Scranton School District
Ventilation Systems Assessment DRAFT report

February 25, 2021

Executive Summary

The Scranton School District (SSD) is currently in the early planning stages of a Facilities Improvement Plan that is focused on prioritizing, budgeting, and implementing Capital Improvements to address the District's aging facilities and replace infrastructure that is at the end of its life cycle.

The district recognizes that current COVID-19 guidelines provide additional facilities challenges including cleaning, sanitizing, social distancing, and other parameters that are required to be implemented in accordance with safe health practices. One area that is especially important to buildings is air quality, and in particular, fresh air to reduce the potential for COVID-19 transmission.

The SSD commissioned Greenman-Pedersen, Inc (GPI) to focus on potential building recommendations to address current COVID-19 guidelines from the CDC and ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers). To complete our preliminary assessment, GPI has issued a draft report that begins to provide recommendations for improving building HVAC system performance, and therefore, helping reduce the spread of COVID-19.

Our initial findings show there is nothing in the district that would preclude the buildings from being occupied. We do however suggest that, although natural ventilation is a valid means of compliance for ventilation, the district avoid occupancy of classroom spaces that have no current means of mechanical ventilation.

The purpose of the draft report is to help the district's team perform an assessment of the HVAC systems and provide recommendations to improve the ventilation systems in the buildings.

We are currently working with the SSD Facilities Department and Scranton Electric Heating and Cooling as they verify operations of the HVAC systems at each building as follows:

1. Identify any areas where mechanical ventilation is not functioning as designed or is not available.
2. Perform repairs where feasible and or identify temporary measures until repairs are implemented.
3. Determine where MERV-13 filtration is feasible.
4. Assess a long-term solution to incorporate bipolar ionization where MERV-13 filtration is not feasible.
5. After the above is complete, consider measurement and verification of the systems to verify that the mechanical ventilation is operating as originally intended.

Once the above information is determined we will work with the district to issue a final report and recommendation.

VENTILATION SYSTEMS ASSESSMENT REPORT

PREPARED FOR

SCRANTON SCHOOL DISTRICT
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Submission	Date	Approval Report Author	Pages Revised
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1.0 Executive Summary

GPI was hired by Scranton School District (SSD) to assess the existing ventilation systems for each school building in the district and the Administration Building. A walkthrough of each building (19 total) was conducted to visually assess the age and condition of the ventilation systems, as well as to receive input from district maintenance personnel on known operational issues. Destructive testing, capacity verification, and measurements of systems' actual performance were not included in the assessment.

GPI has identified has developed a set of four general recommendations that apply to almost every building and they are described in section 2.4 of the report. Each building also has specific recommendations that are detailed in the section of the report dealing with that building. All recommendations have been designated as high, medium or low priority as follows:

- High Priority: Items requiring immediate action to make systems operational and restore ventilation functions originally designed into the systems
- Medium Priority: Items implementing current ASHRAE and CDC guidance for improving HVAC systems performance in reducing the spread of COVID-19.
- Low Priority: Items that will allow for the gathering of information that may inform future recommendations for system adjustments or upgrades.

Table 1 below summarizes the findings and recommendations of this report along with an order of magnitude cost estimate for implementing the various recommendations.

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BUILDING	Report Section	General Recommendations (Section 2.4)				Other Recommendations (Sections 3 to 21)			Order of Magnitude Cost (1,000's)			
		1 - Maintain HVAC systems' functionality and cleanliness	2 - Perform systems flush-out	3 - Open operable windows whenever practical	4 - Verify ventilation airflow rates	Upgrade filters	Add portable air purifiers	Other building specific	High Priority	Medium Priority	Low Priority	Total
Administration	3.0			X				X	$385.0	$0.0	$0.0	$385.0
Charles Sumner Elementary	4.0	X	X	X	X	X	X	X	$17.0	$59.6	$2.1	$78.7
Electric City Academy / Monticello	5.0	X	X		X	X			$0.0	$0.6	$3.6	$4.2
Frances Willard Elementary	6.0	X	X	X	X			X	$13.6	$0.0	$2.8	$16.4
George Bancroft Elementary	7.0	X	X	X	X		X	X	$21.7	$70.0	$1.4	$93.1
Isaac Tripp Elementary	8.0	X	X	X	X	X			$0.0	$1.6	$11.2	$12.8
John Adams Elementary	9.0	X	X	X	X				$77.0	$0.0	$2.4	$79.4
John F. Kennedy Elementary	10.0	X	X	X	X	X	X		$0.0	$73.7	$5.0	$78.7
John G. Whittier Annex	11.0			X			X	X	$420.0	$63.0	$0.0	$483.0
John G. Whittier Elementary	12.0	X	X	X	X	X			$0.0	$0.8	$5.1	$5.9
McNichols Educational Plaza	13.0	X	X		X	X			$0.0	$0.8	$6.0	$6.8
Neil Armstrong Elementary	14.0	X	X	X		X	X		$0.0	$122.6	$0.0	$122.6
Northeast Scranton Intermediate	15.0	X	X	X	X		X	X	$300.2	$0.0	$8.3	$308.5
Robert Morris Elementary	16.0	X	X	X	X	X	X	X	$31.6	$80.6	$2.7	$114.9
Scranton High	17.0	X	X	X	X	X	X	X	$0.8	$209.6	$35.2	$245.6
South Scranton Intermediate	18.0	X	X	X	X			X	$18.4	$0.0	$35.5	$53.9
West Scranton High	19.0	X	X	X	X			X	$133.9	$0.0	$15.3	$149.2
West Scranton Intermediate	20.0	X	X		X	X		X	$0.6	$2.7	$20.9	$24.2
William Prescott Elementary	21.0	X	X	X	X	X	X	X	$42.6	$59.6	$1.7	$103.9
TOTAL									$1,462.4	$745.2	$159.2	$2,366.8

2.0 General

In response to the COVID-19 pandemic, the Scranton School District (SSD) tasked GPI with assessing the existing ventilation systems in each building in the District. A walkthrough of each building (nineteen total) was conducted to visually assess the type, age and overall condition of the ventilation systems, as well as to receive input from District maintenance personnel about known operational issues. Destructive testing, thermal capacity verification, and measurements of systems' actual ventilation performance were not included as part of this effort.

This assessment is a broad overview of the ventilation systems present in the District's facilities and focuses mainly on classrooms and other instructional spaces. The study also includes other types of spaces needed for a functioning school such as administrative spaces, gymnasiums and cafeterias. However, an exhaustive review of every space where students or staff may be present in every building was not performed.

2.1 Published COVID-19 Guidelines and Recommendations

GPI's analysis and recommendations are based largely on the guidance published by AHSRAE concerning the reopening of schools and universities during the COVID-19 pandemic (www.ashrae.org/technical-resources/reopening-of-schools-and-universities). The underlying priorities of these recommendations are to maintain or increase the amount of outdoor ventilation air delivered to occupied spaces (dilution), and to treat recirculated air (filtration). ASHRAE recommends that, if possible, filters with a rating of MERV 13 or higher be used in all HVAC systems that recirculate air in a school building. GPI recommends that MERV 14 or 14A be used. In addition GPI reviewed the information published by the U.S. Centers for Disease Control related to operating schools during the COVID pandemic (www.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/schools.html).

It is important to remember that no ventilation system can prevent the spread of disease. According to health officials the most effective methods to limit the spread of COVID-19, short of complete isolation of an infected person, are good personal hygiene, cleaning and disinfecting communal surfaces, the use of face coverings and social distancing. The guidelines related to ventilation systems are only intended to be applied in addition to the above measures.

2.2 Ventilation Codes and Standards

The required minimum ventilation rate in an occupied building is governed by the Mechanical Code that was in force at the time the building was permitted for construction. These requirements have changed over time and ventilation rates incorporated in a particular system design may be more or less than what is required by the current code. For example, during the 1930's the design ventilation rate for a classroom was 2.0 CFM per square foot which is much higher than current requirements. The codes do not require that the ventilation rates in existing buildings be adjusted to meet current codes.

The code currently enforced in Pennsylvania is the 2015 version of the International Mechanical Code (IMC) which references ASHRAE Standard 62.1-2013 "Ventilation for Acceptable Indoor Air Quality." A summary of required ventilation rates for selected occupancy types found in a school building is included in Table 2. These values reflect the amount of outdoor air in cubic feet per minute (CFM) that is required to be delivered to the breathing zone of each space. For example, a 900 square foot general classroom with 30 students and 1 teacher requires 0.12 CFM per square foot of floor area plus 10 CFM per person, a total of 418 CFM (0.12 X 900 + 10 X 31) of outdoor air delivered to the breathing zone of the classroom. The

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Code further modifies the required ventilation rates by the way air is delivered to and exhausted from the spaces, as well as by the type of ventilation system used.

Table 2 – Minimum Ventilation Rates for Selected Spaces per IMC Table 403.3.1.1

OCCUPANCY CLASSIFICATION	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, CFM/SQUARE FOOT	EXHAUST AIRFLOW RATE, CFM
Cafeteria	7.5	0.18	
Classroom, Art	10	0.18	0.7 / square foot
Classroom, General	10	0.12	
Corridor		0.06	
Gymnasium		0.30	
Locker/dressing Room			0.25 / square foot
Multipurpose	7.5	0.06	
Office	5	0.06	
Reception	5	0.06	
Science Laboratory	10	0.18	1.0 / square foot
Toilet Room			50 / water closet, urinal

2.3 Types of Ventilation Systems Present District Buildings

There are generally three types of ventilation systems utilized in the existing facilities operated by the SSD. Most buildings in the District are equipped with some type of mechanical ventilation system that uses fans or blowers to supply ventilation air into occupied spaces. A few buildings, however, contain no mechanical ventilation system and rely on ventilation provided through operable windows. This type of "natural" ventilation is allowed by the IMC within prescribed parameters involving the availability of operable windows (or other openings) in the occupied spaces that must be opened whenever the space is occupied. This type of system is not practical in a temperate climate like northeast Pennsylvania's because it will likely result in uncomfortable space temperatures during very hot or cold weather.

