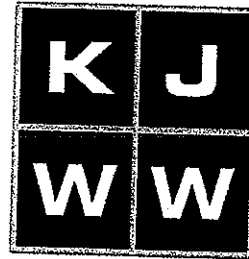


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River Ridge School District

HVAC Feasibility Study

KJWW #14.0582.00

August 1, 2014

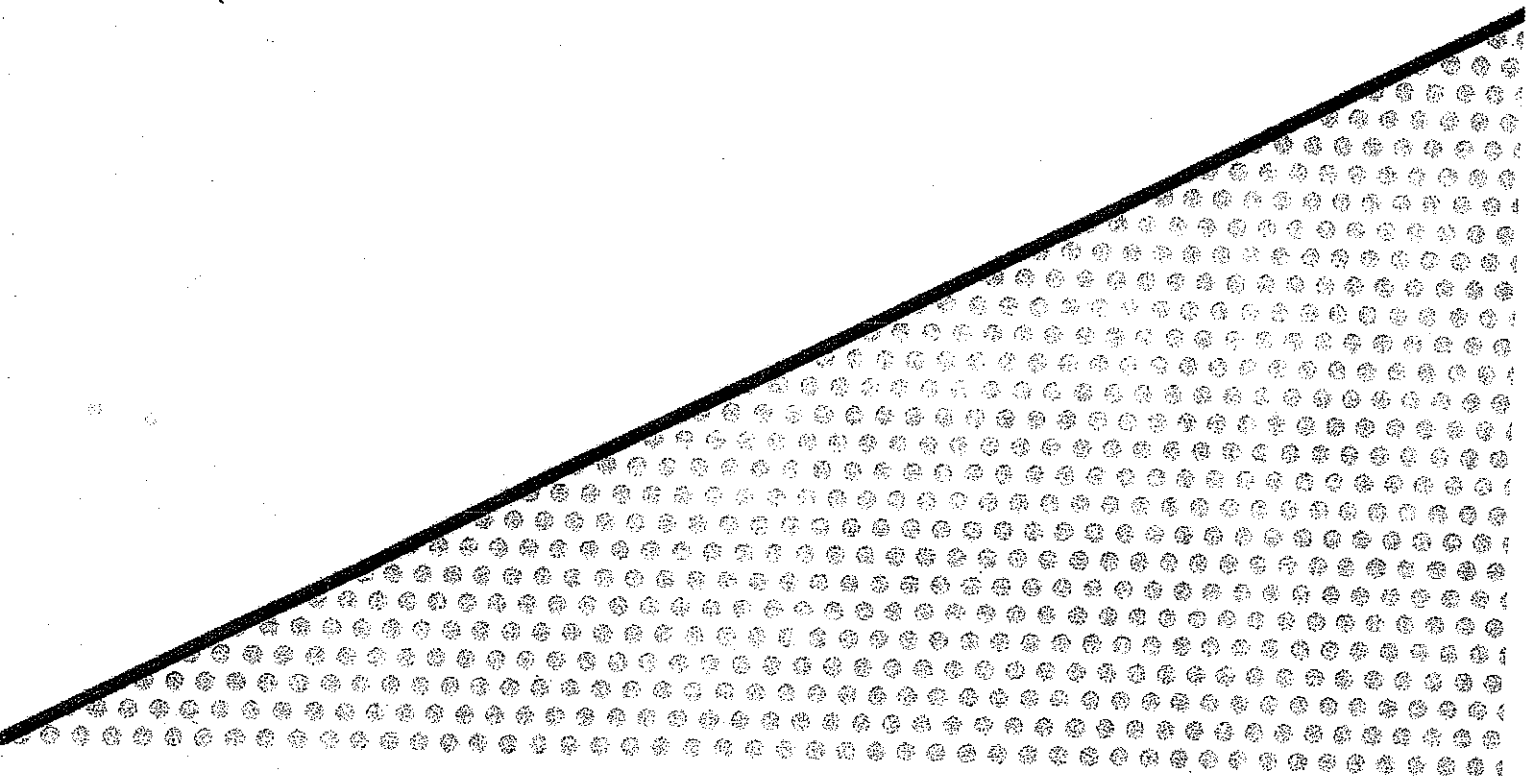
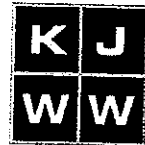


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**HVAC Feasibility Study
for
River Ridge School District
Patch Grove, WI**

**KJWW #14.0582.00
August 1, 2014**

A. Introduction

A representative from KJWW Engineering Consultants toured the River Ridge Schools on July 9, 2014 to observe the existing heating, ventilating, and air conditioning (HVAC) systems and discuss their operation with facilities staff. The observations included in this report are a compilation resulting from the tour, discussions with facility staff, review of available existing drawings and review of existing assessment reports. The recommendations for new systems are based on past project information and American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) recommendations and industry standard design techniques.

