Worcester Public Schools

Ventilation Assessment
&
COVID-19
Mitigation Strategies

for

Durkin Administration Building
Worcester, MA

January 31, 2021

<u>Prepared by</u>:

Nault Architects Inc
71 Hope Ave
Worcester, MA 10603

Seaman Engineering Corporation
22 West St, Unit C
Milbury, MA 01527

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Worcester Public Schools

A. Preface:

Worcester Public School has as Nault Architects Inc. and their consultant Seaman Engineering Corporation (SEC) to review all of their occupied buildings and comment on existing natural and mechanical ventilation.

The first part of the report is SEC's evaluation of the existing mechanical systems.

The second part of the report is an evaluation of the natural ventilation. The Building Code requires ventilation of each occupied space and that can be achieved either through mechanical of natural ventilation methods. If the natural ventilation path is chosen, there must be a clear opening(s) in the space that meet or exceed the 4% of the total room square footage. After the field survey of each room / window type was complete, the ventilation information was added to a spread sheet for calculation of the 4% and color-coding. The calculations were also color-coded on a floor plans of the building for a better overall understanding of the existing conditions.

The natural ventilation color-coding (on the spreadsheet and plans) is as follows:

- **Green Spaces**: meets or exceed the code minimum natural ventilation.
- **Yellow Spaces**: does **not** meet the code minimum natural ventilation, but does have operable window to allow some natural ventilation.
- **Red Spaces**: does not meet the code minimum natural ventilation and does not have any operable windows.

It should be reiterated that the second part of this report is only measuring natural ventilation. Therefore, newer buildings or buildings with large amounts of fixed windows may have large amounts of red and/or yellow spaces, but that doesn't mean they are not code compliant, they may be relying on mechanical ventilation. However, for this part of the report, were asked to show a baseline for all schools without mechanical equipment.

B. Building Description:

Durkin Administration Building (DAB):
Durkin Administration Building is located in the Doherty Quadrant of Worcester at 20 Irving Street. The School was built in 1891, houses the Worcester Public Schools' Administrative offices and the building is 75,836 square feet. The windows are original to the 1891 construction.

C. Table of Contents:

1) Mechanical Ventilation Report

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I. EXECUTIVE SUMMARY

This report briefly describes the existing ventilation systems at the Dr. John E. Durkin Administration Building in Worcester, MA as well as their capabilities to support current code required ventilation rates. In addition, we have evaluated the systems ability to support recommendations in accordance with the American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE) Epidemic Task Force Building Readiness Guidelines (updated 10-20-2020). Several of the ASHRAE recommendations as well as those from the Harvard T.H. Chan School of Public Health and other industry sources have been presented for consideration to assist in further mitigating virus transmission through the buildings heating, ventilation, and air conditioning (HVAC) systems.

Our inspection of the existing systems was limited to visual observations coupled with review of original design drawings, when available. The findings presented in this report presume the systems are operational and delivering air quantities indicated on the original design drawings. Proper operational testing of each piece of equipment and airflow measuring would be required to confirm such operation.

During, our visual inspection we also took several spot measurements of air quality in various locations throughout the building. Measurements taken were limited to Temperature (°F), Relative Humidity (% RH), CO_2 (carbon dioxide in ppm), CH_2O (formaldehyde in ppm) and Total Volatile Organic Compounds (TVOC in ppm).

The results of the readings taken during our inspection were only used to identify areas where possible ventilation issues may exist and/or to identify areas where a source contaminant may be causing elevated levels.

COVID-19 Control Measures:

In line with the current American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE) Epidemic Task Force Building Readiness Guidelines (updated 10-20-2020) and those from the Harvard T.H. Chan School of Public Health - 5-Step Guide to Checking Ventilation Rates in Classrooms, as well as other industry recommendations the following HVAC COVID Control Measures (CCM's) are presented for consideration to assist in mitigating virus transmission thru the HVAC systems. Even though this building is not used for classroom space, the Harvard guidelines were applied as a reference. The following descriptions are abbreviated with additional detail found later within the report.

As of the writing of this report, the city of Worcester Public Schools (WPS) has already begun implementation of several of the measures noted below where possible. For enhanced measures WPS has begun to incorporate Bipolar Ionization (see ECCM-#3) extensively throughout the Dr. John E. Durkin Administration Building to address the current pandemic condition.

<u>CCM #1 – Pre & Post Purge Ventilation</u> - Pre and post purge ventilation of occupiable spaces using outside air introduced thru the HVAC systems for an extended period of time prior to and after occupancy.

Most of the HVAC systems supporting the John E. Durkin Administration Building are capable of implementing this measure.

CCM #2 – Increased Ventilation - Increase the quantity of outdoor air ventilation for improved space dilution where systems allow. Disable demand ventilation reset. The Harvard T.H. Chan School of Public Health identifies 3 outdoor air changes per hour (ACH) as the "bare minimum" during a pandemic condition.

Many of the office areas of the building are supported by fan coil units which cannot support this measure as their outside air duct system has been sized for minimum outside air only. The auditorium air handling system has the ability to provide increased outdoor air however, the existing control drawings do not reflect a sequence of operation on how the system operates. If there are any CO2 demand ventilation reset controls on this system, they should be adjusted during pandemic conditions to allow for elevated outdoor air levels regardless of occupancy.

CCM #3 – Improved Filtration - Improve filtration to up to MERV-13 or higher on recirculating air handling systems which can support such filtration.

Many of the air handling systems supporting the building may support increased filtration above MERV 8 up to a maximum of MERV 13 subject to testing of the respective fans. Unit ventilators and fan coil units cannot support filtration above MERV 8 either due to physical equipment limitations (i.e., fan coils limited to 1" filters) or fan capacity limitations. Increased filter efficiency can lead to faster filter loading and a potential reduction in ventilation air for systems not designed to support this filtration level.