District buildings with no mechanical ventilation systems, other than exhaust systems, include the Administration Building and the Whittier Annex (2 buildings).

Central Forced Ventilation Systems

This type of system is present in buildings built before 1940, and the typical arrangement is shown in Figure 2A. A large central fan (or fans) located in the lowest level of the building circulates 100 percent outdoor air from an outdoor air intake (usually at the roof level) through filters and a heating coil and delivers this air to each classroom via a system of metal ductwork or passages integrated into the building's masonry construction. Excess air is exhausted from each classroom to a roof mounted outlet via metal ducts or passages. The exhaust system may or may not include a fan. This type of system does not include the ability to cool the outdoor air during warm weather and is usually configured to deliver the ventilation air to the classrooms at or slightly above the desired space temperature. This is very similar to a modern dedicated outdoor air system (DOAS) which additionally includes cooling capabilities.

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District buildings that have this type of system include West Scranton High School, Northeast and South Scranton Intermediate Schools, and Adams and Willard Elementary Schools (5 buildings).

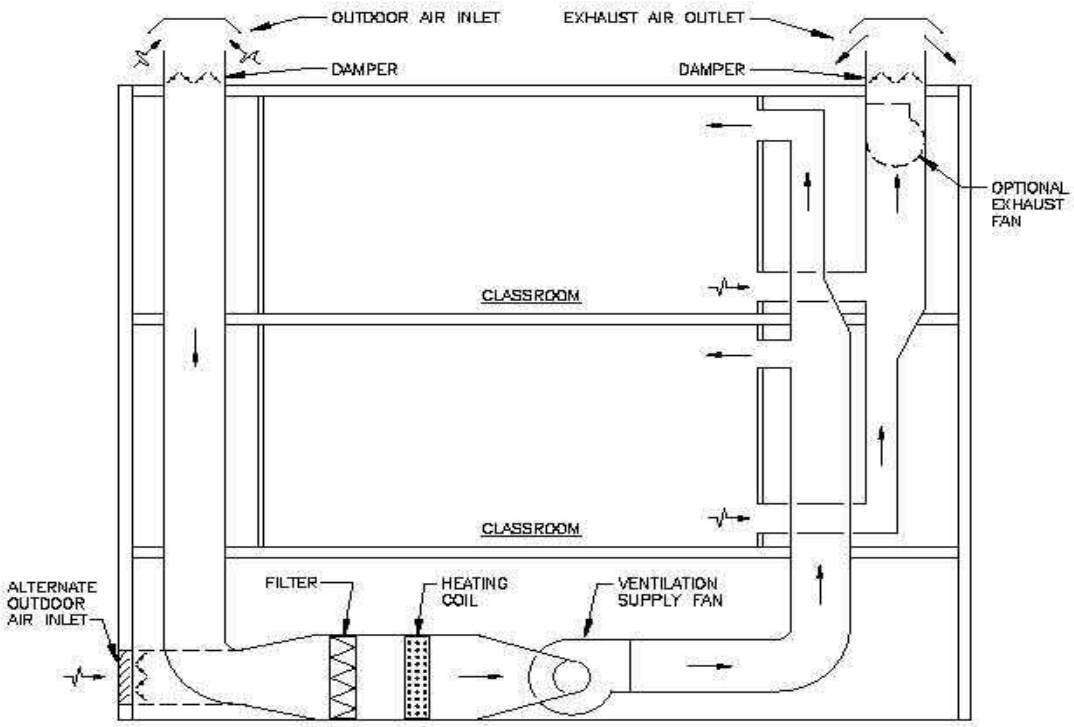

Figure 2A – Schematic Diagram of Central Forced Ventilation System

From a ventilation perspective, these systems typically deliver a large quantity of outdoor ventilation air directly to each space at a flow rate much higher than current codes and standards require. However, no information is available as to the air quantities intended for these systems installed in the District. The downside of this type of system is that the higher ventilation rates result in higher energy consumption and cost during the heating season. Filtration, although required to maintain system cleanliness, is not as critical because this type of system does not recirculate air between spaces in the building.

Unit Ventilators (Unitary Single Zone System)

This type of system has been utilized in school buildings for many years. A typical arrangement of this system is shown in Figure 2B. The system consists of a space-mounted unit, typically in a floor-mounted cabinet located next to an exterior wall. The basic unit ventilator includes a blower, a heating coil, a return air grille inside the space, an outdoor air inlet and grille through the exterior wall, and a filter. The unit supplies air to the space directly through a top discharge grille and the air can be a mixture of outdoor air and return air, or all outdoor air depending on the outdoor temperature and whether heating or cooling is needed in the space. Heat can be provided from hot water, electric resistance or through a direct-expansion heat pump, and the unit can also include the ability to cool the supply air with the same coil or a

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separate coil using chilled water or a direct-expansion heat pump. Excess air is exhausted from each classroom to a roof mounted exhaust outlet via sheet metal ducts. The exhaust system may or may not include a fan. The control of the heating (and cooling when equipped) is via a wall-mounted or unit-mounted thermostat.

District buildings that have this type of system include Scranton High School, and Armstrong, Bancroft, Kennedy, Morris, Prescott and Sumner Elementary Schools (7 buildings).

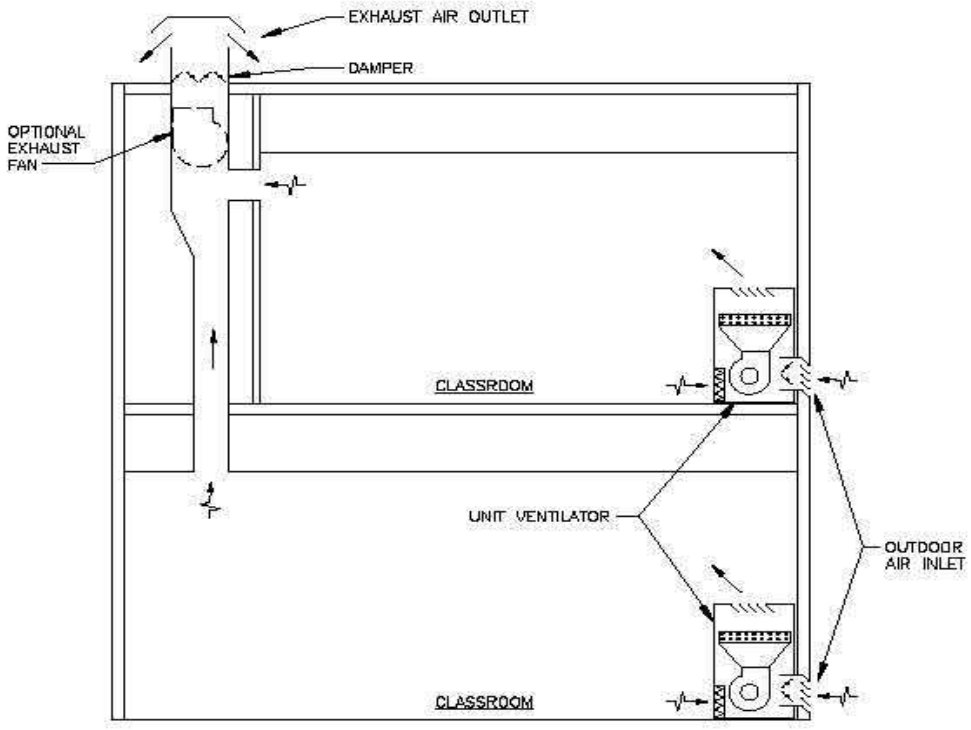

Figure 2B – Schematic Diagram of Unit Ventilator System

From a ventilation perspective, these systems typically can deliver the Code-required outdoor ventilation air directly to each space and will increase the delivery rate under certain conditions. The ability to apply enhanced filtration to these systems is not possible because the filter racks cannot accommodate the thickness or pressure drop requirements of the enhanced filters.

Central HVAC Systems

This type of system is typical in newer school buildings (late 1970's and beyond). There are two basic types, variable air volume (VAV) and constant air volume (CAV). Both types are shown in Figure 2C. These systems consist of large central air handling unit that filters, cools and heats a mixture of outdoor air and return air and supply it to multiple spaces. The temperature of each space is maintained by a terminal unit controlled by a wall-mounted thermostat. In a CAV system the airflow to each space remains constant and

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the space temperature is controlled by varying the temperature of the air supplied to each space. In a VAV system the supply air temperature is held relatively constant and the space temperature is controlled by varying the amount of air supplied to each space. Air from each classroom returns to the air handling unit via sheet metal ducts and this may include a return fan. Excess air (also called relief air) is exhausted at the air handling unit. The air handling units can be either roof-mounted or located in indoors.

District buildings that have this type of system include Scranton High School, West Scranton Intermediate School, Kennedy, McNichols, Tripp and Whittier Elementary Schools, and Electric City Academy (7 buildings).

