# MEP Conditions Assessment - DRAFT

## City of Middleton

Middleton, WI

MIDDC 179714 | September 23, 2024

SEH

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# Mechanical Electrical and Plumbing (MEP)

# Conditions Assessment - DRAFT

City of
Middleton, WI

SEH No. MIDDC 179714

September 23, 2024

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Wisconsin.

_____

NAME, PE

Date: _____ License No.: _____

Reviewed By: _____ Date: _____

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# Contents

# Electrical Mechanical Conditions Assessment

Prepared for City of Middleton

## 1 General

The City of Middleton (City) is in the process of developing the 2025 budget. The City has retained SEH to review the existing electrical and mechanical systems at the City Hall, Library and Senior Center buildings and provide an opinion of condition, life span, and operability. As part of this evaluation, SEH visited the site and spoke with facility staff about maintenance and operability. The assessment included review of utility bills and the existing as-built drawings. The recommendations in this assessment took into consideration the City's sustainability goals. Options evaluated included electrification of the HVAC and modifications to the electrical systems to support solar photovoltaic energy generation, battery storage and microgrid technology.

### 1.1 Overview – City Hall


The City Hall was originally constructed in ____. Major HVAC System renovations and upgrades occurred in 1992 and 2002. The equipment condition and recommendations for improvements are provided in Section 3. The summary of recommended systems is provided in Section 5.

In general, much HVAC equipment is past its expected service life and is in fair or poor condition. The boilers, pumps, and some newer equipment was found to be in satisfactory condition. All recommendations contained in the report will be designed to meet current Wisconsin Energy Code and will be sized according to the existing building function.

### 1.2 Overview - Library

The Library was originally constructed in 1989. Major HVAC System renovations and upgrades occurred in 2001 and 2003. The equipment condition and recommendations for improvements are provided in Section 2. The summary of recommended systems is provided in Section 5.

In general, much HVAC equipment is past its expected service life and is in fair or poor condition. The boilers, pumps, and some newer equipment was found to be in satisfactory condition. All recommendations contained in the report will be designed to meet current Wisconsin Energy Code and will be sized according to the existing building function.

## 1.3 Overview – Senior Center

The Senior Center was originally constructed in _. Major HVAC System renovations and upgrades occurred in 1973 and 2000. Additional furnace replacement occurred in 2020, 2021, 2022, and 2024. The equipment condition and recommendations for improvements are provided in Section 4. The summary of recommended systems is provided in Section 5.

# 2 Electrical and Mechanical Condition Assessment

This assessment is based upon visual inspection and personnel interviews.

## 2.1 City Hall

### 2.1.1 Electrical Condition Assessment

#### 2.1.1.1 Electrical Service and Distribution

Overview:

Electrical service is 600A, 120/208V, 3-phase, 4-wire. With the peak demand measured in 2024 of less than 100kW, approximately half the capacity of the service. Reviewing a broader time frame of demands, the 100kW demand appeared to be an anomaly. A more realistic peak demand is below 60kW where approximately 1/3 of the service capacity was utilized.

Condition:


- The 600A service disconnect and main switchboard are beyond expected service life, and the condition is fair to poor. Availability of replacement breaker may become limited.
- The electric revenue meter is located between the service disconnect and main switchboard. This configuration does not meet current standards.
- The panelboards are beyond the expected service life and are in fair to poor condition with the exception of Panelboard A.
- Panelboard A was replaced in 2002 and is in good condition.

Recommendations:

- Reconfigure electrical service to current MG&E standards. Meter and CT cabinet should be installed between the electric utility service transformer and the service disconnect or switchboard.
- Replace 600A service disconnect and 600A main switchboard with a 600A panelboard with main breaker to serve as the service disconnect.
- Replace all panelboards with the exception of Panelboard A.
- Evaluate if Panelboard A should be replaced as part of overall electrical replacement program.
- As the main switchboard and panelboards are replaced, determine the best location for potential solar PV generation tie in points. Solar PV influences the required ratings of electrical power distribution equipment.

### 2.1.1.2 Lighting

Overview:

In general, limited issues were reported. Many fixtures have not been upgraded to LED. Certain areas were reported to have high light levels with no dimming capabilities.

Condition:

- Lighting fixtures appear to be in satisfactory condition.
- Overall, light levels were adequate.

Recommendations:

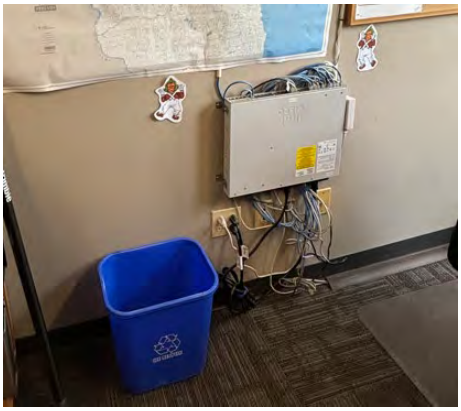
- Upgrade non-LED lighting.
- Evaluate individual areas to develop requirements for temperature/color of light and dimming needs.
- Consider performing a photometric evaluation to determine if certain areas could benefit from reconfiguration of fixture locations rather than direct fixture replacement.
- In conjunction with lighting upgrades, add receptacles to current codes at a minimum. Interview staff to identify additional location as needed.
- Utilize Focus on Energy for energy efficiency incentives.

### 2.1.1.3 Low Voltage Systems

Overview and Condition:

Security camera coverage need improvement. Networking infrastructure is adequate. Several network switches are in office spaces. Some network and security infrastructure lacks dedicated, secured space. Conference rooms and the Council Chambers have a mix to technology solutions.

