INDOOR AIR QUALITY ASSESSMENT

Commonwealth of Massachusetts
Department of Children and Families
1 Washington Street, Mill River Place, Suite 21
Taunton, MA

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
June 2014

Background/Introduction

In response to a request by Rhett Cavicchi, Director of Labor Relations, Executive Office of Health and Human Services (EOHHS), the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health (BEH) provided assistance and consultation regarding indoor air quality (IAQ) at the Department of Children and Families (DCF) area offices, located at 1 Washington Street, Mill River Place, Suite 21, Taunton, Massachusetts. This evaluation was conducted following complaints from members of Local 509 regarding air quality and mold concerns from previous building leaks. On April 15, 2014, a visit to conduct an IAQ assessment was made by Cory Holmes and Jason Dustin, Environmental Analysts/ Inspectors from BEH's IAQ Program. BEH/IAQ staff were accompanied by William Kelly, Project Manager for Division of Capital Asset Management & Maintenance (DCAMM).

The building formerly served as the Taunton Mall; it is a single story building with a flat rubber roof. The current layout includes offices, open work areas (cubicles), conference rooms, library, storage, mail, records/file rooms, utilities and kitchen areas. Most areas of the building have dropped ceiling tiles and carpeting. Windows in the building are unopenable.

Methods

Air tests for carbon dioxide, carbon monoxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor 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/IAQ staff also performed a visual inspection of building materials for water damage and/or microbial growth. In addition, moisture readings were taken in areas of concern using the DELMHORST Model BD-2100 moisture meter.

Results

The employee population of the DCF office is approximately 100 and up to 25 visitors may access the space daily. Test results are presented in Table 1. Figure 1 provides locations referenced in the table.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were below 800 parts per million (ppm) in 40 out of 47 areas tested, indicating adequate air exchange in the majority of areas surveyed at the time of assessment (Table 1). Fresh air is provided by rooftop air-handling units (AHUs; Picture 1).

BEH/IAQ staff accessed the roof to examine the condition of filters in AHUs, which were found to be in clean condition and correctly sized to fit filter racks (Picture 2). Once air is filtered, it is heated or cooled and delivered to occupied areas via ducted supply diffusers (Picture 3). Return air is drawn into a ceiling plenum via vents (Picture 4), grates or spaces around light fixtures and ducted back to rooftop AHUs.

The heating, ventilation and air conditioning (HVAC) system is controlled by digital thermostats. Thermostats examined had a fan switch with two settings, *on* and *auto*. When the fan is set to *on,* the system provides a continuous source of air circulation and filtration. The *automatic* setting on the thermostat activates the HVAC system at a pre-set temperature. Once the pre-set temperature is reached, the HVAC system is deactivated. Therefore, no mechanical ventilation is provided until the thermostat re-activates the system. At the time of assessment, most thermostat fan settings were in the "auto" position (Picture 5). As mentioned, this

thermostat setting can limit airflow. The MDPH typically recommends that thermostats be set to the fan *on* setting during occupied hours to provide continuous air circulation. In addition, two thermostats were found completely deactivated (Picture 6); therefore no fresh air would be supplied to these areas over the course of the day (or longer), while in this setting. This can lead to IAQ/comfort complaints due to lack of air exchange, particulary since windows are not openable and the HVAC system is the sole source of fresh, outside air.

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).

Minimum design ventilation rates are mandated by the Massachusetts State Building Code (MSBC). Until 2011, the minimum ventilation rate in Massachusetts was higher for both occupied office spaces and general classrooms, with similar requirements for other occupied spaces (BOCA, 1993). The current version of the MSBC, promulgated in 2011 by the State Board of Building Regulations and Standards (SBBRS), adopted the 2009 International Mechanical Code (IMC) to set minimum ventilation rates. **Please note that the MSBC is a minimum standard that is not health-based**. At lower rates of cubic feet per minute (cfm) per occupant of fresh air, carbon dioxide levels would be expected to rise significantly. A ventilation rate of 20 cfm per occupant of fresh air provides optimal air exchange resulting in carbon dioxide levels at or below 800 ppm in the indoor environment in each area measured. MDPH recommends that carbon dioxide levels be maintained at 800 ppm or below. This is

because most environmental and occupational health scientists involved with research on IAQ and health effects have documented significant increases in indoor air quality complaints and/or health effects when carbon dioxide levels rise above the MDPH guidelines of 800 ppm for schools, office buildings and other occupied spaces (Sundell et al., 2011). 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.