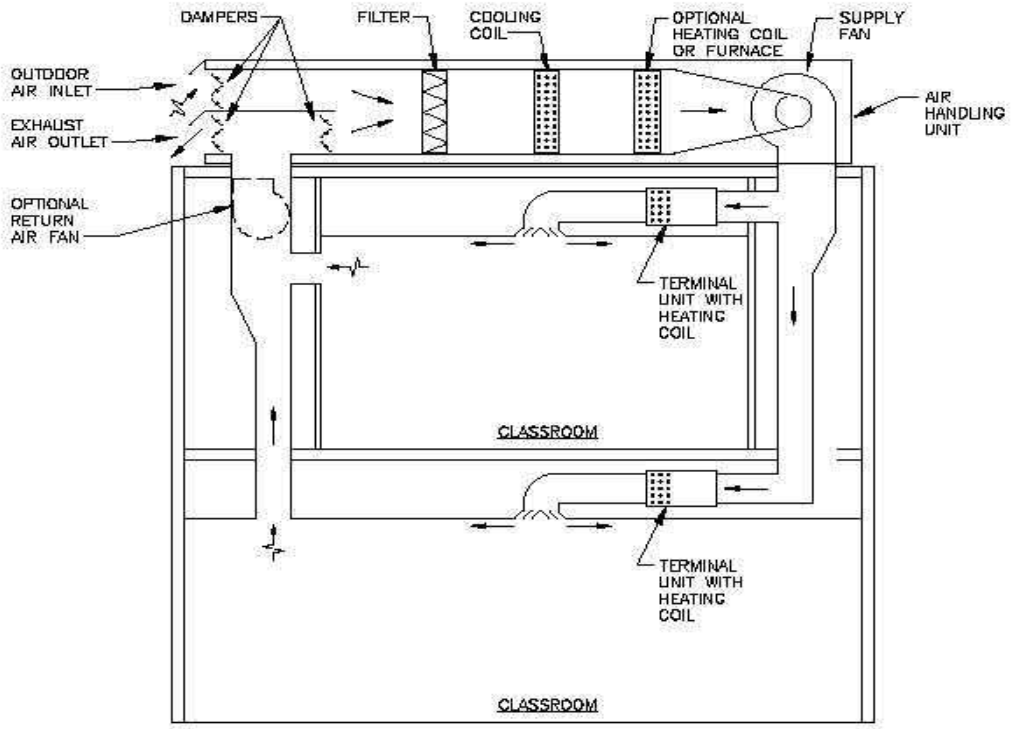

Figure 2C – Schematic Diagram of Central HVAC Systems

From a ventilation perspective, these systems have been designed to deliver the Code-required outdoor ventilation air to each space and will increase the delivery rate under certain conditions. The ability to apply high-efficiency filters to these systems is more likely, but this needs to be reviewed in detail for each air handling unit.

2.4 Recommendations

The specific recommendations presented in the report sections for each building, along with the general recommendations applicable to most buildings listed in this section, have been designated as high, medium or low priority as follows:

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- High Priority: Items requiring immediate action to make systems operational and restore ventilation functions originally designed into the systems
- Medium Priority: Items implementing current ASHRAE and CDC guidance for improving HVAC systems performance in reducing the spread of COVID-19. However, due to the evolving nature of the pandemic and the high cost and/or long lead time of these options, the decision to implement them needs to be considered by the District.
- Low Priority: Items that will allow for the gathering of information that may inform future recommendations for system adjustments or upgrades.

The following are general recommendations should be applied throughout all SSD facilities as applicable:

1. Maintain HVAC Systems' Functionality and Cleanliness (High Priority): Attention should be given to inspecting systems regularly and acting quickly to correct system and equipment malfunctions. Also, teachers and staff should be informed about the intended function of the ventilation system and should be encouraged to report any problems and to not inhibit the operation of the systems by blocking supply outlets or exhaust/return air inlets in an attempt to solve comfort issues in their classrooms. Particular attention should be given to monitoring filters and replacing them when they are dirty to maintain proper system airflows. Where the interiors of air handling equipment, fan plenums and ductwork are readily accessible, surfaces should be vacuumed and wiped down to remove any dirt/dust buildup. Rooms used as air plenums should never be used as storage space. The order of magnitude cost of implementing this recommendation is not detailed in this report, but should already be included in the District's operating budget.

2. Perform System Flush-out (High Priority): Operate HVAC systems in full occupied mode (ie. with ventilation) whenever any staff is present in the buildings. Prior to the beginning of full student occupancy operate HVAC systems for 24 hours in full occupied mode. After full occupancy begins, operate HVAC systems in full occupied mode for two hours before and two hours after students are in the building each day. All of the above increase the ventilation of the building and flush out infective virus particles. Additional operation time will result in increased operating costs. Note that there will be an increase in energy costs associated with implementing this recommendation, but we have not estimated or included it in this report.

3. Open Operable Windows Whenever Practical (High Priority): Most of the occupied classrooms and other occupied spaces in the District's buildings are equipped with operable windows. Teachers and staff should be encouraged to open the windows whenever security and safety concerns allow and it does not result in discomfort to the occupants. Additional airflow into or out of each space will increase the dilution effect and reduce the concentration of viable virus particles. There is only a marginal cost of implementing this recommendation related to training of staff and their minimal time spent implementing it.

4. Verify Ventilation Rates (Low Priority): Initiate a program of verifying ventilation rates, including:
   - ✓ Hiring a test and balance (TAB) contractor to measure ventilation system airflows and building pressurization;
   - ✓ Evaluate the existing airflow and ventilation rates relative to the current IMC requirements;
   - ✓ Make adjustments, improvements and upgrades as necessary to bring all facilities to current minimum Code standards.

   The cost for this (measurement only) is included for each building, where applicable, in the report sections for each building.

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3.0 Administration Building

This facility was built in 1911 as a school building and consists of four stories. The building includes approximately 38,000 gross square feet and serves as administrative office space for the District. It is not known when the building was converted for use as an office building.

3.1 Existing Ventilation & Exhaust Systems

There is no mechanical ventilation system serving this building. There are five gravity ventilators on the roof and corresponding enlarged walls lined up on all floors indicating that a gravity exhaust system was included in the original design of the building. However, there are only a few locations where exhaust grilles are visible. There are operable windows in many spaces.

Photo 3A – Front elevation of building

The toilet rooms located on all floors do not appear to have an active exhaust system. There is an exhaust fan serving the copy center in the basement.

3.2 Recommendations

In addition to general recommendation 3 listed in Section 2.4, GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

<u>High Priority:</u>

- Add ventilation system(s) and exhaust system(s) to serve all occupied spaces in the building. Estimated cost $375,000.
- Add exhaust systems for the toilet rooms. Estimated cost $10,000.

<u>Medium Priority</u>:

- None.

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Low Priority:

- None.

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4.0 Charles Sumner Elementary School

This facility was built in 1968 and consists of two stories. The building includes approximately 34,000 gross square feet and serves approximately 250 students in grades pre-K through 5.

4.1 Existing Ventilation & Exhaust Systems

Ventilation is provided to the classroom areas of the building using unit ventilators (Photo 4A) configured generally as described in Section 2.3. Heating is provided by hot water boilers and there is no cooling in this building. The unit ventilators are in generally poor condition due to their age (over 50 years), with extensive corrosion present. Outdoor air enters each room though the wall louver associated with each unit ventilator. Note that the inlet grille for rooms 001 through 003 on the first floor were sealed with a piece of sheet metal on the outside of the building (Photo 4B).

It is not clear how exhaust air is removed from each classroom. There are a number of grilles high on the corridor walls, so it is assumed that the exhaust air exfiltrates from each room into the corridors, into the grilles, then up to a duct system that terminates at one of three gravity relief hoods on the roof of the building.

Photo 4A – Classroom unit ventilator (Room 103)

Photo 4B – Ventilation air inlet grille blocked off (Room 001, typical of 3)

The multipurpose room on the first floor is heated and ventilated by a dedicated air handling unit located in the janitor's office on the first floor. The unit delivers a mixture of outdoor air (from an intake hood on the roof) and recirculated air to supply air grilles on the two longer walls of the room. Return air is taken from grilles located on the end walls and ducted back to the air handling unit. Exhaust air from this room appears to be through two exhaust fans mounted on the roof.

There are several occupied rooms that have no ventilation air supplied to them. This includes the three small speech therapy rooms that were carved out of the main corridor and the reading specialist's room at the end of the main corridor. The rooms near the main office (nurse, secretary, principal and teacher's lounge) have no source of ventilation air other than operable windows. Several of these rooms have exhaust grilles that appear to be connected via ducts to an exhaust fan on the roof.

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The toilet rooms located on both floors have ceiling mounted exhaust grilles connected to exhaust fans (2) located on the roof.

4.2 Recommendations

In addition to general recommendations 1 through 4 listed in Section 2.4, GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

High Priority:

- Add a ventilation system and exhaust system to serve the rooms on the first floor currently without mechanical ventilation and exhaust. Estimated cost $16,500.
- Remove sheet metal covers from outdoor intake louvers at room 001 through 003. Estimated cost $500.

Medium Priority:

- Add portable air cleaner for each classroom (15), the library and the secretary's area. Estimated cost $59,500.
- Upgrade filters to MERV 14 for the air handling unit serving the multipurpose room. Estimated cost $100.

Low Priority:

- Undertake a program of measurement and verification to determine the current ventilation systems' performance, compare the performance to the requirements of current codes and standards, and implement adjustments, repairs or upgrades as indicated. Estimated cost (measurement only) $2,100.

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5.0 Electric City Academy / Monticello

This leased facility was fit out for the District in 2016 and consists of three stories. The building includes approximately 30,000 gross square feet and serves approximately 150 special needs students in grades K through 12. This building does not have operable windows.

5.1 Existing Ventilation & Exhaust Systems

Ventilation is provided to all areas of the facility by central HVAC systems configured generally as described in Section 2.3. The majority of the building areas are heated and cooled by packaged outdoor units with direct expansion cooling and gas furnaces for heat. There are two grade-mounted units serving the first floor (Photo 5A), one grade-mounted and one roof-mounted unit serving the second floor, and two roof-mounted units serving the third floor (Photo 5B background). There are two additional interior units on the second floor with direct expansion cooling and gas furnaces for heat. These units have remote condensing units located on the roof (Photo 5B foreground). Because these systems were recently installed, it is assumed that they meet the current codes for ventilation. There are several toilet rooms located on each floor with ducted exhaust systems.

