the building. Water-damaged materials should be repaired or replaced.

Water coolers were observed located over carpeted areas (Picture 10). Overflow of the water basins or spills that often occur can moisten carpeting, which can lead to mold growth. It is important that the catch basin of a water cooler be cleaned regularly as stagnant water can be a source of odors, and materials (i.e., dust) collected in the water can provide a medium for mold growth.

The US Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Water-damaged porous materials cannot be adequately cleaned to remove mold growth. The application of a mildewcide to moldy porous materials is not recommended.

Several areas contained a number of plants, many of which were located on carpeting (Picture 11). Plant soil, standing water and drip pans can be a potential source of mold growth. Drip pans should be inspected periodically for mold growth and over watering should be avoided. Plants should also be located away from fresh air diffusers to prevent aerosolization of dirt, pollen or mold.

Other IAQ 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 can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the school environment, BEH staff obtained measurements for carbon monoxide.

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 effects. 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. On the day of assessment, outdoor carbon monoxide concentrations were not detected (ND). (Table 1). Carbon monoxide levels measured in the building were also ND.

Particulate Matter (PM2.5)

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 microgram per cubic meter (μg/m3) 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 μg/m3 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 concentrations the day of the assessment was 17 μg/m3. PM2.5 levels measured inside the building ranged from 5 to 10 μg/m3 (Table 1), which were below the NAAQS PM2.5 level of 35 μg/m3. 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 in a building 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, cooking with the stoves and microwave ovens; use of photocopiers, fax machines and computer printing devices; operation of an ordinary vacuum cleaner and heavy foot traffic indoors.

TVOCs

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 indoor VOC concentrations, BEH staff examined rooms for products containing these respiratory irritants.

Upon entering the dean's office suite, the distinct odor of hand disinfectant was readily detected. Hand disinfectant contains ethyl alcohol and fragrances, both of which can be an eye and respiratory irritant to some individuals (Betco Corporation, 2007; Birchwood Laboratories, Inc., 2007; B4 Brands by AMA, 2006; Georgia-Pacific Consumer Products, 2007). According to MA DPH recommendations concerning H1N1 Flu, protection from flu virus can be achieved by either "[w]ash[ing] your hands often with soap and water or us[ing] alcohol based hand gel (MDPH, 2009, Appendix B).

Some offices contained dry erase boards and dry erase markers. Materials such as dry erase markers and dry erase board cleaners may contain volatile organic compounds (VOCs) (e.g., methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve), which can be irritating to the eyes, nose and throat (Sanford, 1999).

Air fresheners and deodorizing materials were observed in at least one area. Air deodorizers contain chemicals that can be irritating to the eyes, nose and throat of sensitive individuals. Many air fresheners contain 1,4-dichlorobenzene, a VOC which may cause reductions in lung function (NIH, 2006). Furthermore, deodorizing agents do not remove materials causing odors, but rather mask odors that may be present in the area.

Insect spray was observed in one office (Picture 12). Pesticide use indoors can introduce chemicals into the indoor environment that can be sources of eye, nose and throat irritation. The principles of integrated pest management (IPM) should be considered to remove pests in buildings.

Other Concerns

Several other conditions that can affect indoor air quality were noted during the assessment. Numerous exhaust vents were obstructed throughout the building by bookcases, desks, computers, as well as by materials stored on shelving (Picture 13). Occupants of the building have attempted to adjust the air flow within their space by obstructing the air diffusers in an effort to either reduce the volume of air or divert the direction of air as it enters the room (Picture 14). Additional obstructions to airflow in the building are the numerous partitions that have been installed within the building. These alterations can create an imbalance in the system, resulting in uneven heating/cooling conditions leading to occupant discomfort in other areas. A few occupants expressed concerns to BEH staff regarding black particulate matter observed within their offices. As airflow passes over the horizontal surfaces covering many air diffusers, dust which may have settled on the surface could easily become aerosolized within the occupied space. Once aerosolized, the particulates will eventually settle on horizontal surfaces below.