Indoor temperature measurements at the time of assessment ranged from 72° F to 77° F (Table 1), which were within the MDPH recommended comfort range. 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. It is also difficult to maintain comfort without operating the HVAC system as designed.

Indoor relative humidity measurements at the time of assessment ranged from 42 to 55 percent (Table 1), which were within the MDPH recommended comfort range. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. 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

In order for building materials to support mold growth, a source of water exposure is necessary. Mr. Kelly as well as other building occupants reported several water penetration/flooding events that resulted in wet building materials. At the time of the visit, it was reported that building management had taken prompt action to conduct remediation/drying of materials shortly after discovery.

A small water stain on a ceiling tile was observed in area #11 (Table 1). According to Mr. Kelly, roof repairs had been made in this area in an attempt to stop further water penetration. The assessment occurred approximately one week after several days of heavy wind-driven rain. Water-damaged ceiling tiles can provide a source of mold and should be replaced after a water leak is discovered and repaired.

Other recent water events included pressurized water leaking from a capped floor drain in office area #1 (Table 1) following a heavy rainstorm, as well as a hot water heater leak from a

utility room. BEH/IAQ staff conducted moisture measurements of porous materials (i.e., gypsum wallboard and carpeting) in these areas; all materials tested were dry at the time of assessment (Table 1).

The US Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend that porous materials (e.g., carpeting, gypsum wallboard) 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/discarded.

Plants were noted in some areas (Table 1). Plants can be a source of pollen and mold, which can be respiratory irritants to some individuals. Plants should be properly maintained and equipped with drip pans.

Small refrigerators were observed in carpeted areas. Spills or leaks from this equipment can moisten carpet and lead to microbial growth and carpet degradation. All refrigerators should be cleaned regularly and if gaskets and other components cannot be adequately cleaned with an anti-microbial agent, they should be replaced.

Caulking between sink countertops and backsplashes in the kitchen as well as both restroom sinks was missing/damaged (Picture 7). If not watertight, water can penetrate through these seams. Water penetration and chronic exposure of porous and wood-based materials can cause these materials to swell and show signs of water damage.

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 and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5) can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the indoor environment, BEH/IAQ staff obtained measurements for carbon monoxide and PM2.5.

Carbon Monoxide

Carbon monoxide is a by-product of incomplete combustion of organic matter (e.g., gasoline, wood and tobacco). Exposure to carbon monoxide can produce immediate and acute health 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, 2011). 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 non-detect (ND) (Table 1). No measurable levels of carbon monoxide were detected inside the building (Table 1).

Particulate Matter

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

Outdoor PM2.5 was measured at 12 $\mu g/m^3$ (Table 1). PM2.5 levels measured indoors ranged from 3 to 8 $\mu g/m^3$ (Table 1), which were below the NAAQS PM2.5 level of 35 $\mu g/m^3$. 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 buildings can generate particulate matter during normal operations. Sources of indoor airborne particulates may include but are not limited to particles generated during the operation of fan belts in the HVAC system, use of stoves and/or microwave ovens in kitchen areas; use of photocopiers, fax machines and computer printing devices; operation of an ordinary vacuum cleaner and heavy foot traffic indoors.

Volatile Organic Compounds

Indoor air concentrations can be greatly impacted by the use of products containing volatile organic compounds (VOCs). VOCs are carbon-containing substances that have the ability to evaporate at room temperature. Total volatile organic compounds (TVOCs) can result in eye and respiratory irritation if exposure occurs. 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/IAQ staff examined rooms for products containing these respiratory irritants.

Hand sanitizer was found in many offices and common areas (Table 1). Hand sanitizer products may contain ethyl alcohol and/or isopropyl alcohol, which are highly volatile and may be irritating to the eyes and nose and may contain fragrances to which some people may be sensitive.

