MINNEAPOLIS PUBLIC SCHOOLS
Urban Education. Global Citizens.

**Minneapolis Public Schools**
Special School District #1

# Air Conditioning Cost Estimating Study Kenny Community School


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# APPENDIX

## INTRODUCTION / KEY INFORMATION:

Wold Architects and Engineers was hired May 2021 to develop options with a recommended approach and construction cost estimate to expand the air conditioned area at Kenny Community School. The study also reviewed dehumidification capabilities and outlines additional work necessary to provide active dehumidification control. The study approach included a tour of the building site, review of available building construction documents, and a review of previous ventilation studies. Wold collaborated with the District's facility leadership team to establish criteria and guiding principles for developing options and to determine the recommended approach. Cost estimates are developed to reflect construction bids to be received on January 1, 2022 and includes a semi-annual cost inflation escalation to extend bids to January 1, 2025. .

### Key Information:

- Building Address: **Kenny Community School**
  **Minneapolis Public Schools**
  5720 Emerson Ave. S.
  Minneapolis, MN 55419
  Phone: (612) 668-3340
- Architect/Engineers: **Wold Architects and Engineers**
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  St. Paul, MN 55101
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- Study Participants: **Participants**
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## EXECUTIVE SUMMARY:

Wold Architects and Engineers completed a study to determine the recommended approach and project budget to expand the air conditioned area at the Kenny Community School. The options developed are organized around the priorities established by the District based on the use of each space and by grouping areas within each building geographically as served by common systems. In collaboration with the District, the recommendation was developed to serve the highest priority areas within the overall budget constraints. In addition, the building as a whole was evaluated to determine additional features and systems that are required to provide active dehumidification control.

### Criteria / Guiding Principles:

Initial discussions provided a common understanding of the guiding principles to be used to develop options and a hierarchy of priorities based on the use of each space.

Guiding Principles:

- High quality proven system solutions preferred
- Systems shall be easy to operate and maintain
- A high level of temperature zone control required
- Centralized systems preferred
- Vertical unit ventilators may be an option depending on site factors
- DX or chilled water may be options depending on site factors
- Separate systems to serve administration areas should be considered
- COVID risk mitigation measures to focus on ventilation and filtration
- Window AC unit are not an option. Mini-splits may be is limited applications
- Heating for systems may be steam or hot water depending on site factors
- Systems shall be configured to allow for active dehumidification

Air-conditioning classrooms is the primary goal of this study. Additional spaces may be considered where possible within the overall budget constraints. Options were considered where space adjacencies allow opportunities to economically include additional areas. Gymnasiums are not typically air-conditioned but options were considered where they are central to a building and/or used as gathering spaces. It is not an intended outcome of the study to add ventilation and air conditioning to all spaces where it does not currently exist. The summary diagrams for each building identify the remaining unconditioned areas.

In addition, opportunities within each option were determined to provide added value scope where it is economically feasible to accomplish additional deferred maintenance needs within the scope of the air conditioning project i.e. ceilings, lights, and other room finishes.

**Recommended Scope Summary:**

Classrooms Building Areas #1, #2, #3, #4, and #5 (45,585 Sq Ft): Install a new dedicated outside air ventilation system with perimeter displacement and chilled beams air delivery. Install an air-cooled chiller on grade to serve the system cooling needs. The existing boilers will be converted to hot water and all existing steam systems will be replaced or converted. Install a high efficiency boiler for summer operation. The base project includes routing supply ductwork exposed within the classrooms and similar areas.

For consideration, an added scope option is included for providing a new lay-in ceiling and new LED lighting and controls. A perimeter soffit is included as may be required to accommodate the height of the exterior windows.

The cost estimate includes a design contingency to cover risks identified that require further investigation. Identified risks include the following:

- Space heating and cooling loads are estimated to determine preliminary equipment selections as a basis for cost estimating. Final heating and cooling loads need to be completed.
- Determining pathways for horizontal duct distribution that minimizes the impact to other building systems and finishes.
- Adequacy of the existing structure to support the new rooftop unit. Resolution of this risk requires a specific air handling unit selection and an analysis by a structural engineer.
- Modification to perimeter casework and finishes are included only as necessary for the mechanical systems installation.
- Location of proposed air-cooled chiller and necessary site restoration.

**Construction Cost Estimate: $ 6,160,000**
**Add for Ceiling and Lights: $ 729,000**

## EXISTING BUILDING INFORMATION

The original building was constructed in 1954. A six classroom addition was added in 1957. Portable classrooms were added in 1962. A Media Center addition was added and 2000.

There is not a centralized cooling plant. The Media Center and adjacent computer lab are served by a 4 zone multi-zone unit installed in 2000 with DX cooling. A packaged rooftop unit installed in 1997 cools the office area. The Gymnasium and adjacent locker rooms are cooled by two fan coil unit installed in 1997. There are several window AC units throughout the building.

The building is heated with two large dual fuel fire tube steam boilers.

A complete summary of the existing building systems is shown graphically in Appendix A.

### Building Area Summary:

| Year | Area (sq. ft.) |
|---|---|
| 1953 | 47,443 |
| 1957 | 8,354 |
| 2000 | 1,933 |
| **Total** | **57,730** |

## AIR CONDITIONING OPTIONS SUMMARY

The Primary driver of the overall project scope and budget is the decision about the air delivery method. The size of the equipment and the configuration within the building affects the work scope of multiple trades to provide pathways for ductwork and piping and to restore building finishes. With each air delivery method, there are multiple options to provide cooling and multiple options to provide heating which typically are part of the overall building central heating and cooling plant strategy. There are long-term benefits to the overall maintenance and operation of the facility to consider the heating and cooling approach for each air delivery option within the overall plan for the central heating and cooling plants that serve the building.

The range of air delivery options presented in this summary are narrowed to those that fit the District's criteria that includes centralizing systems to the extent possible to minimize regular and periodic maintenance. These options typically include vertical unit ventilators, variable air volume central air handling, and dedicated outside air displacement systems. The full range of options are discussed in more detail in the "Air Conditioning Options Detail" section of this report.