B. Objectives

The purpose of this feasibility study is to analyze the existing River Ridge High School and Elementary School HVAC systems to determine equipment condition, capacity, and age. Additionally, proposed solutions to address HVAC system operational concerns and HVAC system recommendations for proposed building expansion will be provided.

C. Findings & Analysis

1. River Ridge High School

a. Existing Conditions:

- 1) The majority of the high school was constructed in 1960 and much of the equipment serving the space is original to the facility. An addition was completed in 2001, which had separate HVAC systems installed to serve the addition.
- 2) The 1960 building has a large gas-fired air handling unit, located below the stage, to serve a majority of the spaces. Filtered ventilation air is provided to the unit. The unit has two supply fans with variable frequency drives (VFDs), which distribute tempered and warm air through separate underground tunnel distribution systems. Air baseboard cabinets are provided with control dampers that modulate to

provide heating and ventilation to spaces as controlled by room thermostats. Return air is then transferred through door grilles or other transfer grilles into the main corridor of the school. This return air is then brought back to the central air handling unit through the tunnel system or large grilles in the main corridor.

- 3) The district office areas are provided with separate split-system style air conditioning units to provide filtered, heated or cooled ventilation air to the spaces. These units are in addition to some of these spaces being served by the tunnel distribution system.
 - 4) The technology education area is provided with a separate gas-fired air handling unit that distributes heated, filtered ventilation air to the spaces. The unit is not interlocked with exhaust systems and does not appear to provide adequate makeup air for them.
 - 5) The 2001 addition is provided with a variable air volume air handling unit located on the mezzanine that provides filtered, heated or cooled ventilation air to the spaces. The air is distributed through ductwork by a supply fan with a VFD within the air handling unit to hot water heated variable air volume terminal air boxes. Terminal air boxes are controlled by room thermostats to vary heat and ventilation air distributed to the spaces. The air handling unit and terminal heating equipment is served by two 500 MBH boilers and a redundant pumping system. The air handling unit is also served by an air cooled condensing unit, which allows it to provide cooling to the spaces. Return air is transferred to a return air plenum above the ceilings and then ducted to the return fan on the mezzanine.
 - 6) Exhaust fans are provided for toilet rooms, locker rooms, kitchen, science labs, art areas, technology education areas and general exhaust for pressurization purposes.
 - 7) The controls throughout the facility are pneumatic.
- b. Mechanical System expected useful life based on ASHRAE published data.
- 1) Boilers: 25-30 years
 - 2) Pumps: 15-20 years
 - 3) Terminal Equipment: 20-25 years
 - 4) Indoor air handling units: 20-25 years
 - 5) Air cooled chillers: 15-20 years
 - 6) DX coils: 15-20 years
 - 7) Condensing units: 10-15 years
 - 8) Duct free split systems: 10-15 years
 - 9) Pneumatic Control Systems and Accessories: 15-20 years

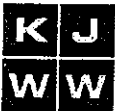


- c. Based on the above published data, much of the equipment in the high school is nearing the end of or is past its useful life. The systems in the 2001 addition, though nearing the end of their ASHRAE recommended useful life, are in good working condition.

2. River Ridge Elementary School

a. Existing Conditions:

- 1) The elementary school was an addition to the high school, constructed in 1980. The school's HVAC systems are separate from those serving the high school.
- 2) The majority of the school is served by a constant volume air handling unit located in the mezzanine area above the center core of the building. The unit provides heated, filtered ventilation air and distributes it with a constant volume supply fan through ductwork routed above the ceiling spaces to terminal heating units. Terminal heating units are controlled by room thermostats to provide heat and ventilation through slot diffusers in the classrooms and support spaces. Due to room modifications and additional interior walls being installed after the original construction, some occupied areas are not provided with Wisconsin Commercial Building Code required ventilation air. Return air from classrooms and support spaces is transferred into the main corridor and then return grilles in the corridor are ducted back to the air handling unit.
- 3) The gym is served by a separate air handling unit, also located above the center core of the building. The unit provides heated, filtered ventilation air and distributes it through ductwork via a constant volume supply fan to the gym. The unit is a single zone unit with a thermostat controlling the hot water heating coil within the unit. The return from the gym is transferred into the main corridor and then return grilles in the corridor are ducted back to the air handling unit.
- 4) The air handling unit heating coils and terminal unit heating coils are provided with heating water from two hot water boilers located in the mezzanine above the center core of the building. The boilers are each 550 MBH and were installed in 1980. The heating water is pumped throughout the building via two pumps with 30 gpm and 41 ft head capacity, operating in a lead-lag style control strategy.
- 5) Exhaust fans are provided for toilet rooms and locker rooms, and relief hoods are provided in the corridors to maintain building pressurization.
- 6) The controls throughout the facility are pneumatic.