One cracked window in a women's restroom was observed. In addition to compromising the efficiency of the air-handling units in the building, this condition can allow unconditioned air into occupied space, potentially leading to condensation as well as mold growth.

Upholstered furniture was observed in some areas of the building. Upholstered furniture is covered with fabric that comes in contact with human skin. This type of contact can leave oils, perspiration, hair and skin cells behind. Dust mites feed upon human skin cells and excrete waste products that contain allergens. In addition, if relative humidity levels increase above 60 percent, dust mites tend to proliferate (US EPA, 1992). In order to remove dust mites and other pollutants, frequent vacuuming of upholstered furniture is recommended (Berry, M.A., 1994). It is also recommended that upholstered furniture (if present in schools), be professionally cleaned on an annual basis. If an excessively dusty environment exists due to outdoor conditions impacting the indoor environment or indoor activities (e.g., renovations), cleaning frequency should be increased to every six months (IICRC, 2000). Elevated outdoor levels of airborne particulates can result in increased levels of indoor particulates by entering into the building through open windows, doors and filter bypass.

Several personal fans and return/exhaust vents had accumulated dust and debris. Dust can be a source for eye and respiratory irritation. If exhaust vents are not functioning, back drafting can occur and aerosolize dust particles. When operating, they can serve to distribute settled dust particles. Open ceiling plenums, missing ceiling tiles and open utility penetrations were observed. These conditions have the potential to draw dusts, odors and vapors into occupied spaces.

An accumulation of paper was observed on the floor, bookcases and desks of some offices. One office contained a large accumulation of stuffed toys. Artificial plants were noted in some areas. The large number of items stored in offices provides surfaces on which dust accumulates. These items (e.g., papers, folders, boxes) make it difficult for custodial staff to clean. Items should be relocated and/or be cleaned periodically to avoid excessive dust build up. In addition, these materials can accumulate on flat surfaces (e.g., desktops, shelving and carpets) in occupied areas and subsequently be re-aerosolized causing further irritation.

The HVAC system penthouse contained a large tub-like structure that was filled with debris (Picture 15). This tub structure also contained a drain. It is likely that the trap for this drain is dry, which could result in odors from the drain system to enter the HVAC mechanical room. Drain system pollutants can be irritating to the eyes, nose and throat.

Conclusions/Recommendations

A decision should be made concerning the water-damaged and in some cases likely mold-contaminated materials stored in the basement. If not addressed, these boxes, documents, books and other stored materials will continue to be a source of mold associated particulates. Under current conditions, ventilation alone cannot serve to reduce or eliminate mold growth in these materials. As an initial step, options concerning the preservation of materials stored in this area should be considered. Since many of the materials appear to be of historical significance, an evaluation concerning disposition of them must be made. Porous materials that are judged not worthy of preservation, restoration or transfer to another media (e.g., microfiche or computer scanning) should be discarded. Where stored materials are to be preserved, restored or otherwise handled, an evaluation should be done by a professional book/records conservator. This process can be rather expensive and should considered for conservation of irreplaceable documents that are colonized with mold. Due to the cost of book conservation, disposal or replacement of moldy materials may be the most economically feasible option. In view of the findings at the time of this visit, the following recommendations should be considered:

1. Repair sources of leaking water and steam in the building's mechanical room. Eliminate sources of pooled water on the mechanical room floor.
2. Repair exhaust fan (EB8) located in the mechanical room to ensure that water vapor and air will once again be removed from the mechanical room.
3. Consider permanently sealing off dumbwaiters to eliminate pathways for movement of odors, particulate matter, etc to each floor.
4. Ensure leaks are repaired and replace water damaged ceiling tiles. Examine the area above and around these areas for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial.
5. Place water coolers located in carpeted areas on surfaces that are impervious to water, such as a rubber mat. Clean catch basins regularly.
6. Consider eliminating the practice of placing plants directly onto carpeted areas. Examine drip pans periodically for mold growth. Disinfect with an appropriate antimicrobial where necessary. In addition, plants should be located away from the air stream of ventilation sources to prevent aerosolization of mold, pollen and particulate matter.
7. Clean dry erase marker trays to prevent the build-up of excessive particulates. Consider purchasing low-odor emitting markers in order to decrease the concentration of VOCs in the classroom.
8. Encourage hand washing consistent with the MDPH to protect against H1N1 flu. These include:

a. Get vaccinated when the vaccine becomes available, especially if you have a medical condition which makes health complications from the flu more likely.