Photo 5A – Grade-mounted, packaged air handling units for first floor

Photo 5B – Roof-mounted air handling units for third floor and condensing units for second floor

5.2 Recommendations

In addition to general recommendations 1, 2 and 4 listed in Section 2.4, GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

<u>High Priority:</u>

- None.

<u>Medium Priority</u>

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- Upgrade filters to MERV 14 for the air handling units serving the facility. Estimated cost $600.

Low Priority:

- Undertake a program of measurement and verification to determine the current ventilation systems' performance, compare the performance to the requirements of current codes and standards, and implement adjustments, repairs or upgrades as indicated. Estimated cost (measurement only) $3,600.

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6.0 Frances Willard Elementary School

This facility was built in 1928 and consists of three stories. The building includes approximately 46,000 gross square feet and serves approximately 350 students in grades pre-K through 5.

6.1 Existing Ventilation & Exhaust Systems

Ventilation is provided to the classroom areas of the building using two central forced ventilation systems configured generally as described in Section 2.3. A pair of large central ventilation fans located in the basement (Photo 6A) supply fresh ventilation air to the classrooms located on all three floors. Each fan serves approximately half of the building. Outdoor air enters through a wall louver at the basement level and is filtered using pocket filters (MERV 8, Photo 6B). The air is heated by steam heating coils prior to entering each fan. The airstream surfaces of the system that could be seen were somewhat dirty and in need of cleaning. Also, there were some boxes and equipment being stored in the outdoor air plenum (Photo 6B).

Air is circulated to each classroom through horizontal ducts located in the basement and crawlspaces and then up through the masonry construction of the building. Air enters each room through a sidewall grille high on one of the walls. It is not known how much air is circulated by the system, or how much enters each classroom, but it is likely that the system is capable of supplying air at a higher rate than required by the current code. It is not known if balance dampers exist in the system that would allow for balancing airflows to each room.

Exhaust air is removed from each classroom through a grille mounted in the ceiling or wall inside of the classrooms' storage closets. The exhaust grille in room 211 was blocked off with cardboard. Exhaust air moves through duct risers up to the attic level and is collected in a duct system that terminates at one of seven gravity relief hoods located on the roof of the building.

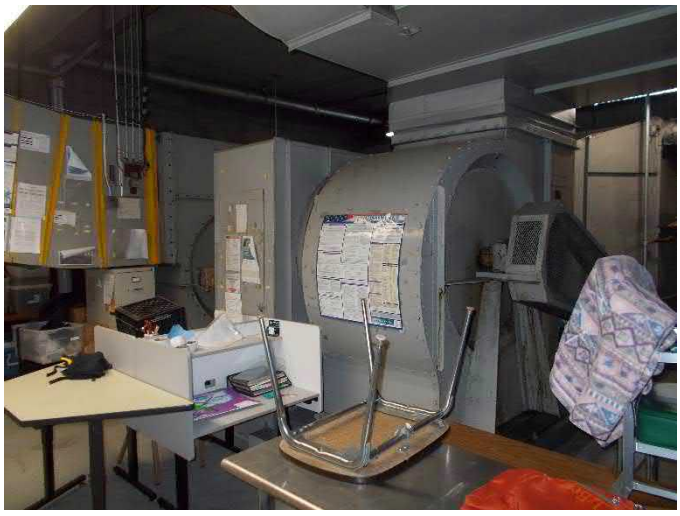

Photo 6A – Classroom ventilation air fans in the basement fan room

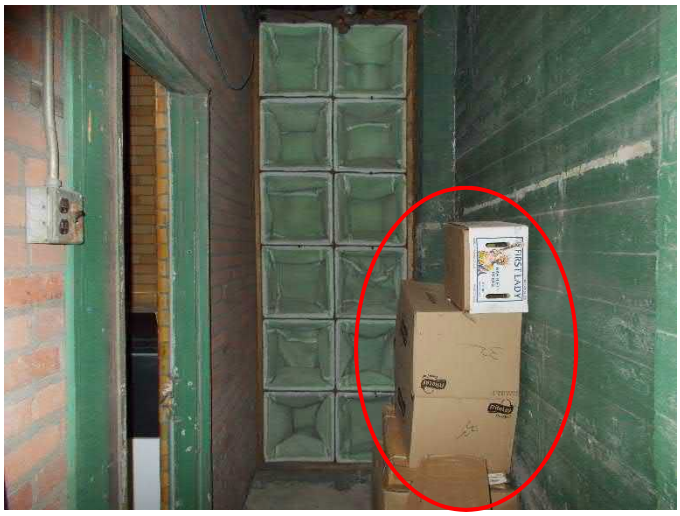

Photo 9B – Ventilation air filters viewed from outdoor air plenum

There is an additional ventilation fan that serves the multipurpose room in the basement. This fan draws air from the same outdoor air plenum used by the other fans and delivers the ventilation air to two sidewall

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grilles in the room. Exhaust air leaves via a single grill located low on the same wall and up to the attic and out through one of the gravity ventilators. The nurse's office in the basement is not ventilated. It should be connected to the ventilation and exhaust systems.

The toilet rooms located on all floors have wall-mounted exhaust grilles that allow air to pass into the pipe chase behind the bathroom fixtures. The intent is that this chase be exhausted, but the exhaust fans (3) located on the second floor (Photo 6C) do not appear to be functioning.

Photo 9C – Typical toilet chase exhaust fan

6.2 Recommendations

In addition to general recommendations 1 through 4 listed in Section 2.4, GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

High Priority:

- Add connections from classroom ventilation supply and exhaust systems to nurse's office in the basement. Estimated cost $4,600.
- Remove cardboard from exhaust air outlet in room 211. Estimated cost $100.
- Install new exhaust fans for toilet rooms. Estimated cost $8,900.

Medium Priority:

- None.

Low Priority:

- Undertake a program of measurement and verification to determine the current ventilation systems' performance, compare the performance to the requirements of current codes and standards, and implement adjustments, repairs or upgrades as indicated. Estimated cost (measurement only) $2,800.

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7.0 George Bancroft Elementary School

This facility was built in 1928 and consists of two stories and a partial basement. The building includes approximately 23,000 gross square feet and serves approximately 200 students in grades pre-K through 5.

7.1 Existing Ventilation & Exhaust Systems

Ventilation is provided to the classrooms and multipurpose room on the second floor using “uninvent” convection units (Photo 7A) configured similar to the unit ventilator system described in Section 2.3, except there is no fan or return air from the rooms to the unit. Heating is provided by steam boilers and there is no cooling in this building. Outdoor air enters each room though the wall louver associated with each convection unit.

Exhaust air is removed from each classroom through a grille mounted in the wall inside of the classrooms’ storage closet (red circle on Photo 7B). Exhaust air moves through duct risers up to the attic level and is collected in a duct system that terminates at one of five gravity relief hoods located on the roof. There are no fans in the system, so all airflow is generated through building stack effect, the tendency of air to move upward due to the buoyancy of warm indoor air relative to cooler outdoor air.

The secretary’s office and the principal’s office on the first floor, and rooms 211 and 212 (nurse) on the second floor have no source of outdoor air, but do have exhaust grilles mounted low on one wall.

Photo 7A – Classroom “univent” convector (Room 106)

Phot 7B – Room exhaust grille located in closet

The lunchroom in the basement has no ventilation air supply system or exhaust system. The toilet rooms located on both floors have no exhaust systems.

7.2 Recommendations

In addition to general recommendations 1 through 4 listed in Section 2.4, GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

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High Priority:

- Add a ventilation system and exhaust system to serve the lunchroom, and rooms on the first and second floors currently without mechanical ventilation and exhaust. Estimated cost $18,000.
- Remove cardboard covers from the exhaust grilles in rooms 104 and 105. Estimated cost $100.
- Add mechanical exhaust systems for the toilet rooms. Estimated cost $3,600.

Medium Priority:

- Add portable air cleaner for each classroom and the multipurpose room (20). Estimated cost $70,000.

Low Priority:

- Undertake a program of measurement and verification to determine the current ventilation systems' performance, compare the performance to the requirements of current codes and standards, and implement adjustments, repairs or upgrades as indicated. Estimated cost (measurement only) $1,400.

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8.0 Isaac Tripp Elementary School

This facility was built in 2011 and consists of three stories. The building includes approximately 93,000 gross square feet and serves approximately 650 students in grades pre-K through 5. It is the newest school building in the District.

8.1 Existing Ventilation & Exhaust Systems

Ventilation is provided to all areas of the facility by central HVAC systems configured generally as described in Section 2.3. All areas of the building are heated and cooled by packaged outdoor units with direct expansion cooling and gas furnaces for heat (Photo 8A).

There are nine variable air volume systems serving the classrooms, the administration area, and the library. All of these systems include energy recovery wheels (Photo 8B). There are four constant volume systems serving the gymnasium, the cafeteria and the kitchen. Because these systems were recently installed, it is assumed that they meet the current codes for ventilation. There are several toilet rooms located on each floor with ducted exhaust systems terminating a roof-mounted exhaust fans.

Photo 8A – Roof-mounted, packaged air handling units for classrooms

Photo 8B – Interior of roof-mounted air handling units showing energy recovery wheel and filters

8.2 Recommendations

In addition to general recommendations 1 through 4 listed in Section 2.4, GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

<u>High Priority:</u>

- None.

