# Worcester Public Schools

## Ventilation Assessment
## &
## COVID-19
## Mitigation Strategies

for

# Nelson Place Elementary School
# Worcester, MA

**January 31, 2021**

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## 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:

Nelson Place Elementary School:
Nelson Place Elementary School is located in the Doherty Quadrant of Worcester at 33 Nelson Place. The School was built in 2017, houses grades K-06, has 52 classrooms and the building is 112,457 square feet. The widows are original to the 2017 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 Nelson Place Elementary School 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 school. 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. 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. For enhanced measures, WPS has begun to incorporate Bipolar Ionization (see ECCM-#3) extensively throughout the Nelson Place Elementary School 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 Nelson Place Elementary School 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 classroom systems provide just less than 3 ACH (2.1 ACH +/-) however, these systems, being of the displacement type, provide more effective outdoor air ventilation into the breathing zone and limit air mixing in the room both of which help in mitigation the spread of the COVID-19 virus. Most of the HVAC systems supporting the Nelson Place Elementary School are capable of implementing increased ventilation subject to outdoor ambient conditions and equipment limitations.

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

Most of the HVAC systems at the Nelson Place Elementary School already have or were originally designed with MERV 13 filter capabilities. WPS shall confirm MERV 13 filters are installed.

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 could 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 improved system ventilation.

ECCM #2: UV-C Light Sterilization - UV-C lights could be considered for insertion in equipment and ductwork to help neutralize virus which becomes 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 virus's ability to infect.

WPS has begun to incorporate Bipolar Ionization extensively throughout the Nelson Place Elementary School 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 Nelson Place Elementary School 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 Nelson Place school to address the current pandemic condition.

| Space | Exist. O.A. Vent. Systems | Recommendations |
|---|---|---|
| **General Classrooms** | Packaged Rooftop Mixed Air Systems | CCM - #1, #2 & #3<br>ECCM - #1 or #3 (*see note below) |
| | | |
| **Art Classroom** | Packaged Rooftop Mixed Air Systems | CCM - #1 & #3 (already 100% OA)<br>ECCM - #1 or #3 (*see note below) |
| | | |
| **Cafetorium** | Packaged Rooftop Mixed Air System | CCM - #1, #2 & #3<br>ECCM - #3 |
| | | |
| **Gymnasium** | Air Handlers | CCM - #1, #2 & #3<br>ECCM - #3 |
| | | |
| **Admin. & Guidance Office** | Packaged Rooftop Mixed Air Systems | CCM - #1, #2 & #3<br>ECCM - #1 or #3 (*see note below) |
| | | |

**Note*: For individual classrooms 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 school 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 school 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 school. 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 / 1.2) 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 Classrooms:

A majority of the classrooms in the building are heated, ventilated and cooled via multiple packaged variable air volume (VAV) rooftop units. These units consist of DX condensers supporting DX cooling coils, hot gas reheat coil, exhaust fans, energy recovery wheels, exhaust and mixing dampers, hot water coils and supply fans. Hot water is fed to all these units from the building's central boiler plant. The units were designed with and should be fitted with 2" thick MERV 8 pre-filters and 4" thick MERV 13 air filters. These systems are capable of supporting the recommended MERV 13 filtrations noted in CCM #3.

Each of the classroom rooftop unit delivers conditioned air to the classroom and associated spaces via a ducted supply air system and a partially ducted plenum return air system. The supply air for most classrooms is delivered via displacement style wall or ceiling diffusers. These diffusers ensure the ventilation air is introduced low within the rooms breathing zone. This type of system also limits mixing of the room air to lessen the potential of cross contamination of occupant air.

The supply air to each room runs through either a VAV terminal fitted with damper operator and in some cases hot water coils for control of primary air and temperature of air delivered to the space they serve. A DDC space thermostat controls the operation of the VAV damper and the hydronic heating valve.

As these are mixed air systems, the amount of outdoor air delivered to each space varies based on the amount of primary air being introduced through the respective VAV terminal. According to the design drawings the percentage of outdoor air from the respective classroom RTU systems vary from approx. 40% to 70% depending on the system.

For a standard classroom, current code would require 10 CFM per person of outside air plus 0.12 CFM per SF. The zone air distribution effectiveness for the classrooms is 1.2 due to the presence of displacement diffusers. As such, an average classroom of 900 SF with 26 occupants (25 students + 1 teacher) would require 306 CFM inclusive of the 1.2 correction. Most classrooms systems deliver in excess of 400 CFM of outside air.

As noted previously most of the classrooms are supported from a VAV system. The systems in place account for reductions in primary air typical of as VAV terminal by increasing the percentage of outdoor air as the supply air drops. In addition, each classroom has a CO2 sensor which is configured to increase system outdoor air and even override VAV damper

minimum should the room require it to maintain proper indoor air quality. We recommend the CO2 outdoor reset be adjusted so as to maintain elevated levels of OA during the pandemic condition.