Recommendations:



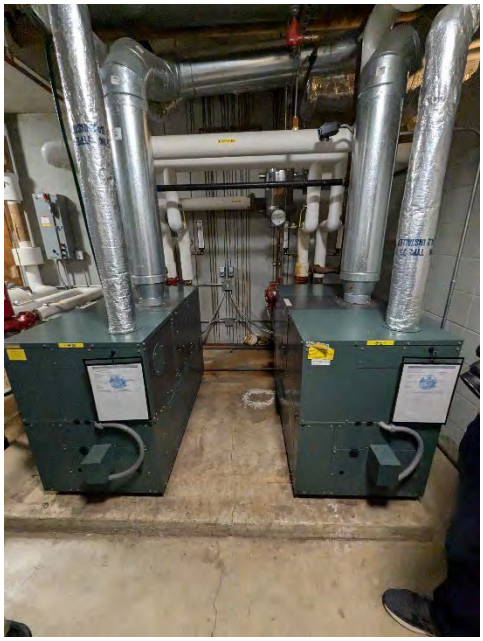
- Relocate network and security infrastructure and allocate dedicated, secure rooms.
- Evaluate equipment age to balance replacement over relocation.
- Relocate and segregate low voltage and power wiring into different raceways.
- Upgrade older technology solutions in conference rooms to match most recent conference room implementation.
- Evaluate and reconfigure technology solutions in Council Chambers to be more accommodating for the public seating in the space.
- Evaluate additional security camera coverage in addition to the public facing front entrance and desk area.

## 2.1.2 HVAC Condition Assessment

### 2.1.2.1 Boilers, B-1 & B-2

Overview:

Raypak H3-0502E Boilers, B-1 & B-2 are 500 MBH input, 425 MBH output, non-condensing natural gas boilers located in the basement. The boilers were installed in the 2002 renovation and serve the entire heating hot water system in City Hall. The boiler system is configured in a primary secondary arrangement with an inline boiler pump and dual inline system pumps.



Equipment Condition:

- Boilers appears to be in satisfactory condition and work as designed according to staff but are past their expected service life.

Recommendations:

- Level 1
  - Replace existing boilers, pumps, and accessories. Provide new high efficiency condensing boilers, pumps, and accessories in the same configuration as the existing system.
- Level 2
  - Remove boilers, associated pumps, controls and piping.
  - Provide new air-cooled heat pump air handling units to fully electrify the HVAC system, utilizing the PV Solar panels on site.
  - New DDC controls shall be compatible with campus wide control system.
- Level 3
  - Remove boilers, associated pumps, controls and piping.
  - Provide new geothermal vertical ground loop on site.
  - Provide new water cooled heat pump air handling units to fully electrify the HVAC system, utilizing the PV Solar panels on site.
  - New DDC controls shall be compatible with campus wide control system.

### 2.1.2.2 System Pumps P-3, P-4 and Boiler Circulating Pumps P-1, P-1

Overview:
Inline system pumps P-3 and P-4 serve the boiler loop associated with Boilers B-1 and B-2. Inline circulating pumps serve as the boiler circulating pumps P-1 and P-2 for each boiler. All system pumps are located in Mech Rm B06 in the basement.

Equipment Condition:

- System Pumps P-3 and P-4 appear to be in good condition.
- Boiler Pumps appear to be in good condition but display a moderate level of corrosion.
- Pumps do not include VFD modulating. System is configured for constant flow.

Recommendations:

- Level 1
  - Existing system pumps P-3, P-4, and accessories to remain.
  - Remove existing boiler circulating pumps P-1 and P-2 and replace with new pumps to match new condensing boiler flow and pressure requirements.
- Level 2
  - Remove boilers, associated pumps, controls and piping.
  - No hydronic pumps required for Level 2 recommendation (air cooled heat pumps)
- Level 3
  - Remove boilers, associated pumps, controls and piping.
  - Provide new geothermal vertical ground loop on site.
  - Provide new glycol pumps, piping, valves, accessories, and controls for new geothermal system.
  - New DDC controls shall be compatible with campus wide control system.

### 2.1.2.3 Air Handling Units; AHU-1 & CU-1 and AHU-2 & CU-2

Overview:

AHU-1 in Mech Rm B10; Carrier air handling unit with DX cooling and remote air cooled condensing unit. The unit was installed in the 2002 renovation. The system serves much of the west end of basement and first floor. The system is configured for constant variable volume operation.


AHU-2 in Mech Rm B26; Trane air handling unit with DX cooling and remote air cooled condensing unit. The unit was installed in the 2002 renovation. The system serves much of the east side of the first floor. The system is configured for variable volume operation.

Equipment Condition:

- Both units appear to be in fair condition but are past their expected service life.

Recommendations:

- Level 1
  - Remove existing air handling units and air-cooled condensing unit.
  - Provide new higher efficiency variable volume air handling units.
  - Existing ductwork to be cleaned.
- Level 2
  - Remove existing air handling units and air-cooled condensing units.
  - Provide new air cooled heat pump fan coil units. The units will be part of a VRF system with heat recovery. Enough new fan coil units will be provided such that there will be more temperature control zones than currently exist in the building.
  - Some existing ductwork, where salvageable will remain and be cleaned.
  - New DDC controls shall be compatible with campus wide control system.
- Level 3
  - Remove existing air handling units and air-cooled condensing units.
  - Provide new cooling and heating water to water heat pumps located in the mechanical room with four pipe fan coil units at the zone level. Enough new fan coil units will be provided such that there will be more temperature control zones than currently exist in the building.
  - Provide new geothermal vertical ground loop on site.
  - Provide new glycol pumps, piping, valves, accessories, and controls for new geothermal system.
  - New DDC controls shall be compatible with campus wide control system.
    - Any salvageable existing ductwork to remain and be cleaned.