<u>Medium Priority</u>:

- Upgrade filters to MERV 14 for the air handling units serving the facility. Estimated cost $1,600.

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Low Priority:

- Undertake a program of measurement and verification to determine the current ventilation systems' performance, compare the performance to the requirements of current codes and standards, and implement adjustments, repairs or upgrades as indicated. Estimated cost (measurement only) $11,200.

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9.0 John Adams Elementary School

This facility was built in 1931 and consists of three stories. The building includes approximately 40,000 gross square feet and serves approximately 250 students in grades pre-K through 5.

9.1 Existing Ventilation & Exhaust Systems

Ventilation is provided to the classroom areas of the building using a central forced ventilation system configured generally as described in Section 2.3. A large central ventilation fan located in the basement supplies fresh ventilation air to the cafeteria in the basement, the gymnasium on the first floor, and the classrooms located on the first and second floors. Outdoor air enters through a wall louver at the basement level and is filtered using pleated box filters (MERV9), but the filters are the wrong size for the rear-loading filter rack frame (Photo 9A). The air is heated by vertical steam heating coil (Photo 9B) prior to entering the fan. The tubes in one section of the coil was previously damaged (most likely from freezing) and repaired. The airstream surfaces of the system that could be seen were somewhat dirty and in need of cleaning. Also, the flexible connector between the heating plenum and the fan (Photo 9C), and between the fan and the supply ductwork (Photo 9D) was torn and must be replaced.

Air is circulated to each classroom through ducts located above the corridor ceilings on each floor and supplied to a sidewall grille high on the wall opposite the windows. It is not known how much air is circulated by the system, or how much enters each classroom, but it is likely that the system is capable of supplying air at a higher rate than required by the current code. Balance dampers were present in the supply ductwork to each room.

Exhaust air from the classrooms is removed from each room through a grille mounted in the ceiling of the classrooms' storage closet. The exhaust grille in room 106 was covered with plastic (Photo 9E). Exhaust air moves through duct risers up to the attic level and is collected in a duct system that terminates at one of three gravity relief hoods located on the roof.

Photo 9A – Ventilation air filters in the basement fan room

Photo 9B – Steam heating coil with coil tubes repaired

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Photo 9C – Torn flexible connector at inlet to ventilation fan

Photo 9D – Torn flexible connector at outlet of ventilation fan

Photo 9E – Exhaust air outlet in room 106 closet

As described above the cafeteria in the basement (no kitchen) receives supply air from the classroom ventilation system, but the means of removing exhaust air could not be determined. There are several other occupied spaces in the basement that do not receive ventilation air, including the library, computer classroom, art classroom and teachers' lounge. If these spaces are intended for occupancy they should be connected to the ventilation and exhaust systems.

The toilet rooms located on floors one and two do not have exhaust grilles, but the plumbing chases behind each appear to be exhausted using roof-mounted exhaust fans. The system should be upgraded to directly exhaust air from the toilet rooms.

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9.2 Recommendations

In addition to general recommendations 1 through 4 listed in Section 2.4, GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

High Priority:

- Replace ventilation air filters with correct size or install new filter rack. Estimated cost $2,000.
- Replace the flexible connectors at inlet and outlet connections to ventilation fan. Estimated cost $1,000.
- Add connections from classroom ventilation supply and exhaust systems to occupied basement rooms including teachers' lounge, art classroom, computer classroom and library. Estimated cost $68,900.
- Remove plastic from exhaust air outlet in room 106. Estimated cost $100.
- Add direct exhaust systems for toilet rooms. Estimated cost $5,000.

Medium Priority:

- None.

Low Priority:

- Undertake a program of measurement and verification to determine the current ventilation systems' performance, compare the performance to the requirements of current codes and standards, and implement adjustments, repairs or upgrades as indicated. Estimated cost (measurement only) $2,400.

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10.0 John F. Kennedy Elementary School

This facility was built in 1964 and was renovated in 2008, including a substantial addition. The building consists of two stories, includes approximately 41,000 gross square feet and houses approximately 400 students in grades pre-K through 5.

10.1 Existing Ventilation & Exhaust Systems

Ventilation is provided to the classrooms of the building using unit ventilators configured generally as described in Section 2.3. Heating is provided by hot water boilers and the units have direct expansion cooling. Outdoor air enters each room though the wall louver associated with each unit ventilator. Exhaust air is removed from each classroom through a ceiling grille connected to ducts that terminate at one of seven gravity relief hoods on the roof of the building.

Ventilation is provided to the rest of the facility by central HVAC systems configured generally as described in Section 2.3. These areas are heated and cooled by packaged outdoor units with direct expansion cooling and gas furnaces for heat (Photo 12A). There are two variable air volume systems serving the administration area, the nurse's office and the small resource rooms on the first floor and in the basement. There are four constant volume systems serving the multipurpose room, the library, the computer lab and the kitchen. The unit serving the multipurpose room includes an energy recovery wheel (Photo 12B). Because these systems were installed relatively recently, it is assumed that they meet the current codes for ventilation. There are several toilet rooms located on each floor with ducted exhaust systems terminating at roof-mounted exhaust fans.

Photo 10A – Roof-mounted, packaged air handling units

Photo 10B – Interior of roof-mounted air handling unit (RTU-5) showing energy recovery wheel and filters

10.2 Recommendations

In addition to general recommendations 1 through 4 listed in Section 2.4, GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

High Priority:

- None

Medium Priority:

- Upgrade filters to MERV 14 for the air handling units serving the facility. Estimated cost $200.
- Add portable air cleaner for each classroom (21). Estimated cost $73,500.

Low Priority:

- Undertake a program of measurement and verification to determine the current ventilation systems' performance, compare the performance to the requirements of current codes and standards, and implement adjustments, repairs or upgrades as indicated. Estimated cost (measurement only) $5,000.

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11.0 John G. Whittier Annex

This leased facility has reportedly been used by the District since 2014 and consists of three stories. The building includes approximately 28,000 gross square feet and serves approximately 200 students in grades pre-K through 5.

11.1 Existing Ventilation & Exhaust Systems

There is no mechanical ventilation system serving this building, but all spaces have operable windows.

Photo 11A – Front elevation of building

Photo 11B – View of exhaust fans in multipurpose room

The toilet rooms located on the second and third floors appear to have an exhaust system, but it is not known if it is functional. There are two large propeller fans positioned at the rear of the multipurpose room on the first floor which, in conjunction with opening the operable windows, can serve to ventilate this space (Photo 11B).

11.2 Recommendations

In addition to general recommendation 3 listed in Section 2.4, GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

<u>High Priority:</u>

- Add ventilation system(s) and exhaust system(s) to serve all occupied spaces in the building. Estimated cost $420,000.
- Verify operation of exhaust systems for the toilet rooms and repair as needed. Estimated cost $2,000.

<u>Medium Priority</u>:

- Add portable air cleaner for each classroom (15), the library, the faculty lounge, and the administrative office. Estimated cost $63,000.

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Low Priority:

- None.

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12.0 John G. Whittier Elementary School

This facility was built in 2010 and consists of three stories. The building includes approximately 42,000 gross square feet and serves approximately 350 students in grades pre-K through 5.

12.1 Existing Ventilation & Exhaust Systems

Ventilation is provided to all areas of the facility by central HVAC systems configured generally as described in Section 2.3. All areas of the building are heated and cooled by packaged outdoor units with direct expansion cooling and gas furnaces for heat (Photo 12A).

There are three variable air volume systems serving the classrooms and the administrative office area. There are four constant volume systems serving the library, the multipurpose room and the kitchen. Two of these systems include energy recovery wheels. Because these systems were recently installed, it is assumed that they meet the current codes for ventilation. There are several toilet rooms located on each floor with ducted exhaust systems terminating a roof-mounted exhaust fans.

Photo 12A – Roof-mounted, packaged air handling units for classrooms

Photo 12B – Interior of typical classroom

12.2 Recommendations

In addition to general recommendations 1 through 4 listed in Section 2.4, GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

<u>High Priority:</u>

- None.

<u>Medium Priority</u>:

- Upgrade filters to MERV 14 for the air handling units serving the facility. Estimated cost $800.

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Low Priority:

- Undertake a program of measurement and verification to determine the current ventilation systems' performance, compare the performance to the requirements of current codes and standards, and implement adjustments, repairs or upgrades as indicated. Estimated cost (measurement only) $5,100.

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13.0 McNichols Educational Plaza

This facility was built in 1977 and consists of approximately 50,000 gross square feet on a single story. It houses approximately 350 students in grades pre-K through 5. This building does not have operable windows.

13.1 Existing Ventilation & Exhaust Systems

Ventilation is provided to all areas of the facility by central HVAC systems configured generally as described in Section 2.3. All areas of the building are heated and cooled by indoor air handling units with chilled water cooling and hot water heat. All systems are of the constant volume type.

Four of the systems are configured as multizone systems and serve the majority of the building areas, including the classrooms. There are four smaller single zone systems that serve the library and the multipurpose room (two systems to each space). All of the systems have outdoor air cabailities, but it is not known if the systems meet current codes concerning ventilation rates. There are several toilet rooms located on each floor with ducted exhaust systems terminating a roof-mounted exhaust fans.

Photo 13A – Multizone, indoor air handling unit AH-5 (serves south end of building)

Photo 13B – Single zone, indoor air handling unit AH-6A (serves multipurpose room)

13.2 Recommendations

In addition to general recommendations 1, 2 and 4 listed in Section 2.4 (except for opening operable windows), GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

<u>High Priority:</u>

- None.

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Medium Priority:

- Upgrade filters to MERV 14 for the air handling units serving the facility. Estimated cost $800.