b. Wash your hands often with soap and water or use alcohol based hand gel.

c. Cough or sneeze into a tissue or the inside of your elbow if you don't have a tissue. Throw the tissue in the trash and wash your hands.

d. Use a regular household cleaner to clean surfaces that might get flu virus on them like door knobs, phones, faucets and toys.

e. Stay home from work and school if you get sick with a flu-like illness and avoid contact with others so the virus does not spread. Stay at home until you have been free from fever for at least 24 hours after your last dose of fever-reducing medication (like Tylenol, Advil or Motrin). For most people this will mean staying at home for about four days (MDPH, 2009).

9. Consider discontinuing use of air deodorizers and insect sprays within the building.

10. Discontinue practice of obstructing ventilation components, both supply and exhaust vents. Once the system is properly balanced, air flow within the occupied space should meet comfort parameters for the majority of occupants. Consider having the systems balanced by an HVAC engineering firm every five years.

11. Repair cracked window in women's room.

12. Professionally clean upholstered furniture on an annual basis.

13. Clean personal fans, air diffusers, exhaust, return vents artificial plants periodically of accumulated dust.

14. Remove unnecessary papers, boxes, stuffed toys from offices in order to assist in keeping office in a clean condition.

15. 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. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

ASHRAE. 1989. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE 62-1989

B4 Brands by AMA. 2006. Avant OriginalTM Instant Hand Sanitizer Materials Safety Data Sheet. B4 Brands by AMA., Nixa, MO.

Berry, M.A. 1994. Protecting the Built Environment: Cleaning for Health, Michael A. Berry, Chapel Hill, NC.

BETCO Corporation. 2007. Clario Foaming Alcohol Instant Hand Sanitizer Material Safety Data Sheet. BETCO Corporation, Toledo, OH.

Birchwood Laboratories, Inc. 2007. Hand Wipe Take Alongs Materials Safety Data Sheet. Birchwood Laboratories, Inc., Eden Prairie, MN.

BOCA. 1993. The BOCA National Mechanical Code/1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL.

Georgia- Pacific Consumer Products. 2007. Cormatic® High Capacity Instant Hand sanitizer Material Safety Data Sheet. Georgia- Pacific Consumer Products, Atlanta, GA.

IICRC. 2000. IICRC S001 Reference Guideline for Professional On-Location Cleaning of Textile Floor Covering Materials Institute of Inspection, Cleaning and Restoration Certification. Institute of Inspection Cleaning and Restoration, Vancouver, WA.

MDPH. 1997. Requirements to Maintain Air Quality in Indoor Skating Rinks (State Sanitary Code, Chapter XI). 105 CMR 675.000. Massachusetts Department of Public Health, Boston, MA.

MDPH. 2009. Public Health Fact Sheet H1N1 Flu (Swine Flu). Massachusetts Department of Public Health, Boston, MA.
http://www.mass.gov/Eeohhs2/docs/dph/cdc/factsheets/swine_flu.pdf

NIH. 2006. Chemical in Many Air Fresheners May Reduce Lung Function. NIH News. National Institute of Health . July 27, 2006. http://www.nih.gov/news/pr/jul2006/niehs-27.htm.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R. 1910.1000 Table Z-1-A.

Sanford. 1999. Material Safety Data Sheet (MSDS No: 198-17). Expo® Dry Erase Markers Bullet, Chisel, and Ultra Fine Tip. Sanford Corporation. Bellwood, IL.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

SMACNA. 1994. HVAC Systems Commissioning Manual. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

US EPA. 1992. Indoor Biological Pollutants. US Environmental Protection Agency, Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, research Triangle Park, NC. EPA 600/8-91/202 January 1992.