In addition to the first cost, the attributes of each system also have an effect on the quality of the learning environment and the on-going operational costs related to energy efficiency and the requirements for regular and periodic maintenance. As an aid for discussion, each of the air delivery options presented are rated relative to each other in terms of good, better, best in each of these performance categories as follows.

| Attribute | Vertical Unit Vents | Central VAV | DOAS / Displacement |
|---|---|---|---|
| Environment Quality | Good | Better | Best |
| Energy Efficiency | Good | Better | Best |
| Maintenance | Good | Better | Best |

A summary of the cost range for viable options for each of the air delivery methods is as follows. The options prioritize adding cooling to the classrooms and are summarized in total to cover all of the currently unconditioned classrooms in the building. Other areas that may include gymnasiums, auditoriums or other common areas are listed separately. All cost are presented as construction costs.

Vertical Unit Ventilators:

Install a vertical unit ventilator along the perimeter of each classroom. The work will include installing a new exterior louver through either a window or cutting a louver through the exterior wall. The range of costs includes is defined by the following approach to heating and cooling.

Low Cost Option: Integral DX, Modify existing steam system

Medium Cost Option: Air-cooled chiller, Modify existing steam system

High Cost Option: Air-cooled chiller, Convert existing boilers to HW

| Vertical Unit Ventilators | | | | | |
|---|---|---|---|---|---|
| **Building Area** | **Serves** | **Area SF** | **Construction Budget** | | |
| | | | **Low** | **Medium** | **High** |
| #1 | Classrooms | 16,875 | | | |
| #2 | Classrooms | 15,150 | | | |
| #3 | Classrooms | 6,280 | | | |
| #4 | Classrooms | 3,185 | | | |
| #5 | Classrooms | 4,095 | | | |
| **Total** | | **45,585** | **$1,769,800** | **$2,461,000** | **$4,457,900** |

Central Variable Air Volume:

Install a variable central air handling system in each of the building areas. The units will be mounted on the roof. Multiple units will be needed as necessary for each wing of the building to minimize the size of the duct mains and work within the structural constraints. The capacity of the existing structure requires further investigation. The construction budget includes an allowance as a placeholder for necessary structural work pending further investigation.

Low Cost Option: Remote DX, Modify existing Steam System, Cooling only VAV's

Medium Cost Option: Remote DX, HW Convertor

High Cost Option: Air-cooled chiller, Convert existing boilers to HW

| Central Variable Air Volume | | | | | |
|---|---|---|---|---|---|
| **Building Area** | **Serves** | **Area SF** | **Construction Budget** | | |
| | | | **Low** | **Medium** | **High** |
| #1 | Classrooms | 15,375 | | | |
| #2 | Classrooms | 17,425 | | | |
| #3 | Classrooms | 6,280 | | | |
| #4 | Classrooms | 3,185 | | | |
| #5 | Classrooms | 4,095 | | | |
| **Total** | | **45,585** | **$3,525,500** | **$4,111,200** | **$4,786,300** |

Dedicated Outside Air/Displacement:

Install a central dedicated outside air system to serve all classroom areas. The units will be mounted on the roof. Multiple units may be needed to minimize the size of the duct mains and work within the structural constraints. The capacity of the existing structure requires further investigation. The construction budget includes an allowance as a placeholder for necessary structural work pending further investigation.

Low Cost Option: Displacement requires both chilled and hot water. Work is necessarily required on the central heating plant.

Medium Cost Option: Displacement requires both chilled and hot water. Work is necessarily required on the central heating plant.

High Cost Option: Air-cooled chiller, Convert existing boilers to HW

| **Dedicated Outside Air / Displacement** | | | | | |
|---|---|---|---|---|---|
| **Building Area** | **Serves** | **Area SF** | **Construction Budget** | | |
| | | | **Low** | **Medium** | **High** |
| #1 | Classrooms | 15,375 | N/A | N/A | |
| #2 | Classrooms | 17,425 | N/A | N/A | |
| #3 | Classrooms | 6,280 | N/A | N/A | |
| #4 | Classrooms | 3,185 | N/A | N/A | |
| #5 | Classrooms | 4,095 | N/A | N/A | |
| **Total** | | **45,585** | N/A | N/A | **$6,160,000** |

Additional Scope:

Additional work that may be considered with each of these options includes the following:

New Ceilings and LED Lights: **Construction Budget** **$ 729,000**

## AIR CONDITIONING SCOPE DETAIL

The following options to expand air conditioning are noted as "Building Area #'s". The area to be air-conditioned is annotated on the Proposed Systems Diagrams in Appendix B.

**Building Area 1 - South Classrooms (16,875 Sq. Ft.):** The following is a summary of the range of possible options considered.

Options Summary:

| Building Area | Air Delivery Method | Cooling Plant | Heating Plant | Option |
|---|---|---|---|---|
| 1 - South Classrooms | A - Mini-Split | B - Remote DX | A - None | 1-ABA |
| | B - Vertical Unit Ventilators | A - Integral DX | B - Steam | 1-BAB |
| | | | C - Hot Water | 1-BAC |
| | | B - Remote DX | B - Steam | 1-BBB |
| | | | C - Hot Water | 1-BBC |
| | | C - Chilled Water | B - Steam | 1-BCB |
| | | | C - Hot Water | 1-BCC |
| | C - Central VAV | B - Remote DX | B - Steam | 1-CBB |
| | | | C - Hot Water | 1-CBC |
| | | C - Chilled Water | B - Steam | 1-CCB |
| | | | C - Hot Water | 1-CCC |
| | D - DOAS | C - Chilled Water | C - Hot Water | 1-DCC |

Notes: * There are multiple central plant options for chilled and hot water. Refer to the Central Plant section of this report.

