
February 10, 2021

From: Chief Facilities Officer

To: All District Administrators and Supervisors

Subject: Heating, Ventilation, and Air Conditioning (HVAC) in Preparation for Limited In-Person Instruction (LIPI) Phase 2 and Hybrid Learning

1. This memorandum provides a summary of HVAC operations and modifications (as needed) in preparation for LIPI Phase 2 and hybrid learning. The memorandum gives district leaders a resource that can be shared with all staff and school communities on the steps being taken to reduce the risk of COVID-19 transmission.
2. This memorandum is organized into seven (7) areas:
 - References
 - HVAC Guidance for COVID-19
 - Target Operating Conditions for All District Facilities
 - Summary of District HVAC Operations and Systems
 - Summary of HVAC Systems at District Facilities
 - Standard Operating Procedures in the Event of HVAC System Maintenance or Failure
 - Frequently Asked Questions (FAQ)
 - Glossary of Acronyms
3. Following the guidance from The Oregon Health Authority (OHA), The Centers for Disease Control and Prevention (CDC), The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), and Healthy Buildings, the district will improve indoor air quality and reduce the risk of COVID-19 transmission for LIPI Phase 2 and hybrid learning by doing the following:
 - Introduce more outside air (OSA) in most buildings.
 - Extend operation run times (in general 6 am - 6 pm).
 - The district will upgrade all Minimum Efficiency Reporting Value (MERV) 8 filters to MERV 13.
 - The district will use portable High Efficiency Particulate Air (HEPA) air cleaners in areas that need them.
 - The district will make some areas off limits for LIPI Phase 2 and hybrid learning
4. The information in this memorandum may require an update as new information or recommendations become available.
5. “We all have a role to play to control the spread of this disease. HVAC is part of it and even more significant are social distancing, hygiene and the influence we can have on personal behavior.”
- ASHRAE Journal, May 2020
6. The Facilities and Maintenance Services team is prepared to answer any questions or assist in any way possible. The point of contact is Nathan Potter, Administrator for Maintenance Services, at (503) 356-4455 or nathan_potter@beaverton.k12.or.us.

Sincerely,
Joshua Gamez

1. References

- The Oregon Department of Education (ODE) and Oregon Health Authority (OHA) [Ready Schools, Safe Learners](#)
- The Centers for Disease Control and Prevention ([CDC](#))
- The American Society of Heating, Refrigeration, and Air Conditioning Engineers ([ASHRAE](#))
- [Healthy Buildings for Health](#), Harvard T.H. Chan School of Public Health
- The U.S. Green Building Council ([USGBC](#))

2. HVAC Guidance for COVID-19

- ODE/OHA Ready Schools, Safe Learners
 - Schools with HVAC systems must evaluate the system to minimize indoor air recirculation (thus maximizing fresh outdoor air) to the extent possible. Schools that do not have mechanical ventilation systems shall, to the extent possible, increase natural ventilation by opening windows and interior doors before students arrive and after students leave, and while students are present. Do not prop open doors that can pose a safety or security risk to students and staff (e.g., exterior doors and fire doors that must remain closed). *[Note: Most district classrooms, main offices, cafeterias, and gymnasiums have mechanical ventilation. The areas that do not have mechanical ventilation are the Barnes Elementary School gym, West TV Elementary School gym, and Terra Nova gym.]*
 - Consider running ventilation systems and changing the filters more frequently. Do not use fans if they pose a safety or health risk, such as increasing exposure to pollen/allergies or exacerbating asthma symptoms. Consider using window fans or box fans positioned in open windows to blow fresh outdoor air into the classroom via one window, and indoor air out of the classroom via another window. Fans must not be used in rooms with closed windows and doors, as this does not allow for fresh air to circulate. *[Note: the district will run systems with extended hours and the approximate run times will be 6 am - 6 pm.]*
 - Consider the need for increased ventilation in areas where students with special health care needs receive medication or treatments.
 - Facilities must be cleaned and disinfected at least daily to prevent transmission of the virus from surfaces.
 - Consider modification or enhancement of building ventilation where feasible.
- CDC
 - Increase ventilation rates.
 - Ensure ventilation systems operate properly and provide acceptable indoor air quality for the current occupancy level for each space.
 - Increase outdoor air ventilation, using caution in highly polluted areas. With a lower occupancy level in the building, this increases the effective dilution ventilation per person.
 - Disable demand-controlled ventilation (DCV). *[Note: The district has restricted how the DCV system functions to ensure that setpoints do not reduce the amount of outside air (OSA) being introduced during light loading. This provides a constant amount of OSA for ventilation.]*
 - Further open minimum outdoor air dampers as high as 100% to reduce or eliminate recirculation. In mild weather, this will not affect thermal comfort or humidity. However, this may be difficult to do in cold or hot weather.
 - Improve central air filtration to the MERV 13 or the highest compatible with the filter rack, and seal edges of the filter to limit bypass.
 - Check filters to ensure they are within service life and appropriately installed.
 - Keep systems running longer hours, 24/7 if possible, to enhance air exchanges in the building space. *[Note: the district will run systems with extended hours and the approximate run times will be 6 am - 6 pm.]*