US EPA. 2001. Mold Remediation in Schools and Commercial Buildings. US Environmental Protection Agency, Office of Air and Radiation, Indoor Environments Division, Washington, DC. EPA 402-K-01-001. March 2001.

US EPA. 2006. National Ambient Air Quality Standards (NAAQS). US Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, DC. http://www.epa.gov/air/criteria.html.

Picture 1

Rooftop Penthouse

Picture 2

AHUs in Closets

Picture 3

Records Stored In Basement

Picture 4

Fresh Air Supply And Return Vent In Records Storage Area.

Picture 5

Pipe Breach

Picture 6

Sump Pump Pit Filled With Water

Picture 7

EB8 Exhaust Vent Motor in Standing Water

Picture 8

Abandoned Dumbwaiter Door on Upper Level of Building

Picture 9

Water Damaged Ceiling Tiles

Picture 10

Water Coolers over Carpeting

Picture 11

Plants on Carpeting

Picture 12

Insect Spray

Picture 13

Blocked Air Vent

Picture 14

Vent Covered With Cardboard.

Picture 15

Tub-Like Structure in the HVAC Penthouse Filled With Debris

Location: Goodell Hall **Indoor Air Results**

Address: 140 Hicks Way, University of Massachusetts, Amherst, MA **Table 1** **Date: 10/9/09**

Location	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Background:	-	69	55	510	ND	17	-	-	-	
Admin. Office	4	70	50	572	ND	6	Y	Y*	Y	DO, Plants, Copier, * Blocked supply
Advising	2	70	50	662	ND	6	Y	Y*	Y	DO, Plants, Paper accumulation, *blocked supply
Advising Off. 1	0	71	49	527	ND	5	N	Y	N	Plants
Records Clerk	0	71	48	544	ND	6	N	Y*	N	PF, Plants
Room 301 (front)	0	74	50	548	ND	6	N	Y	Y	DO, UF
Room 301 (hall)	0	76	50	640	ND	8	N	Y	Y off	WDCT
Room 301 A	0	74	47	452	ND	7	N	Y	Y	DO
Room 301 C	0	73	51	448	ND	8	N	Y	Y	DO

Comfort Guidelines

Carbon Dioxide:	< 600 ppm = preferred	Temperature:	70 - 78 °F
	600 - 800 ppm = acceptable		40 - 60%
	> 800 ppm = indicative of ventilation problems		

Location: Goodell Building **Indoor Air Results**

Address: UMASS, Amherst, MA **Table 1 (continued)** **Date: 10/9/09**

Location	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (μg/m3)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Room 301 Conference	1	79	44	456	ND	8	Y	Y	Y	AC on wall
Room 301 D	1	75	51	742	ND	7	N	Y	Y	DO
Room 301 E	1	72	49	439	ND	9	Y	Y	Y	AC on wall; DO
Room 301 G	0	76	44	443	ND	7	Y	Y	N	DO
Room 301 H	0	74	48	588	ND	6	Y=N	Y	Y	DO
Room 301 J	1	74	50	513	ND	6	N	Y	Y	DO
Room 301 K	1	74	49	519	ND	6	N	Y	Y*	DO, *backdraft into room
Room 302	2	74	48	469	ND	7	N	Y	Y	Water cooler on carpet
Room 303	0	73	50	496	ND	6	Y	Y	Y*	*blocked
Room 303D	1	72	52	472	ND	8	N	Y	N	DO, DEM, PF, Plants
Room 306	7	74	48	525	ND	6	Y	Y	Y	2 DO; CPs; PF; temperature complaints

ppm = parts per million
ND = non-detectable

Comfort Guidelines

Carbon Dioxide:	**< 600 ppm = preferred** **600 - 800 ppm = acceptable** **> 800 ppm = indicative of ventilation problems**	**Temperature:** **Relative Humidity:**	**70 - 78 °F** **40 - 60%**

