Norfolk County Agricultural High School Indoor Air Quality Study and Recommendations

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IAQ STUDY SUMMARY

In light of the recent ongoing health concerns worldwide, Norfolk County Agricultural High School has engaged WB Engineers (WB) to analyze the existing classrooms and offices at Norfolk County Agricultural High School 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. In the attached excel file, a description of each room and associated recommendations can be found. Please note this report includes the remaining 4 buildings evaluated.

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.

Buildings 2, 5, 6 and 8 were largely served by central systems that provides heating and cooling for the buildings. Building 5 differed and was largely served by heating only unit ventilators with centralized exhaust. The central systems for Buildings 2, 6 and 8 all had methods of filtration and outdoor air intake. Different recommendations will be made for each buildings system type and can be found below. Additionally, the Building 5 unit ventilators have outdoor air intakes and a method of filtration. All buildings discussed in this report have been tied into Building Management System (BMS). WB recommends that for all unit ventilators the filters be replaced with new and be changed on a regular basis. The corresponding exhaust fans speed shall be increased if possible, to account for larger amounts of OA 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.

	Code Required OA (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 for rooms served by unit ventilators, WB also recommends opening all operable windows during the weather permitting months. When the weather prohibits open windows (i.e. rain, snow, colder temperatures), WB recommends the use of portable air cleaners to provide added filtration and air changes even in the rooms with unit ventilators. For all the spaces served by Unit Ventilators (univents), heating only RTUs, and heating and cooling RTUs, WB recommends running these units whenever the building is occupied in

order to bring in ventilation air. Lastly, for all centralized units that serve these buildings, WB recommends hiring a testing and balancing contractor to determine airflows and damper positions.

Building 2 (McFarland):

The McFarland building is a 2-story 19,000 SF mixed use building that mainly houses offices and student resources. The majority of the building is served by a single RTU. Within the space, Variable Air Volume (VAV) terminal units with hot water reheat coils and finned tube radiators (FTR) help modulate air and provide heat during the winter time. Most of this building utilizes finned tube radiators (FTR) for heat during the winter months. The RTU has (2) sets of MERV 13 filters and, at the time of the site visit, was operating at 100% outdoor air. WB recommends keeping the current level of filtration and maintain 100% outdoor air capacity. In addition to this, WB recommends increasing the minimum position on the VAVs to at least 20% to keep the air circulating throughout the rooms.

This building also houses (4) classrooms, which are all served by FTR, univents and centralized exhaust fans. These rooms also have operable windows for ventilation air. Based on this system type, WB recommends opening all windows in the rooms. When opening the windows is not feasible (i.e. outdoor conditions), WB recommends providing a portable air cleaner (Refer to Table 3 in Appendix C for more information).

Building 5 (Avery)

The Avery building is a single story 15,000 SF building that mainly houses classrooms. Most of the classrooms have unit ventilators (univents) with a central exhaust system. The univents have operating outdoor air dampers and heating coils to provide ventilation and heat to the classrooms. Each room has an exhaust grille (to ensure proper air changes) and operable windows. Based on this system type, WB recommends opening all windows operable windows and opening the outdoor air dampers for the univents. Furthermore, all exhaust fans (and univents) shall operate when the building is occupied. When opening windows is not feasible (i.e. outdoor conditions), WB recommends providing a portable air cleaner (Refer to Table 3 in Appendix C for more information).

Rooms 5101, 5118, and 5119 are all individually served by split systems (for cooling) and FTR (for heating). Ventilation air is achieved by operable windows. For these rooms WB recommends keeping the windows open as much as possible. When opening windows is not feasible (i.e. outdoor conditions), WB recommends providing a portable air cleaner (Refer to Table 3 in Appendix C for more information).

Building 6 (Animal Science)

The Animal Science building is a 2-story 26,000 SF mixed use building that houses classrooms and labs. Live animals are also kept in this building. The entire building is served by a single RTU that runs 24/7, 365 days a year. The RTU was designed to handle 100% outdoor air but is currently operating at 50%. The RTU has (4) sets of filters including (3) levels of MERV 8's and (1) level of MERV 13's. Based on the function and current RTU settings, WB does not recommend any further upgrades to this HVAC system.

Building 8 (Agricultural Mechanics)

The Agricultural Mechanics (Ag Mech) building is a single story 26,000 SF building that mainly houses classrooms and labs. Most of the rooms/labs are served by Energy Recovery Ventilators (ERV) with multiple exhaust systems. Each shop space, (Construction, Welding, Small Engine and the Main Shop) have their own dedicated ERV and multiple exhaust systems. On top of this, each shop has at least one operable garage door.