Cleaning products contain chemicals that can be irritating to the eyes, nose and throat of sensitive individuals. These products should be properly labeled. Consideration should be given to working with building management to provide staff with cleaning products and supplies consistent with lease agreements to prevent any potential for adverse chemical interactions.

Other Conditions

Other conditions that can affect IAQ were observed during the assessment. Occupants complained of odors in both the men's and women's restrooms. In both restrooms the exhaust vents were found to be ducted and in working condition. Mr. Kelly stated that he had requested the landlord provide larger fans in both restrooms, which were reportedly approved and awaiting installation. Both restrooms also have floor drains (Picture 8). Drains are usually designed with traps in order to prevent the back-up of sewer odors/gases from penetrating into occupied spaces. When water enters a drain, the trap fills and forms a watertight seal. Without a watertight seal, sewer odors and moisture can travel up the drain and enter the occupied space.

Personal heating units were observed in some offices. These items should be kept clean and free of debris to prevent a fire hazard. In addition, if these units have filters they should be maintained in accordance with manufacturer's instructions to prevent them becoming a source of particulates and odors.

In some offices, a large number of items were on flat surfaces (e.g., floors, windowsills, tabletops), which provide a source for dusts to accumulate. These items (e.g., papers, folders, boxes) make it difficult for areas to be cleaned. Items should be relocated and/or be cleaned periodically to avoid excessive dust build up. In addition, dust and debris can accumulate on flat surfaces (e.g., desktops, shelving and carpets) in occupied areas and subsequently be re-aerosolized causing further irritation.

Food and food preparation equipment were observed in many offices and common areas. Food should be kept in tightly-sealed containers to prevent attracting pests. Food preparation equipment should also be kept clean and free of debris. Toasters and toaster ovens in the kitchen

area were found to contain a large amount of food debris that could attract pests (Pictures 9 and 10).

Most areas in the offices are carpeted; the Institute of Inspection, Cleaning and Restoration Certification (IICRC), recommends that carpeting be cleaned annually (or semi-annually in soiled high traffic areas) (IICRC, 2005).

Conclusions/Recommendations

In view of the findings at the time of the visit, the following recommendations are made:

1. Set thermostats to the fan "on" position to provide continuous air circulation/filtration during business hours.
2. Consider adopting a balancing schedule of every 5 years for all mechanical ventilation systems, as recommended by ventilation industrial standards (SMACNA, 1994).
3. 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).
4. Replace water-damaged ceiling tiles when a leak is discovered and repaired. If chronic leaks occur, consult with a roofing contractor for immediate repairs. Staff should be encouraged to report building leaks to management for prompt remediation.
5. Continue with plans to upgrade exhaust fans in restrooms.

6. Pour water into restroom floor drains (e.g., twice a week) to maintain the integrity of drain traps.
7. Re-caulk sink counters/backsplashes in both restrooms as well as the kitchen area.
8. Avoid overwatering of plants. Ensure flat surfaces around plants are free of potting soil and other plant debris. Examine drip pans periodically for mold growth and disinfect with an appropriate antimicrobial where necessary.
9. Place refrigerators and water dispensing equipment in non-carpeted areas or consider using a waterproof mat to contain spills or leaks.
10. Ensure refrigerators are cleaned out regularly. Clean moldy gaskets with a mild detergent or antimicrobial agent, if cannot be adequately cleaned consider replacing. Consider reducing the number of refrigerators in use in the office.
11. Clean/maintain heaters and personal fans regularly to prevent aerosolization of dust and debris. If personal heaters contain filters, they should be maintained in accordance with manufacturer's instructions to prevent them becoming a source of particulates and odors.
12. Relocate or consider reducing the amount of stored materials in offices to allow for more thorough cleaning. Move items from floors when possible. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.
13. Ensure that food is kept tightly sealed and food preparation equipment is cleaned regularly.
14. Refrain from using air fresheners and deodorizers to prevent exposure to VOCs.
15. Ensure spray bottles are properly labeled. All cleaning products used at the facility should be approved with MSDS' available at a central location.