Art Room:

The art room is supported by the same central RTU units as the normal classrooms. The current art room is approx. 1,000 SF in size and is supplied with 940 CFM of supply air from a VAV terminal. All the air in the space is fully exhausted with a 1,100 CFM roof exhaust fan.

Per the current code, art rooms require higher ventilation levels than general use classrooms, being that they require 0.7 CFM/SF of exhaust. The current system complies with this requirement.

Gymnasium:

The gymnasium is supplied with air from a single packaged rooftop unit similar to those supplying the classrooms. The primary difference being that it operates as a single zone VAV varying total supply air based on space temperature and ventilation demand. It also resets outside air volume based on space CO2 levels.

These air handling systems appear to be capable of supporting increased filtration up to a maximum of MERV 13 (see CCM-#3). Systems must be tested and adjusted to accommodate the added pressure drop associated with this increased filter efficiency. In addition, more frequent filter changes would be expected to limit reduction in ventilation air as the filters load.

The gymnasium ventilation needs are based on a percentage of play area and spectator area. Play area requires an outdoor air volume of 0.3 CFM per SF whereas the spectator area requires 7.5 CFM per person plus 0.06 CFM per SF. The zone air distribution effectiveness is 1.0 based on ceiling supply and floor returns as well as reduced supply air temperatures. With actual spectator area unknown, presuming the entire gym is play area would yield a required outdoor air rate of 1,743 CFM. The current system has a listed design outdoor air rate of 3,000 CFM well above 1,743 CFM.

We recommend the single zone VAV feature as well as the CO2 demand ventilation control reset feature be adjusted so as to maintain elevated levels of OA during the pandemic condition.

Cafeteria, Media Center & Offices:

The cafeteria, Media Center & Offices are supported by the same central RTU units which support the classroom spaces.

All these spaces are supported with VAV terminals. These VAV terminals are fitted with damper operators and hot water coils for control of primary air and temperature of air delivered to the space they serve. A DDC space thermostat controls the operation of the VAV damper and the hydronic heating valve.

As these are mixed air systems, the amount of outdoor air delivered to each space varies based on the amount of primary air being introduced through the respective VAV terminal. According to the design drawings the percentage of outdoor air from the central systems varies by system from as low as 16% to as high as 43% with all areas appearing to comply with current ventilation codes.

Since most of the spaces are heated with perimeter fin-tube radiation, the heating supply air temperatures are moderate yielding a zone air distribution effectiveness for most of the areas of 1.0.

The media center as well as the cafeteria include CO2 based demand ventilation control reset which can reduce outdoor air levels as space occupancy reduces. We recommend this feature be disabled on all systems during the pandemic condition so as to maintain elevated levels of outdoor air.

Controls:

Most of the major HVAC systems supporting the school are controlled by a building energy management system (EMS). The EMS system was installed and is currently supported by Automated Logic. It appears the system controls most of the building HVAC systems including the rooftop units, air handlers, VAV & FVAV terminals, exhaust fans, etc… The packaged RTU units have factory furnished controls which control much of their internal operation with the EMS interfacing to these controls.

The operating schedule for much of the equipment is based on the school'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 school. 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.