In addition to the above suggested measures, we have also presented Enhanced HVAC COVID-19 Control Measures (ECCM) which could be considered for implementation. Where the above CCM's cannot be employed, one or more of the ECCM measures outlined herein may be utilized to improve indoor air quality. The following descriptions are abbreviated with additional detail found later within the report:

ECCM #1: Portable Room Purifiers - Portable room air purifiers may be used in select areas and rooms to help clean the air within the room. These can be especially helpful where rooms have low outdoor air changes per hour and cannot be supplied with additional outdoor air or where existing systems cannot accommodate improved filtration.

ECCM #2: UV-C Light Sterilization - UV-C lights may be considered for insertion in equipment and ductwork to help neutralize viruses as it is exposed to the light.

ECCM #3: Bipolar Ionization - Air ionizers may be installed in air handling systems or portable units installed in rooms to improve indoor air quality. These systems cause particles and airborne contaminants to bind together thereby increasing their size, so they tend to either drop out of the breathing zone or be better removed by air filtration. Recent studies have also shown Bipolar Ionization may inhibit the COVID-19 viruses' ability to infect.

WPS has begun to incorporate Bipolar Ionization extensively throughout the Dr. John E. Durkin Administration Building to address the current pandemic condition.

Recommendations Summary:

Based on our site inspections, sample air quality readings and review of original drawings we found that a majority of the occupied areas of the Durkin Administration building comply with current ventilation codes with few exceptions noted herein. However, in order to address the pandemic level conditions currently in place the following table summarizes our recommendations, several of which, align with the American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE) Epidemic Task Force Building Readiness Guidelines (updated 10-20-2020) as well as those from the Harvard T.H. Chan School of Public Health.

WPS has already begun to incorporate Bipolar Ionization (ECCM-#3) extensively throughout the Dr. John E. Durkin Administration Building to address the current pandemic condition.

Space	Exist. O.A. Vent. Systems	Recommendations
Auditorium	Air Handler	CCM - #1, #2 & #3 ECCM - #3
Office, etc.…	Make-up Air Handler and Fan Coils	CCM - #1 ECCM - #1 or #3 (*see note below)

**Note: For individual offices and other areas noted, ECCM #1 – Portable Air Filtration and/or ECCM #3 – Ionization, are noted as possible options to improve air cleaning and changeover during pandemic conditions.*

Inevitably, during a pandemic, the best approach is a multi-faceted one which should include the above HVAC strategies as well as proper housekeeping (cleaning of spaces and surfaces), occupant actions (hand cleaning, wearing masks, social distancing, following recommended CDC guidelines) and other mitigation strategies.

II. HVAC VENTILATION ASSESSMENT

A. GENERAL

Over the last several weeks we performed site inspections of the existing building to assess the ventilation systems in place. Manufacturer and model information was obtained from the existing ventilation equipment, when available/accessible, and visual conditions were noted.

For our review, original design drawings as well as drawings of various modifications over the years for the building were received from school facilities. In addition, we have also received and reviewed the available HVAC control drawings to ascertain current control configuration. We have used these documents to ascertain the original design ventilation rates so as to compare them to current ventilation codes and standards.

Our inspection was limited to visual assessment of systems and did not include operational testing of each piece of equipment or airflow measuring. We have however, taken some spot measurements of air quality in various locations throughout the building. Measurements taken were limited to:

- Temperature (°F)
- Relative Humidity (% RH)
- CO_2 (carbon dioxide in ppm)
- CH_2O (formaldehyde in ppm)
- Total Volatile Organic Compounds (TVOC in ppm)

These readings were taken at a specific moment in time and may vary during the day based on space occupancy, use and activities as well as the operational state of the HVAC systems. For example, most all spaces surveyed were unoccupied or very lightly occupied and as such most all CO_2 levels were low since space CO_2 is primarily generated by occupants.

TVOC's sources can vary widely and include but are not limited to paints, finishes, adhesives, cigarette smoke, pesticides, personal care products, car exhaust, new furnishings, wall coverings, cleansers, and cooking fuels. The meter used included the following chemicals in its TVOC analysis: Acetone, Ethylene Glycol, Formaldehyde, Xylene, 1,3-Butadiene, Tetrachloroethene, Hydrogen Sulfide, Ammonia, Toluene, Benzene, Methylene Chloride, Perchloroethylene, and MTBE. The meter cannot read every possible VOC nor quantify percentages of various VOC's. In addition, we did notice the TVOC readings tended to drift up during the study, possibly due to a calibration issue, as such, the readings in this report were only used to identify areas where possible ventilation issues may exist and/or to identify areas where a source contaminant may be causing elevated levels.

The report ventilation calculations presume, the existing systems are operating to the levels reflected on the original design drawings. Testing and Balancing by a certified balancer would be required to confirm actual airflows.

For ventilation calculations, data from current codes including the International Mechanical Code (IMC) 2015 and ASHRAE 62.1-Ventilation for Acceptable Indoor Air Quality were used. The outdoor airflow values have been corrected to adjust for the distribution systems ability to get the outdoor air to the space breathing zone with the breathing zone being within 6 feet of the occupied floor. This correction factor also known as the Zone Air Distribution Effectiveness (ZDE), varies based on how and where the air is introduced and removed from the room as well as the temperature of the air entering the room. Some examples of ZDE for various systems are as follows:

Distribution Configuration	ZDE
Ceiling supply of cool air (air below room temp.)	1.0
Ceiling supply of warm air & floor return	1.0
Clg. supply of warm Air >15F above space temp. & clg. return	0.8
Floor supply of warm air & floor return	1.0
Floor supply of warm air & ceiling return	0.7
Displacement cooling floor supply & ceiling return	1.2

For example, a displacement cooling system with a ZDE of 1.2 would require 17% (1.0 / 1.2) less outside air to properly ventilate a space than a system with warm air supplied at the ceiling level being that the displacement system is more effective in getting the outdoor air into the breathing zone. A room with a ZDE of 0.8 would require 25% (1.0 / 0.8) more outdoor air to comply with ventilation standards.