16. Clean carpeting annually or semi-annually in soiled high traffic areas as per the recommendations of the Institute of Inspection, Cleaning and Restoration Certification (IICRC). Copies of the IICRC fact sheet can be downloaded at: http://1.cleancareseminars.net/?page_id=185 (IICRC, 2005).

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

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.

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

IICRC. 2005. Carpet Cleaning FAQ 4 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.

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

SBBRS. 2011. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations, 8th edition. 780 CMR 1209.0

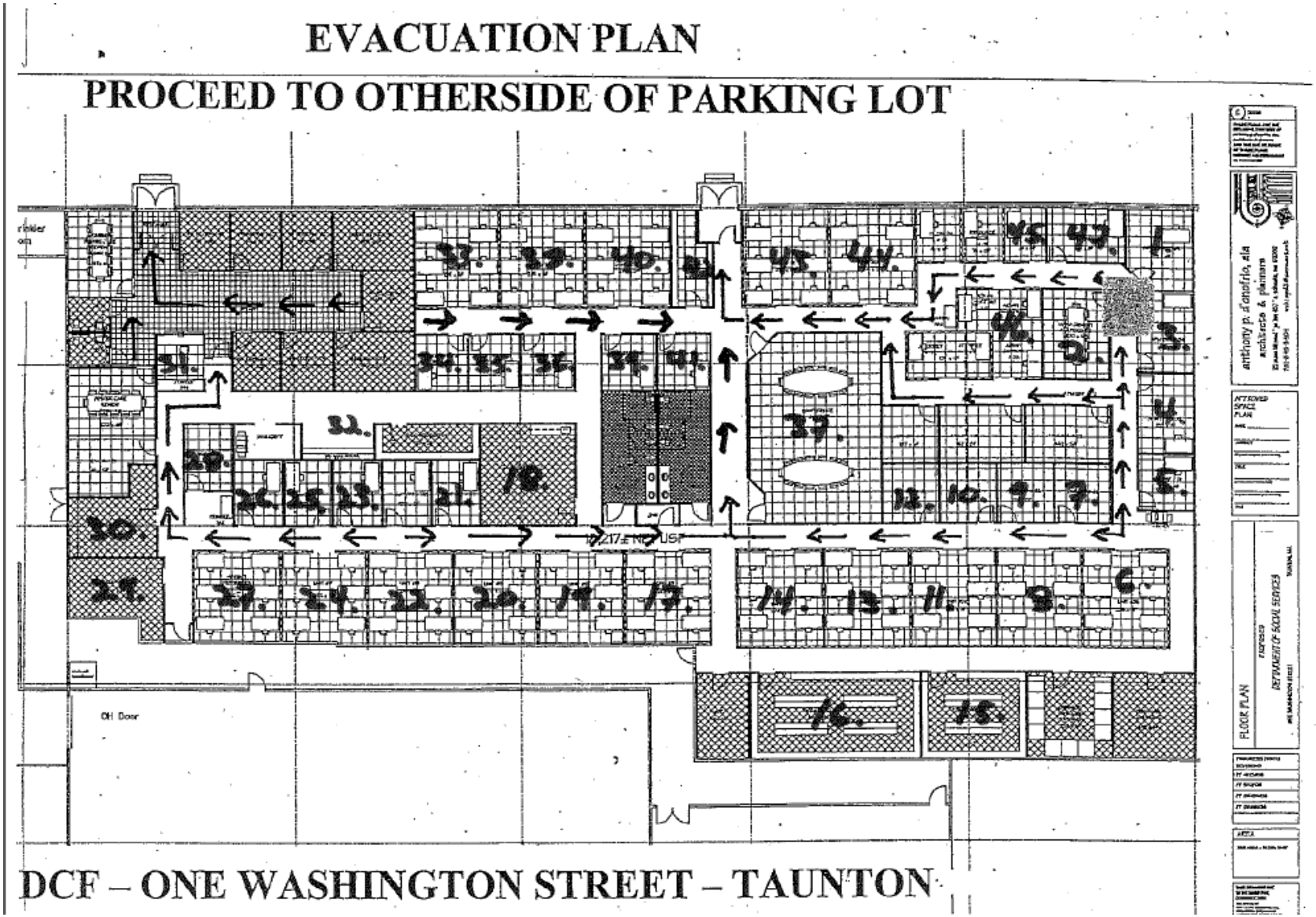
SMACNA. 1994. HVAC Systems Commissioning Manual. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