#### 2.1.2.4 Fan Coil Unit & Remote Condenser, FC-1 & CU-2

Overview:

Carrier fan coil unit with DX cooling and remote air cooled condensing unit. The system serves the Mech Rm B26. The system is configured for constant volume operation.

Equipment Condition:

- The unit appears to be in fair condition but is past its expected service life.

Recommendations:

- Level 1
  - Remove existing fan coil unit and air-cooled condensing unit.
  - Provide new higher efficiency fan coil unit with DX cooling and remote air cooled condensing unit.
  - Existing ductwork to be cleaned.
- Level 2
  - Remove existing fan coil unit and air-cooled condensing unit.
  - Provide new air-cooled heat pump fan coil unit as part of a VRF system with heat recovery.
  - Any salvageable existing ductwork to remain and be cleaned.
  - New DDC controls shall be compatible with campus wide control system.
- Level 3
  - Remove existing fan coil unit, air-cooled condensing unit, and associated heating coil.
  - Provide new cooling and heating water to water heat pumps located in the mechanical room with four pipe fan coil units at the zone level. Enough new fan coil units will be provided such that there will be more temperature control zones than currently exist in the building.
  - Provide new geothermal vertical ground loop on site.
  - Provide new glycol pumps, piping, valves, accessories, and controls for new geothermal system.
  - New DDC controls shall be compatible with campus wide control system.
  - Any salvageable existing ductwork to remain and be cleaned.

#### 2.1.2.5 Powered Roof ventilators: EF-Basement Locker Rooms,

Overview:

Three powered rooftop ventilators serving the basement locker rooms, basement restrooms, and first floor West-restrooms were installed during original construction of the building. Exhaust fan EF-1 serves the first floor East-restrooms, EF-2 serves Process Room 144, and EF-3 serves Book Room 151.

Equipment Condition:

- All exhaust fans appear to be in fair or poor condition and are past their expected service life.

**Recommendations:**

- Level 1
  - Remove and replace all exhaust fans in place with new fans.
- Level 2
  - Remove existing fans.

- Provide new energy recovery ventilators to replace existing exhaust fans.
- Any salvageable existing ductwork to remain and be cleaned.
- New DDC controls shall be compatible with campus wide control system.

- Level 3
  - Remove existing fans.
  - Provide new energy recovery ventilators to replace existing exhaust fans.
  - Any salvageable existing ductwork to remain and be cleaned.
  - New DDC controls shall be compatible with campus wide control system.

### 2.1.2.6 Computer Room Air Conditioning Unit

Overview:

Carrier fan coil unit with DX cooling and remote air cooled condensing unit. The system serves the Electronics Room B31.

Equipment Condition:

- The unit appears to be in good condition and appears to have several years of service life remaining.

Recommendations:

- Level 1
  - Existing fan coil unit and air-cooled condensing unit to remain.
  - Existing ductwork to be cleaned and filter replaced.
- Level 2
  - Remove existing fan coil unit and air-cooled condensing unit.
  - Provide new air-cooled heat pump fan coil unit as part of a VRF system with heat recovery.
  - New DDC controls shall be compatible with campus wide control system.
- Level 3
  - Remove existing fan coil unit, air-cooled condensing unit, and associated heating coil.
  - Provide new cooling and heating water to water heat pumps located in the mechanical room with four pipe fan coil units at the zone level. Enough new fan coil units will be provided such that there will be more temperature control zones than currently exist in the building.

## 2.1.2.7 Variable Air Volume, VAV Boxes

### Overview:

Each VAV includes inlet damper and hot water heating coil with piping run-out and valves. Most of the VAV boxes are original to the 1992 or 2002 HVAC System Renovations and serve the majority of the offices and rooms throughout the building. Heating hot water provided for the VAV box reheat coils only operates in the winter, resulting in less controllability of humidity and lower comfort/higher humidity throughout the building. Additionally, staff have communicated that many spaces throughout the building are typically being over-cooled or over-heated. This problem is likely due to insufficient quantity of temperature controlled zones.


### Equipment Condition:

- These units appear to be in fair condition but are nearing the end of their expected service life.
- VAVs are equipped with two-way modulating valves for variable flow service.
- Staff have indicated that some of the coils and valves are leaky and/or not functional. Valves have leaked and stained ceilings resulting in the need for ceiling repairs.

**Recommendations:**

- Level 1
  - Existing functional VAV boxes will remain and should be rebalanced if needed.
  - Replace all VAV boxes that are nonfunctional or have leaky coils or valves.
  - Provide additional VAV boxes where more temperature control is needed.
- Level 2
  - Remove all VAV boxes, piping, ductwork, and accessories.
  - Provide new air-cooled heat pump fan coil units for each temperature control zone currently served by VAV boxes.
  - Any salvageable existing ductwork to remain and be cleaned.
  - New DDC controls shall be compatible with campus wide control system.
- Level 3
  - Remove all VAV boxes, piping, ductwork, and accessories.
  - Provide new water-cooled heat pump fan coil units for each temperature control zone currently served by VAV boxes.
  - Any salvageable existing ductwork to remain and be cleaned.
  - New DDC controls shall be compatible with campus wide control system.

### 2.1.2.8 Ductwork

Overview:

Galvanized steel ductwork located above ceilings. Ductwork downstream of VAV boxes is externally insulated. In general, ductwork appeared to be located and sized as indicated on the plans.