Each ERV has (2) sets of MERV 8 filters and (1) set of MERV 13's. Based on the current system; WB does not recommend making any adjustments. However, when the weather permits, WB recommends keeping all garage doors open in the shop spaces.

Additionally, room 8126, is served by a univent with an exhaust fan. It was noted that the actuator for the univent is currently not working but is in the process of being fixed. Once fixed, WB recommends, opening the damper to 100% and providing a portable air cleaner for when the weather does not prohibit 100% outdoor air.

The remainder of the spaces, room 8117, 8118, and 8119 are served by a VRF system, that includes an ERV to duct outdoor directly in the space. Additionally, 8110 is served by a fan coil with outdoor ducted directly to the unit. For the 8117-8119, WB does not recommend altering the HVAC design, however, because these units cannot accept MERV 13 filters, WB recommends providing additional portable air cleaners to meet the required filter rating.

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

APPENDICES

Appendix A:

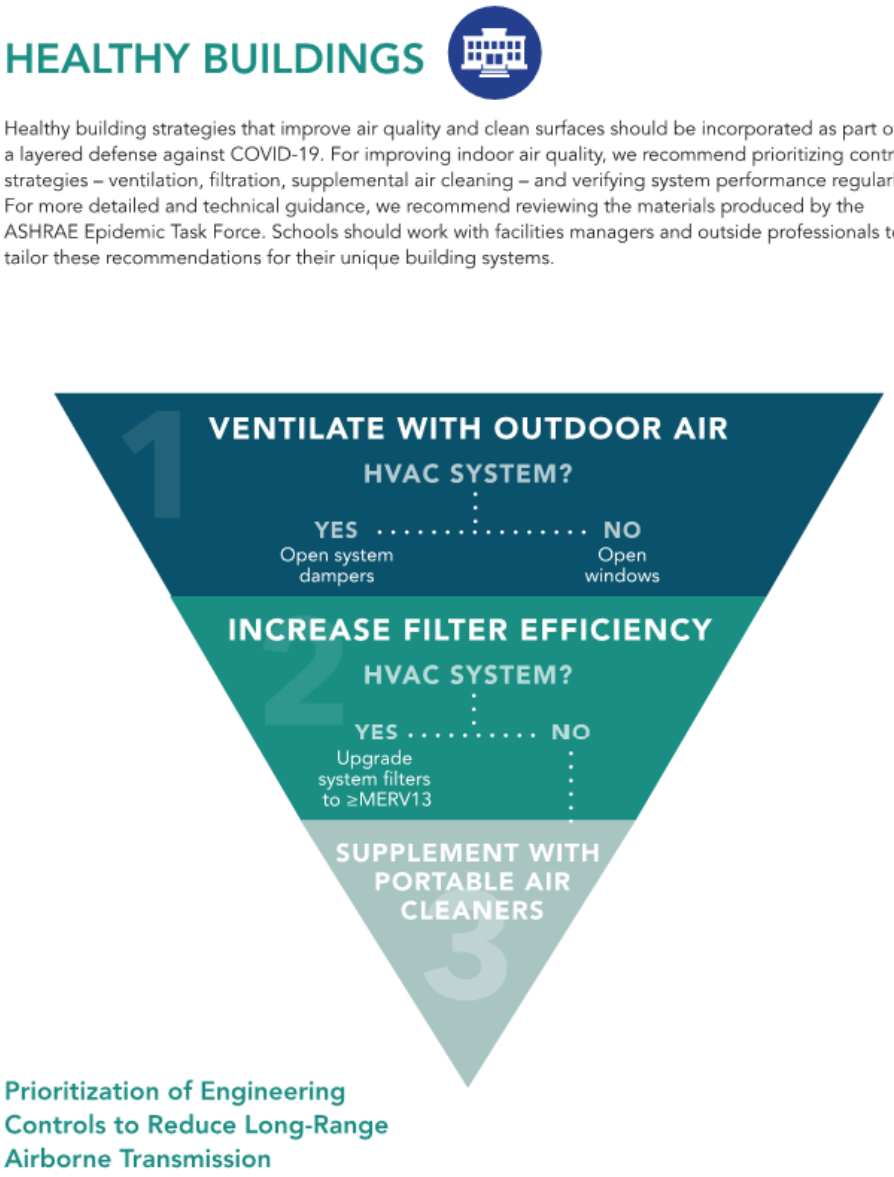

Figure 1: Harvard School of Public Health's healthy buildings summary.

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.