Sundell. 2011. Sundell, J., H. Levin, W. W. Nazaroff, W. S. Cain, W. J. Fisk, D. T. Grimsrud, F. Gyntelberg, Y. Li, A. K. Persily, A. C. Pickering, J. M. Samet, J. D. Spengler, S. T. Taylor, and C. J. Weschler. 2011. Ventilation rates and health: multidisciplinary review of the scientific literature. *Indoor Air*, Volume 21: pp 191–204.

US EPA. 2001. "Mold Remediation in Schools and Commercial Buildings". Office of Air and Radiation, Indoor Environments Division, Washington, DC. EPA 402-K-01-001. March 2001. Available at: http://www.epa.gov/mold/mold_remediation.html.

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.

Figure 1: Floor Plan



Picture 1

Rooftop air handling unit

Picture 2

MERV 8 pleated air filter

Picture 3

Supply air diffuser

Picture 4

Return vent

Picture 5

Digital thermostat, note fan in "auto" setting (arrow)

Picture 6

Digital thermostat, note system in "off" setting (arrow)

Picture 7

Missing caulking in bathroom sink

Picture 8

Floor drain in restroom

Picture 9

Food crumbs/debris in toaster oven

Picture 10

Food crumbs/debris in toaster oven

Location: Department of Children and Families **Indoor Air Results**

Address: 1 Washington St. # 21 Taunton, MA **Table 1** **Date: 4/15/2014**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Background	225	ND	66	69	12					Cloudy & humid am, heavy rain pm
Ladies Room						0	N	Y	Y	Ducted exhaust, dusty, floor drain, caulk missing behind sink cabinet
Men's Room						0	N	Y	Y	Ducted exhaust, caulk missing behind sink, floor drain
#1	689	ND	72	55	3	0	N	Y	Y	Carpet w/capped floor drain, moisture meter readings dry for GW & carpet
#2 Small Conference Room	810	ND	73	52	8	0	N	Y	Y	DEM, DO
#3	705	ND	73	51	3	0	N	Y	Y	AF, PF, Plants, DO, HS, candle warmer
#4	788	ND	73	52	3	1	N	Y	Y	PF, candle, HS, DO, MF
#5	757	ND	74	51	3	1	N	Y	N	DO, microwave
#6	770	ND	74	49	3	0	N	Y	Y	HS, MF, toaster oven, plants
#7	735	ND	74	48	5	0	N	Y	N	HS, DO, DEM, water stain on wall outside office, GW: dry, carpet: dry
#8	760	ND	75	49	4	3	N	Y	Y	HS, DEM

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
DEM = dry erase materials
DO = door open
GW = gypsum wallboard
HS = hand sanitizer
UF = upholstered furniture
NC = non-carpeted
PF = personal fan
MF = mini fridge

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Department of Children and Families **Indoor Air Results**

Address: 1 Washington St. # 21 Taunton, MA **Table 1** **Date: 4/15/2014**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
#9	825	ND	75	47	4	0	N	Y	N	DO, plant, HS, AF (reeds)
#10	802	ND	76	47	4	1	N	Y	N	Plant, DO
#11	830	ND	76	47	6	3	N	Y	Y	Water stain on ceiling tile; carpet dry. HS, plants
#12	859	ND	76	47	4	1	N	Y	N	Plant, HS, PF
#13	762	ND	75	47	5	5	N	Y	Y	Plants, HS, PF, accumulated items, MF
#14	752	ND	75	46	4	1	N	Y	Y	MF
#15 File Room	679	ND	74	44	4	0	N	Y	Y	
#16 Open Case Room	706	ND	74	42	3	0	N	Y	Y	DO
#17	657	ND	74	48	4	3	N	Y	Y	MF, thermostat on auto
#18 Kitchen	549	ND	74	48	4	0	N	Y	Y	toasters w/crumbs, microwave, sink needs caulking
#19	675	ND	75	49	5	2	N	Y	Y	MF, HS, plants