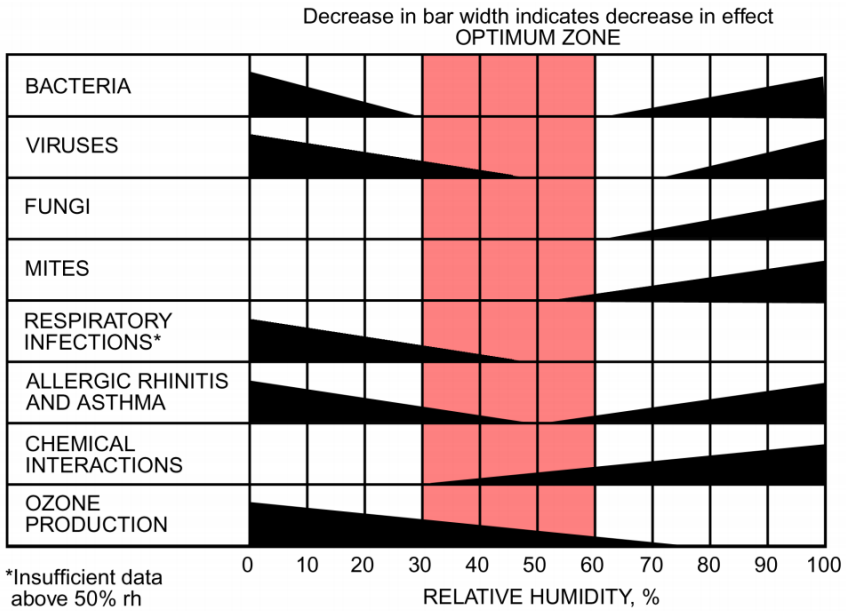


**Fig. 1 Optimum Humidity Range for Human Comfort and Health**
(Adapted from Sterling et al. 1985)

The Nelson Place Elementary School HVAC systems have no active humidification control but does have active dehumidification control built in to most all the rooftop HVAC systems. In addition, even though there are no humidification systems, all of the classroom spaces are served by ventilation units which have energy recovery wheels that transfer moisture generated by occupants and activity within the space back into the incoming outdoor air during the cold winter months. This moisture exchange aids in providing some moisture into the dry outdoor air stream dependent on exterior conditions and space occupancy. For spaces that are air conditioned, the energy wheels can also assist in removing moisture from incoming summer air to aid in space humidity control.

Space dehumidification is controlled on all main rooftop HVAC units through the use of DX cooling coils and hot gas reheat coils which use waste compression heat to reheat air if needed. The current systems were designed to limit indoor humidity to a range of 50 to 55% RH.

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 Nelson Place Elementary School 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." Many of the general classrooms in the Nelson Place Elementary School have an outdoor air exchange rate of less than 3 (2.1+/- ACH) however, these systems, being of the displacement type, provide more effective outdoor air ventilation into the breathing zone and limit air mixing in the room both of which help in mitigation the spread of airborne contaminants and viruses.

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 that 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.

| Nelson Place Elem. School IAQ Sampling Summary | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Space Tested | Temp. | Humidity | CO2 | TVOC | HCHO | Room Area | Room Ht. | Volume | Original Design OA | Original OA Air | Notes |
| | °F | % RH | % | ppm | ppm | SqFt | Ft | Cubic Feet | CFM | ACH | |
| **Lower Floor** | | | | | | | | | | | |
| Special Ed C073 | 71 | 38.8 | 470 | 0.92 | 0.07 | 942 | 13 | 12246 | 528 | 2.6 | |
| Speech C084 | 70.4 | 42.1 | 446 | 0.72 | 0.09 | 459 | 13 | 5967 | 131 | 1.3 | |
| Science Classroom C089 | 71.2 | 41.7 | 460 | 0.88 | 0.12 | 967 | 13 | 12571 | 279 | 1.3 | |
| Classroom C096 | 70.1 | 42.6 | 462 | 0.66 | 0.12 | 925 | 13 | 12025 | 683 | 3.4 | |
| | | | | | | | | | | | |
| **Main Floor** | | | | | | | | | | | |
| Kindergarten A101 | 73.4 | 46.7 | 407 | 0.74 | 0.06 | 908 | 13 | 11804 | 506 | 2.6 | |
| Kindergarten A106 | 72.1 | 48.6 | 415 | 0.52 | 0.08 | 915 | 13 | 11895 | 432 | 2.2 | |
| Pre-Kindergarten A124 | 70.7 | 50.7 | 409 | 0.31 | 0.05 | 930 | 13 | 12090 | 479 | 2.4 | |
| Medical Suite B134 | 72.3 | 48.7 | 461 | 0.52 | 0.1 | 506 | 13 | 6578 | 53 | 0.5 | |
| General Office B130 | 71.2 | 49.6 | 425 | 0.34 | 0.05 | 456 | 13 | 5928 | 60 | 0.6 | |
| Lobby B150 | 71.8 | 49.4 | 431 | 0.38 | 0.07 | 3013 | 13 | 39169 | 284 | 0.4 | |
| Gym B140 | 71.3 | 50.6 | 412 | 0.17 | 0.02 | 5811 | 24 | 139464 | 2974 | 1.3 | |
| Cafeteria B145 | 70.9 | 50.6 | 416 | 0.15 | 0.02 | 4202 | 24 | 100848 | 2399 | 1.4 | |
| Media Center B151 | 72.7 | 48.3 | 411 | 0.38 | 0.09 | 3151 | 13 | 40963 | 894 | 1.3 | |
| Computer B152 | 72.8 | 49 | 411 | 0.43 | 0.09 | 880 | 13 | 11440 | 290 | 1.5 | |
| Music C182 | 70.5 | 51.3 | 418 | 0.32 | 0.07 | 1125 | 13 | 14625 | 430 | 1.8 | |
| Art C185 | 70.3 | 51.3 | 421 | 0.23 | 0.03 | 999 | 13 | 12987 | 404 | 1.9 | |
| | | | | | | | | | | | |
| **Upper Floor** | | | | | | | | | | | |
| Common A200 | 72 | 46.4 | 422 | 0.59 | 0.09 | 1620 | 13 | 21060 | 534 | 1.5 | |
| Art A206 | 71.7 | 47.2 | 415 | 0.48 | 0.1 | 987 | 13 | 12831 | 268 | 1.3 | |
| Computer A216 | 71.6 | 46.9 | 422 | 0.49 | 0.07 | 795 | 13 | 10335 | 358 | 2.1 | |
| Classroom A225 | 71.4 | 47.5 | 418 | 0.61 | 0.09 | 929 | 13 | 12077 | 413 | 2.1 | |
| Music A226 | 71.9 | 46.4 | 420 | 0.46 | 0.07 | 995 | 13 | 12935 | 429 | 2 | |

*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.

**Nelson Place Elementary School 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. (FPM) | Proposed CCM # | Proposed ECCM # | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| RTU-1 | Classrooms Section A | 18850 | 7185 | 38 | 2" MERV 8 Pre & 4" MERV 13 Final | 13 | | 1, 2 | 1, 3 | a |
| RTU-2 | Classrooms Section A | 12750 | 7000 | 55 | 2" MERV 8 Pre & 4" MERV 13 Final | 13 | | 1, 2 | 1, 3 | a |
| RTU-3 | Gymnasium | 7435 | 3000 | 40 | 2" MERV 8 Pre & 4" MERV 13 Final | 13 | | 1, 2 | 3 | a |
| RTU-4 | Offices and Lobby | 5760 | 900 | 16 | 2" MERV 8 Pre & 4" MERV 13 Final | 13 | | 1, 2 | 1, 3 | a |
| RTU-5 | Media Center | 5920 | 1600 | 27 | 2" MERV 8 Pre & 4" MERV 13 Final | 13 | | 1, 2 | 1, 3 | a |
| RTU-6 | Cafetorium | 8905 | 3825 | 43 | 2" MERV 8 Pre & 4" MERV 13 Final | 13 | | 1, 2 | 3 | a |
| RTU-7 | Classrooms Section C | 15535 | 6700 | 43 | 2" MERV 8 Pre & 4" MERV 13 Final | 13 | | 1, 2 | 1, 3 | a |
| RTU-8 | Classrooms Section C | 9950 | 6900 | 69 | 2" MERV 8 Pre & 4" MERV 13 Final | 13 | | 1, 2 | 1, 3 | a |

*Ventilation System Summary Notes:*

a. *Disable any $CO_2$ 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.

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 Nelson Place Elementary School 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 Nelson Place School 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.

Most of the rooftop HVAC systems supporting the Nelson Place School are capable of implementing this measure subject to outdoor ambient conditions and equipment limitations.

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.

A majority of the main air handling systems in the building already have MERV 13 filtration or are designed to support filtration up to MERV 13.

## 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 under the respective schools 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 Nelson Place Elementary Schools case they could be installed in the supply air duct of the respective mixed air handling systems. WPS has already begun to incorporate Bipolar Ionization extensively throughout the Nelson Place School to address the current pandemic condition.

Air ionizers appear to be showing quite a bit of promise for low system impact in retrofit application. 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 the ionizers work on neutralizing virus's 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 regards 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 in facilities such as convention centers, 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

# Nelson Place School

| 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 CASEMENT | 11.16 | B CASEMENT | 7.05 | | | | |
| **Lower Level** | | | | | | | | | | | |
| C061 - Men's | toilet | 53 | 2.12 | | | | | 0.00 | 2.12 | NO | |
| C062 - Women's | toilet | 56 | 2.24 | | | | | 0.00 | 2.24 | NO | |
| C063 - Boy's | toilet | 174 | 6.96 | | | | | 0.00 | 6.96 | NO | |
| C064 - Girls | toilet | 174 | 6.96 | | | | | 0.00 | 6.96 | NO | |
| C065.5 - Cust | support | 191 | 7.64 | | | | | 0.00 | 7.64 | NO | |
| C071 | classroom | 942 | 37.68 | | 1 | | | 11.16 | 26.52 | NO | |
| C072 - Observation | support | 68 | 2.72 | | | | | 0.00 | 2.72 | NO | |
| C073 - Spec Edu | classroom | 942 | 37.68 | | 1 | | | 11.16 | 26.52 | NO | |
| C073.2 - Ther Pl | support | 46 | 1.84 | | | | | 0.00 | 1.84 | NO | |
| C073.3 - Toilet A | toilet | 124 | 4.96 | | | | 2 | 14.09 | -9.13 | YES | |
| C073.3 - Toilet B | toilet | 27 | 1.08 | | | | | 0.00 | 1.08 | NO | |
| C074 | classroom | 926 | 37.04 | | 1 | | | 11.16 | 25.88 | NO | |
| C075 - Learning Lab | support | 458 | 18.32 | | | | 4 | 28.19 | -9.87 | YES | |
| C076 | classroom | 926 | 37.04 | | 2 | | | 22.31 | 14.73 | NO | |
| C081 - Instruct Coach | support | 249 | 9.96 | | | | | 0.00 | 9.96 | NO | |
| C082 - Councelor | office | 174 | 6.96 | | | | | 0.00 | 6.96 | NO | |
| C083 - Conference | conference | 301 | 12.04 | | | | | 0.00 | 12.04 | NO | |
| C084 - Speech | classroom | 459 | 18.36 | | | | | 0.00 | 18.36 | NO | |
| C085 - Planning | support | 184 | 7.36 | | | | | 0.00 | 7.36 | NO | |
| C085.1 - Work | support | 179 | 7.16 | | | | | 0.00 | 7.16 | NO | |
| C086 - Storage | storage | 351 | 14.04 | | | | | 0.00 | 14.04 | NO | |
| C087 - Toilet | toilet | 63 | 2.52 | | | | | 0.00 | 2.52 | NO | |
| C088 - Janitor | support | 119 | 4.76 | | | | | 0.00 | 4.76 | NO | |
| C089 - Science Classoom | classroom | 967 | 38.68 | | | | | 0.00 | 38.68 | NO | |
| C089.1 - Science Prep | support | 187 | 7.48 | | | | | 0.00 | 7.48 | NO | |
| C090 - Common Area | meeting | 0 | 0 | | | | | 0.00 | 0.00 | NO | |
| C0901 | classroom | 941 | 37.64 | | 1 | | | 11.16 | 26.48 | NO | |
| C092 - Observ | support | 69 | 2.76 | | | | | 0.00 | 2.76 | NO | |
| C093 - Spec Ed | classroom | 941 | 37.64 | | 1 | | | 11.16 | 26.48 | NO | |
| C093.2 - Ther Pl | support | 44 | 1.76 | | | | | 0.00 | 1.76 | NO | |
| C093.3 - Toilet A | toilet | 121 | 4.84 | | | | 2 | 14.09 | -9.25 | YES | |
| C093.3 - Toilet B | toilet | 29 | 1.16 | | | | | 0.00 | 1.16 | NO | |
| C094 | classroom | 924 | 36.96 | | 1 | | | 11.16 | 25.80 | NO | |
| C095 - Learning Lab | classroom | 458 | 18.32 | | | | 4 | 28.19 | -9.87 | YES | |
| C096 | classroom | 925 | 37 | | 1 | | | 11.16 | 25.84 | NO | |

**Main Floor**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| A100 - Common | common | 0 | 0 | | | 0.00 | 0.00 | NO | |
| A101 - Kindergarten | classroom | 908 | 36.32 | 2 | | 22.31 | 14.01 | NO | |
| A102 - Storage | storage | 71 | 2.84 | | | 0.00 | 2.84 | NO | |
| A103 - Kindergarten | classroom | 917 | 36.68 | 1 | | 11.16 | 25.52 | NO | |
| A103.2 - Storage | storage | 48 | 1.92 | | | 0.00 | 1.92 | NO | |
| A103.3 - Toilet A | toilet | 54 | 2.16 | | | 0.00 | 2.16 | NO | |
| A103.3 - Toilet B | toilet | 31 | 1.24 | | | 0.00 | 1.24 | NO | |
| A103.4 - Storage | storage | 104 | 4.16 | | 1 | 7.05 | -2.89 | YES | |
| A104 - Kindergarten Spec Ed | classroom | 915 | 36.6 | 1 | | 11.16 | 25.44 | NO | |
| A104.2 - Ther Pl | support | 44 | 1.76 | | | 0.00 | 1.76 | NO | |
| A104.3 - Toilet A | toilet | 54 | 2.16 | | | 0.00 | 2.16 | NO | |
| A104.3 - Toilet B | toilet | 31 | 1.24 | | | 0.00 | 1.24 | NO | |
| A104.4 - Storage | storage | 104 | 4.16 | | 1 | 7.05 | -2.89 | YES | |
| A105 - Observation | support | 69 | 2.76 | | | 0.00 | 2.76 | NO | |
| A106 - Kindergarten | classroom | 915 | 36.6 | | 1 | 7.05 | 29.55 | NO | |
| A107 - Custodian Storage | storage | 149 | 5.96 | | | 0.00 | 5.96 | NO | |
| A111 - Learning Lab | classroom | 461 | 18.44 | | | 0.00 | 18.44 | NO | |
| A112 - Learning Lan | classroom | 460 | 18.4 | | | 0.00 | 18.40 | NO | |
| A115 - Speech | classroom | 457 | 18.28 | | | 0.00 | 18.28 | NO | |
| A116 - Men's | toilet | 50 | 2 | | | 0.00 | 2.00 | NO | |
| A117 - Women's | toilet | 50 | 2 | | | 0.00 | 2.00 | NO | |
| A118 - Storage | storage | 269 | 10.76 | | | 0.00 | 10.76 | NO | |
| A119 - OT / PT | classroom | 1125 | 45 | | | 0.00 | 45.00 | NO | |
| A121 - Pre-Kindergarten | classroom | 934 | 37.36 | 1 | | 11.16 | 26.20 | NO | |
| A122 - Observation | support | 66 | 2.64 | | | 0.00 | 2.64 | NO | |
| A123 - Pre-Kindergarten | classroom | 943 | 37.72 | 1 | | 11.16 | 26.56 | NO | |
| A123.2 - Ther Pl | support | 48 | 1.92 | | | 0.00 | 1.92 | NO | |
| A123.3 - Toilet A | toilet | 54 | 2.16 | | | 0.00 | 2.16 | NO | |
| A123.3 - Toilet B | toilet | 31 | 1.24 | | | 0.00 | 1.24 | NO | |
| A123.4 - Storage | storage | 103 | 4.12 | | 2 | 14.09 | -9.97 | YES | |
| A124 - Pre-Kindergarten | classroom | 930 | 37.2 | 1 | | 11.16 | 26.04 | NO | |
| A124.2 - Toilet | toilet | 31 | 1.24 | | | 0.00 | 1.24 | NO | |
| A124.3 - Toilet | toilet | 54 | 2.16 | | 1 | 7.05 | -4.89 | YES | |
| A125 - Observation | support | 72 | 2.88 | | | 0.00 | 2.88 | NO | |
| A126 - Work | classroom | 140 | 5.6 | | | 0.00 | 5.60 | NO | |
| A126.1 - BCBA Office | office | 302 | 12.08 | | | 0.00 | 12.08 | NO | |
| A127 - Office | office | 245 | 9.8 | | | 0.00 | 9.80 | NO | |
| A128 - Observ & Int | support | 266 | 10.64 | | | 0.00 | 10.64 | NO | |
| A128.1 - Early Childhood | classroom | 578 | 23.12 | 1 | | 11.16 | 11.96 | NO | |
| A128.2 - Toilet | toilet | 54 | 2.16 | | 1 | 7.05 | -4.89 | YES | |
| A129 - Team Meeting | support | 352 | 14.08 | | | 0.00 | 14.08 | NO | |
| B130.3 - Toilet | toilet | 49 | 1.96 | | | 0.00 | 1.96 | NO | |
| B130.4 - Records | storage | 130 | 5.2 | | | 0.00 | 5.20 | NO | |
| B130 / B130.1 - Waiting & Gen Office | office | 456 | 18.24 | | | 0.00 | 18.24 | NO | |
| B131 - Copy | support | 177 | 7.08 | | | 0.00 | 7.08 | NO | |
| B132 - Spec Ed Conference | conference | 295 | 11.8 | | | 0.00 | 11.80 | NO | |
| B133 - Conference | conference | 244 | 9.76 | | | 0.00 | 9.76 | NO | |
| B134.1 - Nurse | nurse | 151 | 6.04 | | | 0.00 | 6.04 | NO | |
| B134.2 - Toilet | toilet | 89 | 3.56 | | | 0.00 | 3.56 | NO | |
| B134.3 - Exam | nurse | 112 | 4.48 | | | 0.00 | 4.48 | NO | |
| B134.5 - Quarantine | nurse | 96 | 3.84 | | | 0.00 | 3.84 | NO | |
| B135 - Family Learning | classroom | 244 | 9.76 | | | 0.00 | 9.76 | NO | |
| B136 - Spec Ed Office | office | 173 | 6.92 | | | 0.00 | 6.92 | NO | |
| B137 - Psych Office | office | 231 | 9.24 | | | 0.00 | 9.24 | NO | |
| B138 - V.P. Office | office | 209 | 8.36 | | | 0.00 | 8.36 | NO | |
| B139 - Principal | office | 310 | 12.4 | | | 0.00 | 12.40 | NO | |
| B140 - Gym | gym | 5811 | 232.44 | | | 0.00 | 232.44 | NO | |
| B140.1 - Storage | storage | 68 | 2.72 | | | 0.00 | 2.72 | NO | |
| B140.2 - Gym Storage | storage | 254 | 10.16 | | | 0.00 | 10.16 | NO | |
| B140.3 - Gym Office | office | 136 | 5.44 | 1 | | 11.16 | -5.72 | YES | |
| B141 - Women's | toilet | 216 | 8.64 | | | 0.00 | 8.64 | NO | |
| B142 - Men's | toilet | 216 | 8.64 | | | 0.00 | 8.64 | NO | |
| B143 - Vestibule | entry | 254 | 10.16 | | | 0.00 | 10.16 | NO | |
| B143.1 - Boys | toilet | 47 | 1.88 | | | 0.00 | 1.88 | NO | |
| B143.2 - Girls | toilet | 47 | 1.88 | | | 0.00 | 1.88 | NO | |
| B144 - Platform | aud | 1178 | 47.12 | | | 0.00 | 47.12 | NO | |
| B144.2 - Storage | storage | 179 | 7.16 | | | 0.00 | 7.16 | NO | |
| B144.3 - Instrament Storage | storage | 222 | 8.88 | | | 0.00 | 8.88 | NO | |
| B145 - Cafeteria | café | 4202 | 168.08 | | | 0.00 | 168.08 | NO | |
| B145.1 - Table Storage | storage | 365 | 14.6 | | | 0.00 | 14.60 | NO | |
| B145.2 - Staff Dinning | café | 302 | 12.08 | | | 0.00 | 12.08 | NO | |
| B150 - Lobby | entry | 3013 | 120.52 | | | 0.00 | 120.52 | NO | |
| B150.1 - Vestibule | entry | 249 | 9.96 | | | 0.00 | 9.96 | NO | |
| B151 - Media Center | classroom | 3151 | 126.04 | | | 0.00 | 126.04 | NO | |
| B151.1 - Office | office | 105 | 4.2 | | | 0.00 | 4.20 | NO | |
| B151.2 - Toilet | toilet | 45 | 1.8 | | | 0.00 | 1.80 | NO | |
| B152 - Computers | classroom | 880 | 35.2 | | | 0.00 | 35.20 | NO | |
| B153 - Kitchen | café | 1680 | 67.2 | | | 0.00 | 67.20 | NO | |
| B153.1 - Women's | toilet | 52 | 2.08 | | | 0.00 | 2.08 | NO | |
| B153.2 - Men's | toilet | 52 | 2.08 | | | 0.00 | 2.08 | NO | |
| B153.3 - Freezer | café | 174 | 6.96 | | | 0.00 | 6.96 | NO | |
| B153.4 - ReFridge | café | 166 | 6.64 | | | 0.00 | 6.64 | NO | |
| B154 - Server | support | 169 | 6.76 | | | 0.00 | 6.76 | NO | |
| B155 - Dry Storage | storage | 211 | 8.44 | | | 0.00 | 8.44 | NO | |
| B156 - Office | office | 91 | 3.64 | | | 0.00 | 3.64 | NO | |
| C157 - Dishroom | café | 203 | 8.12 | | | 0.00 | 8.12 | NO | |
| C161 - Men's | toilet | 53 | 2.12 | | | 0.00 | 2.12 | NO | |
| C162 - Women's | toilet | 53 | 2.12 | | | 0.00 | 2.12 | NO | |
| C163 - Boy's | toilet | 175 | 7 | | | 0.00 | 7.00 | NO | |
| C164 - Girl's | toilet | 174 | 6.96 | | | 0.00 | 6.96 | NO | |
| C165 - Custodial Office | office | 163 | 6.52 | | | 0.00 | 6.52 | NO | |
| C166 - Receiving | support | 649 | 25.96 | | | 0.00 | 25.96 | NO | |
| C166.1 - Custodial Storage | storage | 149 | 5.96 | | | 0.00 | 5.96 | NO | |
| C167 - Outdoor Storage | storage | 194 | 7.76 | | | 0.00 | 7.76 | NO | |
| C171 | classroom | 947 | 37.88 | 1 | | 11.16 | 26.72 | NO | |
| C172 - Observation | support | 68 | 2.72 | | | 0.00 | 2.72 | NO | |
| C173 - Spec Ed | classroom | 942 | 37.68 | 1 | | 11.16 | 26.52 | NO | |
| C173.2 - Ther Pl | support | 45 | 1.8 | | | 0.00 | 1.80 | NO | |
| C173.3 - Toilet A | toilet | 121 | 4.84 | | 2 | 14.09 | -9.25 | YES | |
| C173.3 - Toilet B | toilet | 27 | 1.08 | | | 0.00 | 1.08 | NO | |
| C174 | classroom | 932 | 37.28 | 1 | | 11.16 | 26.12 | NO | |
| C175 - Learning Lab | classroom | 451 | 18.04 | | 4 | 28.19 | -10.15 | YES | |
| C176 | classroom | 924 | 36.96 | 2 | | 22.31 | 14.65 | NO | |
| C181 - OT / PT | classroom | 795 | 31.8 | | | 0.00 | 31.80 | NO | |
| C182 - Music | classroom | 1125 | 45 | | | 0.00 | 45.00 | NO | |
| C184 - Janitor | support | 44 | 1.76 | | | 0.00 | 1.76 | NO | |
| C185 - ART | classroom | 999 | 39.96 | | | 0.00 | 39.96 | NO | |
| C185.1 - Art Storage | storage | 101 | 4.04 | | | 0.00 | 4.04 | NO | |
| C191 | classroom | 944 | 37.76 | 1 | | 11.16 | 26.60 | NO | |
| C192 - Observation | support | 68 | 2.72 | | | 0.00 | 2.72 | NO | |
| C193 - Spec - Ed | classroom | 944 | 37.76 | 1 | | 11.16 | 26.60 | NO | |
| C193.2 - Ther Pl | support | 46 | 1.84 | | | 0.00 | 1.84 | NO | |
| C193.3 - Toilet | toilet | 121 | 4.84 | | 2 | 14.09 | -9.25 | YES | |
| C193.4 - Toilet | toilet | 29 | 1.16 | | | 0.00 | 1.16 | NO | |
| C194 | classroom | 921 | 36.84 | 1 | | 11.16 | 25.68 | NO | |
| C195 - Learning Lab | classroom | 449 | 17.96 | | 4 | 28.19 | -10.23 | YES | |
| C196 | classroom | 924 | 36.96 | 1 | | 11.16 | 25.80 | NO | |
| C199 - Common | common | 0 | 0 | | | 0.00 | 0.00 | NO | |

