INDOOR AIR QUALITY ASSESSMENT

Commonwealth of Massachusetts
Department of Transitional Assistance
21 Spring Street
Taunton, MA

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

Background/Introduction

In response to a request from Pamela Jackson, Director of Human Resources, Office of Children, Youth and Families, Executive Office of Health and Human Services (EOHHS), the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health (BEH) conducted an indoor air quality (IAQ) assessment at the Taunton area office for the Department of Transitional Assistance (DTA), 21 Spring Street, Taunton, Massachusetts. The assessment was prompted by occupant reports of musty odors and concerns regarding building leaks and possible mold growth. On February 19, 2014, a visit to conduct an IAQ assessment was made by Cory Holmes and Sharon Lee, Environmental Analysts/Inspectors for BEH's IAQ Program. BEH/IAQ staff were accompanied by Mary Farrell, Property Management, Office of Leasing and State Owned Properties, EOHHS.

The DTA has occupied space on the first floor of the building for over 20 years. The building also contains other state offices including MassHealth (Office of Medicaid), the Massachusetts Rehabilitation Commission (MRC), and the Massachusetts Department of Developmental Services (DDS). Since each of the area offices has separate heating, ventilation, and air conditioning (HVAC) equipment, the BEH/IAQ visit was limited to the DTA space.

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 performed a visual inspection of building materials for water damage and/or microbial growth. Moisture content of porous building materials (i.e., gypsum wallboard, ceiling tiles, and carpeting) was measured using a Delmhorst, BD-2000 Model Moisture Detector. Test results are included as Table 1.

Results

The DTA has an employee population of approximately 50 with up to 70 members of the public conducting business at the office daily. Test results appear in Table 1 and are listed by numerical designation on the floor plan attached as Picture 1. Windows are not openable in the DTA space.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were above 800 parts per million (ppm) in all areas tested, indicating a lack of air exchange at the time of assessment. It is important to note that the assessment occurred after several days of subzero weather. During extreme cold conditions, fresh air intakes on the building exterior are often limited to reduce the amount of cold air supplied to the HVAC equipment. Limiting cold air increases thermal comfort of occupants and prevents freezing of pipes and/or HVAC equipment. The current thermostat setting also limits provision of air to the office space.

Fresh air is provided by rooftop air-handling units (AHUs; Picture 2). Fresh air is drawn into the AHUs through a bank of high efficiency pleated air filters, heated or cooled, and delivered to occupied areas via ducted air diffusers (Picture 3). Return air is drawn into ceiling or wall-mounted vents and ducted back to the rooftop AHUs (Picture 4). It was noted that there did not appear to be any supply vents located in the reception area, which had the highest carbon dioxide reading. Provisions should be made to duct supply ventilation into this area.

The HVAC system is controlled by digital thermostats. Thermostats examined had a fan switch with two settings, *on* and *auto* (Picture 5). 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, the thermostat fan setting as in the "auto" position. 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. All of the thermostats examined at the DTA were set to the fan *auto* setting at the time of assessment.

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). At the time of assessment, the last date of balancing was not known.

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 temperatures at the time of the assessment ranged from 70°F to 76°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.

Relative humidity measurements at the time of assessment ranged from 21 to 32 percent (Table 1), which were below the MDPH recommended comfort range in all areas surveyed. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

In order for building materials to support mold growth, a source of water exposure is necessary. The main concern voiced by DTA employees was related to musty odors from chronic water leaks in the central/open work area. DTA staff pointed out water-damaged ceiling tiles, specifically in workstations 151-156 (Picture 1; Picture 6). It was reported that ceiling tiles in these areas have been changed a number of times due to repeated leaks. BEH/IAQ staff removed tiles in this area to observe conditions in the ceiling plenum. Approximately 3 to 4 feet above the ceiling tile system appeared to be a metal/tin-style ceiling (Picture 7), which would not be conducive to mold growth. However, bats of fiberglass insulation (Pictures 7 and 8), as well as old/loose ceiling tiles were found resting directly on top of water stained ceiling tiles observed. These absorbent materials are likely the source of musty odors reported by occupants.