Equipment Condition:

- Ductwork is in adequate condition.

Recommendations:

- Replace, modify or re-balance existing ductwork as necessary to meet space ventilation requirements as space usage and equipment changes.

### 2.1.2.9 Finned Tube Radiation

Overview:

Finned tube radiation provides perimeter space heating throughout the building.

Equipment Condition:

- Finned tube radiation appears to be in fair condition.

Recommendations:

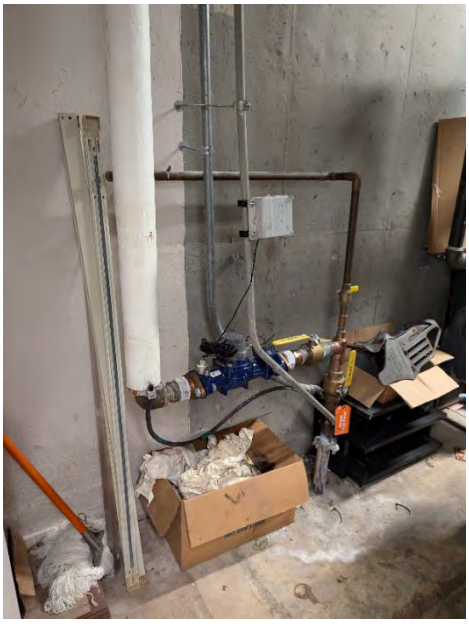
- Level 1
  - Existing finned tube radiation will remain.
- Level 2
  - Remove all hot water finned tube radiation.
  - Provide new air-cooled heat pump fan coil units for each temperature control zone currently served by finned tube radiation.
  - New DDC controls shall be compatible with campus wide control system.
- Level 3
  - Remove all hot water finned tube radiation.
  - Provide new water-cooled heat pump fan coil units for each temperature control zone currently served by finned tube radiation.
  - Existing ductwork to be cleaned.
  - New DDC controls shall be compatible with campus wide control system.

## 2.1.3 Plumbing Condition Assessment

### 2.1.3.1 Domestic Water and Sanitary Sewer Systems

Overview:

The building is served by a 2” domestic water service with water meter. Domestic water is softened with a Hellenbrand H-100 series water softener and brine tank. Domestic hot water is provided by an electric tank Ruud water heater and circulating pump. This equipment creates and transports hot water throughout the building for use in various bathrooms, kitchens, janitor rooms, etc. Water is drained from the buildings foundation to a Zoeller sump pump located in the basement.



Condition:

- The domestic water and sanitary drain waste and vent systems appear to be in satisfactory condition with no major issues. The water heater was replaced in 2016 and the sump pump was replaced in 2023.

Recommendations:

- The water heater will need replacement in the next 5-10 years. It is recommended that the replacement be a hybrid electric heat pump water heater, providing higher efficiency but at a higher upfront cost compared to a traditional electric resistive water heater.
- The building needs a set of ADA restrooms. ADA plumbing fixtures will be required when this renovation occurs.
- Replacing traditional urinals with waterless urinals can help reduce overall domestic water consumption as well as reduce the amount of wastewater leaving the building.
- To further reduce water consumption, a rain capture system can be installed to catch, treat, and store water. This non-potable water can be used in lieu of domestic water for supply to water closets in the building.
- Provide additional electric water coolers with bottle fillers.

## 2.2 Library

This assessment is based upon visual inspection and personnel interviews. No O&M documents were provided to determine past equipment failures or to quantify regular maintenance schedule.

## 2.2.1 Electrical Condition Assessment

### 2.2.1.1 Electrical Service and Distribution

Overview:

Electrical service is 1200A, 120/208V, 3-phase, 4-wire. Electric meter is located indoors on the line side of the service disconnect in accordance with modern standards. With the peak demand measured at <80 kW, the switchboard has in excess of 75% available capacity. Panelboards are aging, but have been maintained well in protected, temperature-controlled environments.

Condition:

- Electrical service switchboard is original to the 1989 building and in good-to-fair condition. Mix of legacy and modern breakers. Modern breakers are readily available in event of failure or upgrades. Remaining useful life 5-10 years if properly maintained.
- Panelboards A & B are original to building and in good-to-fair condition. A mix of legacy and modern breakers are present. Modern replacement breakers readily available. Nearly all circuits are in use. Limited expansion available within existing panelboards. Remaining useful life 10-15 years if properly maintained.
- Panelboard C was installed as part of a 2003 remodel project. Panelboard is of modern design, installed in a clean, temperature-controlled environment, and 29 spare circuits. Remaining useful life is 15-25 years
- The electrical disconnects and starters supporting legacy HVAC equipment are in fair condition and nearing the end of useful life.

Recommendations:

- If aging HVAC equipment is replaced in-kind, the electrical disconnects and starters should be opportunistically replaced.
- Additional load from electrification of HVAC or adding solar PV generation will not require replacement of the main switchboard but should be evaluated to be an opportunistic replacement as part of larger projects.
- When main switchboard is replaced, evaluate if reducing the size from 1200A to 1000A or 800A due to low utilization.
- Replacement of Panelboards A & B should be planned to be included as part of larger projects for modernization and expansion of capacity.
- As the main switchboard and panelboards are replaced, determine the best location for potential solar PV generation tie in points. Solar PV influences the required ratings of electrical power distribution equipment.

### 2.2.1.2 Lighting

Overview/Condition:

Overall, lighting was not a major concern. Lighting was upgraded to LEDs in 2019. Offices has limited or no dimming capabilities.

Recommendations:

- Add dimmers in offices where required.
- Evaluate day light sensors on first floor and available Focus on Energy incentive for implementation.