This report contains a brief description of the types of ventilation systems serving the building as well as makes recommendations, where applicable, to improve ventilation of area served by these systems. Our evaluation considered the recommendations made by the American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE) Epidemic Task Force Building Readiness Guidelines (updated 10-20-2020) as well as those from the Harvard T.H. Chan School of Public Health and other industry sources. All to assist in further mitigating virus transmission through the buildings heating, ventilation, and air conditioning (HVAC) systems.

B. EVALUATION

The following evaluation is based on visual observation of systems and equipment and excludes any operational testing which we understand is on-going by WPS. Evaluation includes information obtained from Worcester Public Schools on current air filters as well as existing building mechanical plans when available. In some cases, equipment was not accessible, and assessment was based only on original design drawings where available.

General Offices & Misc. Areas:

A majority of the office spaces and other areas in the building are heated and cooled with fan coil units. These units are fed with hot water and chilled water from a central boiler/chiller plant. Most of the units are fitted with air 1" thick filters with an estimated MERV rating of 8 which is typical for units of this type. These units can support a maximum filter efficiency of MERV 8.

Outdoor air to these fan coil units is provided from a dedicated make-up air handling unit identified as AHU-1 located in the basement. The unit consists of a filter section, coil section and supply fan and is fitted with MERV 8 filters. This unit is sized to support only that which was required for minimum outdoor air ventilation used during the design.

These units may be able to support improved filtration of MERV 11 or potentially even MERV 13 however, any improvement in filtration must be confirmed thru unit airflow testing to evaluate if the unit can support the added pressure drop from higher filtration without risk of reducing airflow. As the unit conveys 100% outside air, it is not filtering contaminated space air but only outside air and, as such, the space air quality would not benefit greatly by increasing filtration at the risk of a potential reduction in air volume from higher pressure drop faster loading higher MERV filters.

For general office space, current code would require 5 CFM per person of outside air plus 0.06 CFM per SF. The amount of outdoor air to areas varies but in general equates to approximately 10% to 15%+/- of outside air for each fan coil system. This percentage of outside air would accommodate light office occupancies of approx. 170 SF per person. Corrected for a zone air distribution effectiveness of 0.8, as most spaces would have with ceiling supply and return, the allowable occupant density becomes even lighter at near 220 SF per person. Higher density areas such as meeting/conference spaces would require higher percentages of outdoor air to support the occupant density.

Auditorium:

Outdoor air ventilation for the auditorium space is supported by one (1) air handling unit located in an attic space labeled as AHU-2. The unit is a mixed air system configured with mixing dampers, filter section, hot/chilled water coil and supply fan. The unit has 2" thick pleated filters with an estimated MERV rating of 8. The design drawings reflect a relatively a high percentage of outdoor air at 77% which would not comply with current ventilation

code for a typical cafeteria occupancy. The units do, however, appear to the have the capability to introduce more outdoor air.

This unit currently has MERV 8 filters and may be able to support improved filtration pending unit airflow testing to evaluate the unit's capabilities.

For an auditorium space, current code would require 5 CFM per person of outside air plus 0.06 CFM per SF. The current space encompasses approx. 1,784 SF which, with 270 occupants, would require 1,457 CFM of outside air, well below the current 5,000 CFM of design OA from AHU-2.

Controls:

Most of the major HVAC systems supporting the building are controlled by a building energy management system (EMS). The EMS system is currently supported by Automated Building Systems, Inc (ABS). The existing control drawings do not reflect a detailed sequence of operation for the systems but do indicate control of such systems. A further review with the EMS vendor would be required to ascertain the extent of the system control.

The operating schedule for much of the equipment is based on the building's occupancy schedule. The schedule is adjustable via the front-end computer workstation.

C. IAQ & Ventilation Summary

IAQ Summary:

During our inspection we obtained spot measurements of air quality in various locations throughout the building. Measurements taken were limited to:

- Temperature (°F)
- Relative Humidity (% RH)
- CO_2 (carbon dioxide in ppm)
- CH_2O (formaldehyde in ppm)
- Total Volatile Organic Compounds (TVOC in ppm)

The readings were taken at a specific moment in time and may vary during the day based on space occupancy, use and activities as well as the operational state of the HVAC systems. For example, most all spaces surveyed were unoccupied or very lightly occupied and as such most all CO_2 levels were low since space CO_2 is primarily generated by occupants.

In addition, we noted some elevated TVOC levels and/or formaldehyde levels in areas which would not generally be expected to have such elevated levels. Although TVOC's (which includes formaldehyde) may come from varied sources such as cleaners, air fresheners and such, formaldehyde levels are often from off-gassing of furnishings or building materials. It is important to note that elevated levels of TVOC's may have been partially caused by recent enhanced cleaning measures or due to ventilation systems that were not in full operation at the time.

Measurements taken included space humidity. Humidity levels has been found to play a role in the controlling the spread of COVID-19. ASHRAE recommends winter humidity levels be kept between 40% to 50% and summer humidity levels between 50% and 60% with a summer target of 50%. Maintaining humidity levels within the above ranges has been found to limit the growth and transmission of certain bacteria and viruses as well as supports respiratory function. The below chart is taken from the 2020 ASHRAE Handbook – HVAC Systems and Equipment and reflects the impact of space humidity on the increase or decrease of effect on various space contaminants. This chart only reflects increase or decrease of effect from humidity and does not intend to imply that there is zero growth or impact of a certain contaminant when the sloped bar graph zero's out.