Air Delivery: The original 1953 building construction and subsequent 1957 addition installed horizontal unit ventilators typically for the classroom areas. The unit ventilators are located along the perimeter built into casework along the perimeter with integral steam finned tube radiation. Steam and condensate are distributed through the tunnel directly below. The following outlines possible new air delivery methods:

*Mini-split:* The systems would be installed while leaving the existing heating and ventilation systems in place. Because unconditioned ventilation air is delivered to the space through the existing unit ventilator, there is a risk of creating high humidity conditions.

*Vertical Unit Ventilators:* Install new vertical unit ventilators to replace the existing central air handling system. Modifications will be required to install a new louver through a window on the exterior wall and to perimeter casework and steam finned tube radiation.

*Central Variable Air Volume (VAV):* Install a new roof mounted air handling unit with ductwork distributed below the structure to serve the individual temperature control zones. The intent would be to route as much of the main ductwork and associated variable air volume boxes in the corridor to the extent possible. Soffits and ceilings should be considered as part of the final design to minimize sound and improve air distribution.

*Dedicated Outside Air (DOAS):* Options for locating a new DOAS unit are similar to locating the VAV unit as describe above. The advantage of a DOAS unit is that the volume of air it is moving is approximately 1/3 as compared to the VAV system. The equipment and associated ductwork are smaller and easier to retrofit.

Cooling Plant: Viable options studied include integral packaged DX, remote DX, and construction of a new central chilled water plant. The tight site and proximity to the neighboring residential areas presents challenges in designing new equipment to meet the noise criteria at the property line. The following outlines possible cooling plant options:

*Integral Direct Expansion (DX):* Integral DX is an option with the vertical unit ventilators and there is precedent with this type of system in the District. Design considerations need to include meeting the classroom ambient sound levels. Integral cooling systems have an impact on future maintenance by distributing possible failure points of the system.

*Remote Direct Expansion (DX):* Remote DX is an option for mini-split systems and vertical unit ventilators. The condensing units can be located directly above each space on the roof.

*Chilled Water:* There are multiple options to generate chilled water to meet the cooling needs of the building. Refer to the central plant options in this report for a discussion of each.

Heating Plant: Viable options include leaving the existing steam systems in place and installing a cooling only system, connecting to the existing steam plant, installing a steam to hot water convertor, or installing a new high efficiency hot water plant. The following outlines possible heating plant options.

*Steam:* The building is currently heated by two large dual fuel steam fire tube boilers. The steam options includes modifying steam and condensate distribution piping to accommodate the new systems.

*Hot Water HX:* Includes the installation of a new steam-to-hot water heat exchanger, pumps and distribution system to deliver hot water to the new systems. Hot water distribution piping is more flexible to route to location as necessary than steam piping. The installation of a heat exchanger will easily accommodate future conversion of the stem plant to hot water.

*Hot Water Plant:* There are multiple options to generate hot water to meet the heating needs of the building. Refer to the central plant options in this report for a discussion of each.

Dehumidification: Active dehumidification requires a heating source that is currently not available with the existing steam plant during the summer months. Options for active dehumidification will depend on the extent of hot water that is installed with the new systems. If hot water distribution is included as the heating source, the heating coils will be located in the reheat position downstream of the cooling coils. If hot water is generated through a steam-to-hot water convertor, then reheat will only be possible when the steam boiler is in operation. An option to extend the time that hot water is available is to add a small high efficiency gas boiler. If the project include replacing the steam plant, the boiler capacity would be selected to provide adequate turn down during low load periods.

Project Risks: The following are design risks identified in implementing this project. The cost estimate includes a 15% design contingency to cover these risks. Further investigation into each of these could better define the solution and allow the design contingency to be reduced.

- Determine structural constraints. Roof mounted remote condensing units will need to be reviewed for structural limitations. Further structural investigation is required.
- Space heating and cooling loads are estimated based on typical loads for this type of space. Final heating and cooling loads need to be completed.
- Integrity of the existing steam and condensate systems for options that include steam heating. Piping in poor condition may necessitate additional pipe removal. The best method to mitigate this risk is to pursue the hot water heating solution as outlined in the heating section above.

Additional Scope Considerations: The following items could be considered for inclusion in the project work scope. These items are not directly related to adding air conditioning but there would be cost efficiency by including them in the project scope and the have added value as noted.

- *Provide new ceilings and lights:* Provide new lay-in ceilings typically throughout with new LED lighting and controls. With the vertical unit ventilator options, new ceilings would allow for the air distribution above the ceiling to reduce the system noise. The ceiling condition likely will require a soffit along the exterior walls to accommodate the existing windows elevations.

Typical Photos:

**Room 107**

**Building Area 2 - West Classrooms (15,150 Sq. Ft.):** The following is a summary of the range of possible options considered.

Options Summary:

<table>
<tr><th>Building Area</th><th>Air Delivery Method</th><th>Cooling Plant</th><th>Heating Plant</th><th>Option</th></tr>
<tr><td rowspan="12">2 - West Classrooms</td><td>A - Mini-Split</td><td>B - Remote DX</td><td>A - None</td><td>2-ABA</td></tr>
<tr><td rowspan="6">B - Vertical Unit Ventilators</td><td rowspan="2">A - Integral DX</td><td>B - Steam</td><td>2-BAB</td></tr>
<tr><td>C - Hot Water</td><td>2-BAC</td></tr>
<tr><td rowspan="2">B - Remote DX</td><td>B - Steam</td><td>2-BBB</td></tr>
<tr><td>C - Hot Water</td><td>2-BBC</td></tr>
<tr><td rowspan="2">C - Chilled Water</td><td>B - Steam</td><td>2-BCB</td></tr>
<tr><td>C - Hot Water</td><td>2-BCC</td></tr>
<tr><td rowspan="4">C - Central VAV</td><td rowspan="2">B - Remote DX</td><td>B - Steam</td><td>2-CBB</td></tr>
<tr><td>C - Hot Water</td><td>2-CBC</td></tr>
<tr><td rowspan="2">C - Chilled Water</td><td>B - Steam</td><td>2-CCB</td></tr>
<tr><td>C - Hot Water</td><td>2-CCC</td></tr>
<tr><td>D - DOAS</td><td>C - Chilled Water</td><td>C - Hot Water</td><td>2-DCC</td></tr>
</table>

Notes: * There are multiple central plant options for chilled and hot water. Refer to the Central Plant section of this report.