Location: Goodell Building **Indoor Air Results**

Address: UMASS, Amherst, MA **Table 1 (continued)** **Date: 10/9/09**

Location	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (μg/m3)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Room 309 (mail room side)	2	74	47	481	ND	7	N	Y		Passive vent in wall near door; DO
Room 309 hallway (to 301 side)	0	73	48	459	ND	7	N	Y		Passive vent in wall near door
Room 404	2	73	49	548	ND	10	N	Y	Y	PF
Room 404 A	2	73	48	483	ND	7	N	Y	Y on wall; blocked	
Room 404 F	1	72	49	464	ND	7	N	Y	N	Kitchen odors; peeling paint; AD on door; microwave; toaster; refrig.; DO
Room 404E	0	73	49	537	ND	7	N	Y	N	DO, DEM
Room 405	9	73	47	489	ND	7	Y	Y	Y	Plants
Room 406	8	72	48	501	ND	7	Y	Y	Y	PC; PF; MT
Room 406 C	1	72	49	450	ND	7	N	Y	Y	DO; PF
Room 406B	2	73	50	610	ND	7	N	Y	Y*	DO, *blocked, partitions

ppm = parts per million
ND = non-detectable

Comfort Guidelines

Carbon Dioxide:	**< 600 ppm = preferred**	**Temperature:**	**70 - 78 °F**
	600 - 800 ppm = acceptable	**Relative Humidity:**	**40 - 60%**
	> 800 ppm = indicative of ventilation problems		

Location	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (μg/m3)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Room 406C	0	73	49	516	ND	6	N	Y	N	DC, partition, exhaust on other side of partition
Room 407 (reception area)	3	73	47	475	ND	7	N	Y	Y	CPs; PF; plants; DO
Room 407 (conference)	0	72	46	459	ND	7	N	Y	N	DEM; DO; PF
Room 407 A (area outside office)	2	72	48	463	ND	7	N	Y	Y on wall; blocked	PC; PF; plants
Room 408 (back)	2	73	45	529	ND	6	Y	Y	Y	
Room 408 Entrance	3	72	46	559	ND	6	Y	Y dust	Y	Water cooler on carpet; CPs; PF PC; microwave; Frig.; designjet printer
Room 416	0	74	46	693	ND	6	Y	Y	Y*	DC, DEM, *blocked by partitions
Room 419	0	76	43	521	ND	5	N	Y	Y	DC, CT ajar, passive vent in door
Room 419A	1	76	44	590	ND	7	Y ½ open	Y*	Y	DO, PF
Room 419B	1	75	45	684	ND	5	N	Y*	Y	DO, *blocked

ppm = parts per million
ND = non-detectable

Comfort Guidelines

Carbon Dioxide:	**< 600 ppm = preferred** **600 - 800 ppm = acceptable** **> 800 ppm = indicative of ventilation problems**	**Temperature:** **Relative Humidity:**	**70 - 78 °F** **40 - 60%**

Location: Goodell Building **Indoor Air Results**

Address: UMASS, Amherst, MA **Table 1 (continued)** **Date: 10/9/09**

Location	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
Room 499E	3	75	46	653	ND	7	N	Y	Y	DC, Broken floor tiles
Room 504 (Kitchen)	1	71	47	518	ND	8	N	N	N	Kitchen odors; MTs; WD CTs; Refrig.; Toaster; Microwave
Room 504 A	0	71	47	504	ND	7	N	Y cardboard	N	PF
Room 504 Comm. (College Kiosk Area)	3	69	50	494	ND	7	N	Y	Y	Plants on Window sill and on floor; MTs; PF; Kitchen odors; Damaged floor tiles in 504 C; Exhaust vent amd MTs in 504 F
Room 506	0	71	44	502	ND	6	Y			PF
Room 508	1	71	48	862	ND	7	Y	Y	N	
Room 511	0	73	42	485	ND	7	Y 1 of 2 open	Y	N	Window AC
Room 512	1	73	43	503	ND	7	Y		Y	Window ACs; WD on wall; subdivided offices along wall with common reception
Room 514	2	76	43	494	ND	7	N	Y water stains	N	CF – on; Plants; water cooler on carpet; DO; temperature control complaints
Room 514 B	0	74	41	561	ND	6	N	N	N	PCs; printers