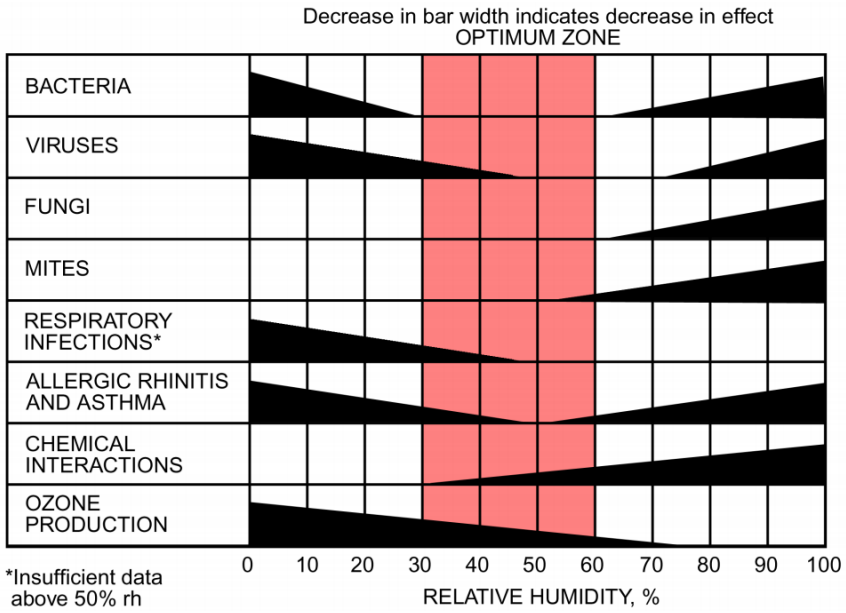

Fig. 1 Optimum Humidity Range for Human Comfort and Health
(Adapted from Sterling et al. 1985)

The Durkin Administration building HVAC systems have no active humidity control. Space dehumidification is limited only to those areas which have air conditioning cooling. However, this dehumidification is not actively controlled by a humidity setpoint. Moisture removal only occurs when these systems are operating in the cooling mode. As such, space humidity may climb above 60% during periods when low thermal loads require less cooling (i.e., a cool damp day) or swing above and below 60% as the systems cycle based on space temperature.

Caution must be taken when considering adding active humidification to existing buildings as it is imperative that the buildings thermal envelope and vapor barriers be reviewed. Although newer structures, such as Dr. John E. Durkin Administration Building often have a fair vapor barrier the varying wall and window construction and thermal characteristics may limit the ability for active humidification. Adding humidity in the wintertime without consideration of the building construction could result in moisture condensation on windows and within wall assemblies which may create a damaging and unhealthy condition for the building and its occupants. Review of the building envelope should take place prior to consideration of the addition of any humidification system. As such, our recommendations contained with this report exclude active humidification control until such time as the envelope can be reviewed.

The IAQ readings taken during the time of the inspection are contained within the table below. In addition, the table reflects the outdoor air exchange rate in the rooms based on design data from existing plans.

The document entitled "5-Step Guide to Checking Ventilation Rates in Classrooms" from the Harvard T.H. Chan School of Public Health recommends a target outdoor air exchange rate during these pandemic conditions. The document identifies 5 air changes per hour (ACH) and above as "excellent" down to a 3 ACH being considered "bare minimum". The general offices spaces in the Dr. John E. Durkin Administration Building have an outdoor air exchange rate well below the bare minimum criteria of 3. When the outdoor air exchange rate is lower than the target 5 ACH, the document recommends the following strategies:

1. Increase outdoor air (see CCM #2)
2. Use MERV 13 filters (or greater) on recirculated air (see CCM #3)
3. Add portable air cleaners with HEPA filters to the classroom (see ECCM #1)

It should be made clear however, that a room that has less than what this document considers the bare minimum outdoor air exchange rate may meet or exceed the most current ventilation standards and therefore is not under ventilated. The 5 ACH or greater recommendation is meant to address the pandemic conditions being experienced as this level of ACH would equate to nearly 100% outside air requirement for a conventional mixed air cooling & heating system.

The following tables describe areas and systems where the above measures as well as others presented in this report may be applied.