Air Delivery: The original 1953 building construction and subsequent 1957 addition installed horizontal unit ventilators typically for the classroom areas. The unit ventilators are located along the perimeter built into casework along the perimeter with integral steam finned tube radiation. Steam and condensate are distributed through the tunnel directly below. The following outlines possible new air delivery methods:

*Mini-split:* The systems would be installed while leaving the existing heating and ventilation systems in place. Because unconditioned ventilation air is delivered to the space through the existing unit ventilator, there is a risk of creating high humidity conditions.

*Vertical Unit Ventilators:* Install new vertical unit ventilators to replace the existing central air handling system. Modifications will be required to install a new louver through a window on the exterior wall and to perimeter casework and steam finned tube radiation.

*Central Variable Air Volume (VAV):* Install a new roof mounted air handling unit with ductwork distributed below the structure to serve the individual temperature control zones. The intent would be to route as much of the main ductwork and associated variable air volume boxes in the corridor to the extent possible. Soffits and ceilings should be considered as part of the final design to minimize sound and improve air distribution.

*Dedicated Outside Air (DOAS):* Options for locating a new DOAS unit are similar to locating the VAV unit as describe above. The advantage of a DOAS unit is that the volume of air it is moving is approximately 1/3 as compared to the VAV system. The equipment and associated ductwork are smaller and easier to retrofit.

<u>Cooling Plant:</u> Viable options studied include integral packaged DX, remote DX, and construction of a new central chilled water plant. The tight site and proximity to the neighboring residential areas presents challenges in designing new equipment to meet the noise criteria at the property line. The following outlines possible cooling plant options:

*Integral Direct Expansion (DX):* Integral DX is an option with the vertical unit ventilators and there is precedent with this type of system in the District. Design considerations need to include meeting the classroom ambient sound levels. Integral cooling systems have an impact on future maintenance by distributing possible failure points of the system.

*Remote Direct Expansion (DX):* Remote DX is an option for mini-split systems and vertical unit ventilators. The condensing units can be located directly above each space on the roof.

*Chilled Water:* There are multiple options to generate chilled water to meet the cooling needs of the building. Refer to the central plant options in this report for a discussion of each.

<u>Heating Plant:</u> Viable options include leaving the existing steam systems in place and installing a cooling only system, connecting to the existing steam plant, installing a steam to hot water convertor, or installing a new high efficiency hot water plant. The following outlines possible heating plant options.

*Steam:* The building is currently heated by two large dual fuel steam fire tube boilers. The steam options includes modifying steam and condensate distribution piping to accommodate the new systems.

*Hot Water HX:* Includes the installation of a new steam-to-hot water heat exchanger, pumps and distribution system to deliver hot water to the new systems. Hot water distribution piping is more flexible to route to location as necessary than steam piping. The installation of a heat exchanger will easily accommodate future conversion of the stem plant to hot water.

*Hot Water Plant:* There are multiple options to generate hot water to meet the heating needs of the building. Refer to the central plant options in this report for a discussion of each.

<u>Dehumidification:</u> Active dehumidification requires a heating source that is currently not available with the existing steam plant during the summer months. Options for active dehumidification will depend on the extent of hot water that is installed with the new systems.

If hot water distribution is included as the heating source, the heating coils will be located in the reheat position downstream of the cooling coils. If hot water is generated through a steam-to-hot water convertor, then reheat will only be possible when the steam boiler is in operation. An option to extend the time that hot water is available is to add a small high efficiency gas boiler. If the project include replacing the steam plant, the boiler capacity would be selected to provide adequate turn down during low load periods.

Project Risks: The following are design risks identified in implementing this project. The cost estimate includes a 15% design contingency to cover these risks. Further investigation into each of these could better define the solution and allow the design contingency to be reduced.

- Determine structural constraints. Roof mounted remote condensing units will need to be reviewed for structural limitations. Further structural investigation is required.
- Space heating and cooling loads are estimated based on typical loads for this type of space. Final heating and cooling loads need to be completed.
- Integrity of the existing steam and condensate systems for options that include steam heating. Piping in poor condition may necessitate additional pipe removal. The best method to mitigate this risk is to pursue the hot water heating solution as outlined in the heating section above.

Additional Scope Considerations: The following items could be considered for inclusion in the project work scope. These items are not directly related to adding air conditioning but there would be cost efficiency by including them in the project scope and the have added value as noted.

- *Provide new ceilings and lights:* Provide new lay-in ceilings typically throughout with new LED lighting and controls. With the vertical unit ventilator options, new ceilings would allow for the air distribution above the ceiling to reduce the system noise. The ceiling condition likely will require a soffit along the exterior walls to accommodate the existing windows elevations.

Typical Photo:


**West Wing Corridor – Looking West**

**Building Area 3 – North Classrooms (6,285 Sq. Ft.):** The following is a summary of the range of possible options considered.

Options Summary:

| Building Area | Air Delivery Method | Cooling Plant | Heating Plant | Option |
|---|---|---|---|---|
| 3 - North Classrooms | A - Mini-Split | B - Remote DX | A - None | 3-ABA |
| | B - Vertical Unit Ventilators | A - Integral DX | B - Steam | 3-BAB |
| | | | C - Hot Water | 3-BAC |
| | | B - Remote DX | B - Steam | 3-BBB |
| | | | C - Hot Water | 3-BBC |
| | | C - Chilled Water | B - Steam | 3-BCB |
| | | | C - Hot Water | 3-BCC |
| | C - Central VAV | B - Remote DX | B - Steam | 3-CBB |
| | | | C - Hot Water | 3-CBC |
| | | C - Chilled Water | B - Steam | 3-CCB |
| | | | C - Hot Water | 3-CCC |
| | D - DOAS | C - Chilled Water | C - Hot Water | 3-DCC |

Notes: * There are multiple central plant options for chilled and hot water. Refer to the Central Plant section of this report.