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
DEM = dry erase materials
DO = door open
GW = gypsum wallboard
HS = hand sanitizer
UF = upholstered furniture
NC = non-carpeted
PF = personal fan
MF = mini fridge

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Department of Children and Families **Indoor Air Results**

Address: 1 Washington St. # 21 Taunton, MA **Table 1** **Date: 4/15/2014**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m^3)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
#20	688	ND	75	48	5	2	N	Y	Y	HS, accumulated items on surfaces
#21	888	ND	75	47	4	0	N	Y	N	AF strong, DO
#22	650	ND	74	48	4	4	N	Y	Y	Accumulated items on surfaces
#23	804	ND	74	49	4	2	N	Y	N	DO, MF
#24	713	ND	74	49	3	3	N	Y	Y	MF
#25	694	ND	73	49	5	1	N	Y	N	DO, PF, MF
#26	632	ND	73	49	5	0	N	Y	N	DO, PF
#27	598	ND	72	50	3	1	N	Y	Y	MF, PF, HS
#28	520	ND	72	49	4	0	N	Y	N	AF, DO, MF, DEM
#29 Quiet Room	620	ND	72	50	4	0	N	Y	Y	UF, pillows, area rug
#30	715	ND	73	50	4	1	N	Y	Y	DO, accumulated Items, thermostat Off; fan on auto

ppm = parts per million
µg/m^3 = micrograms per cubic meter
ND = non detect
AF = air freshener
DEM = dry erase materials
DO = door open
GW = gypsum wallboard
HS = hand sanitizer
UF = upholstered furniture
NC = non-carpeted
PF = personal fan
MF = mini fridge

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Department of Children and Families **Indoor Air Results**

Address: 1 Washington St. # 21 Taunton, MA **Table 1** **Date: 4/15/2014**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m^3)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
#31 Reception area	695	ND	73	51	4	1	N	Y	N	PF
#32 Mail Area	646	ND	74	50	6	0	N	Y	Y	
#33	646	ND	75	52	5	5	N	Y	Y	HS, accumulated items on surfaces
#34	624	ND	76	47	4	0	N	Y	N	AF (reeds), HS
#35	738	ND	77	49	4	0	N	Y	N	HS, accumulated items on surfaces
#36	690	ND	76	47	4	2	N	Y	N	AF
#37 Large Conference Room	644	ND	75	51	7	0	N	Y	Y	DEM
#38	618	ND	75	51	4	5	N	Y	Y	Plants, HS
#39	658	ND	76	49	5	0	N	Y	N	MF, HS, DO, plants
#40	661	ND	76	50	4	3	N	Y	Y	HS, plants
#41	725	ND	76	48	4	1	N	Y	N	PF, MF

ppm = parts per million
µg/m^3 = micrograms per cubic meter
ND = non detect
AF = air freshener
DEM = dry erase materials
DO = door open
GW = gypsum wallboard
HS = hand sanitizer
UF = upholstered furniture
NC = non-carpeted
PF = personal fan
MF = mini fridge

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location: Department of Children and Families **Indoor Air Results**

Address: 1 Washington St. # 21 Taunton, MA **Table 1** **Date: 4/15/2014**

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
#42 Library	617	ND	75	47	4	0	N	Y	N	
#43	691	ND	75	50	5	2	N	Y	Y	HS
#44	708	ND	75	51	4	1	N	Y	Y	
#45	683	ND	74	50	4	0	N	Y	Y	
#46	680	ND	74	51	4	2	N	Y	Y	PF, thermostat off; fan on
#47	707	ND	74	51	4	0	N	Y	Y	HS

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AF = air freshener
DEM = dry erase materials
DO = door open
GW = gypsum wallboard
HS = hand sanitizer
UF = upholstered furniture
NC = non-carpeted
PF = personal fan
MF = mini fridge

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%