		Durkin Admin Bldg IAQ Sampling Summary									
Space Tested	Temp. °F	Humidity % RH	CO2 %	TVOC ppm	HCHO ppm	Room Area SqFt	Room Height Ft	Volume Cubic Ft	Original Design OA CFM	Original OA ACH	Notes
Basement											
Cafeteria 002A	71.4	35	514	1.5	0.21	508	8.08	4105	80	1.2	
Instructional Tech 004A	70.9	20.6	477	1.31	0.17	376	7.91	2974	80	1.6	
Reception and Security 005A	72.2	36	547	1.43	0.2	350	8	2800	80	1.7	
Avid District Office 007	71	35.1	489	1.38	0.2	524	7.91	4145	60	0.9	
Room 008A	71.3	32.8	521	1.48	0.24	400	7.83	3132	70	1.3	
Digital Document and Mail 010	71.8	34	506	1.44	0.21	895	10	8950	0	0	
First Floor											
School Safety 101A	72.1	32	510	1.5	0.24	204	10	2040	120	3.5	
Deputy Superintendent 102A	71	29.4	545	1.38	0.18	511	10.25	5238	80	0.9	
Office 102B	70.7	29.3	555	1.37	0.18	213	10.08	2147	80	2.2	
Office of Instruction 103	71	29.7	548	1.35	0.18	521	9.91	5163	40	0.5	
Managers 104A	71.5	27.6	476	1.33	0.15	318	9.83	3126	40	0.8	
Superintendent Secretaries 105	73.3	31	503	1.36	0.2	575	13	7475	40	0.3	
Superintendent 107	72.8	30.2	490	1.35	0.18	575	13	7475	40	0.3	
School Committee 108A	73.8	26.8	457	1.32	0.2	525	10.08	5292	40	0.5	
Human Resources 110A	74.2	24.8	485	1.5	0.23	661	10.08	6663	40	0.4	
Office 110B	75.4	22.8	504	1.52	0.26	264	10	2640	60	1.4	
Human Resources 111A	72.3	26.6	500	1.46	0.22	593	10.08	5977	120	1.2	
Second Floor											
Child Study 201A	72.4	27.2	474	1.35	0.18	330	10.08	3326	120	2.2	
Research 202A	72.8	26.5	470	1.32	0.2	528	9.75	5148	80	0.9	
Facilities Engineering 203	73.3	27.9	519	1.42	0.22	528	10	5280	440	5	
Facilities Office 204A	72.8	27.9	544	1.39	0.23	431	9.91	4271	80	1.1	
Auditorium 200A	72.3	28.5	511	1.42	0.2	1784	33.41	59603	5000	5	
Curriculum 207	72.8	29.1	495	1.43	0.22	628	9.83	6173	80	0.8	
Office 208A	72.8	29.3	460	1.35	0.19	506	9.91	5014	40	0.5	
Grants 209	73.3	26.8	451	1.34	0.18	510	10	5100	40	0.5	
Grants Office 210A	74.3	27.2	466	1.34	0.18	444	10.08	4476	40	0.5	
Office 210B	75.7	24.7	482	1.33	0.18	278	10	2780	80	1.7	
Third Floor											
Special Education 301A	73	26.6	540	1.37	0.28	409	10.08	4123	80	1.2	
Special Education 302	73.9	26.6	547	1.49	0.24	951	9.92	9434	160	1	
Special Education 304A	73.6	26.6	535	1.43	0.21	422	10	4220	120	1.7	
Special Education 306A	73	30.6	495	1.4	0.2	226	19.33	4369	30	0.4	
Info Tech 307A	73.1	31.6	472	1.38	0.2	329	19.33	6360	30	0.3	
Info Systems 308A	72.9	29.8	495	1.5	0.26	297	10	2970	80	1.6	
Special Ed 310	72.3	27.6	525	1.49	0.24	912	10.08	9193	80	0.5	
Special Ed File 311	72.1	28.1	506	1.45	0.26	742	10.08	7479	120	1	
Fourth Floor											
Nutrition Office 402A	72.9	29	542	1.41	0.2	805	9.92	7986	60	0.5	
C.F.O & Operations 404	73	30.8	535	1.43	0.22	477	10	4770	100	1.3	
Supply Management 408A	72.8	30.6	551	1.56	0.28	519	10	5190	80	0.9	
Payroll Office 409	71.8	29.8	516	1.45	0.19	567	9.75	5528	100	1.1	
Conference 410	70.1	31	516	1.4	0.21	825	9.92	8184	120	0.9	
Nutrition Director 411	71.2	30.6	572	1.36	0.19	278	9.83	2733	40	0.9	
Conference 412	71.5	30	502	1.37	0.19	514	9.92	5099	200	2.4	

Note: As noted previously, the TVOC readings tended to drift up during the study, possibly due to a calibration issue, as such, the readings in this report were only used to identify areas where possible ventilation issues may exist and/or to identify areas where a source contaminant may be causing elevated levels.

Ventilation System Summary & Recommendations:

The following table is based on original design drawings and reflect most of the systems which provide ventilation air to the building. The units ID tag, area served, ventilation data and filter efficiencies are listed. The table also reflects possible COVID Control Measures (CCM) and Enhanced COVID Control Measures (ECCM) described later in this report which may apply to such systems to improve performance either during pandemic conditions and/or post pandemic conditions.

Durkin Admin Bldg Ventilation System Summary

Unit ID	Area Served	Exist. Supply CFM	Exist. O.A. CFM	Exist. O.A. %	Exist. Filter Qty & Size	Exist. Filter MERV Rating	Exist. Filter Vel. Velocity (FPM)	Proposed CCM #	Proposed ECCM #	Notes
AHU-1	BASEMENT	7000	7000	100	(8) 16x25x2	8	N/A	#1	#1, #3	a
AHU-2	AUDITORIUM	6500	5000	77	N/A	N/A	N/A	#1, #2 #3	#3	b. c

Ventilation System Summary Notes:

a. *For individual rooms, ECCM #1 – Portable Air Filtration and/or ECCM #3 – Ionization is noted as a possible option to improve air cleaning and changeover during pandemic conditions.*

b. *Improved filtration up to MERV 13 is subject to testing of respective unit to confirm fan can support the increased resistance.*

c. *Disable any CO2 demand ventilation reset or occupancy sensor-based system shutdown (during scheduled occupied periods) during pandemic conditions.*

II. COVID-19 HVAC MITIGATION MEASURES

A. HVAC COVID-19 CONTROL MEASURES

In line with the current American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE) Epidemic Task Force Building Readiness Guidelines (updated 10-20-2020) and those from the Harvard T.H. Chan School of Public Health - 5-Step Guide to Checking Ventilation Rates in Classrooms, as well as other industry recommendations the following HVAC COVID Control Measures (CCM's) are presented for consideration to assist in mitigating virus transmission thru the HVAC systems. Even though this building is not used for classroom space, the Harvard guidelines were applied as a reference.

The ASHRAE Epidemic Task Force recommends several measures to assist in COVID-19 mitigation with more aggressive action with epidemic conditions in place (ECiP) and post-epidemic conditions in place (P-ECiP). For ECiP conditions in place the HVAC COVID-19 Control Measures (CCM) that could be readily applied to the Dr. John E. Durkin Administration Building surveyed are outline herein. Refer to the Ventilation System Summary Table for applicable CCM recommendations.

It is imperative that all systems be maintained and checked to confirm proper operation in line with their original design, adjusted where applicable, as described herein. In addition, a Testing and Balancing company should be enlisted to adjust and confirm all systems are properly achieving their design outdoor air, supply air and exhaust air levels.