- ASHRAE
 - Inspection and Maintenance: Consider assessing the condition of systems and making necessary repairs. All building owners and service professionals should follow ASHRAE Standard 180-2018 “Standard Practice for the Inspection and Maintenance of Commercial HVAC Systems.”
 - Ventilation: A good supply of OSA, in accordance with ASHRAE Standard 62.1-2019, to dilute indoor contaminants is a first line of defense against aerosol transmission of SARS-CoV-2. Pre- and post-occupancy purge cycles are recommended to flush the building with clean air. *[Note: ASHRAE Standard 62.1-2019 outlines minimum ventilation rates and other measures intended to provide indoor air quality that is acceptable to human occupants and that minimize adverse health effects. The rationale behind the flow requirements is to deal with “more bioeffluents” coming from children.]*
 - Filtration: Use of at least MERV 13 rated filters is recommended if it does not adversely impact system operation. If MERV 13 filters cannot be used, including when there is no mechanical ventilation of a space, portable HEPA air cleaners in occupied spaces may be considered.
 - Air Cleaning: Air cleaners such as germicidal ultraviolet air disinfection devices may also be considered to supplement ventilation and filtration. Technologies and specific equipment should be evaluated to ensure they will effectively clean space air without generating additional contaminants or negatively impacting space air distribution.

- Healthy Buildings for Health
 - For improving indoor air quality in the classroom, [we] recommend prioritizing control strategies - ventilation, filtration, supplemental air cleaning - and targeting a combined 4-6 air changes per hour (ACH) for classrooms through any combination of these approaches.
 - Increase outdoor air ventilation
 - Bring in more fresh outdoor air
 - Filter indoor air
 - Increase the level of the air filter to MERV 13 or higher on recirculated air
 - Inspect filters to make sure they are installed and fit correctly
 - Check that sufficient airflow can be maintained across the filter
 - Maintain and change filters based on manufacturer’s recommendation
 - Supplement with portable air cleaners
 - Supplement ventilation and filtration with air cleaning devices
 - Select portable air cleaners with HEPA filters
 - Size devices carefully based on the size of the room
 - Verify ventilation and filtration performance
 - Verify through commissioning and testing
 - Work with an expert to evaluate building systems, ventilation, filtration, and air cleaning
 - Measure carbon dioxide (CO₂) as a proxy for ventilation
 - Consider advanced air quality techniques
 - Attempt to maintain indoor relative humidity between 40-60%
 - Consider advanced air cleaning with ultraviolet germicidal irradiation (UVGI)

3. Target Operating Conditions for All District Facilities

Every building system was originally designed to provide a safe, healthy environment. Prior to the pandemic, most district buildings operated in approximately four (4) to five (5) ACH by using MERV 8 filters and introducing minimum OSA. All MERV 8 filters in HVAC systems were replaced with new MERV 8 filters in the Spring 2020. MERV 13 filters that were already present in some newer facilities were left in place.

The district will focus its efforts on the guidance from Healthy Buildings for Health and target five (5) ACH for through any combination of these approaches.

The district will improve indoor air quality and reduce the risk of COVID-19 transmission for LIPI Phase 2 and hybrid learning by doing the following:

- Introduce more OSA in most buildings.
- Extend operation run times (in general 6 am - 6 pm).
- The district will upgrade all MERV 8 filters to MERV 13.
- The district will use portable HEPA air cleaners in areas that need them.
- The district will make some areas off limits for LIPI Phase 2 and hybrid learning.