ppm = parts per million
ND = non-detectable

Comfort Guidelines

Carbon Dioxide:	**< 600 ppm = preferred** **600 - 800 ppm = acceptable** **> 800 ppm = indicative of ventilation problems**	**Temperature:** **Relative Humidity:**	**70 - 78 °F** **40 - 60%**

Location	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
Room 514 D	0	75	43	485	ND	6	Y	Y	N	Plants; DO
Room 514 E	0	75	41	472	ND	6	N sealed	Y	N	WD CTs; DO; PF
Room 517	4	73	43	490	ND	7	N	Y	N	CF – off; PF; PC; DO
Room 517 A	0	74	42	490	ND	10	N	Y	N	CF – off; DO
Room 517/518 hallway										WD CTs
Room 518	0	73	43	531	ND	7	Y 1 of 1 open	Y	N	WD CTs; DO
Room 518	1	73	46	580	ND	6	N	Y*	N	DO, Plants, PF, * blocked
Room 524	3	72	47	563	ND	6	Y	Y	N	DO, WC, Plants
Room 526	0	73	45	552	ND	6	N	Y	N	DO
Room 527	2	72	47	621	ND	8	N	Y	N	DC, CF

ppm = parts per million
ND = non-detectable

Comfort Guidelines

Carbon Dioxide:	**< 600 ppm = preferred** **600 - 800 ppm = acceptable** **> 800 ppm = indicative of ventilation problems**	**Temperature:** **Relative Humidity:**	**70 - 78 °F** **40 - 60%**

Location: Goodell Building **Indoor Air Results**

Address: UMASS, Amherst, MA **Table 1 (continued)** **Date: 10/9/09**

Location	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
Room 528	0	71	47	514	ND	5	N	Y	N	DO, Plants
Room 528A	2	71	48	590	ND	5	Y	Y	N	DO, PF
Room 530	2	71	47	504	ND	8	Y 2/2 open	Y	N	CF, PF, Plants, Stuffed animals
Room 532 (Lobby)	0	71	47	583	ND	7	Y	Y	N	DC
Room 532A	1	71	47	553	ND	9	Y	Y	N	DO, DEM, Plants
Room 534 (front)	2	72	47	613	ND	5	N	Y	N	DC, CF, PF
Room 534 (graduation)	2	73	45	641	ND	6	N	Y	N	CF, Plants
Room 534A	0	73	45	615	ND	6	N	Y	Y	DO
Room 536 B	3	69	53	785	ND	7	Y	Y	N	DO, PF, Plants, insecticide
Room 538	5	72	48	639	ND	9	N	Y	N	PF
Room 538C	0	72	48	609	ND	6	N	Y	Y*	DO, Plants, PF, *blocked

ppm = parts per million
ND = non-detectable

Comfort Guidelines

Carbon Dioxide:	**< 600 ppm = preferred** **600 - 800 ppm = acceptable** **> 800 ppm = indicative of ventilation problems**	**Temperature:** **Relative Humidity:**	**70 - 78 °F** **40 - 60%**