CCM #1 – Pre & Post Purge

Pre- and post-purge ventilation of occupiable spaces using outside air introduced the HVAC systems. This would be accomplished by starting the ventilation systems in occupied mode (i.e., OA at design or higher) 4 hours prior to schedule building occupancy and maintain the occupied mode for 4-hours after occupancy ends.

Most of the HVAC systems supporting the Dr. John E. Durkin Administration Building are capable of implementing this measure.

CCM #2 – Increased Ventilation

Increase outdoor air ventilation for improved space dilution where systems allow. This would entail increasing the minimum outdoor air damper positions on all mixed air style systems within the limits of the equipment capacity and overriding any demand ventilation reset schemes (i.e., CO_2 reset). A control sequence would need to be implemented for the respective air handlers which would limit the outdoor air volume to the unit's respective capability such that proper control of the discharge air can be maintained as well as freeze protection of coils. In addition, sequence would need to include limitation based on boiler plant and cooling system capabilities and summertime moisture limitations. For buildings which have anti-freeze in water-based heating and/or cooling systems concern of unitary coil freeze up is reduced.

The fan coil systems supporting much of the building are not capable of supporting this measure. The air handler serving the auditorium space may be able to support this measure or at a minimum, maintain elevated outdoor air levels during pandemic conditions.

CCM #3 – Improved Filtration

Improve filtration to up to MERV-13 on air handling systems, especially those which recirculate air. In addition, if possible, as filters are replaced provide sealant or gasketing between and/or around filters to reduced air bypass around filter sections.

Higher filtration on the two (2) AHU units may be considered subject to unit fan capabilities. The fan coil units supporting much of the building cannot support filtration in excess of MERV 8. All replacement filters for these terminal units should meet MERV 8 requirements.

Prior to implementation of higher filtration levels in excess of MERV 8, existing AHU equipment capabilities must be reviewed to verify it can support the added pressure drop imposed by MERV-13 filtration. Testing and Balancing to confirm current airflow, pressure drops, and fan motor power coupled with manufacturer published data would be required to confirm the unit's capability for improved filtration.

B. ENHANCED HVAC COVID-19 CONTROL MEASURES

In addition to the suggested above measures below are some Enhanced HVAC COVID-19 Control Measures (ECCM) which could be considered for implementation. Refer to the Ventilation System Summary Table for applicable recommendations.

ECCM #1: Portable Room Purifiers

Portable room air purifiers could be used in select areas and rooms to help clean the air within the room. These could be applied in areas such as those where the population is in a higher risk group of developing COVID-19 complications or anywhere where real time space cleaning is required. Products which include HEPA filters and fans with air exchange rate appropriate for the size room should be selected.

ECCM #2: UV-C Light Sterilization

UV-C lights can be inserted in equipment and ductwork to help neutralize viruses as it is exposed to the light. UV technology has been studied and used extensively, primarily in hospital settings for virus and bacteria control and in the general HVAC primarily to prevent build-up on coils. To properly mitigate the virus an extended run of return air duct would need to be identified to allow for adequate exposure to UV-C light since a light bar just at the unit coil or filter will primarily just prevent build-up of mold, bacteria, and viruses on those surfaces.

ECCM #3: Bipolar Ionization

Air ionizers are meant to be installed in the supply air duct or plenum downstream of fans and filters. They are also offered as portable units for room application. In Dr. John E. Durkin Administration Building's case, they could be installed in the supply air duct of the respective air handling systems and fan coil units. WPS has already begun to incorporate Bipolar Ionization extensively throughout the Dr. John E. Durkin Administration Building to address the current pandemic condition.

Air ionizers appear to be showing quite a bit of promise for low system impact in retrofit applications. For years, these products have been used to primarily clean air of dust and particles by forcing the particles to bind together and either drop out of the breathing zone and/or better be able to be captured by HVAC system air filters by making particles larger. Recently, there are studies which claim to show that ionizers work on neutralizing viruses in the space prior to needing to draw these pollutants back to the units where filters and/or other cleaning technology such as UV-C could occur.

ASHRAE has not taken a definitive stance on Bipolar Ionization with regard to virus mitigation as of yet and has deferred to CDC's comment that it is still considered an emerging technology in this regard. Bipolar Ionization has been used for decades primarily for the removal of particles within the air. During that period, its use was focused more on facilities such as convention centers, airports, casinos, and the like as there are large amounts of occupant and activity generated pollutants. Only recently has bipolar ionization been

looked at for virus mitigation which is why ASHRAE and CDC still view it as an emerging technology being that there are not extensive 3rd party studies and reviews of its capability in this regard.

That said, even ignoring its potential virus neutralizing capabilities, the ability of the product to bind smaller particles into larger particles results in an overall desirable indoor air quality benefit in that it increases the capabilities of air filters to filter the air as well as promotes particles to drop out of the breathing zone. We do, however, recommend the technology be provided on systems that meet code required outdoor air ventilation levels as this technology is not a replacement for outdoor air.

Inevitably, during an epidemic, the best approach is a multi-faceted one and should include the above HVAC strategies as well as proper housekeeping (cleaning of spaces and surfaces), occupant actions (hand cleaning, wearing masks, social distancing, following recommended CDC guidelines) and other mitigation strategies.