4. Summary of District HVAC Operations and Systems

- a. HVAC stands for Heating, Ventilation, and Air Conditioning. It may be a little misleading but “air conditioning” does not mean “mechanical cooling”. Air conditioning is the blending of air - recirculated (inside air), OSA, hot, and cold - all to provide healthy, normally comfortable, ventilation. To respond to COVID-19 the district has introduced significantly more OSA and there will be times where the systems are providing safe, clean, and quality air but it may not be comfortable during peak temperatures.
- b. All buildings in the district have direct digital control (DDC) systems that allow remote scheduling and operation. About 80% of the district's classrooms have control systems that allow the district to remotely monitor each room. The classrooms that are not directly monitored are still functioning and provide safe levels of ventilation but these classrooms require a Maintenance Technician to physically check the equipment to verify operation. The DDC system also stores historical data to analyze how a system has been operating and generates an alarm that warns of system failures.
- c. District HVAC systems were designed around the maximum number of persons allowed in a space by ventilation code. When running these systems with few occupants the spaces may have larger temperature swings and/or occupants may feel drafts. It is perfectly safe but staff can reach out to Maintenance if there are any questions about that specific space.
- d. There are three aspects to air quality - mechanical ventilation, air filtration, and air cleaning - that the district has been focused on to meet the ASHRAE guidance and provide a safe, clean, and healthy environment.
- e. Mechanical ventilation.
 - i. All classrooms, offices, cafeterias, and all but three gyms (Barnes Elementary School, West TV Elementary School, and Terra Nova) in the district have mechanical ventilation. Some areas in the district do not have mechanical cooling capabilities but these areas all have sufficient ventilation per Oregon Mechanical Specialty Code.
 - ii. The district is currently starting all HVAC systems two hours before the arrival of teaching staff (approximately 6 am) to pre-purge the buildings and then continue with normal operations for the remainder of the school day.
 - iii. When indoor athletics, LIPI, and hybrid instruction begins the daily operation schedule will be set to start two hours before the arrival of teaching staff (approximately 6 am) and run two hours later than staff is anticipated to be in the building.
 - iv. All district HVAC systems are designed to meet the requirements of the Oregon Mechanical Specialty Code. The basis of that code is ASHRAE 62.1 ventilation standards. This means the systems are designed to provide each student with approximately 12 to 15 cubic feet of fresh air per minute (CFM). This is calculated based on the maximum occupancy rating for the classroom and the size of the space using the Section 403.3.1.1, Table 403.3.1.1

Minimum Ventilation Rates of the 2019 Oregon Mechanical Specialty Code for Mechanical Ventilation.

- v. Most of the district's classrooms are designed for 25 to 35 students. When a space is used with half the capacity of students, as is the plan for hybrid instruction, the ventilation rate is essentially doubled for that space. This provides each facility with a significant factor of safety when it comes to providing substantial air quality.
 - vi. ASHRAE and the CDC have advised to increase air exchanges and how this is achieved is through introducing fresh, OSA and filtering recirculated air.
 - vii. The district's HVAC systems mix a combination of return air and OSA, filter it and condition it. Prior to the pandemic, the buildings varied between 5% and 30% OSA driven by what is called DCV. HVAC systems are operated based on a balance of operating efficiency and space conditioning requirements. DCV monitored the level of CO2 either in the space or at the HVAC system. CO2 levels provide an approximation of air quality. The higher the value the less ventilated the space is. The district is overriding or resetting the minimum to 20% and allowing CO2 to drive OSA upward as needed. This increases the amount of OSA in keeping with CDC and ASHRAE recommendations.
 - viii. In response to COVID-19, the district will adjust the DCV settings so that each system cannot drop below a minimum OSA rate that was the basis of design and per OMSC (see item iv. above).
- f. Air filtration.
- i. Filters are rated on a Minimum Efficiency Reporting Value (MERV) scale between one (1) and 16. A MERV rating measures how effectively the filter stops dust and other contaminants from passing through the filter and into the air stream. Filters with higher MERV ratings trap small particles more effectively than filters with lower MERV ratings. Above MERV 16 is considered HEPA.
 - ii. MERV 13 filters that were already present in some newer facilities and were left in place this past Spring 2020.
 - iii. Air velocities are designed to be low to prevent viral resuspension.
 - iv. Filters, combined with increased OSA, allow us to increase the number of effective ACH for a building.
- g. Air cleaning.
- i. The district will use portable HEPA air cleaners in areas with limited mechanical ventilation. The district will also include one portable HEPA air cleaner in all school isolation rooms as an additional safety measure, even if the room has adequate ACH.
 - ii. The district is not actively pursuing technologies such as ultraviolet germicidal irradiation (UVGI), ozone air cleaners, ionizer air purifier, or Dry Hydrogen Peroxide to kill or filter microorganisms. These technologies are mostly unproven and potentially introduce other safety risks in creating chemicals that are respiratory hazards such as ozone. USGBC recommends focusing effort and resources on ventilation and filtration.