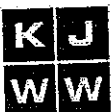


- b. Mechanical System expected useful life based on ASHRAE published data.
 - 1) Boilers: 25-30 years
 - 2) Pumps: 15-20 years
 - 3) Terminal Equipment: 20-25 years
 - 4) Indoor air handling units: 20-25 years
 - 5) Pneumatic Control Systems and Accessories: 15-20 years
- c. Based on the above published data, much of the equipment in the elementary school is nearing the end of or is past its useful life.

D. Recommendations

1. River Ridge High School:

- a. A new approximately 47,000 CFM variable air volume air handling unit, providing code required ventilation air, with hot water reheat should be provided to serve the existing high school classrooms, offices and cafeteria. A second approximately 12,000 CFM variable air volume air handling unit, providing code required ventilation air, with hot water reheat should be provided to serve the gymnasium and support spaces. The underground tunnel system should be capped and abandoned, with the existing central air handling unit removed.
- b. A new hot water boiler system should be provided to serve the new air handling unit coils and all terminal equipment. The boiler system should contain two, approximately 2,000 MBH sealed combustion boilers and operate in a primary-secondary pumping arrangement. Heating water piping should be routed through the corridors to air handling unit coils and terminal equipment.
- c. Supply air should be ducted through insulated supply mains to variable air volume terminal air boxes with hot water reheat to serve the classrooms and offices. Air handling units should be located on the roof with pumped heating coils or within a mechanical room with standard heating coils. Supply duct mains should route through the main corridor to the terminal air boxes. Terminal air boxes should have hot water reheat coils and control heating and airflow provided to individual temperature control zones. Return ductwork should also route through the main corridor and be ducted to each classroom or office space, as required to meet Wisconsin Commercial Building Code requirements.
- d. Three new gas-fired makeup air units should be provided and sized appropriately to provide makeup air for the kitchen exhaust, dust collection exhaust, and welding exhaust. These units should be controlled to operate intermittently to maintain space temperatures and provide minimum ventilation air during



occupied times when exhaust systems are off. They should be set up to provide 100% outside makeup air to the spaces when corresponding exhaust systems are in operation.

- e. The school should be upgraded to a direct digital control system to provide better control and meet current industry standards.
- f. As an option, cooling could be provided to the air handling units serving the gym and classroom/office air handling units. Cooling would be provided by direct expansion (DX) coils within the air handling units. Refrigerant piping would be routed to packaged air cooled systems for rooftop air handling units or to remote condensing units for indoor air handling units.
- g. The systems in the 2001 addition, though nearing the end of their ASHRAE recommended useful life, are in good working condition. These systems should be provided with recommended operation and maintenance practices to help extend their life.

2. River Ridge Elementary School:

- a. The air handling and heating equipment is nearing the end of life and should be replaced. The exhaust fans, pumps and boilers should be replaced with like units to serve the elementary addition. A new approximately 25,000 CFM air handling unit with supply and return fan VFDs should be installed and variable air volume reheat boxes should be provided to increase thermal comfort levels.
- b. The ductwork and piping distribution should be replaced where it or its insulation is torn, deteriorating or in poor condition. The distribution and overall temperature control zoning should be updated to serve the proposed new classrooms and LMC. Any transfer grilles or door grilles in the area should be replaced with transfer grilles above the ceiling to eliminate using the corridor as a return plenum and be in compliance with current codes. The return duct from the new air handling unit should be ducted to above the plenum.
- c. The school should be upgraded to a direct digital control system to provide better control and meet current industry standards.