2) Natural Ventilation Summary

Durkin Administration Building

Room Name / Number	Space Use	Net Floor Area (SF)	4% of Net Area	Number of Windows by Type																		Total open Area (SF)	Difference between actual and required SF	PASS?	Additional Notes
				A DBL HUNG	8.44	B DBL HUNG	15.33	C DBL HUNG	0.00	D DBL HUNG	7.67	E DBL HUNG	6.88	F AWNING	8.77	G DBL HUNG	5.60	H DBL HUNG	4.15	I DBL HUNG	4.51				
Basement																									
000A - Lobby (all 3 sections)	lobby	1967	78.68																			0.00	78.68	NO	
002A - Cafeteria	café	508	20.32																			0.00	20.32	NO	
002A - Women's Room	toilet	138	5.52																			0.00	5.52	NO	
002B - Storage	storage	190	7.6																			0.00	7.60	NO	
002C - Custodian	support	176	7.04																			0.00	7.04	NO	
003 - Storage	storage	190	7.6																			0.00	7.60	NO	
004A - Instr Technology & Digital Learning	classroom	376	15.04																			0.00	15.04	NO	
004B - Office	office	89	3.56		1																	8.44	-4.88	YES	
004C - Office	office	154	6.16		3																	25.31	-19.15	YES	
004D	office	181	7.24		4																	33.75	-26.51	YES	
005A - Security & Reception	office	350	14		2																	16.88	-2.88	YES	
005B	office	108	4.32																			0.00	4.32	NO	
005C	storage	53	2.12		1																	8.44	-6.32	YES	
Storage (off Basement Lobby)	storage	26	1.04																			0.00	1.04	NO	
Vestibule	entry	96	3.84																			0.00	3.84	NO	
Storage (off Basement Lobby)	storage	33	1.32																			0.00	1.32	NO	
007 - Avid District Office	office	524	20.96		3																	25.31	-4.35	YES	
008A	conference	400	16		3																	25.31	-9.31	YES	
008B - Curriculum Liaisons	office	316	12.64		5																	42.19	-29.55	YES	
Storage (off Basement Lobby)	storage	25	1																			0.00	1.00	NO	
009A - Spec Edu	storage	386	15.44																			0.00	15.44	NO	
009B	office	155	6.2																			0.00	6.20	NO	
010 - Digital Document Center & Mail Rm	office	895	35.8																			0.00	35.80	NO	
Cust Storage	storage	151	6.04																			0.00	6.04	NO	
011B - Passageway	support	526	21.04																			0.00	21.04	NO	
First Floor																									
100A - First Floor Lobby	entry	2404	96.16																			0.00	96.16	NO	
101A - School Safety Office	office	204	8.16																			0.00	8.16	NO	
101B - Office	office	220	8.8				3															46.00	-37.20	YES	
Toilet	toilet	58	2.32						2													0.00	2.32	NO	
Storage	storage	166	6.64																			0.00	6.64	NO	
102A - Deputy Superintendent	office	511	20.44				3															46.00	-25.56	YES	
102A - Storage	storage	25	1																			0.00	1.00	NO	
102B - Office	office	213	8.52				4															61.33	-52.81	YES	
102C - Office	office	179	7.16				1															15.33	-8.17	YES	
103 - Office of Instruction & School LSHP	office	521	20.84										3									20.63	0.22	NO	
103 - Storage	office	32	1.28																			0.00	1.28	NO	
104A - Managers of Office of Instr & Ldshp	office	124	4.96																			0.00	4.96	NO	
104B - Office	office	116	4.64										1									6.88	-2.24	YES	
104C - Office	office	129	5.16										2									13.75	-8.59	YES	
104D - Office	office	123	4.92										3									20.63	-15.71	YES	
104E - Office	office	116	4.64										2									13.75	-9.11	YES	
105 - Superintendent Secretaries	office	575	23				3															46.00	-23.00	YES	
106A - Superintendent	office	230	9.2								2											15.33	-6.13	YES	
106B - Office	office	72	2.88																			0.00	2.88	NO	
107 - Superintendent	office	575	23				3															46.00	-23.00	YES	
108A - School Committee	office	525	21				4															61.33	-40.33	YES	
108B - Office	office	216	8.64				4															61.33	-52.69	YES	
108C	office	70	2.8																			0.00	2.80	NO	
109A - English Learners	office	268	10.72																			0.00	10.72	NO	
109B - Office	office	163	6.52				2															30.67	-24.15	YES	
109C	office	82	3.28				1															15.33	-12.05	YES	
110A - Human Resources	office	661	26.44				4															61.33	-34.89	YES	
110B	office	264	10.56				4															61.33	-50.77	YES	
Toilet	toilet	58	2.32						2													0.00	2.32	NO	
Storage	storage	161	6.44																			0.00	6.44	NO	
111A - Human Resources	office	593	23.72				3															46.00	-22.28	YES	
111B - Office	office	176	7.04				2															30.67	-23.63	YES	
111C - Office	office	188	7.52				2															30.67	-23.15	YES	
111D - Office	office	82	3.28																			0.00	3.28	NO	
111E - File Room	storage	282	11.28																			0.00	11.28	NO	
Closet off Lobby	storage	13	0.52																			0.00	0.52	NO	