### 2.2.1.3 Low Voltage Systems


Condition:

Networking infrastructure is adequate. Some network and security infrastructure lacks dedicated, secured space. Rescue Star system in shared space with elevator equipment. Audio/video equipment for one community/conference room works well. Bluetooth sound to hearing aids does not work well.

Recommendations:

- Relocate network and security infrastructure and allocate dedicated, secure rooms.
- Evaluate need for addition community rooms audio/video upgrades similar to existing.

## 2.2.2 Mechanical Condition Assessment

### 2.2.2.1 Boilers, B-1, B-2, B-3, & B-4

Overview:

IBC Boilers, B-1, B-2, B-3, & B-4 are natural gas condensing boilers located in the basement. The boilers were installed in 2015 and serve the entire library. The boiler system is configured in a primary secondary arrangement with an inline boiler pump and dual inline system pumps.

Equipment Condition:

- Boilers appears to be in good condition and are approximately halfway through their expected service life.
- Some of the boilers appear to have had the heat exchangers replaced.


Recommendations:

- Level 1
  - Existing boilers, pumps, and accessories to remain.
  - Repair/replace existing air-cooled condensing unit.
  - Repair/replace existing VAV boxes that are leaky or nonfunctional.
- Level 2
  - Remove boilers, associated pumps, controls and piping.
  - Provide new air-cooled heat pump air handling units to fully electrify the HVAC system, utilizing the PV Solar panels on site.
  - New DDC controls shall be compatible with campus wide control system.
- Level 3
  - Remove boilers, associated pumps, controls and piping.
  - Provide new geothermal vertical ground loop on site.
  - Provide new glycol pumps, piping, valves, accessories, and controls for new geothermal system.
  - New DDC controls shall be compatible with campus wide control system.

### 2.2.2.2 System Pumps: P-1, P-2

Overview:

Inline system pumps P-1 and P-2 serve the boiler loop associated with Boilers B-1, B-2, B-3, and B-4. Inline circulating pumps serve as the boiler circulating pumps each boiler. All system pumps are located in Mechanical/Electrical Room 008 in the basement.

Equipment Condition:

- System Pumps P-1 and P-2 appear to be in good condition.
- Boiler Pumps appear to be in good condition.
- Pumps do not include VFD modulating. System is configured for constant flow.

Recommendations:

- Level 1
  - Existing pumps, and accessories to remain.
- Level 2
  - Remove boilers, associated pumps, controls and piping.
  - No hydronic pumps required for Level 2 recommendation (air cooled heat pumps)
- Level 3
  - Remove boilers, associated pumps, controls and piping.
  - Provide new geothermal vertical ground loop on site.
  - Provide new glycol pumps, piping, valves, accessories, and controls for new geothermal system.
  - New DDC controls shall be compatible with campus wide control system.

### 2.2.2.3 Air Handling Units; AHU-1 & CU-1 (Mech Rm 028) and AHU-1 & CU-1 (Mech Rm 008)

Overview:

AHU-1 in Mech Rm 008; Carrier air handling unit with DX cooling and remote air cooled condensing unit. The unit was installed originally with the building in 1992. The unit is interlocked with exhaust fan PRV-2. The system serves much of the basement as well as the first floor open reading area. The system is configured for constant variable volume operation.

AHU-1 in Mech Rm 028; Trane air handling unit with DX cooling and remote air cooled condensing unit. The unit was installed in the 2004 building renovation. The system serves much of the east side of the basement. The system is configured for constant volume operation.

Equipment Condition:

- Both units appear to be in fair condition but are past their expected service life.
- The associated air cooled condensing unit paired with the older AHU-1 is currently not fully operational and needs repair or replacement.

Recommendations:

- Level 1
  - Remove existing air handling units and air-cooled condensing unit.
  - Provide new higher efficiency variable volume air handling units.
  - Existing ductwork to be cleaned.
- Level 2
  - Remove existing air handling unit and air-cooled condensing unit.
  - Provide new air cooled heat pump fan coil units. The units will be part of a VRF system with heat recovery. Enough new fan coil units will be provided such that there will be more temperature control zones than currently exist in the building.
  - Some existing ductwork, where salvageable will remain and be cleaned.
  - New DDC controls shall be compatible with campus wide control system.
- Level 3
  - Remove existing air handling units and air-cooled condensing units.
  - Provide new cooling and heating water to water heat pumps located in the mechanical room with four pipe fan coil units at the zone level. Enough new fan coil units will be provided such that there will be more temperature control zones than currently exist in the building.
  - Provide new geothermal vertical ground loop on site.
  - Provide new glycol pumps, piping, valves, accessories, and controls for new geothermal system.
  - New DDC controls shall be compatible with campus wide control system.
    - Any salvageable existing ductwork to remain and be cleaned.

#### 2.2.2.4 Fan Coil Unit & Remote Condenser, FC-1 & CU-2

Overview:

Carrier fan coil unit with DX cooling and remote air cooled condensing unit. The unit is interlocked with exhaust fan PRV-1. The system serves the Meeting/Music Room 006. The system is configured for constant volume operation.

Equipment Condition:

- The unit appears to be in fair condition but is past its expected service life.

Recommendations:

- Level 1
  - Remove existing fan coil unit, air-cooled condensing unit, and associated heating coil.
  - Provide new fan coil unit with DX cooling and remote air cooled condensing unit.