3. Proposed Addition:

- a. The proposed addition, containing a gym and locker rooms should be provided with a new approximately 15,000 CFM packaged DX-cooled, gas-fired rooftop unit. Unit should be provided with multiple stages of cooling and digital scroll

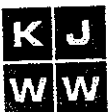


compressors to prevent short cycling. The unit should be ducted throughout the gym using fabric ductwork and routed to the locker rooms to provide make-up air. Return air should be ducted from the gym back to the air handling unit and exhaust air should be ducted to a new exhaust fan serving the locker rooms.

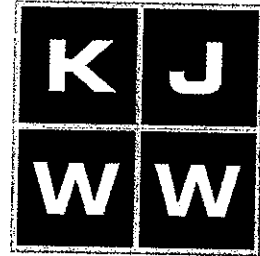
- b. The school should be provided with a direct digital control system to provide quality control and meet current industry standards.
- c. As an option, a total energy recovery unit could be provided to serve this space. In lieu of exhaust fan serving the locker rooms, all exhaust air would be routed through a total energy recovery wheel to pre-treat all ventilation area serving the air handling unit. This option would provide energy savings for the school.

Prepared by: Steven E. Mumm, PE, LEED AP BD+C

SEM/sem



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River Ridge School District

Bloomington Middle School

HVAC Feasibility Study

14.0582.00

August 6, 2014

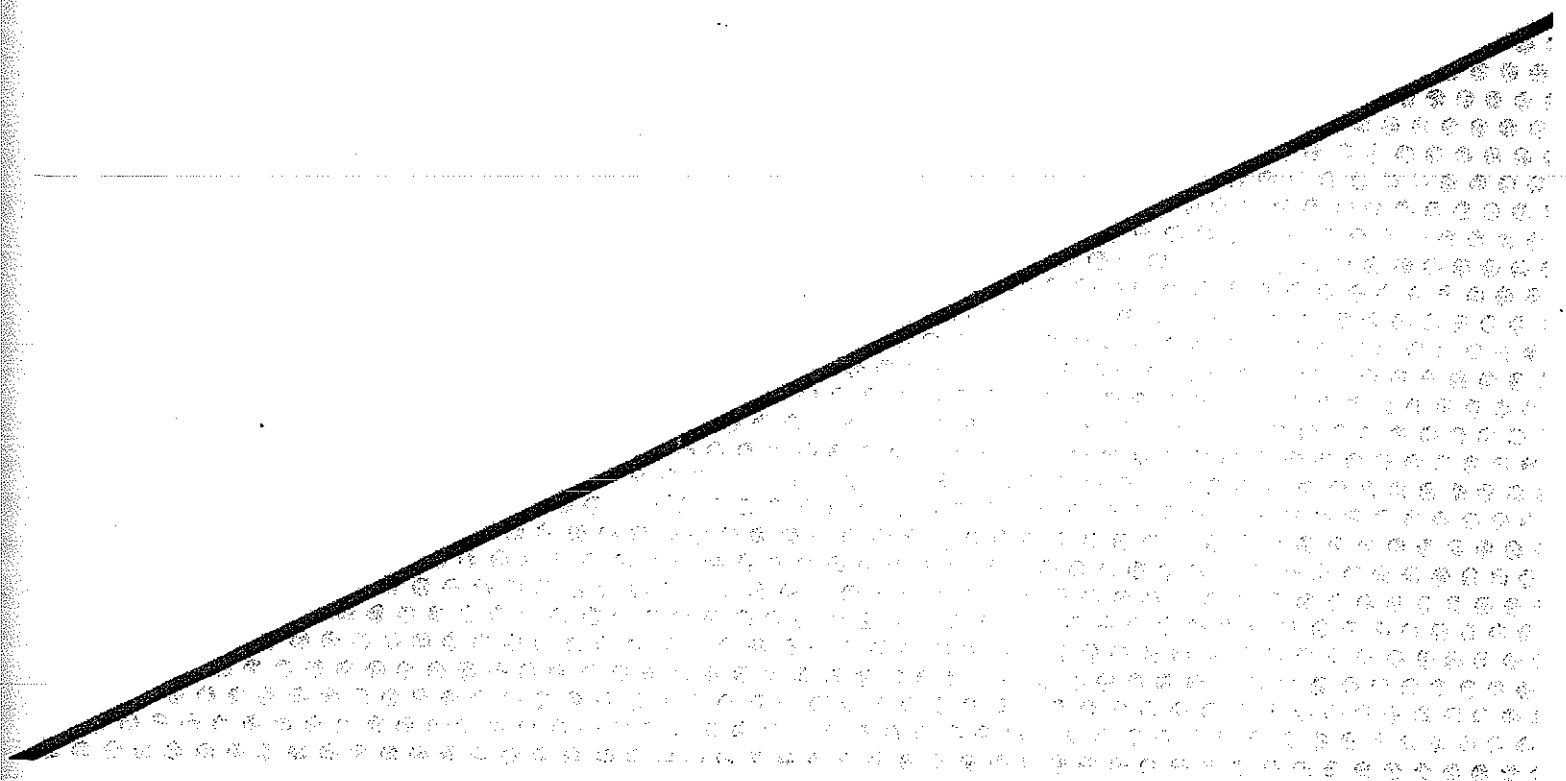


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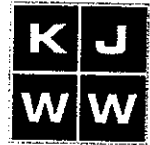
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**HVAC Feasibility Study
for
River Ridge Middle School
Bloomington, WI**

**KJWW #14.0582.00
August 6, 2014**

A. Introduction

A representative from KJWW Engineering Consultants toured the River Ridge Schools on July 9, 2014 to observe the existing heating, ventilating, and air conditioning (HVAC) systems and discuss their operation with facilities staff. The observations included in this report are a compilation resulting from the tour, discussions with facility staff, review of available existing drawings and review of existing assessment reports. The recommendations for new systems are based on past project information and American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) recommendations and industry standard design techniques.

B. Objectives

The purpose of this feasibility study is to analyze the existing River Ridge Middle School HVAC systems to determine equipment condition, capacity, and age. Additionally, proposed solutions to address HVAC system operational concerns will be provided.

C. Findings & Analysis

1. River Ridge Middle School

a. Existing Conditions:

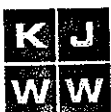
- 1) The middle school was constructed in 1961 and much of the equipment serving the space is original to the facility.