Air Delivery: The original 1953 building construction and subsequent 1957 addition installed horizontal unit ventilators typically for the classroom areas. The unit ventilators are located along the perimeter built into casework along the perimeter with integral steam finned tube radiation. Steam and condensate are distributed through the tunnel directly below. The following outlines possible new air delivery methods:

*Mini-split:* The systems would be installed while leaving the existing heating and ventilation systems in place. Because unconditioned ventilation air is delivered to the space through the existing unit ventilator, there is a risk of creating high humidity conditions.

*Vertical Unit Ventilators:* Install new vertical unit ventilators to replace the existing central air handling system. Modifications will be required to install a new louver through a window on the exterior wall and to perimeter casework and steam finned tube radiation.

*Central Variable Air Volume (VAV):* Install a new roof mounted air handling unit with ductwork distributed below the structure to serve the individual temperature control zones. The intent would be to route as much of the main ductwork and associated variable air volume boxes in the corridor to the extent possible. Soffits and ceilings should be considered as part of the final design to minimize sound and improve air distribution.

*Dedicated Outside Air (DOAS):* Options for locating a new DOAS unit are similar to locating the VAV unit as describe above. The advantage of a DOAS unit is that the volume of air it is moving is approximately 1/3 as compared to the VAV system. The equipment and associated ductwork are smaller and easier to retrofit.

Cooling Plant: Viable options studied include integral packaged DX, remote DX, and construction of a new central chilled water plant. The tight site and proximity to the neighboring residential areas presents challenges in designing new equipment to meet the noise criteria at the property line. The following outlines possible cooling plant options:

*Integral Direct Expansion (DX):* Integral DX is an option with the vertical unit ventilators and there is precedent with this type of system in the District. Design considerations need to include meeting the classroom ambient sound levels. Integral cooling systems have an impact on future maintenance by distributing possible failure points of the system.

*Remote Direct Expansion (DX):* Remote DX is an option for mini-split systems and vertical unit ventilators. The condensing units can be located directly above each space on the roof.

*Chilled Water:* There are multiple options to generate chilled water to meet the cooling needs of the building. Refer to the central plant options in this report for a discussion of each.

Heating Plant: Viable options include leaving the existing steam systems in place and installing a cooling only system, connecting to the existing steam plant, installing a steam to hot water convertor, or installing a new high efficiency hot water plant. The following outlines possible heating plant options.

*Steam:* The building is currently heated by two large dual fuel steam fire tube boilers. The steam options includes modifying steam and condensate distribution piping to accommodate the new systems.

*Hot Water HX:* Includes the installation of a new steam-to-hot water heat exchanger, pumps and distribution system to deliver hot water to the new systems. Hot water distribution piping is more flexible to route to location as necessary than steam piping. The installation of a heat exchanger will easily accommodate future conversion of the stem plant to hot water.

*Hot Water Plant:* There are multiple options to generate hot water to meet the heating needs of the building. Refer to the central plant options in this report for a discussion of each.

Dehumidification: Active dehumidification requires a heating source that is currently not available with the existing steam plant during the summer months. Options for active dehumidification will depend on the extent of hot water that is installed with the new systems.

If hot water distribution is included as the heating source, the heating coils will be located in the reheat position downstream of the cooling coils. If hot water is generated through a steam-to-hot water convertor, then reheat will only be possible when the steam boiler is in operation. An option to extend the time that hot water is available is to add a small high efficiency gas boiler. If the project include replacing the steam plant, the boiler capacity would be selected to provide adequate turn down during low load periods.