Location	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Room 602	1	73	44	481	ND	7	Y	Y	N	DO; plants; PF
Room 602 A	1	73	43	478	ND	7	Y 1 of 2 open	Y	N	Plants along window; DO; portable AC off
Room 604	0	72	47	459	ND	7	N	Y	Y	WD CTs; MTs; DEM; CD
Room 608	2	72	46	514	ND	8	Y 1/3 open	Y	Y*	DO, Plants, WC on carpet, *blocked
Room 608A	1	69	51	504	ND	7	Y	Y	Y*	DO, * blocked by partition
Room 609	3	70	50	532	ND	8	Y	Y*	Y	DO, blocked by plastic file bin
Room 609A	0	70	50	518	ND	7	Y	Y	N	DO
Room 609B	1	70	51	553	ND	5	Y	Y*	N	DC, *blocked
Room 609D	1	70	52	772	ND	6	Y 2/2 open	Y	N	DO, Plants
Room 610	2	71	52	652	ND	6	Y ¼ open	Y	Y*	DO, WC on carpet, * blocked

ppm = parts per million
ND = non-detectable

Comfort Guidelines

Carbon Dioxide:	**< 600 ppm = preferred** **600 - 800 ppm = acceptable** **> 800 ppm = indicative of ventilation problems**	**Temperature:** **Relative Humidity:**	**70 - 78 °F** **40 - 60%**

Location: Goodell Building **Indoor Air Results**

Address: UMASS, Amherst, MA **Table 1 (continued)** **Date: 10/9/09**

Location	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
Room 612	2	72	44	521	ND	6	Y		N	Window AC; plants
Room 614	1	73	43	479	ND	7	Y		N	Window AC; CPs; DEM; DO
Room 615 (Left side)	2	74	42	482	ND	7	Y	Y	Y	
Room 615 (Right side)	3	74	43	509	ND	7	Y	Y	Y	Window ACs; PF; water cooler on carpet; Frig.; microwave; PC; plants
Room 615 A	0	74	42	494	ND	8	Y	Y	Y	Window AC
Women's Room	2	73	47	618	ND	8	Y 1/1 open	N	Y	DC, WD materials, Window cracked

ppm = parts per million
ND = non-detectable

Comfort Guidelines

Carbon Dioxide:	**< 600 ppm = preferred**	**Temperature:**	**70 - 78 °F**
	600 - 800 ppm = acceptable	**Relative Humidity:**	**40 - 60%**
	> 800 ppm = indicative of ventilation problems		

Appendix B

PUBLIC HEALTH FACT SHEET	H1N1 Flu (Swine Flu)

Massachusetts Department of Public Health

What is H1N1 flu?

Flu is a disease of the body's breathing system, including the nose, throat and lungs. Flu is short for "influenza." H1N1 flu is caused by a new virus that was first recognized in April of 2009, and was called "swine flu." H1N1 flu quickly spread to many parts of the world and is now a "pandemic," or global outbreak. H1N1 flu is not the same as swine flu, which is a virus that pigs can get. It is not the same as "seasonal" flu which occurs every year, during the winter and early spring. But H1N1 flu causes symptoms that are similar to seasonal flu, is spread like seasonal flu, and can be prevented like seasonal flu.

What are the symptoms of H1N1 flu?

H1N1 flu symptoms are very similar to seasonal flu symptoms. Most common are fever, cough, and sore throat. Symptoms can also include body aches, headache, chills, runny nose and feeling very tired. Some people also have diarrhea and vomiting. Symptoms last from a few days to up to a week or more.

Is H1N1 flu serious?

Illness with H1N1 flu has ranged from mild to severe. While most people sick with H1N1 flu get better without needing medical treatment, severe illness and deaths have occurred in some people. Like seasonal flu, some people are at higher risk of serious health problems when they get the H1N1 flu. This includes pregnant women, infants, and people with medical conditions like asthma, diabetes, heart disease, kidney disease, muscle or nerve conditions that affect their breathing and weakened immune systems.

How does H1N1 flu spread?

The flu virus is in the wet spray (droplets of saliva and mucous) that comes out of the nose and mouth of someone who coughs or sneezes. If you are close enough to a person with the flu (3 - 6 feet) when they cough or sneeze, you can breathe in the virus and get sick. Flu symptoms start 1 - 4 days (usually 2 days) after a person breathes in the virus.