Water-damaged ceiling tiles were also observed in the conference room above windows (Picture 9). BEH/IAQ Staff also noted fiberglass insulation above water-stained ceiling tiles in the conference room. Water-damaged ceiling tiles in the copy room are reportedly from an elbow joint leak that has since been repaired (Pictures 10 and 11). BEH/IAQ staff did not observe any active leakage at the time of assessment.

Visible mold growth from chronic moisture exposure was observed in both the men's and women's employee restrooms. Walls in these areas, as well as other perimeter walls throughout the space (e.g. Area Director's office), consist of gypsum wallboard (GW) panels sealed with vinyl wallpaper (Picture 12). BEH/IAQ staff peeled back the material in several areas along the restroom floor near water sources (e.g., toilets, pipes) and found GW water-damaged and colonized with mold (Pictures 13 through 15). Since GW is a porous material prone to mold growth, use of it along restroom walls that can experience repeated moisture exposure is not recommended. Since the vinyl covering serves as an impermeable barrier, the GW cannot dry; moisture trapped behind the vinyl wallpaper can result in further damage.

Occasional water infiltration was also reported in the Area Director's office. The Area Director indicated that water leakage from above the windows occurs during wind-driven rain events. Signs of water damage in the interior wall, including bubbling vinyl wallpaper, were observed. BEH/IAQ staff examined conditions on the exterior outside these areas and noted mortar around brickwork in need of repointing (Pictures 16 and 17). The condition of the building exterior (e.g. missing mortar) is likely source of water infiltration.

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

Other water damage issues were noted by BEH/IAQ staff. Plants were observed in several areas. Water-damaged/stained carpeting was observed beneath plants in the conference room as a result of over-watering or leaking drip pans (Picture 18). In some cases, plants were resting on paper or cardboard (Picture 19). Plants, soil, and drip pans can serve as sources of mold/bacterial growth. Porous materials such as paper and dirt/debris trapped in carpets can be a source of mold growth, if moistened repeatedly. Plants should be properly maintained, over-watering of plants should be avoided, and drip pans should be inspected periodically for mold growth.

The lunchroom contains two refrigerators, white and tan. Visible mold growth was seen on the exterior of the tan refrigerator and on gaskets inside (Picture 20). Mold and debris trapped in the gasket can result in irritation or illness.

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. Outdoor carbon monoxide concentrations were non-detect (ND) at the time of assessment (Table 1). No measurable levels of carbon monoxide were detected inside the building during the assessment (Table 1).

Particulate Matter

The US EPA has established NAAQS limits for exposure to particulate matter. Particulate matter includes airborne solids that can be irritating to the eyes, nose, and throat. The NAAQS originally established exposure limits to PM with a diameter of 10 μm or less (PM10). In 1997, US EPA established a more protective standard for fine airborne particulate matter with a diameter of 2.5 μm or less (PM2.5). The NAAQS has subsequently been revised, and PM2.5 levels were reduced. 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 PM concentrations in the indoor environment.

Outdoor PM2.5 concentrations the day of assessment were measured at 14 $\mu g/m^3$. PM2.5 levels measured inside the building ranged from 6 to 14 $\mu g/m^3$ (Table 1). Both indoor and outdoor PM2.5 levels 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 indoors 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.

Other Conditions

Other conditions that can affect indoor air quality were observed during the assessment. Physically damaged GW was noted in the lunchroom (Picture 21), and missing/ajar or broken ceiling tiles were observed in a few areas (Table 1). Holes in walls should be repaired/sealed and ceiling tiles should be intact and flush with the tile system to prevent movement of materials from the wall cavity and ceiling plenum, respectively, into occupied space where they can serve as a source of odors and/or irritation.

Air fresheners, deodorizing materials, and other scented products were observed in some areas (Table 1). 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.

Conclusions/Recommendations

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

Water-Damaged Materials

1. Work with building management to help identify areas of chronic leaks within DTA occupied space. Building management should consult with a professional roofing contractor to ensure leaks are repaired.

2. Remove water-damaged fiberglass insulation, particularly in areas where chronic leakage occurs, to remove absorbent materials and prevent musty odors.

3. Replace water-damaged ceiling tiles (e.g., areas 151-156, conference room) once leaks are repaired. Monitor for further leaks. If staining of ceiling tiles reoccurs, report to building management for prompt remediation.

4. Remove furniture and personal items or cover employee workstations with plastic sheeting in areas of remediation to protect items and facilitate cleanup.

5. Remediate damaged walls in the restrooms.

    a. Contain/isolate areas of remediation. If the areas cannot be properly contained/ isolated, remediation work should be conducted during non-business hours.

    b. Remove water-damaged/mold-colonized GW in employee restrooms in a manner consistent with recommendations found in "Mold Remediation in Schools and Commercial Buildings" published by the US Environmental Protection Agency (US EPA, 2001).

    c. Remove any additional water-damaged materials found during remediation (e.g., GW, fiberglass insulation).

    d. Place water-damaged/mold-colonized materials in plastic bags for transport/disposal.

    e. Consider using a water/mold-resistant material such as cement board instead of GW in areas of chronic water leaks (e.g., restrooms).

    f. Ensure air-handling units are deactivated and seal vents temporarily in remediation areas during removal/remediation of GW.

6. Ensure all areas of remediation are thoroughly cleaned and vacuumed using a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner and/or wet wiping of flat surfaces after remediation is complete.

General IAQ Recommendations

1. Set thermostats to the fan "on" position to provide continuous air circulation/filtration during business hours.
2. Work with building management and/or an HVAC engineer to make provisions for supply ventilation in the reception area.
3. Consider adopting a balancing schedule of every 5 years for all mechanical ventilation systems, as recommended by ventilation industrial standards (SMACNA, 1994).
4. 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).
5. Remove large plants from carpeted area in conference room. Refrain from placing plants on porous materials (e.g., paper, cardboard, carpeting).
6. 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.

7. Re-point exterior brick to prevent further water damage and water penetration.
8. Ensure refrigerators are cleaned out regularly. Clean moldy gaskets with a mild detergent or antimicrobial agent, if cannot be adequately cleaned consider replacing.
9. Avoid the use of scented products including air fresheners.
10. Replace missing/damaged ceiling tiles.
11. Repair damaged wallboard in lunchroom.
12. 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.

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.

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

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

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

Picture 1

Floor Plan, Taunton Area DTA 21 Spring Street

Picture 2

Example of rooftop air handling unit

Picture 3

Ceiling-mounted air diffuser

Picture 4

Wall-mounted return vent

Picture 5

Digital thermostat set to fan "auto"

Picture 6

Water-damaged ceiling tiles in common work area (151-156) where reoccurring leaks were reported

Picture 7

Metal ceiling panels above water-damaged ceiling tiles in common work area (151-156)

Picture 8

Fiberglass insulation above water-damaged ceiling tiles in common work area (151-156)

Picture 9

Water-damaged ceiling tiles in conference room

Picture 10

Water-damaged ceiling tiles in copy room

Picture 11

Leaking elbow joint (repaired) above water-damaged ceiling tiles in copy room

Picture 12

Vinyl covered wall panels

Picture 13

Water-damaged/mold-colonized gypsum wallboard in employee men's restroom

Picture 14

Water-damaged/mold-colonized gypsum wallboard in employee women's restroom

Picture 15

Water-damaged/mold-colonized gypsum wallboard in employee women's restroom

Picture 16

Missing/damaged mortar around exterior brick outside DTA

Picture 17

Missing/damaged mortar around exterior brick outside DTA

Picture 18

Water-damaged/stained carpeting under plants in conference room

Picture 19

Plant on water-damaged/mold-colonized cardboard in work area

Picture 20

Mold growth on tan refrigerator/gasket in lunchroom

Picture 21

Damaged drywall in lunch room

Location: Department of Transitional Assistance **Indoor Air Results**

Address: 21 Spring Street, Taunton, MA **Date: 2/19/2014**

Table 1

Location	Carbon Dioxide (ppm)	Temp (°F)	Relative Humidity (%)	Carbon Monoxide (ppm)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		
Background	389	34	65	ND	14					Scattered clouds, cold, dry
104	1251	74	21	ND	11	2	N	Y	Y	
105	1169	73	23	ND	10	0	N	Y	Y	
107	1256	73	24	ND	7	1	N	Y	Y	Thermostat fan "auto"
108 Photo Room	1336	73	25	ND	7	2	N	Y	Y	
111	1312	71	32	ND	7	1	N	Y	Y	DO
115	1240	70	29	ND	7	1	N	Y	Y	
116 Lunch Room	1032	70	28	ND	8	0	N	Y	Y	Damaged GW, plants on newspaper, visible mold growth on refrigerator/gasket
119 Fraga Office	1013	73	25	ND	6	3	N	Y	Y	Occasional leaks during heavy wind/rain over window, GW moisture measurement-dry, thermostat fan "auto"
120	1066	74	24	ND	7	1	N	Y	N	DO

ppm = parts per million
AD = air deodorizer
ND = non detect
CT = ceiling tile
WD = water-damaged
DO = door open
$\mu g/m^3$ = micrograms per cubic meter
GW = gypsum wallboard

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%

Table 1 (continued)

Location	Carbon Dioxide (ppm)	Temp (°F)	Relative Humidity (%)	Carbon Monoxide (ppm)	PM2.5 (μg/m³)	Occupants in Room	Windows Openable	Ventilation		
121	1174	74	23	ND	9	1	N	Y	Y	
122	1192	74	24	ND	6	1	N	Y	Y	AD
Copy Room	1377	76	24	ND	6	0	N	Y	Y	WD CT moisture measurement-dry, elbow joint leak (reportedly repaired) above CT
123	1458	76	24	ND	6	1	N	Y	Y	2 WD CT, DO, AD
124	1254	75	23	ND	6	0	N	Y	N	WD CT
125	1221	75	23	ND	6	0	N	Y	Y	
126	1315	75	24	ND	6	0	N	Y	Y	
127	1234	75	23	ND	6	0	N	Y	Y	Thermostat fan "auto"
128	1254	75	24	ND	6	0	N	Y	Y	Broken CT, wall crack
129	1310	75	24	ND	8	1	N	Y	Y	Painted over CT

ppm = parts per million
AD = air deodorizer
ND = non detect
CT = ceiling tile
WD = water-damaged
DO = door open
μg/m³ = micrograms per cubic meter
GW = gypsum wallboard

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 Transitional Assistance **Indoor Air Results**

Address: 21 Spring Street, Taunton, MA **Table 1 (continued)** **Date: 2/19/2014**

Location	Carbon Dioxide (ppm)	Temp (°F)	Relative Humidity (%)	Carbon Monoxide (ppm)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		
130	1333	75	23	ND	8	1	N	Y	Y	
131	1382	75	24	ND	8	1	N	Y	Y	DO
132	1363	74	25	ND	8	1	N	Y	Y	DO
138-143	1296	73	26	ND	8	3	N	Y	Y	Plants
144-146	1298	73	24	ND	7	1	N	Y	Y	
147-149	1394	73	26	ND	8	3	N	Y	Y	Plants
151-156	1363	73	25	ND	8	5	N	Y	Y	Chronic leaks reported, WD CT moisture measurement-dry
Reception Area	1738	74	29	ND	14	1	N	N	Y	2 WD CT, no supply vent identified
Multi-Purpose Storage Room (paper supply)	1196	73	25	ND	7	0	N	Y	Y	
Conference Room	1178	73	25	ND	7	2	N	Y	Y	Plants-WD carpeting-moist, WD CT corner near windows

ppm = parts per million
AD = air deodorizer
ND = non detect
CT = ceiling tile
WD = water-damaged
DO = door open
$\mu g/m^3$ = micrograms per cubic meter
GW = gypsum wallboard

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	Carbon Dioxide (ppm)	Temp (°F)	Relative Humidity (%)	Carbon Monoxide (ppm)	PM2.5 (μg/m^3)	Occupants in Room	Windows Openable	Ventilation		
159-162	1377	72	26	ND	9	11	N	Y	Y	
163-168	1262	72	25	ND	9	6	N	Y	Y	
169-176	1219	73	24	ND	7	5	N	Y	Y	Plants on cardboard-moldy
174-178	1225	73	26	ND	7	2	N	Y	Y	
180-181	1236	75	24	ND	7	0	N	Y	N	Thermostat fan "auto"

ppm = parts per million
AD = air deodorizer
ND = non detect
CT = ceiling tile
WD = water-damaged
DO = door open
μg/m^3 = micrograms per cubic meter
GW = gypsum wallboard

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%