| Upper Level | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| A200 - Common | common | 0 | 0 | | | | 0.00 | 0.00 | NO | |
| A201 | classroom | 935 | 37.4 | 2 | | | 22.31 | 15.09 | NO | |
| A202 - Observation | support | 65 | 2.6 | | | | 0.00 | 2.60 | NO | |
| A203 - Spec Edu | classroom | 949 | 37.96 | 1 | | | 11.16 | 26.80 | NO | |
| A203.2 - Ther Pl | support | 48 | 1.92 | | | | 0.00 | 1.92 | NO | |
| A203.3 - Toilet A | toilet | 54 | 2.16 | | | | 0.00 | 2.16 | NO | |
| A203.3 - Toilet B | toilet | 31 | 1.24 | | | | 0.00 | 1.24 | NO | |
| A203.4 - Storage | storage | 935 | 37.4 | | | 1 | 7.05 | 30.35 | NO | |
| A204 | classroom | 927 | 37.08 | 1 | | | 11.16 | 25.92 | NO | |
| A205 | classroom | 923 | 36.92 | 1 | | | 11.16 | 25.76 | NO | |
| A206 - Art | classroom | 987 | 39.48 | 1 | | | 11.16 | 28.32 | NO | |
| A206.1 - Art Storage | storage | 74 | 2.96 | | | | 0.00 | 2.96 | NO | |
| A211 - Learning Lab | classroom | 464 | 18.56 | | | | 0.00 | 18.56 | NO | |
| A212 - Learning Lab | classroom | 461 | 18.44 | | | | 0.00 | 18.44 | NO | |
| A213 - Speech | classroom | 346 | 13.84 | | | | 0.00 | 13.84 | NO | |
| A215 - Planning | classroom | 237 | 9.48 | | | | 0.00 | 9.48 | NO | |
| A215.1 - Work | support | 174 | 6.96 | | | | 0.00 | 6.96 | NO | |
| A216 - Computer | classroom | 795 | 31.8 | | | | 0.00 | 31.80 | NO | |
| A217 - Men's | toilet | 47 | 1.88 | | | | 0.00 | 1.88 | NO | |
| A218 - Women's | toilet | 47 | 1.88 | | | | 0.00 | 1.88 | NO | |
| A219 - Janitor | support | 62 | 2.48 | | | | 0.00 | 2.48 | NO | |
| A221 | classroom | 936 | 37.44 | 1 | | | 11.16 | 26.28 | NO | |
| A222 - Observation | support | 65 | 2.6 | | | | 0.00 | 2.60 | NO | |
| A223 - Spec Edu | classroom | 946 | 37.84 | 1 | | | 11.16 | 26.68 | NO | |
| A223.2 - Ther Pl | support | 49 | 1.96 | | | | 0.00 | 1.96 | NO | |
| A223.3 - Toilet A | toilet | 46 | 1.84 | | | | 0.00 | 1.84 | NO | |
| A223.3 - Toilet B | toilet | 31 | 1.24 | | | | 0.00 | 1.24 | NO | |
| A223.4 - Storage | storage | 104 | 4.16 | | | 4 | 28.19 | -24.03 | YES | |
| A224 | classroom | 931 | 37.24 | 1 | | | 11.16 | 26.08 | NO | |
| A225 | classroom | 929 | 37.16 | 1 | | | 11.16 | 26.00 | NO | |
| A226 - Music | classroom | 995 | 39.8 | 1 | | | 11.16 | 28.64 | NO | |
| A227 - Boy's | toilet | 194 | 7.76 | | | | 0.00 | 7.76 | NO | |
| A228 - Girl's | toilet | 194 | 7.76 | | | | 0.00 | 7.76 | NO | |

| Window Type | Width | Hieght | Projection | Venting |
|---|---|---|---|---|
| A - Casement | 24.5 | 52 | 21 | 11.16 |
| B - Casement | 24.5 | 25 | 20.5 | 7.05 |
| | | | | |
| | | | | |

| 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) |