5. Summary of HVAC Systems at District Facilities

- a. Portables. The district's portables are capable of safe operation for LIPI Phase 2 and hybrid learning when set up properly. Schools should notify Maintenance as soon as possible if portables will be used for LIPI Phase 2 and/or hybrid learning. Maintenance will upgrade all MERV 8 filters to MERV 13 in all portables. The priority for replacement of filters will be elementary schools and expected to start in March 2021. Maintenance will inspect the HVAC units on these portables and set for extended operation. The systems ventilating portables are essentially electric closed residential systems. Most systems are capable of running 100% OSA; however, do not have DDC and require manual settings. These systems are typically set to operate with approximately 20% OSA. When more OSA is introduced, it will be a challenge to keep the temperature comfortable in these spaces. Moving forward, there are approximately 200

units that need to be manually inspected and adjusted to make them function within a yet to be determined optimum range. Portable HEPA air cleaners will be placed in portables as needed when OSA cannot be adjusted.

b. **Elementary Schools**

Aloha-Huber Park K-8: Newer facilities and constructed multi zone variable air volume (VAV) systems consisting of packaged rooftop air handlers and Direct Digital Control (DDC). Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Barnes: All classrooms have mechanical ventilation. The older section has individual unit ventilators. The newer section is rooftop multi-zone VAV systems. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. **Areas that will not be used for LIPI Phase 2 or hybrid learning: the gym does not have adequate ventilation and will not be used.**

Beaver Acres: All classrooms have mechanical ventilation provided by rooftop multi-zone units serving a VAV system. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Bethany: All classrooms have mechanical ventilation. The library end has some individual rooftop units. The main section is rooftop multi-zone VAV systems. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Bonny Slope: Newer facilities and constructed multi zone VAV systems consisting of packaged rooftop air handlers and Direct Digital Control (DDC). Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Cedar Mill: All classrooms have a dedicated rooftop unit for each room. The office areas share one unit in a Variable Volume & Temperature (VVT) system. Lower area around the cafeteria is ventilated with a dedicated 100% outside air unit. Heating and cooling is provided by Variable Refrigerant Flow (VRF). Gym is well ventilated. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Chehalem: All classrooms are ventilated by rooftop multi-zone VAV systems. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Cooper Mountain: classrooms are served by older constant velocity multi-zone units that have had a recent control upgrade. Modular building has individual rooftop units. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Elmonica: Library end classrooms are served by air handlers in mechanical enclosures on the roof with VAV systems. The modular classrooms each have a dedicated roof top unit. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Errol Hassell: Library end classrooms are served by air handlers located in a mechanical enclosure on the roof with VAV systems. The modular classrooms each have a dedicated roof top unit. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Findley: All classrooms are served by rooftop VAV systems with hot-water reheat. Hallways and common areas are well ventilated. Portables being used specifically as a classroom need to be VAV identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Fir Grove: Center classrooms are served by rooftop VAV systems with hot-water reheat. A hall has a home style furnace in each classroom that does supply OSA. Common areas are all ventilated. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Greenway: Air handlers in mechanical rooms and packaged rooftop units with VAV distribution. Older sections are still pneumatic controls but all have good ventilation. Modular has individual heat-pumps for each room. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Hazeldale: System far exceeds ASHRAE guidelines. They are specifically designed to run on 100% OSA. This school does not use demand control ventilation for energy savings. In extreme temperatures (>90 degrees, <30 degrees) fans that are running at 100% OSA are reduced to approximately 50%. Typically, a building blend is approximately 20% OSA for occupied and 5% for unoccupied. MERV 13 are not needed to filter the OSA, there is no re-circulation. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Hiteon: Air handlers in mechanical rooms and packaged rooftop units with VAV distribution. Older sections are still pneumatic controls but all have good ventilation. Gym and cafeteria have mechanical cooling systems. All classrooms and offices have adequate air quality. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Jacob Wismer: Newer facilities and constructed multi zone VAV systems consisting of packaged rooftop air handlers and Direct Digital Control (DDC). Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Kinnaman: Air handlers in mechanical rooms and packaged rooftop units with VAV distribution. Older sections are still pneumatic controls but all have good ventilation. Modular has individual heat-pumps for each room. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

McKay: Central heating plant with two condensing boilers provides hot water heat to VAV systems, cooling is provided by a central chiller. Cafeteria end of the building is rooftop units. Full Niagara Direct Digital Control (DDC) system. Gym is heat only but well ventilated. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

McKinley: Central heating plant with hot water boiler. Package rooftop VVT and VAV air handlers. Direct Digital Control (DDC) controls with some stand alone thermostats. Classrooms have perimeter fin-tube hot water convectors in addition to VAV. Library and gym are heat only. The modular addition has individual rooftop units. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Montclair: Central heating plant with hot water boiler. Package rooftop air handlers. Direct Digital Control (DDC) controlled. 1970 classrooms, library, cafeteria, and office addition conditioned by VAV system with hot-water reheat. Gym and kitchen are heat only. 1992 classroom addition conditioned by individual rooftop units. Portables being used specifically as a

classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Nancy Ryles: All classrooms are served by rooftop VAV systems with hot-water reheat. Hallways and common areas are well ventilated. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Oak Hills: Central heating plant with hot water boiler. Package rooftop air handlers. Direct Digital Control (DDC) controlled "A" wing classrooms conditioned by a VAV system with hot-water reheat. "B" wing classrooms have a package rooftop multi-zone system. Gym and kitchen are heat only. 1992 classrooms addition has individual rooftop units. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Raleigh Hills K-8: Library end is VRF with package rooftop air handlers condition the central office areas. A heat-only multi-zone system serves the gym, kitchen and cafeteria. The classrooms and library are conditioned by unit ventilators with steam heat. Controlled by a Direct Digital Control (DDC) system. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Raleigh Park: Central heating plant with hot water boiler. Classrooms and library conditioned by unit ventilators. Office conditioned by VAV system with hot-water reheat and a rooftop air handler. Controlled with a Direct Digital Control (DDC) "front end." Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Ridgewood: Central heating plant with hot water boiler. Classrooms are conditioned by unit ventilators. Library conditioned by packaged rooftop air handler. Offices have VRF with a DOAS providing ventilation. Controlled by a Direct Digital Control (DDC) "front end." Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Rock Creek: Air handlers in mechanical rooms and packaged rooftop units with VAV distribution. Full Direct Digital Control (DDC) control system.. Modular has individual heat-pumps for each room. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Sato: System far exceeds ASHRAE guidelines. They are specifically designed to run on 100% OSA. This school does not use demand control ventilation for energy savings. In extreme temperatures (>90 degrees, <30 degrees) fans that are running at 100% OSA are reduced to approximately 50%. Typically, a building blend is approximately 20% OSA for occupied and 5% for unoccupied. MERV 13 are not needed to filter the OSA, there is no re-circulation. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Scholls Heights: All classrooms are served by rooftop VAV systems with hot-water reheat. Hallways and common areas are well ventilated. System is functioning well with minimum comfort related issues. **Areas that will not be used for LIPI Phase 2 or hybrid learning: some storage spaces behind the library may have been converted to student use and need to be evaluated for intended use.**

Sexton Mountain: System consists of 40 individual package rooftop air handlers. The cafeteria/multi-purpose room and the gym have heat only systems. System is DDC controlled.

Classrooms all served by individual units; offices conditioned by multi-zone VVT systems. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Springville K-8: Newer facilities and constructed multi zone VAV systems consisting of packaged rooftop air handlers and Direct Digital Control (DDC). Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Terra Linda: All classrooms in the main building are served by rooftop VAV systems with hot-water reheat. Hallways and common areas are well ventilated. The modular classrooms each have a dedicated roof top unit. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Vose: System far exceeds ASHRAE guidelines. They are specifically designed to run on 100% OSA. This school does not use demand control ventilation for energy savings. In extreme temperatures (>90 degrees, <30 degrees) fans that are running at 100% OSA are reduced to approximately 50%. Typically, a building blend is approximately 20% OSA for occupied and 5% for unoccupied. MERV 13 are not needed to filter the OSA, there is no re-circulation. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

West Tualatin View: Classrooms are served by individual unit ventilators that supply adequate ventilation. **Each classroom will have a portable HEPA air cleaner for LIPI Phase 2 or hybrid learning. Areas that will not be used for LIPI Phase 2 or hybrid learning: the gym has sub-optimum airflow and is not usable in its current condition. The cafeteria has some OSA from a ceiling mounted ventilator at one end but does not adequately ventilate the space. The cafeteria should be limited to 30 students and staff.**

William Walker: System far exceeds ASHRAE guidelines. They are specifically designed to run on 100% OSA. This school does not use demand control ventilation for energy savings. In extreme temperatures (>90 degrees, <30 degrees) fans that are running at 100% OSA are reduced to approximately 50%. Typically, a building blend is approximately 20% OSA for occupied and 5% for unoccupied. MERV 13 are not needed to filter the OSA, there is no re-circulation. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

c. Middle Schools

Cedar Park: Central heating plant with two condensing boilers and an air-cooled chiller. Separate heating and cooling coils in all classroom unit ventilators. Split systems for small offices. Gyms have heating only gas packs on the roof. Cafeteria, kitchen, library, music room have air handlers with both heating and cooling water coils. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Conestoga: Newer facilities and constructed multi zone VAV systems consisting of packaged rooftop air handlers and Direct Digital Control (DDC). Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Five Oaks: Central heating and cooling plant, three hot water boilers: two condensing boilers and one steel boiler; and chilled water system: air cooled scroll chiller. Multi-zone air handlers with hot water and chilled water coils condition classrooms and office areas. Library and kitchen air handlers have heating and cooling coils. Gyms and locker rooms are heat only. Controlled

by a Direct Digital Control (DDC) “front end.” Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Highland Park: Central heating plant with two condensing boilers and one old firebox boiler. Cooling is supplied by a central plant chiller. Classrooms heated by hot water coils in unit ventilators with two pipe changeovers for cooling. Air handlers with hot water and chilled water coils serve the library (multi-zone), and cafeteria. Heat only air handlers serve the three gyms. Office conditioned by VAV system with hot-water reheat and rooftop air handlers. Controlled by a Direct Digital Control (DDC). Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Meadow Park: Central heating and cooling plant. Separate heating and cooling coils in classroom unit ventilators, library, kitchen, music, cafeteria. Gyms are gas heat only from rooftop units. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Mountain View: Multizone rooftop units with DX cooling. No central plant. Gyms are heating only and no mechanical cooling. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Stoller: Newer facilities and constructed multi zone VAV systems consisting of packaged rooftop air handlers and Direct Digital Control (DDC). Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Timberland (ACMA at 118th): Systems are essentially brand new and far exceed ASHRAE guidelines. Facilities have state of the art systems and already utilize MERV 13 filters. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Whitford: Central heating plant with three condensing boilers. Cooling is supplied by a central plant chiller. Classrooms are heated and cooled by a two pipe changeover system. Air handlers with hot water and chilled water coils supply the cafeteria, kitchen, library. Gyms are heating only and no mechanical cooling. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

d. High Schools

Aloha: Older systems with full central plant heating and cooling systems. Multizone air-handlers all have DDC control but individual thermostats are pneumatic. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. **Areas that will not be used for LIPI Phase 2 or hybrid learning: the old rifle range (pre-1980) below the auditorium.**

Beaverton: The main building, Merle Davies, the cafeteria, and the West Annex, has a collection of just about all HVAC technologies. Unit ventilators provide heat and direct exchange (DX, mechanical cooling) cooling to the east and west classrooms. Combination of multi-zone and single zone air handlers provide conditioned air to the large spaces and interior areas. The 2003 cafeteria addition added rooftop heat pumps with DX cooling and natural gas fired back-up heat, along with Direct Digital Control (DDC). The 2004 classroom infill project added individual rooftop units, natural gas fired heat, DX cooling, DDC controls. The 2017 upgrade to all eastern classroom univents and the Southeast classroom and library and media center received VRF with DOAS. How it performs: All classrooms and offices have adequate air quality and challenges typically are with comfort issues associated with the pneumatic controls system in the west end of the facility which creates issues moving from cooling to heating. **Areas that will not be used for LIPI Phase 2 or hybrid learning: the West Annex batting cage (with the doors closed) and music practice rooms.**

Mountainside: Systems are essentially brand new and far exceed ASHRAE guidelines. Facilities have state of the art systems and already utilize MERV 13 filters. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Southridge: Newer facilities and constructed multi zone VAV systems consisting of packaged rooftop air handlers and Direct Digital Control (DDC). Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Sunset: Old building that has had many upgrades and remodels. Combination of steam, hot water and rooftop gas packs. About 1/3 of the building is still in pneumatic control. About half of the classrooms do not have mechanical cooling systems. Gyms and the auditorium are not mechanically cooled. **Areas that will not be used for LIPI Phase 2 or hybrid learning: area below the auditorium (old rifle range (pre-1980)/costume storage).**

Westview: Newer facilities and constructed multi zone VAV systems consisting of packaged rooftop air handlers and Direct Digital Control (DDC). Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

e. Option Programs

ACMA: The new building will exceed ventilation standards in both the performing arts center and the main building. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

BASE (Capital Center): Rooftop VAV systems with older DDC controls. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

International School of Beaverton: Rooftop VAV systems with hot-water reheat. Modular is individual rooftop heat pumps. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Merlo Campus Community School: Newer facilities and constructed multi zone VAV systems consisting of packaged rooftop air handlers and Direct Digital Control (DDC). Recent HVAC replacement. Portables being used specifically as a classroom need to be identified and evaluated to confirm OSA blend. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Terra Nova Science and Sustainability: The building has mechanical ventilation but it does not have a central control system (no DDC). Scheduling is done with two paragon timers. The Rooftop unit over the office area is controlled by Honeywell programmable 7350 thermostat. Office has acceptable ventilation. Furnace downstairs that supplies the cafeteria is also controlled by a programmable thermostat. The five classrooms have electric heat unit ventilators that are turned off and on by timer. These have some OSA but have not been balanced. One of these units is down waiting for a motor. **Areas that will not be used for LIPI Phase 2 or hybrid learning: gymnasium, all indoor spaces, other than the office, until occupancy and OSA can be verified.**

f. Support Facilities

Administration Center: All offices are safe for normal use. Meetings of more than two should be moved into conference rooms instead of offices and social distancing should be followed. Establish a minimum of 35 square feet per person when determining room capacity. The IT server room should be limited to two occupants or they should open the outside door.

Maintenance/Custodial: Offices have ventilation. Warehouse spaces do not have outside ventilation. Outside doors should be open when working in an area for more than 15 minutes. Establish a minimum of 35 square feet per person when determining room capacity. **Include a portable HEPA air cleaner in the office containing more than one individual.**

BHS Student Health Clinic (Virginia Garcia): This section of the West Annex has adequate ventilation. Establish a minimum of 35 square feet per person when determining room capacity. This area requires MERV 13 filters for *normal* operation.

Aloha Office/Autism Annex/SPED:

Main: This building is served by three residential type furnaces with split heat pumps on the roof. There is good air flow but no way to verify the level of OSA exchange. Okay for current light usage. Recommended that they keep the restroom exhaust fan running 24/7. Establish a minimum of 35 square feet per person when determining room capacity. **The filters will be upgraded to MERV13 and four supplemental portable HEPA air cleaners with one in each general space.**

Modular: This space is served by a single home gas furnace with a split A/C outside. Good air flow but limited OSA exchange. Establish a minimum of 35 square feet per person when determining room capacity. **The filter in this modular will be upgraded to a MERV 13 and one portable HEPA air cleaner will be placed in the center of the space.**

Portable: the HVAC unit is not working properly. **The portable will only be used for storage until it has been repaired.**

Transportation (5th Street North): All offices and the warehouse are safe for normal use. The driver lounges should be limited in use. Establish a minimum of 35 square feet per person when determining room capacity.

Transportation (5th Street South): Individual offices are safe for normal use. Meetings should be avoided or held in large open areas. Establish a minimum of 35 square feet per person when determining room capacity.

Transportation (Allen Street): Shop spaces should have doors partially open when possible. Upstairs lounge area should be limited to five (5) occupants until OSA setting can be verified.

Transportation Support Center/Warehouse/Mailroom: This building has good ventilation. The driver's lounge should be limited to 1/3 normal occupancy. Offices should not be used as meeting rooms.

Multilingual (Capital Center): This area is Rooftop VAV with full DDC. Establish a minimum of 35 square feet per person when determining room capacity. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Nutrition Services (Capital Center): This area is Rooftop VAV with full DDC. Establish a minimum of 35 square feet per person when determining room capacity. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Transitions/ACE (Capital Center): This area is Rooftop VAV with full DDC. Establish a minimum of 35 square feet per person when determining room capacity. Areas that will not be used for LIPI Phase 2 or hybrid learning: none.

Help Outreach (Angel Street): This space is leased space and supplied by a residential HVAC system but there is no way to verify the level of OSA exchange. **Maintenance will need to confirm occupancy and may supply a portable HEPA air cleaner.**

6. Standard Operating Procedures in the Event of HVAC System Maintenance or Failure

- a. Notification by control network or notification from the school (e.g. report from a custodian, teacher, other staff)
- b. Maintenance front office or HVAC tech is notified
- c. Maintenance Administrator and Chief Facilities Officer notified
- d. Assessment made ASAP and determination made on next steps (move students to another location, add equipment, restrict use of areas, or transition to CDL)
- e. Communication with Building Administrator on status and next steps

7. Frequently Asked Questions (FAQ)

I hear our schools have poor ventilation.

Many school districts across the country have a large number of pre-1960 buildings that have not received ventilation upgrades. BSD was formed in 1960 and the majority of the district's buildings have been built since that time and building codes required mechanical ventilation. The district does have older buildings that received equipment upgrades and remodels throughout the years. Some areas of the district do not have mechanical air conditioning and have aging systems that break down, but the mechanical ventilation is reliable.

I am in a space with no operable windows and no visible HVAC unit. How does my classroom get outside air ventilation?

The HVAC unit serving your space has an outside air damper that exchanges building air with OSA. The air grills that provide heating also provide the ventilation in most classrooms. These grills can be hard to identify. They are often slotted diffusers that are only inches wide and run four feet or more.

My classroom is too hot or too cold, does that mean that my room is also not getting the required ventilation?

Temperature swings will occur when there is large amounts of ventilation occurring. How an HVAC system responds during peak temperatures, cold or hot, is to reduce the amount of air that is being brought in that would need to be either heated or cooled. In response to COVID-19 the district disabled these features and have been introducing more OSA. There will be times where the systems are providing safe, clean, and quality air but it may not be comfortable during peak temperatures.

Should I feel the air moving in my room?

Air movement should feel barely detectable at desk level. You are more likely to hear air movement in diffusers than to feel it. The systems use high-velocity air deflectors to cause large slow currents throughout the classroom.

Can the coronavirus travel through the HVAC unit from one classroom to another?

This is very unlikely for a couple of reasons. Many of the district's classrooms are supplied by individual units or are in discrete zones for temperature control. These zones do not readily mix or share air flow. For the district's larger air handlers that handle common areas in a building, the number of filters in the pathway and the length of the ducting, along with the mixing of OSA, dilute the concentration of a virus as it makes its way from an air intake, through the system, and back down a duct to a space.

If my classroom has operable windows should I open them?

Most operable windows are in classrooms that used to only have steam radiators and relied on windows for ventilation. Opening windows is okay but you may actually reduce the ventilation rate by upsetting the air balance in the system.

I am in a small space that was created for me. Is this space safe without a window?

There are some spaces in the district that were created without permits that may not have proper ventilation. However, most of these spaces were updated through building wide HVAC upgrades. Contact the Maintenance front office at (503) 356-4450 to verify your space is appropriate for occupancy.

How much outside air is brought into my classroom? How was this verified?

All district HVAC systems are designed to meet the ASHRAE 62.1 ventilation standards. This means the systems are designed to provide each student with approximately 15 cubic feet of fresh air per minute (CFM). This is calculated by a mechanical engineer based on the maximum occupancy rating for the classroom and the size of the space using, currently, Section 403.3.1.1, Table 403.3.1.1 Minimum Ventilation Rates of the 2019 Oregon Mechanical Specialty Code for Mechanical Ventilation. After the contractor finished installing the equipment a “test and balance” technician balanced and verified that each grill and damper was set as designed. These records are in the archives with the blueprints and BSD Maintenance runs air balancing reports to confirm the district’s systems are operating as designed.

My building is more than fifty years old and I often have complaints about heating and cooling.

This is often where Maintenance hears the most complaints but there is a difference between comfort and quality when it comes to air flow. Ventilation is the moving of air into a space. Conditioning is the mixing of that air to make it comfortable. Ventilation is more reliable than some of the district’s heating and cooling sections. All classrooms and offices have safe and adequate air flow. Older systems also have less fine control and do not vary the amount of heating or cooling widely. They are set to a specific temperature range that is managed by a thermostat but unlike a home furnace the district fans keep running to bring in Outside Air (OSA) that can be outside that range and it just takes time for that system to respond.

What should I do if I believe my HVAC is not working?

Notify your custodian and they will check to ensure your unit is running. If not, they will put in a work order for investigation and repairs (as needed).

What does VAV mean?

VAV stands for Variable Air Volume. In its simplest form, VAV systems use varying air flow at a constant temperature to heat and cool buildings. This is opposite of a Constant Air Volume (CAV) system, which supplies consistent air flow at varying temperatures to heat or cool a space. Most district VAV boxes also have a reheat coil to maintain individual heating setpoints. These large air-handlers have air measurement systems that ensure that the needed ventilation is supplied regardless of fan speed.

What does DCV mean?

DCV stands for Demand Control Ventilation. This is an energy saving strategy that matches ventilation rates to actual occupancy in a space. This is usually done by measuring CO2 levels in a system.

What does DOAS mean?

DOAS stands for Dedicated Outside Air System. This system supplies 100% tempered outside air to each classroom separate from the heating and cooling system.

Glossary of Acronyms

ACH	Air Changes per Hour
ASHRAE	The American Society of Heating, Refrigerating, and Air-Conditioning Engineers
CDC	The Centers for Disease Control and Prevention
CFM	Cubic Feet of Fresh Air per Minute
DCV	Demand Controlled Ventilation
DDC	Direct Digital Control
DOAS	Dedicated Outside Air System
HEPA	High Efficiency Particulate Air
HVAC	Heating, Ventilation, and Air Conditioning
LIPI	Limited In-Person Instruction
MERV	Minimum Efficiency Reporting Value
ODE	The Oregon Department of Education
OHA	The Oregon Health Authority
OSA	Outside Air
VAV	Variable Air Volume
VRF	Variable Refrigerant Flow
VVT	Variable Volume & Temperature