Low Priority:

- Undertake a program of measurement and verification to determine the current ventilation systems' performance, compare the performance to the requirements of current codes and standards, and implement adjustments, repairs or upgrades as indicated. Estimated cost (measurement only) $6,000.

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14.0 Neil Armstrong Elementary School

This facility was built in 1969 and consists of one story. The building includes approximately 78,000 gross square feet and serves approximately 550 students in grades pre-K through 5.

14.1 Existing Ventilation & Exhaust Systems

Ventilation is provided to most classroom areas of the building using unit ventilators (Photo 14A) configured generally as described in Section 2.3. Heating is provided by hot water boilers and cooling is provided by a chiller via a two-pipe, dual-temperature piping system. The unit ventilators are in generally poor condition due to their age (over 50 years), with extensive corrosion present. Outdoor air enters each room though the wall louver associated with each unit ventilator.

Exhaust air is removed from each classroom through grilles located high on the walls opposite the windows. A duct system collects the air and conducts it to one of 9 roof-mounted gravity relief hoods.

Two classrooms (129 & 130) are served by a fan coil unit concealed above the ceiling, and one (small kindergarten near the main office) is served by a floor-mounted fan coil unit. There are several other support spaces served by fan-coil units as well. For all of the spaces served by fan-coil units it is not known if they are supplied with outdoor air. All of the fan-coil units (Photo 14B) are in generally poor condition due to their age.

Photo 14A – Typical classroom unit ventilator (Room 117)

Photo 14B – Typical fan-coil unit (Library workroom)

The multipurpose room on the first floor is air-conditioned and ventilated by two air handling units located above the stage. The units deliver a mixture of outdoor air (from intake hoods on the roof) and recirculated air to supply air grilles on the two longer walls of the room. Return air is taken from grilles located on the end walls and ducted back to the air handling unit. Exhaust air from this room exits the building through a gravity relief hood on the roof.

The toilet rooms located throughout the building have ceiling mounted exhaust grilles connected to exhaust fans (4) located on the roof.

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Because this building is scheduled for an HVAC system replacement next year, the program of ventilation system verification is not being recommended for this building.

14.2 Recommendations

In addition to general recommendations 1, 2 and 3 listed in Section 2.4, GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

High Priority:

- None.

Medium Priority:

- Add portable air cleaner for each classroom (33), the library and the reception area. Estimated cost $122,500.
- Upgrade filters to MERV 14 for the air handling unit serving the multipurpose room. Estimated cost $100.

Low Priority:

- None.

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15.0 Northeast Scranton Intermediate School

This facility was originally constructed as the Technical High School in 1904. A substantial addition was constructed in 1930. The building consists of five stories and approximately 138,000 gross square feet. It became an intermediate school in 2002 and it houses approximately 750 students in grades 6 through 8.

15.1 Existing Ventilation & Exhaust Systems

Ventilation is provided to the classroom areas of the building using two central forced ventilation systems (refer to Section 2.2 above). In the newer addition section of the building, the ventilation system is configured generally as described in Section 2.3. A large central ventilation fan located in the basement (Photo 15A) supplies fresh ventilation air to the classrooms located on the ground floor through the third floor. Outdoor air enters at the roof level and is filtered (MERV 8 pocket type) at the base of the outdoor air shaft (Photo 15B). The air is heated by a bank of cast iron steam heaters prior to entering the fan (Photo 15C). The airstream surfaces of the system that could be seen were somewhat dirty, and there were some stored materials located inside the supply fan plenum enclosure (red circle Photo 15A). Air is circulated to each classroom through ducts and supplied to a sidewall grille high on the wall opposite the classroom windows.

It is not known how much air is circulated by the system, or how much enters each room, but it is likely that the system is capable of supplying air at a higher rate than required by the current code. There does not appear to be any means for balancing the system airflows between individual spaces.

Exhaust air from the classrooms is removed from each room through a grille located low on the same wall as the supply grille and conducted upward to the attic level and into a duct system. There is a large central exhaust fan for the classrooms located in the penthouse mechanical room, but the fan is not operational (Photo 15D).

Photo 15A – Classroom ventilation fan for the building addition

Photo 15B – Outdoor air filters for the building addition

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Photo 15C – Classroom ventilation air heater bank With bypass below for the building addition

Photo 15D – Classroom exhaust fan for the building addition

There is a separate ventilation system serving the auditorium, with its supply fan also located in the basement and receiving its outdoor air from the same outdoor air shaft as the main building fan. Air enters the auditorium through outlets located under the seats. Exhaust air is partly through a gravity hood located above the stage, and partly through grilles at the back of the mezzanine. The exhaust fan for those grilles is also located in the penthouse mechanical room, but the fan is not operational.

The two gymnasiums on the ground and second floors have individual exhaust duct systems that terminate at exhaust fans in the mechanical penthouse. Neither of these fans are operational. Outside air enters the gymnasiums via outdoor air grilles at the perimeter walls and is heated in wall convector units. The two locker/shower rooms associated with each gymnasium have exhaust ductwork that terminates at individual exhaust fans in the mechanical penthouse. Like the other fans in this room, they are not operational. No direct source of outdoor air for the locker rooms was observed, and it is likely intended to be indirectly provided from the connected gymnasiums and the adjacent corridors.

There is a kitchen and a cafeteria located in the basement. There are two Type I exhaust hoods in the kitchen, one older and one newer. The older hood is connected to an exhaust fan in the mechanical penthouse which appears to be inoperable. The newer hood is connected to an exhaust fan on the roof of the auditorium by an exposed, stainless steel duct riser. It is not known if the fan is operational. A makeup air duct with supply grilles is exposed at the kitchen ceiling, but the source of the makeup air was not identified, but it may be supplied from the classroom ventilation system. The cafeteria appears to have exhaust grilles at the ceiling connected to an exhaust fan in the mechanical penthouse. This fan also non-functional. Outside air enters the cafeteria through outdoor air grilles at the perimeter walls and is heated in wall convector units.

A single central exhaust fan located on the roof of the mechanical penthouse serves the toilet rooms on the ground floor though the third floor. This fan and exhaust ductwork appear to be relatively new and the fan is functioning.

In the original portion of the building, the central forced ventilation system is configured generally as described in Section 2.3, but it additionally provides the heating for the rooms served, with the supply air temperature to each space controlled individually via wall-mounted thermostats. A large central ventilation

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fan located on the ground floor (Photo 15E) supplies fresh ventilation air to the classrooms located on the first through third floors. Note that the rooms on the ground floor of the original building are not served by this ventilation system and are not mechanically ventilated.

Outdoor air enters at the roof level and is pre-heated by a bank of cast iron steam heaters prior to entering the fan. The outdoor air damper at the base of the shaft is not operational and was blocked only partly open with a piece of old pipe (Photo 15F). The airstream surfaces of the system that could be seen were very dirty, and the filter rack at the inlet to the fan had no filters installed (Photo 15G). Air is circulated from the fan through sub-slab passages and up to heating coils at the ground floor level (Photo 15H), and then up to each classroom through masonry chases built into the building core wall construction. Each classroom has a sidewall supply air grille high on one wall.

Photo 15E – Classroom ventilation fan for the original part of the building

Photo 15F – Non-functional outdoor air damper

Photo 15G – Empty rear-access filter rack at ventilation fan inlet

15H – Cast-iron heating coil for classroom 325 located in room 19 (ground floor)

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It is not known how much air is circulated by the system, or how much enters each room, but it is likely that the system is capable of supplying air at a higher rate than required by the current code. There does not appear to be any means for balancing the system airflows between individual spaces.

Exhaust air is removed from each classroom through an exhaust grille low on the same wall as the supply grille and conducted upward to the attic level. The exhaust air is gathered into duct systems in the attic (Photo 15l) which terminate at three gravity ventilators on the roof. It was noted that dampers on two of the three relief ducts were in the closed position.

Both the supply and exhaust air grilles in the guidance suite (first floor) and the room adjacent to the medical office suite (third floor) were blanked off. GPI could not access the medical suite to verify ventilation to that area.

Photo 15l – Exhaust air ductwork in attic of original building

15.2 Recommendations

In addition to general recommendations 1 through 4 listed in Section 2.4, GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

<u>High Priority:</u>

- Provide new ventilation air units and new supply ductwork including serving the ground floor of original section of the building, and administrative office on first floor. Estimated cost $150,000.
- Controls upgrades including replacing outdoor air dampers at both building sections and interlock with the respective supply fans, add damper actuators at all exhaust air outlets in original building (3) and addition (1) and interlock with operation of respective supply air fans Estimated cost $150,000.
- Verify there is mechanical ventilation in the medical suite. Estimated cost $200.

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Medium Priority:

- None.

Low Priority:

- Undertake a program of measurement and verification to determine the current ventilation systems' performance, compare the performance to the requirements of current codes and standards, and implement adjustments, repairs or upgrades as indicated. Estimated cost (measurement only) $8,300.

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16.0 Robert Morris Elementary School

This facility was built in 1895 with a major addition and renovation conducted in 1996. The building consists of three stories, encompasses approximately 44,000 gross square feet and serves approximately 250 students in grades pre-K through 5.

16.1 Existing Ventilation & Exhaust Systems

Ventilation is provided to the classroom areas of the building using unit ventilators (Photo 16A) configured generally as described in Section 2.3. Heating is provided by hot water boilers and there is no cooling in this building. The unit ventilators are in generally poor condition due to their age (over 50 years), with some corrosion present. Outdoor air enters each room though the wall louver associated with each unit ventilator.

Exhaust air is removed from each classroom through an exhaust grill located low on a wall that are connected through ducts to powered exhaust fans located on the roof. There are a number of grilles high on the corridor walls, so it is assumed that the exhaust air exfiltrates from each room into the corridors, into the grilles, then up to a duct system that terminates at one of three gravity relief hoods on the roof of the building. Note that in several classrooms (101,102, & 201) the return air grille was blocked with furniture.