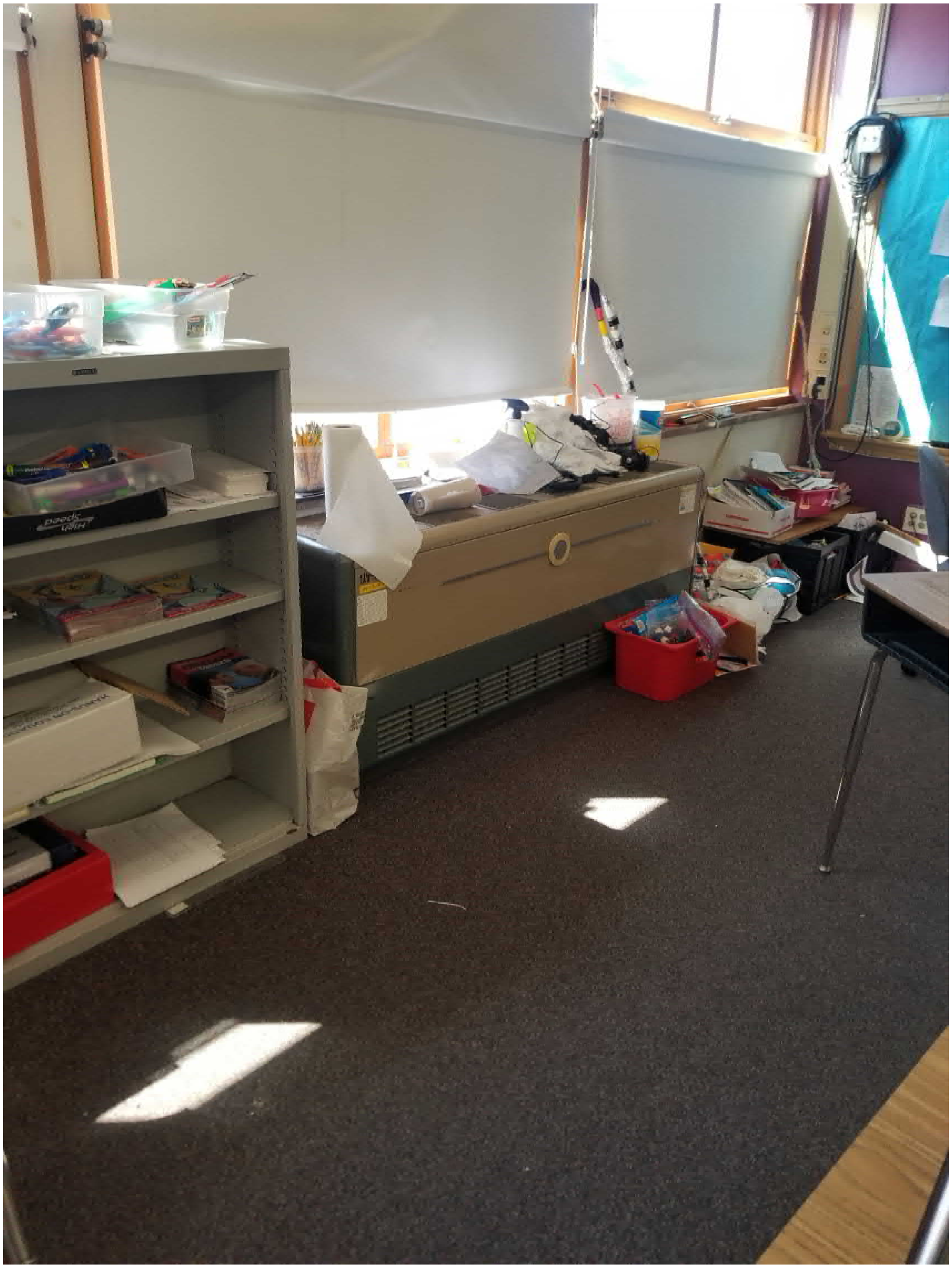
Project Risks: The following are design risks identified in implementing this project. The cost estimate includes a 15% design contingency to cover these risks. Further investigation into each of these could better define the solution and allow the design contingency to be reduced.

- Determine structural constraints. Roof mounted remote condensing units will need to be reviewed for structural limitations. Further structural investigation is required.
- Space heating and cooling loads are estimated based on typical loads for this type of space. Final heating and cooling loads need to be completed.
- Integrity of the existing steam and condensate systems for options that include steam heating. Piping in poor condition may necessitate additional pipe removal. The best method to mitigate this risk is to pursue the hot water heating solution as outlined in the heating section above.

Additional Scope Considerations: The following items could be considered for inclusion in the project work scope. These items are not directly related to adding air conditioning but there would be cost efficiency by including them in the project scope and the have added value as noted.

- *Provide new ceilings and lights:* Provide new lay-in ceilings typically throughout with new LED lighting and controls. With the vertical unit ventilator options, new ceilings would allow for the air distribution above the ceiling to reduce the system noise. The ceiling condition likely will require a soffit along the exterior walls to accommodate the existing windows elevations.

Typical Photos:



**Room 112**

**Building Area 4 – Music Room (3,185 Sq. Ft.):** The following is a summary of the range of possible options considered.

Options Summary:

| Building Area | Air Delivery Method | Cooling Plant | Heating Plant | Option |
|---|---|---|---|---|
| 4 - Music Room | A - Mini-Split | B - Remote DX | A - None | 4-ABA |
| | B - Vertical Unit Ventilators | A - Integral DX | B - Steam | 4-BAB |
| | | | C - Hot Water | 4-BAC |
| | | B - Remote DX | B - Steam | 4-BBB |
| | | | C - Hot Water | 4-BBC |
| | | C - Chilled Water | B - Steam | 4-BCB |
| | | | C - Hot Water | 4-BCC |
| | C - Central VAV | B - Remote DX | B - Steam | 4-CBB |
| | | | C - Hot Water | 4-CBC |
| | | C - Chilled Water | B - Steam | 4-CCB |
| | | | C - Hot Water | 4-CCC |
| | D - DOAS | C - Chilled Water | C - Hot Water | 4-DCC |

Notes: * There are multiple central plant options for chilled and hot water. Refer to the Central Plant section of this report.

Air Delivery: The music room was part of the original 1953 construction and is ventilated by a horizontal unit ventilator along the outside wall. Steam and condensate are distributed through the tunnel directly below. The following outlines possible new air delivery methods:

*Mini-split:* The systems would be installed while leaving the existing heating and ventilation systems in place. Because unconditioned ventilation air is delivered to the space through the existing unit ventilator, there is a risk of creating high humidity conditions.

*Vertical Unit Ventilators:* Install new vertical unit ventilators to replace the existing central air handling system. Modifications will be required to install a new louver through a window on the exterior wall and to perimeter casework and steam finned tube radiation.

*Central Variable Air Volume (VAV):* Install a new roof mounted air handling unit with ductwork distributed below the structure to serve the individual temperature control zones. The intent would be to route as much of the main ductwork and associated variable air volume boxes in the corridor to the extent possible. Soffits and ceilings should be considered as part of the final design to minimize sound and improve air distribution.

*Dedicated Outside Air (DOAS):* Options for locating a new DOAS unit are similar to locating the VAV unit as describe above. The advantage of a DOAS unit is that the volume of air it is moving is approximately 1/3 as compared to the VAV system. The equipment and associated ductwork are smaller and easier to retrofit.

<u>Cooling Plant:</u> Viable options studied include integral packaged DX, remote DX, and construction of a new central chilled water plant. The tight site and proximity to the neighboring residential areas presents challenges in designing new equipment to meet the noise criteria at the property line. The following outlines possible cooling plant options:

*Integral Direct Expansion (DX):* Integral DX is an option with the vertical unit ventilators and there is precedent with this type of system in the District. Design considerations need to include meeting the classroom ambient sound levels. Integral cooling systems have an impact on future maintenance by distributing possible failure points of the system.