- 2) The building is served by a 200 BHP Cleaver Brooks fire-tube, hot water boiler. The combustion air for the boiler room is provided through a wall louver that is damaged and not functioning properly. The heating hot water is pumped throughout the facility to unit ventilators, cabinet unit heaters, baseboard radiation and other terminal units. Heating only unit ventilators, with minimum filtration, are the main source of heat and ventilation to the classrooms, gymnasium and cafeteria. Relief air from

the spaces is transferred into the corridor and used for makeup air for toilet rooms, locker rooms, kitchen and other areas.

- 3) The office areas are provided with packaged terminal air conditioning units to provide cooling to the spaces. These units do not provide proper ventilation for the office areas.
 - 4) Exhaust fans are provided for toilet rooms, locker rooms, kitchen, science labs, art areas, technology education areas and general exhaust for pressurization purposes.
 - 5) Pneumatic controls are provided throughout the facility.
- b. Mechanical System expected useful life based on ASHRAE published data.
- 1) Boilers: 25-30 years
 - 2) Pumps: 15-20 years
 - 3) Terminal Equipment: 20-25 years
 - 4) Unit Ventilators: 15-20 years
 - 5) Exhaust fans: 20-25 years
 - 6) Packaged Terminal Air Conditioners: 10-15 years
 - 7) Pneumatic Control Systems and Accessories: 15-20 years
- c. Based on the above published data, much of the equipment in the middle school is nearing the end of or is past its useful life.

D. Recommendations

1. River Ridge Middle School:
 - a. The unit ventilators, exhaust fans and terminal equipment serving the building are nearing the end or past their useful life and should be replaced. Transfer air ducts should be provided to transfer air to above corridor ceiling spaces in lieu of using the corridor as a return air plenum. Corridors should be provided with proper ventilation per the Wisconsin Commercial Building Code.
 - b. The large boiler, pump, and piping serving the building are showing signs of wear and are nearing or past their useful life. These components should all be replaced if a major renovation occurs. New boilers should be high-efficiency sealed combustion style to eliminate combustion air concerns.
 - c. The office area should be provided with a new split system style air conditioner to provide heated or cooled ventilation air via supply and return ductwork to the offices.



- d. New dedicated make-up air units should be provided for the technology education and kitchen areas. These should operate when exhaust systems are in operation to provide proper make-up air for the systems.
- e. The school should be upgraded to a direct digital control system to provide better control and meet current industry standards.

Prepared by: Steven E. Mumm, PE, LEED AP BD+C

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[http://projects.kjww.com/sites/14.0582.00/Design Library/River Ridge School District-Bloomington.docx](http://projects.kjww.com/sites/14.0582.00/Design%20Library/River%20Ridge%20School%20District-Bloomington.docx)