Second Floor																							
200A - Auditorium	aud	1784	71.36																	0.00	71.36	NO	
200A - Stage	aud	477	19.08																	0.00	19.08	NO	
201A - Child Study	office	330	13.2																	0.00	13.20	NO	
201A - Closet A	storage	20	0.8																	0.00	0.80	NO	
201A - Closet B	storage	20	0.8																	0.00	0.80	NO	
201B - Office	office	156	6.24				3													46.00	-39.76	YES	
201C - Office	office	167	6.68				2													30.67	-23.99	YES	
Toilet	toilet	58	2.32						2											0.00	2.32	NO	
Storage	storage	200	8																	0.00	8.00	NO	
202A - Research & Accountability	office	528	21.12									3								20.63	0.50	NO	
202B - Office	office	215	8.6									2								13.75	-5.15	YES	
202C - Office	office	183	7.32									1								6.88	0.45	NO	
203 - Facilities	office	528	21.12				3													46.00	-24.88	YES	
204A - Facilities	office	431	17.24				2													30.67	-13.43	YES	
204B - Office	office	258	10.32				5													76.67	-66.35	YES	
204C - Office	office	177	7.08				1													15.33	-8.25	YES	
205 - Child Study	office	625	25									3								20.63	4.38	NO	
206 - Library	media	469	18.76									2								13.75	5.01	NO	
207 - Curriculum Liaisons	office	628	25.12				3													46.00	-20.88	YES	
208A - Curriculum & Prof Learning	office	506	20.24									4								27.50	-7.26	YES	
208A - Storage	storage	30	1.2																	0.00	1.20	NO	
208B - Office	office	237	9.48				4													61.33	-51.85	YES	
208C - Office	office	75	3																	0.00	3.00	NO	
209 - Grants Office	office	510	20.4									3								20.63	-0.22	YES	
209 - Storage	storage	10	0.4																	0.00	0.40	NO	
210A - Grants Office	office	444	17.76				2													30.67	-12.91	YES	
210A - Closet	storage	34	1.36																	0.00	1.36	NO	
210B - Office	office	278	11.12				5													76.67	-65.55	YES	
210C - Office	office	177	7.08				1													15.33	-8.25	YES	
Toilet	toilet	79	3.16						2											0.00	3.16	NO	
Storage + Closet	storage	183	7.32																	0.00	7.32	NO	
211A - English Language Arts & Math	office	590	23.6									3								20.63	2.98	NO	
211B - Office	office	125	5									2								13.75	-8.75	YES	
Third Floor																							
301A - Spec Edu	office	409	16.36																	0.00	16.36	NO	
301B - Office	office	139	5.56				2													30.67	-25.11	YES	
301C - Office	office	170	6.8				3													46.00	-39.20	YES	
Toilet	toilet	76	3.04						2											0.00	3.04	NO	
302 - Special Education	office	951	38.04				8													122.67	-84.63	YES	
303A - Special Education	office	262	10.48																	0.00	10.48	NO	
303B - Office	office	106	4.24				1													15.33	-11.09	YES	
303C - Office	office	155	6.2				2													30.67	-24.47	YES	
304A - Special Educations	office	422	16.88				1													15.33	1.55	NO	
304B - Office	office	129	5.16				1													15.33	-10.17	YES	
304C - Office	office	130	5.2				2													30.67	-25.47	YES	
304D - Office	office	194	7.76				4													61.33	-53.57	YES	
305 - Special Education Dept. Heads	office	473	18.92				3													46.00	-27.08	YES	
306A - Special Education	office	226	9.04																	0.00	9.04	NO	
306A - Balcony + Common	entry	1618	64.72																	0.00	64.72	NO	
306B - Special Education	office	237	9.48				2													30.67	-21.19	YES	
307A - Information Tech	office	329	13.16				1													15.33	-2.17	YES	
307B - Office	office	131	5.24				2													30.67	-25.43	YES	
308A - Information Systems	office	297	11.88																	0.00	11.88	NO	
308B - Office	office	122	4.88				1													15.33	-10.45	YES	
308C - Office	office	144	5.76				3													46.00	-40.24	YES	
308D - Office	office	143	5.72				3													46.00	-40.28	YES	
308E - Office	office	139	5.56				1													15.33	-9.77	YES	
309A - Information Technology Officer	office	380	15.2				1													15.33	-0.13	YES	
309B - Office	office	148	5.92				2													30.67	-24.75	YES	
310 - Special Education	office	912	36.48				8													122.67	-86.19	YES	
310 - Closet	storage	33	1.32																	0.00	1.32	NO	
Toilet	toilet	76	3.04						2											0.00	3.04	NO	
Storage	storage	322	12.88																	0.00	12.88	NO	
311 - Special Education File Room	support	742	29.68				5													76.67	-46.99	YES	

Forth Floor																							
Common Area / Corridor	common	1221	48.84																	0.00	48.84	NO	
401 - Financial Coord of Grants	office	275	11														4			22.39	-11.39	YES	
Toilet	toilet	50	2			1														15.33	-13.33	YES	
402A - Nutrition	office	805	32.2			2														30.67	1.53	NO	
402A - Closet	storage	31	1.24																	0.00	1.24	NO	
402B - Nutrition MGR	office	139	5.56			3														46.00	-40.44	YES	
403A - Budget Office	office	447	17.88																	0.00	17.88	NO	
403A - Entry	entry	166	6.64																	0.00	6.64	NO	
403B - Asst. Operations Manager	office	231	9.24														3			16.79	-7.55	YES	
404A - CFO & Operations Manager	office	477	19.08																5	22.57	-3.49	YES	
404B - CFO Clerk	office	253	10.12																2	9.03	1.09	NO	
408A - Supply Management	office	519	20.76			3														46.00	-25.24	YES	
408B - Supply Management MGR	office	338	13.52			5														76.67	-63.15	YES	
409 - Payroll	office	567	22.68														3			16.79	5.89	NO	
409 - Entry	entry	145	5.8																	0.00	5.80	NO	
409A	storage	49	1.96																	0.00	1.96	NO	
410 - Conference Room	conference	825	33			6														92.00	-59.00	YES	
410 - Storage A	storage	86	3.44																	0.00	3.44	NO	
410 - Storage B	storage	46	1.84																	0.00	1.84	NO	
Toilet	toilet	58	2.32					2												0.00	2.32	NO	
411 - Office	office	278	11.12														4			22.39	-11.27	YES	
412 - Conference Room	conference	514	20.56															3		12.46	8.10	NO	

Window Type	Width	Height	Projection	Venting
A - Double Hung	45	27	0	8.44
B - Double Hung	46	48	0	15.33
C - Double Hung (sealed)	0	0	0	0.00
D - Double Hung	46	24	0	7.67
E - Double Hung	45	22	0	6.88
F - Awning	40	26.5	19	8.77
G - Double Hung	26	31	0	5.60
H - Double Hung	26	23	0	4.15
I - Double Hung	26	25	0	4.51

Room Color Key	
	Rooms that meet or exceed the minimum code required ventilation
	Rooms that do not meet the code required ventilation, but have operable windows.
	Rooms that do not have operable windows (either fixed or none present)