*Remote Direct Expansion (DX):* Remote DX is an option for mini-split systems and vertical unit ventilators. The condensing units can be located directly above each space on the roof.

*Chilled Water:* There are multiple options to generate chilled water to meet the cooling needs of the building. Refer to the central plant options in this report for a discussion of each.

<u>Heating Plant:</u> Viable options include leaving the existing steam systems in place and installing a cooling only system, connecting to the existing steam plant, installing a steam to hot water convertor, or installing a new high efficiency hot water plant. The following outlines possible heating plant options.

*Steam:* The building is currently heated by two large dual fuel steam fire tube boilers. The steam options includes modifying steam and condensate distribution piping to accommodate the new systems.

*Hot Water HX:* Includes the installation of a new steam-to-hot water heat exchanger, pumps and distribution system to deliver hot water to the new systems. Hot water distribution piping is more flexible to route to location as necessary than steam piping. The installation of a heat exchanger will easily accommodate future conversion of the stem plant to hot water.

*Hot Water Plant:* There are multiple options to generate hot water to meet the heating needs of the building. Refer to the central plant options in this report for a discussion of each.

<u>Dehumidification:</u> Active dehumidification requires a heating source that is currently not available with the existing steam plant during the summer months. Options for active dehumidification will depend on the extent of hot water that is installed with the new systems. If hot water distribution is included as the heating source, the heating coils will be located in the reheat position downstream of the cooling coils. If hot water is generated through a steam-to-

hot water convertor, then reheat will only be possible when the steam boiler is in operation. An option to extend the time that hot water is available is to add a small high efficiency gas boiler. If the project include replacing the steam plant, the boiler capacity would be selected to provide adequate turn down during low load periods.

Project Risks: The following are design risks identified in implementing this project. The cost estimate includes a 15% design contingency to cover these risks. Further investigation into each of these could better define the solution and allow the design contingency to be reduced.

- Determine structural constraints. Roof mounted remote condensing units will need to be reviewed for structural limitations. Further structural investigation is required.
- Space heating and cooling loads are estimated based on typical loads for this type of space. Final heating and cooling loads need to be completed.
- Integrity of the existing steam and condensate systems for options that include steam heating. Piping in poor condition may necessitate additional pipe removal. The best method to mitigate this risk is to pursue the hot water heating solution as outlined in the heating section above.

Additional Scope Considerations: The following items could be considered for inclusion in the project work scope. These items are not directly related to adding air conditioning but there would be cost efficiency by including them in the project scope and the have added value as noted.

- *Provide new ceilings and lights:* Provide new lay-in ceilings typically throughout with new LED lighting and controls. With the vertical unit ventilator options, new ceilings would allow for the air distribution above the ceiling to reduce the system noise. The ceiling condition likely will require a soffit along the exterior walls to accommodate the existing windows elevations.

Typical Photos:

**Room 141 - Music**

**Building Area 5 – Portables (4,095 Sq. Ft.):** The following is a summary of the range of possible options considered.

Options Summary:

| Building Area | Air Delivery Method | Cooling Plant | Heating Plant | Option |
|---|---|---|---|---|
| 5 - Portables | A - Mini-Split | B - Remote DX | A - None | 5-ABA |
| | B - Vertical Unit Ventilators | A - Integral DX | B - Steam | 5-BAB |
| | | | C - Hot Water | 5-BAC |
| | | B - Remote DX | B - Steam | 5-BBB |
| | | | C - Hot Water | 5-BBC |
| | | C - Chilled Water | B - Steam | 5-BCB |
| | | | C - Hot Water | 5-BCC |
| | C - Central VAV | B - Remote DX | B - Steam | 5-CBB |
| | | | C - Hot Water | 5-CBC |
| | | C - Chilled Water | B - Steam | 5-CCB |
| | | | C - Hot Water | 5-CCC |
| | D - DOAS | C - Chilled Water | C - Hot Water | 5-DCC |

Notes: * There are multiple central plant options for chilled and hot water. Refer to the Central Plant section of this report.

Air Delivery: The portable classrooms were added in 1962 and are ventilated by perimeter unit ventilators. The steam piping is routed underground below the building. The unit ventilators are located along the perimeter built into casework along the perimeter with integral steam finned tube radiation. Steam and condensate are distributed through the tunnel directly below. The following outlines possible new air delivery methods:

*Mini-split:* The systems would be installed while leaving the existing heating and ventilation systems in place. Because unconditioned ventilation air is delivered to the space through the existing unit ventilator, there is a risk of creating high humidity conditions.

*Vertical Unit Ventilators:* Install new vertical unit ventilators to replace the existing central air handling system. Modifications will be required to install a new louver through a window on the exterior wall and to perimeter casework and steam finned tube radiation.

*Central Variable Air Volume (VAV):* Install a new roof mounted air handling unit with ductwork distributed below the structure to serve the individual temperature control zones. The intent would be to route as much of the main ductwork and associated variable air volume boxes in the corridor to the extent possible. Soffits and ceilings should be considered as part of the final design to minimize sound and improve air distribution.

*Dedicated Outside Air (DOAS):* Options for locating a new DOAS unit are similar to locating the VAV unit as describe above. The advantage of a DOAS unit is that the volume of air it is moving is approximately 1/3 as compared to the VAV system. The equipment and associated ductwork are smaller and easier to retrofit.

Cooling Plant: Viable options studied include integral packaged DX, remote DX, and construction of a new central chilled water plant. The tight site and proximity to the neighboring residential areas presents challenges in designing new equipment to meet the noise criteria at the property line. The following outlines possible cooling plant options:

*Integral Direct Expansion (DX):* Integral DX is an option with the vertical unit ventilators and there is precedent with this type of system in the District. Design considerations need to include meeting the classroom ambient sound levels. Integral cooling systems have an impact on future maintenance by distributing possible failure points of the system.

*Remote Direct Expansion (DX):* Remote DX is an option for mini-split systems and vertical unit ventilators. The condensing units can be located directly above each space on the roof.

*Chilled Water:* There are multiple options to generate chilled water to meet the cooling needs of the building. Refer to the central plant options in this report for a discussion of each.

Heating Plant: Viable options include leaving the existing steam systems in place and installing a cooling only system, connecting to the existing steam plant, installing a steam to hot water convertor, or installing a new high efficiency hot water plant. The following outlines possible heating plant options.

*Steam:* The building is currently heated by two large dual fuel steam fire tube boilers. The steam options includes modifying steam and condensate distribution piping to accommodate the new systems.

*Hot Water HX:* Includes the installation of a new steam-to-hot water heat exchanger, pumps and distribution system to deliver hot water to the new systems. Hot water distribution piping is more flexible to route to location as necessary than steam piping. The installation of a heat exchanger will easily accommodate future conversion of the stem plant to hot water.

*Hot Water Plant:* There are multiple options to generate hot water to meet the heating needs of the building. Refer to the central plant options in this report for a discussion of each.

Dehumidification: Active dehumidification requires a heating source that is currently not available with the existing steam plant during the summer months. Options for active dehumidification will depend on the extent of hot water that is installed with the new systems.

If hot water distribution is included as the heating source, the heating coils will be located in the reheat position downstream of the cooling coils. If hot water is generated through a steam-to-hot water convertor, then reheat will only be possible when the steam boiler is in operation. An option to extend the time that hot water is available is to add a small high efficiency gas boiler. If the project include replacing the steam plant, the boiler capacity would be selected to provide adequate turn down during low load periods.

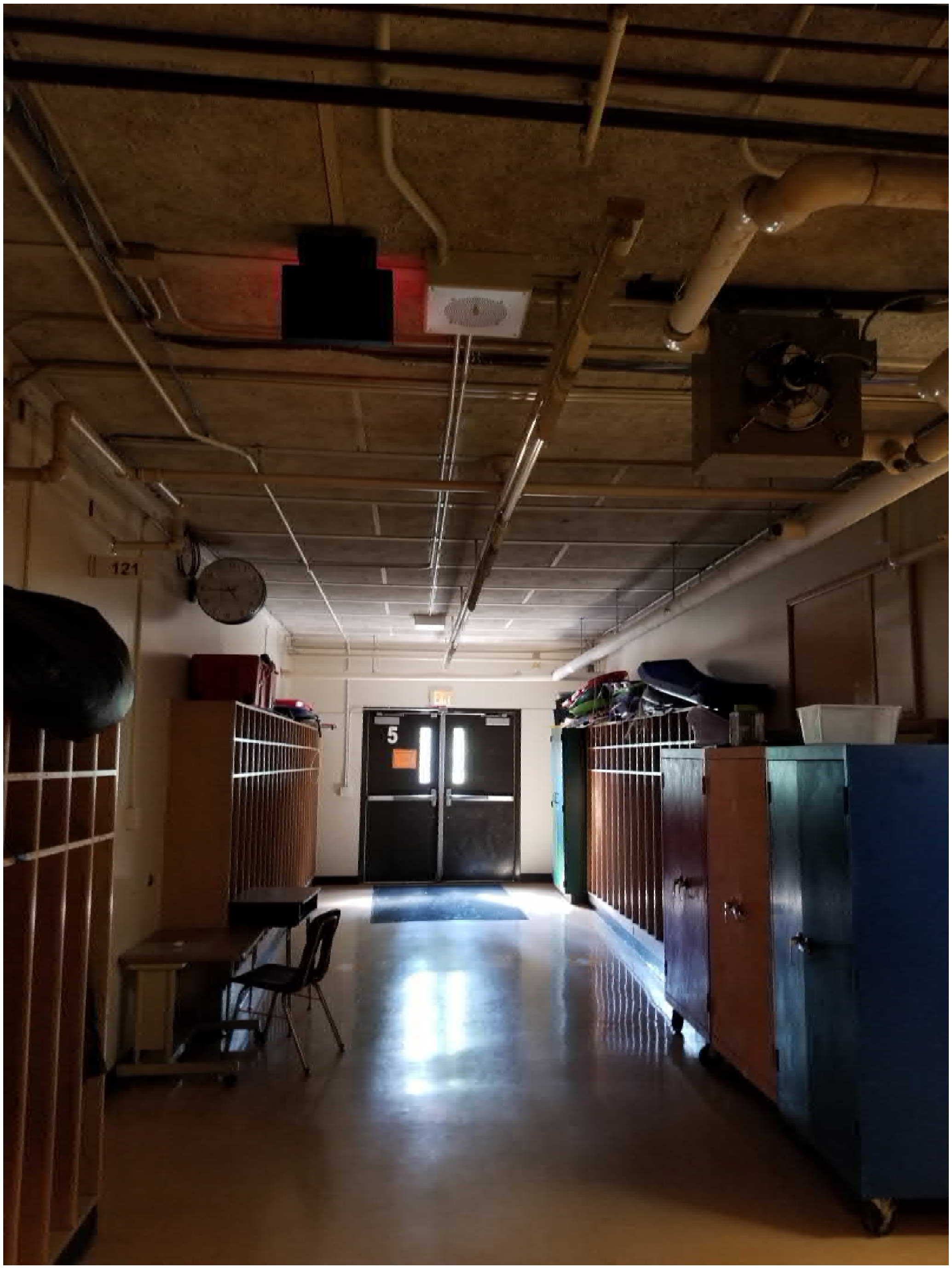
Project Risks: The following are design risks identified in implementing this project. The cost estimate includes a 15% design contingency to cover these risks. Further investigation into each of these could better define the solution and allow the design contingency to be reduced.

- Determine structural constraints. Roof mounted remote condensing units will need to be reviewed for structural limitations. Further structural investigation is required.
- Space heating and cooling loads are estimated based on typical loads for this type of space. Final heating and cooling loads need to be completed.
- