# Malden Public Schools
# Indoor Air Quality Study and Recommendations

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## IAQ STUDY SUMMARY

In light of the recent ongoing health concerns worldwide, Malden Public Schools has engaged WB Engineers (WB) to analyze the existing classrooms and offices at the public schools within Malden to develop an understanding of the current HVAC system as well as explore methods to maximum the ventilation and increase Indoor Air Quality to help reduce the spread of COVID-19 within the school(s). In the attached excel file, a description of each room and associated recommendations can be found. Please note this report includes the following buildings: Ferryway, Forestdale, Linden, Salemwood, and Malden High School.

During the study, WB focused on (2) key improvements, increased outdoor air and increased filtration, to better the indoor air quality and adhere to ASHRAE and CDC recommendations. In order to assess each room on a case by case basis, WB determined if the rooms were served by a central HVAC system (i.e. a roof top unit (RTU) or a central air handling unit (AHU)) and if they were not, if any other means of providing ventilation air in the space existed(i.e. unit ventilators, operable windows, or providing portable air filters). A complete breakdown of our findings can be found in the attached excel file. Below is a brief summary of the excel file. Additionally, please refer to Appendix A for more information regarding the approach to this study.

Only Building C of the High School is served by heating only unit ventilators, exhaust air fans, and operable windows. Each unit ventilator did have an outdoor air intake and a method of filtration. All remaining buildings of the High School as well as the Ferryway School, Forestdale School, Linden School, and Salemwood School are served by central HVAC systems via several rooftop units (RTUs). All buildings discussed in this report are tied into a Building Management System (BMS).

WB recommends that for all unit ventilators the filters be replaced with new and be changed on a regular basis. Additionally, the exhaust air fans speed shall be increased if possible, to account for larger amounts of outdoor air (O/A) being brought in by the unit ventilators. For outdoor air recommendations for typical school spaces please refer to Table 1 below. Additional outdoor air rates and code requirements can be found in Appendix B.

To ensure proper function of the HVAC systems providing ventilation fresh air to the school(s), it is important to refrain from tampering with the thermostats/temperature sensors located within the classrooms. It is also important to ensure the univents grille discharge is free from obstructions (e.g. books, supplies, decorations, etc.).

| | Code Required O/A (CFM/SF) | | Covid-19 Recommendation (CFM/SF) | |
|---|---|---|---|---|
| | 50% Occupancy | 100% Occupancy | 50% Occupancy | 100% Occupancy |
| Auditoriums | 0.44 | 0.81 | 0.57 | 1.05 |
| Classrooms | 0.30 | 0.47 | 0.38 | 0.61 |
| Day Care | 0.31 | 0.43 | 0.40 | 0.56 |
| Media Center | 0.25 | 0.37 | 0.32 | 0.48 |
| Music | 0.24 | 0.41 | 0.31 | 0.53 |
| Science Lab | 0.31 | 0.43 | 0.40 | 0.56 |
| Wood/Metal Shops | 0.28 | 0.38 | 0.36 | 0.49 |

*Table 1: Outdoor air rates per space type within a school based on Table 2 (in Appendix B)*

Please note that along with this, WB also recommends opening the windows during the weather permitting months, even if the room is served by a unit ventilator. When the weather prohibits open

windows (i.e. rain, snow, colder temperatures), portable air cleaners may be used to provide added filtration and air changes even in the rooms with unit ventilators. Please note that for all the spaces served by univents, or heating only AHUs, WB recommends running these units whenever the building is occupied, even if the heating coil is not being utilized, in order to bring in ventilation air.

**Ferryway School:**

The Ferryway School is a 3-story 138,000 SF K through 8 school. The entirety of the Ferryway School is served by a central HVAC system via several RTUs that provide ventilation fresh air to the school. All RTUs and associated equipment appear to be in excellent condition and all RTUs are provided with MERV 13 filters. All perimeter spaces also have operable windows. Perimeter vertical fan coils units are also provided for comfort heating and cooling (these units do NOT provide ventilation fresh air).

Based on this system type, WB recommends increasing the outdoor air (O/A) damper on all RTUs to maximize the amount of ventilation fresh air provided to the school spaces and continuing the use of MERV 13 filters for the RTUs. Further, WB recommends opening all windows in rooms that have them, weather permitting. When opening windows is not feasible (i.e. outdoor conditions), WB recommends maintaining the O/A damper in the increased position for all RTUs to maximize the amount of ventilation fresh air provided to the school spaces. WB recommends the O/A damper position to be 100% open whenever possible and adjusted accordingly for temperature conditions. WB recommends maintaining a minimum damper position of 30% open. For additional measure, a portable air cleaner may be provided (Refer to Table 3 in Appendix C for more information).

**Forestdale School:**

The Forestdale School is a 3-story 115,000 SF K through 8 school. The entirety of the Forestdale School is served by a central HVAC system via several RTUs that provide ventilation fresh air to the school. All RTUs and associated equipment appear to be in excellent condition and all RTUs are provided with MERV 13 filters. All perimeter spaces also have operable windows. Perimeter vertical fan coils units are also provided for comfort heating and cooling (these units do NOT provide ventilation fresh air).

Based on this system type, WB recommends increasing the outdoor air (O/A) damper on all RTUs to maximize the amount of ventilation fresh air provided to the school spaces and continuing the use of MERV 13 filters for the RTUs. Further, WB recommends opening all windows in rooms that have them, weather permitting. When opening windows is not feasible (i.e. outdoor conditions), WB recommends maintaining the O/A damper in the increased position for all RTUs to maximize the amount of ventilation fresh air provided to the school spaces. WB recommends the O/A damper position to be 100% open whenever possible and adjusted accordingly for temperature conditions. WB recommends maintaining a minimum damper position of 30% open. For additional measure, a portable air cleaner may be provided (Refer to Table 3 in Appendix C for more information).

**Linden School:**

The Linden School is a 3-story 138,000 SF K through 8 school. The entirety of the Linden School is served by a central HVAC system via several RTUs that provide ventilation fresh air to the school. All RTUs and associated equipment appear to be in excellent condition and all RTUs are provided with MERV 13 filters. All perimeter spaces also have operable windows. Perimeter vertical fan coils units are also provided for comfort heating and cooling (these units do NOT provide ventilation fresh air).

Based on this system type, WB recommends increasing the outdoor air (O/A) damper on all RTUs to maximize the amount of ventilation fresh air provided to the school spaces and continuing the use of MERV 13 filters for the RTUs. Further, WB recommends opening all windows in rooms that have them,

weather permitting. When opening windows is not feasible (i.e. outdoor conditions), WB recommends maintaining the O/A damper in the increased position for all RTUs to maximize the amount of ventilation fresh air provided to the school spaces. WB recommends the O/A damper position to be 100% open whenever possible and adjusted accordingly for temperature conditions. WB recommends maintaining a minimum damper position of 30% open. For additional measure, a portable air cleaner may be provided (Refer to Table 3 in Appendix C for more information).

**Salemwood School:**

The Salemwood School is a 4-story 204,000 SF K through 8 school. The entirety of the Salemwood School is served by a central HVAC system via several RTUs that provide ventilation fresh air to the school. All RTUs and associated equipment appear to be in excellent condition and all RTUs are provided with MERV 13 filters. Most perimeter spaces also have operable windows. Existing drawings were not available to confirm which RTUs served which space(s). Perimeter vertical fan coils units are also provided for comfort heating and cooling (these units do NOT provide ventilation fresh air).

Based on this system type, WB recommends increasing the outdoor air (O/A) damper on all RTUs to maximize the amount of ventilation fresh air provided to the school spaces and continuing the use of MERV 13 filters for the RTUs. Further, WB recommends opening all windows in rooms that have them, weather permitting. When opening windows is not feasible (i.e. outdoor conditions), WB recommends maintaining the O/A damper in the increased position for all RTUs to maximize the amount of ventilation fresh air provided to the school spaces. WB recommends the O/A damper position to be 100% open whenever possible and adjusted accordingly for temperature conditions. WB recommends maintaining a minimum damper position of 30% open. For additional measure, a portable air cleaner may be provided (Refer to Table 3 in Appendix C for more information).

**Malden High School:**

The Malden High School is a 4-story 476,500 SF 9 through 12 school consisting of (3) buildings: Building A, Building B, Building C. Building A and Building B of the Malden High School are served by a central HVAC system via several RTUs that provide ventilation fresh air to the school. All RTUs and associated equipment appear to be in excellent condition and all RTUs are provided with MERV 13 filters. All perimeter spaces also have operable windows.

Based on this system type, WB recommends increasing the outdoor air (O/A) damper on all RTUs to maximize the amount of ventilation fresh air provided to the school spaces and continuing the use of MERV 13 filters for the RTUs. Further, WB recommends opening all windows in rooms that have them, weather permitting. When opening windows is not feasible (i.e. outdoor conditions), WB recommends maintaining the O/A damper in the increased position for all RTUs to maximize the amount of ventilation fresh air provided to the school spaces. WB recommends the O/A damper position to be 100% open whenever possible and adjusted accordingly for temperature conditions. WB recommends maintaining a minimum damper position of 30% open. For additional measure, a portable air cleaner may be provided (Refer to Table 3 in Appendix C for more information).

Building C of the Malden High School is served by unit ventilators (univents) with a central exhaust system. The univents have operating outdoor air dampers, heating and cooling coils to provide ventilation and comfort heating/cooling to the classrooms. Additionally, each room has an exhaust grille (to ensure proper air changes) and operable windows.

Based on this system type, WB recommends opening all operable windows and opening the O/A dampers for the univents. Additionally, all exhaust fans (and univents) shall operate when the building is occupied. When opening windows is not feasible (i.e. outdoor conditions), WB recommends opening the O/A dampers for the univents. WB recommends the O/A damper position to be 100% open

whenever possible and adjusted accordingly for temperature conditions. WB recommends maintaining a minimum damper position of 30% open. According to existing drawings, the current O/A damper setting for Building C univents is roughly 40% open which satisfies and exceeds current guidelines for rooms of those size. For additional measure, a portable air cleaner may be provided (Refer to Table 3 in Appendix C for more information). For rooms that do not have operable windows, WB recommends providing a portable air cleaner whenever this room is occupied or planning to be in use.

As previously mentioned, the attached excel file documents the exact recommendation for each room throughout the school.

## APPENDICES

### Appendix A:

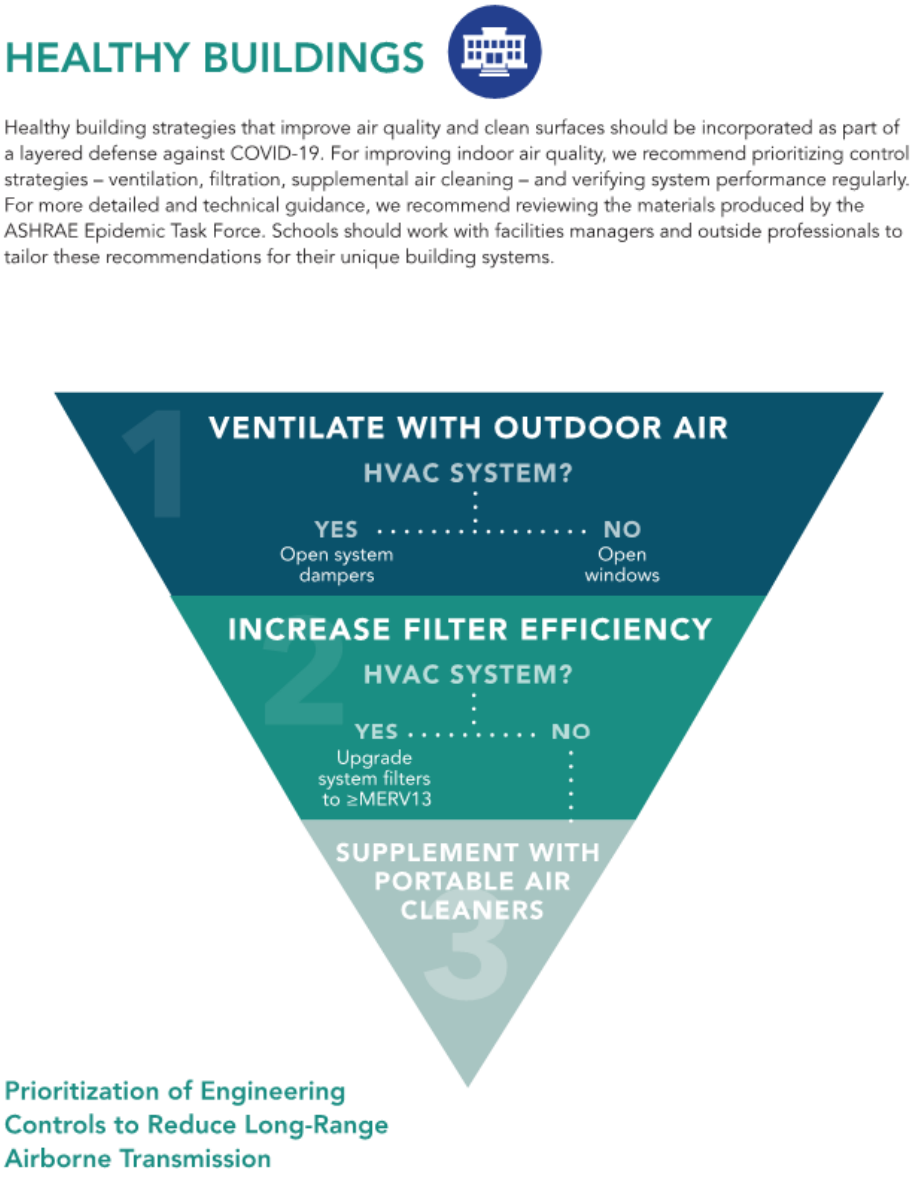


**Figure 1: Harvard School of Public Health's healthy buildings summary.**

## Appendix B:

**TABLE 403.3.1.1**
**MINIMUM VENTILATION RATES**

| OCCUPANCY CLASSIFICATION | OCCUPANT DENSITY #/1000 FT$^2$ [a] | PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, $R_p$ CFM/PERSON | AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, $R_a$ CFM/FT$^2$ [a] |
|---|---|---|---|
| **Education** | | | |
| Art classroom[g] | 20 | 10 | 0.18 |
| Auditoriums | 150 | 5 | 0.06 |
| Classrooms (ages 5-8) | 25 | 10 | 0.12 |
| Classrooms (age 9 plus) | 35 | 10 | 0.12 |
| Computer lab | 25 | 10 | 0.12 |
| Corridors (see public spaces) | — | — | — |
| Day care (through age 4) | 25 | 10 | 0.18 |
| Lecture classroom | 65 | 7.5 | 0.06 |
| Lecture hall (fixed seats) | 150 | 7.5 | 0.06 |
| Locker/dressing rooms[g] | — | — | — |
| Media center | 25 | 10 | 0.12 |
| Multiuse assembly | 100 | 7.5 | 0.06 |
| Music/theater/dance | 35 | 10 | 0.06 |
| Science laboratories[g] | 25 | 10 | 0.18 |
| Smoking lounges[b] | 70 | 60 | — |
| Sports locker rooms[g] | — | — | — |
| Wood/metal shops[g] | 20 | 10 | 0.18 |

**Table 2: IMC 2015 Table 403.3.1.1 Minimum Ventilation Rates**

## Appendix C:

| Air Cleaner | SF Range (SF) | Typical Room Height | Air Cleaner Flow rate (CFM) | Air Change Rate (ACH) | Price Point |
|---|---|---|---|---|---|
| Blueair Classic 205 | Up to 250 | 10 | 200 | 4.8 | $350 |
| Whirlpool WPPRO2000 | 250-500 | 10 | 328 | 3.9 | $430 |
| Blueair Classic 605 | 500-900 | 10 | 500 | 3.3 | $830 |
| Blueair PRO L | 500-900 | 10 | 630 | 4.2 | $980 |
| Carrier FN1AAF | Up to 3000 SF | 10 | 1500 | 3.0 | Quote from Manuf. Required |

**Table 3: Recommended portable air cleaners and associated air change rates.**

Notes:

1. Calculated air change rates were calculated based on max SF range and the typical room height of 10 ft. Actual room heights and square footage may yield a better air change rate than calculated above. Below is the equation used to calculate air changes per hour (ACH).

$$ACH = \frac{CFM \times 60}{Area \times Height_{ceiling}}$$

2. As the air cleaners get larger in size (size of the room increases) they do become louder. The Carrier FN1AAF may not be suitable for a classroom environment but rather a gymnasium or cafeteria.
3. The above units are some of the recommended air cleaners but not all, there are a variety that will work in these circumstances.