  - Provide new associated hot water heating coil.
  - Existing ductwork to be cleaned.
- Level 2
  - Remove existing fan coil unit, air-cooled condensing unit, and associated heating coil.
  - Provide new air-cooled heat pump fan coil unit as part of a VRF system with heat recovery.
  - Existing ductwork to be cleaned.
  - New DDC controls shall be compatible with campus wide control system.
- Level 3
  - Remove existing fan coil unit, air-cooled condensing unit, and associated heating coil.
  - Provide new cooling and heating water to water heat pumps located in the mechanical room with four pipe fan coil units at the zone level. Enough new fan coil units will be provided such that there will be more temperature control zones than currently exist in the building.
  - Provide new geothermal vertical ground loop on site.
  - Provide new glycol pumps, piping, valves, accessories, and controls for new geothermal system.
  - New DDC controls shall be compatible with campus wide control system.
  - Any salvageable existing ductwork to remain and be cleaned.

### 2.2.2.5 Powered Roof Ventilators: EF-1, EF-2, PRV-1, and PRV-2

Overview:

Powered rooftop ventilators, EF-1 and EF-2, serve the elevator equipment room and mechanical room respectively. PRV-1 serves the basement level meeting/music room and restrooms, and PRV-2 serves the first floor restrooms.

Equipment Condition:

- These units appear to be in fair condition and are operating as designed.

**Recommendations:**

- Level 1
  - Existing fans will remain and should be rebalanced if needed.
- Level 2
  - Remove existing fans.
  - Provide new energy recovery ventilators to replace existing exhaust fans.
  - Existing ductwork to be cleaned.
  - New DDC controls shall be compatible with campus wide control system.
- Level 3
  - Remove existing fans.
  - Provide new energy recovery ventilators to replace existing exhaust fans.
  - Existing ductwork to be cleaned.
  - New DDC controls shall be compatible with campus wide control system.

### 2.2.2.6 Variable Air Volume, VAV Boxes

Overview:

Each VAV includes inlet damper and hot water heating coil with piping run-out and valves.

VAV boxes are original to the 2004 HVAC System Renovations and serve the majority of the offices and rooms throughout the building.

Equipment Condition:

- These units appear to be in fair condition but are nearing the end of their expected service life.
- VAVs are equipped with two-way modulating valves for variable flow service.
- Staff have indicated that some of the coils and valves are leaky and/or not functional. Valves have leaked and stained ceilings resulting in the need for ceiling repairs.

**Recommendations:**

- Level 1
  - Existing functional VAV boxes will remain and should be rebalanced if needed.
  - Replace all VAV boxes that are nonfunctional or have leaky coils or valves.
- Level 2
  - Remove all VAV boxes, piping, ductwork, and accessories.
  - Provide new air-cooled heat pump fan coil units for each temperature control zone currently served by VAV boxes.
  - Existing ductwork to be cleaned.
  - New DDC controls shall be compatible with campus wide control system.
- Level 3
  - Remove all VAV boxes, piping, ductwork, and accessories.
  - Provide new water-cooled heat pump fan coil units for each temperature control zone currently served by VAV boxes.
  - Existing ductwork to be cleaned.
  - New DDC controls shall be compatible with campus wide control system.

### 2.2.2.7 Ductwork

Overview:

Galvanized steel ductwork located above ceilings. Ductwork downstream of VAV boxes is externally insulated. In general, ductwork appeared to be located and sized as indicated on the plans.

Equipment Condition:

- Ductwork is in adequate condition.

Recommendations:

- Replace, modify or re-balance existing ductwork as necessary to meet space ventilation requirements as space usage and equipment changes.

### 2.2.2.8 Finned Tube Radiation

Overview:

Finned tube radiation provides perimeter space heating throughout the building.

Equipment Condition:

- Finned tube radiation appears to be in fair condition.

Recommendations:

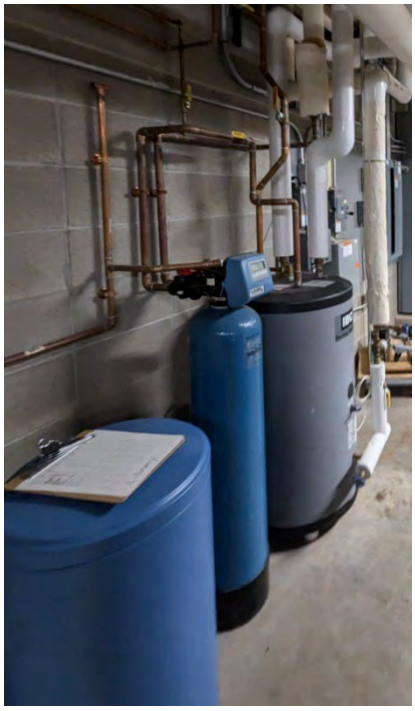
- Level 1
  - Existing finned tube radiation will remain.
- Level 2
  - Remove all hot water finned tube radiation.
  - Provide new air-cooled heat pump fan coil units for each temperature control zone currently served by finned tube radiation.
  - New DDC controls shall be compatible with campus wide control system.
- Level 3
  - Remove all hot water finned tube radiation.
  - Provide new water-cooled heat pump fan coil units for each temperature control zone currently served by finned tube radiation.
  - Existing ductwork to be cleaned.
  - New DDC controls shall be compatible with campus wide control system.

## 2.2.3 Plumbing Condition Assessment

### 2.2.3.1 Domestic Water and Sanitary Sewer Systems

Overview:

The building water service provides water for the fire sprinkler system and 2.5" domestic water system. The domestic water is softened with a Hellenbrand H-100 series water softener and brine tank. Domestic hot water is provided via an indirect water heater. This unit exchanges heat from the hydronic heating hot water system. This equipment creates and transports hot water throughout the building for use in various bathrooms, janitor rooms, etc. Water is drained from the building's foundation to a Zoeller sump pump located in the basement.



Condition:

- The domestic water and sanitary drain waste and vent systems appear to be in satisfactory condition with no major issues. The indirect water heater was installed in 2015 and the sump pump was replaced in 2023.
- Staff have communicated low pressure issues with the existing domestic hot water system.

Recommendations:

- If the existing hydronic heating hot water system is removed, it is recommended that the indirect water heater be replaced with a hybrid electric heat pump water heater, providing higher efficiency but at a higher upfront cost compared to a traditional electric resistive water heater.
- To achieve proper domestic water pressure throughout the building, some of the existing domestic water piping can be upsized and/or a water booster pumping system can be added.
- The restrooms have recently been renovated with new commercial plumbing fixtures.
- Replacing traditional urinals with waterless urinals can help reduce overall domestic water consumption as well as reduce the amount of wastewater leaving the building.
- To further reduce water consumption, a rain capture system can be installed to catch, treat, and store water. This non-potable water can be used in lieu of domestic water for supply to water closets in the building.
- Provide additional electric water coolers with bottle fillers.

# 2.3 Senior Center

This assessment is based upon visual inspection and personnel interviews.

## 2.3.1 Electrical Condition Assessment

### 2.3.1.1 Electrical Service and Distribution

Overview:

Electrical service is 600A, 120/208V, 3-phase, 4-wire. Electric meter is located indoors on the line side of the service disconnect in accordance with modern standards. With the peak demand measured at ~50 kW, the main panelboard has in excess of 75% available capacity. Panelboards are modern, but have been maintained well in protected, temperature-controlled environments.

Overall, power distribution equipment is in very good condition.

Condition:

- Main panelboard was installed around 2000 and is in good condition. Mix of legacy and modern breakers. Modern breakers are readily available in event of failure or upgrades. Remaining useful life 20-30 years if properly maintained.
- Panelboards were also installed around 2000 and in good condition. Modern replacement breakers readily available. Remaining useful life 20-30 years if properly maintained.

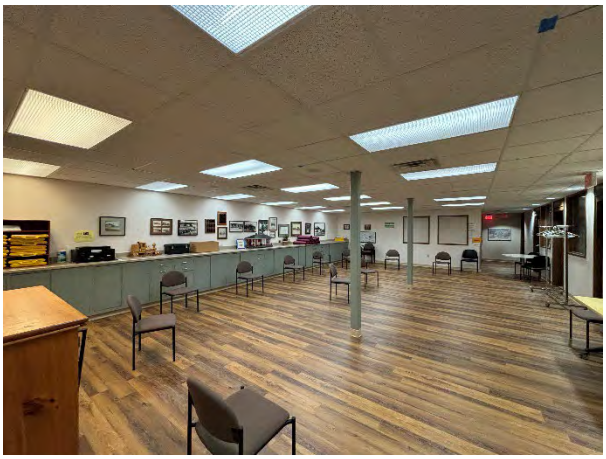
Recommendations:

- Power distribution has excess capacity to support electrification of HVAC and integration of solar PV generation.

### 2.3.1.2 Lighting

Overview/Condition:

Lighting was a mix of LED and traditional fixtures. Lighting in basement was reported for have issues.



Recommendations:

- Upgrade traditional lighting with LED equivalents.
- Evaluate issues in basement to determine solution such as additional fixture or existing problems need addressed.

#### 2.3.1.3 Low Voltage Systems

Condition:

Networking infrastructure is adequate. Network and security wiring were well segregated from power wiring. No RFID fobs are utilized. Security video is recorded but no alarm system is available. The tenant space has no network connectivity.

Recommendations:

- Evaluate providing a door access control system.
- Perform a needs assessment for an alarm system.
- Extent networking connectivity to tenant space.

## 2.3.2 Mechanical Assessment

### 2.3.2.1 Furnaces F-1, F-2, F-3, F-4, F-5, F-6, & F-7 and Air Cooled Condensing Units

Overview:

Carrier Furnaces, F-1 thru F-7 are gas fired furnaces located in mechanical rooms paired with condensing units located on the roof. These units have been installed in 2020, 2021,2022, and 2024. Staff have communicated that some spaces are being overcooled and generally the building has poor air quality.

Equipment Condition:

- Most of the furnaces are in good condition and have been replaced recently. Some of the furnaces are equipped with humidifiers and/or ionizing air purifiers.


Recommendations:

- Level 1
  - Provide additional air cooled heat pumps providing additional zones to reduce over-cooling issues.
  - Replace existing exhaust fans and outside air ducts with energy recovery ventilators. This will allow for much more outside air to be delivered to the spaces while also recovering energy from the exhaust air.
  - Provide air purifiers for all air systems.
- Level 2
  - Remove all furnaces and air cooled condensing units.
  - Replace existing exhaust fans and outside air ducts with energy recovery ventilators. This will allow for much more outside air to be delivered to the spaces while also recovering energy from the exhaust air.
  - Provide new air-cooled heat pump air handling units to fully electrify the HVAC system, utilizing the PV Solar panels on site.
  - Provide air purifiers for all air systems.
  - New DDC controls shall be compatible with campus wide control system.

- Level 3
  - Remove all furnaces and air cooled condensing units.
  - Replace existing exhaust fans and outside air ducts with energy recovery ventilators. This will allow for much more outside air to be delivered to the spaces while also recovering energy from the exhaust air.
  - Provide new geothermal vertical ground loop on site.
  - Provide new water cooled heat pump air handling units to fully electrify the HVAC system, utilizing the PV Solar panels on site.
  - Provide air purifiers for all air systems.
  - New DDC controls shall be compatible with campus wide control system.

## 2.3.3 Plumbing Condition Assessment

### 2.3.3.1 Domestic Water and Sanitary Sewer Systems

Overview:

The building is served by a 2" domestic water service with water meter. Domestic water is softened with Capital water softeners and brine tank. Domestic hot water is provided by a natural gas tank style Ruud water heater and circulating pump. This equipment creates and transports hot water throughout the building for use in various bathrooms, kitchens, janitor rooms, etc.


Condition:

- The domestic water and sanitary drain waste and vent systems appear to be in satisfactory condition with no major issues. The water heater was replaced in 2018.
- Staff have communicated issues regarding sewage backups in the basement.

Recommendations:

- The water heater will need replacement in the next 5-10 years. It is recommended that the replacement be a hybrid electric heat pump water heater, providing higher efficiency but at a higher upfront cost compared to a traditional electric resistive water heater.
- Replacing traditional urinals with waterless urinals can help reduce overall domestic water consumption as well as reduce the amount of wastewater leaving the building.
- To further reduce water consumption, a rain capture system can be installed to catch, treat, and store water. This non-potable water can be used in lieu of domestic water for supply to water closets in the building.
- Provide additional electric water coolers with bottle fillers.
- Provide a backwater valve on the sanitary piping exiting the building to prevent future sewage backups.

# 3 Summary of Recommended Systems

## 3.1 Level 1 Upgrades – No Major Changes in Equipment Type

Overview:

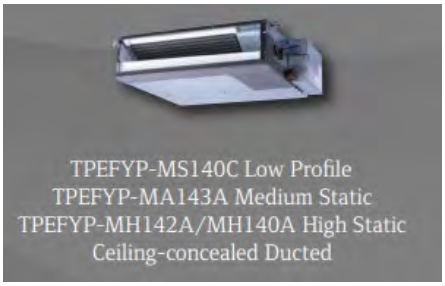
Replacing existing equipment that is past or near the end of its expected service life will provide slightly higher system efficiency at a relatively low cost. Much of the savings are obtained from keeping the existing ductwork and piping. By cleaning the existing ductwork, adding air purification, increasing outside air, and adding temperature controlled zones would increase overall comfort and air quality

## 3.2 Level 2 Upgrades – Air Cooled VRF Heat Pumps

Overview:

Installing Air Cooled VRF Heat Pumps will require removal and replacement of the existing HVAC equipment. This can potentially eliminate all gas-fired equipment, fully electrifying the HVAC system to utilize the PV solar panels on site. It's anticipated that some of the existing ductwork can be salvaged if most of the temperature controlled zones remain unchanged. The amount of equipment in mechanical rooms is greatly reduced with this system. The primary equipment consists of zone level fan coil units or ceiling cassette units tied connected to outdoor heat pump condensing units. No large central air handling units are required, but much smaller energy recovery ventilators or fan coil units will need to be provided to distribute outside air to each zone.






Total cost of the air cooled VRF system is estimated to be between $70 - $90 per square foot of building. Total cost is largely dependent on quantity of zones.

## 3.3 Level 3 Upgrades – Water to Water Geothermal Heat Pumps


Overview:

Installing a geothermal system will require removal and replacement of the existing HVAC equipment. The existing system would be modified to include a new geothermal vertical ground loop system, glycol pumps and accessories, distributed water source heat pumps, and other equipment. The geothermal ground loops would be centralized at City Hall or the Library, with the system glycol pumps located in the mechanical room. Each building would have between 3-6 Water to Water heat pump units located in respective building mechanical rooms. These heat pumps would provide hydronic heating and cooling water to zone level fan coil units. To provide optimal zoning, a combination of cassette fan coil units can be located in individual offices and ducted fan coil units can serve zones consisting of more than one room.

AirStream™ 42WKN Hydronic Cassette Fan Coil Units

0.75 to 3 Tons
ETL Listed

**42DE**

**Ceiling model with galvanized casing for ducted applications. Standard units are constructed with 18 gauge galvanized steel and are provided with a galvanized finish. (600-2000 cfm)**

Total cost of the geothermal system is estimated to be between $100 - $150 per square foot of building. Savings are highly dependent on location and soil type. Dense soils conduct heat better and will provide better performance. In addition, a significant amount of land is required to absorb and reject heat from the facility and backup heating/cooling systems may be required. It is anticipated that approximately 25,000 to 50,000 square feet of land may be required for the well field. Furthermore, the following should be considered.

a. Geothermal system will have a higher installed cost and will require a significant retrofit.
b. Geothermal systems are more complex and require a higher level of maintenance than traditional heating systems.
c. Some soils work better than others. In addition a significant amount of land is required for the well field.
d. Savings are dependent on price of natural gas vs. the price of electricity.

e. Backup heating and cooling systems may be required.

Below is a site map with potential locations for geothermal vertical ground loops highlighted in blue. Ideally the geothermal grid would be all in one concise location. However, if one of these areas is insufficient in size, this system is still feasible but would be decentralized and require additional equipment.


It is anticipated that annual energy savings may be in the range of 20%- 40%. It should be noted that this range is highly dependent on site conditions as well as gas and electric utility rates and should only be used as a guide to help determine if geothermal systems are feasible and/or desired by the City of Middleton. A more thorough and accurate analysis will require energy modeling of the facility as well as detailed analysis of soil conditions and other site specific factors. If the capital costs are deemed to be feasible, and the City would like to further explore geothermal systems, it is recommended that the facility be modeled using energy analysis software to achieve a detailed energy savings rate. With this information, an accurate return on investment can be determined.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