Flu is spread easily from person to person. The virus can also live for a short time on things you touch like doorknobs, phones and toys. After you touch these objects, you can catch the virus when you touch your mouth, nose, or eyes. However, when the wet droplets on these types of objects dry out, the virus can't cause infection. Adults with the H1N1 flu can spread it from about one day before symptoms appear to about one week after. Children can spread the flu even longer after they get sick.

How is H1N1 flu treated?

There are drugs available that your doctor may prescribe to treat H1N1 flu. The drugs work best if started soon after the start of symptoms. Your doctor can determine if you need treatment.

People sick with any type of flu should make sure to drink plenty of fluids, get plenty of rest, eat healthy foods, wash their hands frequently and stay home to avoid spreading the flu to other people. Over the counter pain relievers may help people with the flu feel more comfortable. Children and teens with the flu should never take aspirin, because a rare but serious disease called Reye syndrome can occur.

Is there a vaccine for H1N1 flu?

Yes. A vaccine helps your body to protect itself against a disease. There are two types of H1N1 vaccine available to protect against H1N1 flu. One is a "shot" that is given with a needle, usually in the arm. The other is a "nasal spray" (a spray inhaled through the nose). People 10 years of age and over will need one

Appendix B

dose of vaccine. Most children under the age of 10 will need two doses of H1N1 vaccine, separated by 3- 4 weeks. Getting flu vaccine will **not** give you the flu or any other type of illness. Ask your doctor which type of H1N1 vaccine is best for you and your family.

Who should get H1N1 flu vaccine?

Certain groups should get the H1N1 vaccine when it becomes available: pregnant women; people who live with or provide care for infants under 6 months of age (e.g., parents, siblings, and daycare providers); healthcare and emergency medical services personnel; people age 6 months to 24 years; and people age 25 to 64 years who have medical conditions that put them at higher risk for influenza-related complications. After these groups, it is expected that there will be enough H1N1 flu vaccine for anyone who chooses to get vaccinated. Please note that the groups listed above may change based on vaccine availability. *Note: current studies indicate the risk for infection among persons over 65 years of age is less than the risk for persons in younger age groups.*

How do I know if I have H1N1 flu?

If you have symptoms of flu, it could be seasonal or H1N1 flu. If you think you have the flu, stay home from work and school and avoid contact with others so you do not spread the virus. If you think you might have flu and you need to see your doctor, call ahead and let them know you might have the flu. That way, your doctor's office can take steps to avoid the spread of flu to others. The doctor may recommend that you be tested for influenza.

How do I protect myself from getting sick with H1N1 flu?

- Get vaccinated when the vaccine becomes available, especially if you have a medical condition which makes health complications from the flu more likely.
- Wash your hands often with soap and water or use alcohol based hand gel.
- Cough or sneeze into a tissue or the inside of your elbow if you don't have a tissue. Throw the tissue in the trash and wash your hands.
- Use a regular household cleaner to clean surfaces that might get flu virus on them like door knobs, phones, faucets and toys.
- **Stay home from work and school if you get sick with a flu-like illness and avoid contact with others so the virus does not spread. Stay at home until you have been free from fever for at least 24 hours after your last dose of fever-reducing medication (like Tylenol, Advil or Motrin).** For most people this will mean staying at home for about four days.

How do I take care of someone who is sick with H1N1 flu?

Flu: What You Can Do - Caring for People At Home is a booklet available in nine languages that gives you lots of information to help you care for someone who has the flu in their home. A video is also available in English and Spanish. *Flu: What You Can Do* information can be found at: mass.gov/flu

Where can I get more information?

- Mass 2-1-1 provides flu information for the general public: call 211 or 1-877-211-MASS (6277). Interpreter services available in many languages.
- Call your doctor, nurse or clinic, or your local board of health
- Call the MA Department of Public Health, Immunization Program at: (617) 983-6800 or toll-free at (888) 658-2850
- Massachusetts Department of Public Health website at mass.gov/flu
- Center for Disease Control and Prevention (CDC) at: www.cdc.gov/flu

For flu clinic information, visit the MassPRO Public Flu Clinic Finder website at: http://flu.masspro.org/

Updated November 6, 2009