Photo 16A – Classroom unit ventilator (Room 103)

Photo 16B – One of two air handling units serving the multipurpose room

The multipurpose room on the first floor is heated and ventilated by a pair of dedicated air handling units located on either side of the stage (photo 16B). The units deliver a mixture of outdoor air (from a wall intake louver) and recirculated air to a wall-mounted supply air grille. Return air is taken from grilles located on the same wall (low) and ducted back to the air handling unit. It is not clear how air is exhausted from the space.

Other than the operable windows, there are several occupied rooms that have no ventilation air supplied to them. This includes the secretary's and principal's office on the first floor, and the art room, counseling room and teacher's workroom in the basement. All of these rooms except the counseling room have exhaust grilles that appear to be connected via ducts to an exhaust fan on the roof.

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The toilet rooms located throughout have ceiling mounted exhaust grilles connected to exhaust fans located on the roof.

16.2 Recommendations

In addition to general recommendations 1 through 4 listed in Section 2.4, GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

High Priority:

- Add a ventilation system to serve the rooms in the basement currently without mechanical ventilation. Estimated cost $31,500.
- Remove furniture blocking exhaust air grille in rooms 101, 102, and 201. Estimated cost $100.

Medium Priority:

- Add portable air cleaner for each classroom (20), the library, the art room and the counseling room. Estimated cost $80,500.
- Upgrade filters to MERV 14 for the air handling unit serving the multipurpose room. Estimated cost $100.

Low Priority:

- Undertake a program of measurement and verification to determine the current ventilation systems' performance, compare the performance to the requirements of current codes and standards, and implement adjustments, repairs or upgrades as indicated. Estimated cost (measurement only) $2,700.

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17.0 Scranton High School

This facility was built in 2001. The building consists of three stories, includes approximately 293,000 gross square feet and houses approximately 1,550 students in grades 9 through 12.

17.1 Existing Ventilation & Exhaust Systems

Ventilation is provided to the general classrooms of the building using unit ventilators configured generally as described in Section 2.3 (Photo 17A). Heating is provided by hot water boilers and cooling is provided by a central chiller system. Outdoor air enters each room though the wall louver associated with each unit ventilator. Exhaust air is removed from each classroom trough a ceiling grille connected to a duct that terminates at wall louver associated with each room.

Ventilation is provided to the rest of the facility by central HVAC systems configured generally as described in Section 2.3. These areas are heated and cooled by a combination of roof-mounted and indoor air handling units (total of 20) connected to the building's central hot water and chilled water plants. There are three variable air volume systems (AC-6, 7 & 14) serving the administration area, the guidance office and the library. The VAV terminal units are equipped with hot water reheat coils.

Photo 17A – Typical classroom unit ventilator (Room 229) (RTU-5) showing energy recovery wheel and filters

Photo 17B – Roof-mounted VAV air handling unit AC-7 serving the library

The remainder of the HVAC systems are constant volume type, either single zone or multiple zone with hot water reheat. A number of systems include heat recovery heat exchangers which reduce the amount of energy needed to heat or cool the outdoor ventilation air. There is also a special dehumidification unit serving the natatorium. Because these systems were installed relatively recently, it is assumed that they meet the current codes for ventilation. There are toilet rooms located throughout the facility with ducted exhaust systems terminating either a roof-mounted or an indoor-mounted exhaust fan.

In general, the equipment is in good condition, but showing some signs of age including some corrosion and buildup of dirt inside the air systems. Some of the filters were found to be very dirty and in need of replacement.

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Photo 17C – Indoor constant volume air handing unit AC-2 serving B wing common areas

Photo 17D – Indoor constant volume air handing unit AC-4 serving B wing science labs (includes heat recovery)

17.2 Recommendations

In addition to general recommendations 1 through 4 listed in Section 2.4, GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

High Priority:

- Check operation of outdoor air damper on AC-1. Estimated cost $200.
- Clean AC-9 cooling coil. Estimated cost $100.
- Change filters on AC-9 & 10 and verify changeout schedule, very dirty.
- Check belts on AC-12 supply fan. Estimated cost $100.
- Check operation of AC-14 (library) both fan drives in full speed bypass (should be VAV). Estimated cost $200.
- Check roof of AC-19 for water leaks. Visual evidence of water leaking into the unit. Estimated cost $200.

Medium Priority:

- Upgrade filters to MERV 14 for the air handling units that recirculate air (18). Estimated cost $3,100
- Add portable air cleaner for each general classroom (59). Estimated cost $206,500.

Low Priority:

- Undertake a program of measurement and verification to determine the current ventilation systems' performance, compare the performance to the requirements of current codes and standards, and implement adjustments, repairs or upgrades as indicated. Estimated cost (measurement only) $35,200.

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18.0 South Scranton Intermediate School

This facility was originally built in 1937. The building consists of four stories, includes approximately 183,000 gross square feet and houses approximately 700 students in grades 6 through 8.

18.1 Existing Ventilation & Exhaust Systems

Ventilation is provided to the classroom areas of the building using a central forced ventilation system configured generally as described in Section 2.3. A large central ventilation fan located in the basement (Photo 17A) supplies fresh ventilation air to the classrooms located on the first through third floors. Outdoor air enters at the roof level and flows through an air shaft to the fan room. The air is filtered using pleated box filters (MERV9), but the filter rack has no retaining clips and so several of the filters had fallen out of the rack (Photo 17B). The air is heated by a bank of cast iron steam heaters (Photo 17C) prior to entering the fan. The last row of the lower bank was damaged, most likely from freezing (damaged area framed in red in Photo 17C). The airstream surfaces of the system that could be seen were somewhat dirty, and there were some stored materials located inside the fan room plenum. Air is circulated to each classroom through ducts located above the corridor ceilings on each floor and supplied to a sidewall grille high on the wall opposite the windows. In some rooms the supply grille was blocked with cardboard or plywood.

Photo 17A – Classroom ventilation fan located in the basement fan room

Photo 17B – Filter rack for classroom ventilation system with filters displaced

It is not known how much air is circulated by the system, or how much enters each classroom, but it is likely that the system is capable of supplying air at a higher rate than required by the current code. (The nameplate on the fan indicates it was selected for 100,000 CFM and the system serves about 54 classrooms, so that's about 1850 CFM per classroom.) It is not known if there are any means for balancing the system airflows between individual spaces.

Exhaust air from the classrooms is removed from each room through a grille mounted low on the same wall as the supply grille. In some rooms the grille was blocked with cardboard, plywood or furniture. Exhaust air moves through duct risers up to the attic level and is collected in a duct system that terminates at one of six gravity relief hoods located on the roof.

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Photo 17C – Heating bank for classroom ventilation system with damaged section

Photo 17D – Inlet plenum for the auditorium supply fan with furniture stored in the plenum

There is a separate ventilation system serving the auditorium on the first floor, with its supply fan also located in the basement and receiving its outdoor air from its own outdoor air intake on the south side of the building. This system includes a filter bank (pleated box filter MERV 9) and a heating coil. Similar to the classroom system, the rear-access filter rack has no retaining clips and so several of the filters had fallen out of the rack, and there is apparent freeze damage to the heating coil bank. In addition, there is furniture being stored in the fan inlet plenum (Photo 17D). Air is delivered to the auditorium using the food supply storage room in the basement as a supply air plenum. Air is supplied to the auditorium through outlets located under the seats. Exhaust air is through a duct system located above the auditorium ceiling with an exhaust fan located in a mechanical penthouse at the attic level.

Outside air enters the gymnasium on the second floor via outdoor air grilles at the perimeter walls that is heated in wall convector units. Exhaust air relieved through four gravity ventilators on the gymnasium roof. The locker/shower rooms on the first floor has exhaust ductwork in the basement that terminates at an exhaust fan in the basement. The locker rooms also have a makeup air system that originates at a fan in the basement, is heated and distributed through a metal duct system located in the basement. The fan is currently not connected to the ductwork because the flexible connectors have been removed.

There is a kitchen and a cafeteria located in the basement. The kitchen has a single Type I exhaust hood with its fan located on the south wall of the building, near the loading dock. The source of makeup air for the kitchen is not clear, but it could be from the classroom ventilation system. The cafeteria has several unit ventilators for heating and ventilation. The path for the exhaust relief air could not be determined, but it is assumed to be included with the relief system that serves the classrooms. There is also an exhaust air connection to the dishwasher which may be connected to an exhaust fan in the mechanical penthouse.

The toilet rooms located on all floors at the inside corner of the L-shaped building have a ducted exhaust system with a single exhaust fan located in the mechanical penthouse. Some of the rooms in the basement are served by unit ventilators, exhaust fans or both.

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18.2 Recommendations

In addition to general recommendations 1 through 4 listed in Section 2.4, GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

High Priority:

- Add retaining clips to filter racks for the classroom and auditorium ventilation systems. Estimated cost $1,000.
- Remove blank-off panels from ventilation supply air inlets and/or relief air outlets at various rooms throughout the building, including rooms 107, 116, 203, 211A, 212, 215, 216 and 319. Estimated cost $300.
- Remove stored items from auditorium fan plenum.
- Add connections to classroom ventilation supply and exhaust systems in rooms 112 and 210. Estimated cost $16,600.
- Install flexible connectors on makeup fan for the locker rooms. Estimated cost $500.

Medium Priority:

- None.

Low Priority:

- Undertake a program of measurement and verification to determine the current ventilation systems' performance, compare the performance to the requirements of current codes and standards, and implement adjustments, repairs or upgrades as indicated. Estimated cost (measurement only) $11,000.
- Add a supply air duct system to serve the auditorium. Estimated cost $24,500.

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19.0 West Scranton High School

This facility was constructed in 1932. The building consists of four stories and 255,000 gross square feet of floor space. The school serves approximately 1,200 students in grades 9 through 12.

19.1 Existing Ventilation & Exhaust Systems

Ventilation is provided to the classroom areas of the building using two central forced ventilation systems configured generally as described in Section 2.3. Two large central ventilation fans located at the north end of the basement (Photo 19A) supplies fresh ventilation air to the classrooms located on the first through third floors. Outdoor air enters at the roof level and flows through two separate shafts to the fan rooms. The outdoor air is not currently filtered. The air is heated by a bank of cast iron steam heaters prior to entering the fans (Photo 19B). The airstream surfaces of the system that could be seen were somewhat dirty, and there were some stored materials located inside the fan room plenum (red circles Photos 19A & B). Air is circulated to each classroom through ducts located above the corridor ceilings on each floor and supplied to a sidewall grille high on the wall opposite the windows. In some rooms the supply grille was blocked with cardboard or plywood.

Photo 19A – Classroom ventilation fan located In the northwest fan room

Photo 19B – Heating coil bank located in the northwest fan room

It is not known how much air is circulated by the system, or how much enters each room, but it is likely that the system is capable of supplying air at a higher rate than required by the current code. It is not known if there are any means for balancing the system airflows between individual spaces.

Exhaust air from the classrooms is removed from each room through a return air grille low on the same wall as the supply grille. In some rooms the return grille was blocked with cardboard, plywood or furniture. Exhaust air moves through duct risers up to the attic level and is collected in a duct system that terminates at one of seven gravity relief hoods located on the roof.

There is a separate ventilation system serving the auditorium, with its supply fan also located in the basement and receiving its outdoor air from its own outdoor air shaft from the roof. This system includes a filter bank (pleated box filter MERV9) and a heating coil. Air enters the auditorium through outlets located

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under the seats. Exhaust air is through a duct system located above the auditorium ceiling with a relief fan located in a mechanical room on the third floor.

For the two gymnasiums on the first floor outside air enters the gymnasiums via outdoor air grilles at the perimeter walls and is heated in wall convector units. Air is exhausted through gravity ventilators on the gymnasium roofs. The two locker/shower areas in the basement (below the gymnasiums) do not have mechanical exhaust systems. No direct source of ventilation air for the locker rooms was observed.

There is a kitchen and a cafeteria located on the third floor. The kitchen has a single Type I exhaust hood which appears to be of the makeup air type. Both the exhaust fan and the makeup air unit are located on the roof. The kitchen is also air-conditioned by a rooftop HVAC unit. The cafeteria has several unit ventilators for heating and ventilation. The path for the relief air could not be determined, but it is assumed to be included with the relief system that serves the classrooms. There is also a Type II hood in the serving area with its exhaust duct out through a blocked off window.

The toilet rooms located at the northwest corner of the first through third floors and the southwest corner of the first and second floors have exposed exhaust duct systems, but the exhaust fans were not located (possibly on the roof). The toilet rooms on the east side of the building have no visible exhaust systems and appear to not be in use.

Some of the rooms in the basement are served by unit ventilators, exhaust fans or both.

19.2 Recommendations

In addition to general recommendations 1 through 4 listed in Section 2.4, GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

High Priority:

- Install new filter racks and filters (MERV 8) upstream of main heating coils for both classroom ventilation systems. Estimated cost $5,000.
- Remove blank-off panels from ventilation supply air inlets and/or relief air outlets at various rooms throughout the building including rooms 101, 113, 116, 119, 120, 206, 218, 219, 224, and 329. (Note that not all rooms were accessed during the survey and there may be other rooms where this occurs.) Estimated cost $500.
- Add ventilation supply and return ducts to serve the vice principal's office (across the hall from room 117). Estimated cost $3,600.
- Add ventilation and exhaust systems to serve the locker rooms. Estimated cost $124,800.

Medium Priority:

- None

Low Priority:

- Undertake a program of measurement and verification to determine the current ventilation systems' performance, compare the performance to the requirements of current codes and standards, and implement adjustments, repairs or upgrades as indicated. Estimated cost (measurement only) $15,300.

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20.0 West Scranton Intermediate School

This facility was built in 1975 and consists of approximately 174,000 gross square mostly on one story. It houses approximately 650 students in grades 6 through 8. This building does not have operable windows.

20.1 Existing Ventilation & Exhaust Systems

Ventilation is provided to all areas of the facility by central HVAC systems configured generally as described in Section 2.3. Most areas of the building are heated and cooled by indoor air handling units with chilled water cooling coils. Each zones served by these units has a reheat coil positioned in the supply air ductwork. Some areas are heated only and are served by indoor heating/ventilating units that have only heating coils. All systems are of the constant volume type. It is not known if the systems meet current codes concerning ventilation rates. The general condition of the equipment is fair to poor due to their age (45 plus years).

There is a new roof-mounted dehumidification unit serving the natatorium. The toilet rooms located through the facility are served by ducted exhaust systems terminating a roof-mounted exhaust fans.

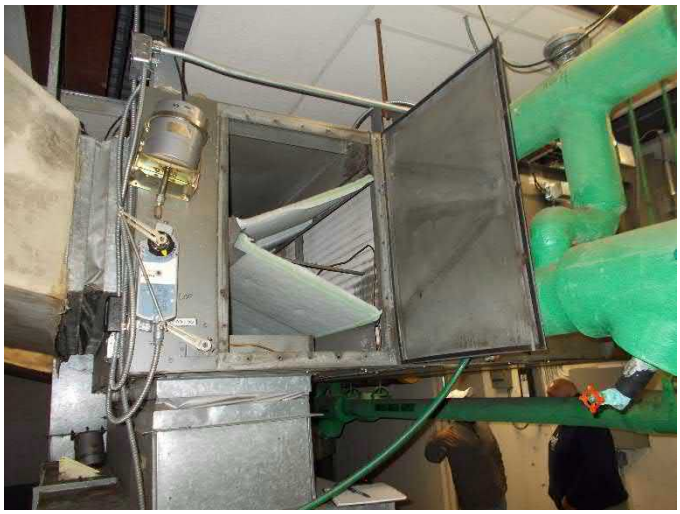

Photo 20A – Indoor air handling unit AH-4 (serves auditorium)

Photo 20B – Indoor heating/ventilating unit HV-4

20.2 Recommendations

In addition to general recommendations 1, 2 and 4 listed in Section 2.4 (except for opening operable windows), GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

<u>High Priority:</u>

- For AH-3 fix outdoor air damper linkage. Estimated cost $300.
- For AH-4 reconnect outdoor air damper linkage and verify proper operation. Estimated cost $300.

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Medium Priority:

- Upgrade filters to MERV 14 for the air handling units serving the facility that recirculate air (15). Estimated cost $2,700.

Low Priority:

- Undertake a program of measurement and verification to determine the current ventilation systems' performance, compare the performance to the requirements of current codes and standards, and implement adjustments, repairs or upgrades as indicated. Estimated cost (measurement only) $20,900.

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21.0 William Prescott Elementary School

This facility was built in 1966 and consists of three stories. The building includes approximately 28,000 gross square feet and serves approximately 250 students in grades pre-K through 5.

21.1 Existing Ventilation & Exhaust Systems

Ventilation is provided to most of the classroom areas of the building using unit ventilators (Photo 21A) configured generally as described in Section 2.3. Heating is provided by hot water boilers and there is no cooling in this building. The unit ventilators are in generally poor condition due to their age (over 50 years), with extensive corrosion present. Outdoor air enters each room though the wall louver associated with each unit ventilator.

Exhaust air is removed from each classroom through sidewall grilles located low on a wall. Note that the exhaust grilles in room 104 was blocked by boxes. Exhaust air is then removed from the building by a series of air shafts that terminate at exhaust fans on the roof of the building.

Photo 21A – Typical classroom unit ventilator

The multipurpose room in the basement is heated and ventilated by a dedicated air handling unit located in the adjacent storage rooms. The unit delivers a mixture of outdoor air (from an intake wall louver) and recirculated air to sidewall grilles along the one wall of the room. Return air is taken from a sidewall grille located near the floor and ducted back to the air handling unit. The means of exhausting air from this space is not clear but it may be included with the classroom exhaust system.

There are several occupied rooms that have no source of mechanical ventilation, only operable windows This includes all rooms in the basement (excepting the multipurpose room described above), the principal's and secretary's office on the first floor, and the teacher's lounge on the second floor. Some of these rooms have exhaust grilles that appear to be connected via ducts to an exhaust fan on the roof.

The toilet rooms located on all floors have wall-mounted exhaust grilles which appear to be connected by ductwork to several exhaust fans located on the roof.

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21.2 Recommendations

In addition to general recommendations 1 through 4 listed in Section 2.4, GPI recommends the following specific actions for this building. The estimated order-of-magnitude cost is included with each item.

High Priority:

- Remove boxes from in front of exhaust grille in room 104. Estimated cost $0.
- Add ventilation system(s) and exhaust system(s) to serve the rooms on all three floors that are currently without mechanical ventilation and exhaust. Estimated cost $42,600.

Medium Priority:

- Add portable air cleaner for each classroom (16), and the library. Estimated cost $59,500.
- Upgrade filters to MERV 14 for the air handling unit serving the multipurpose room. Estimated cost $100.

Low Priority:

- Undertake a program of measurement and verification to determine the current ventilation systems' performance, compare the performance to the requirements of current codes and standards, and implement adjustments, repairs or upgrades as indicated. Estimated cost (measurement only) $1,700.

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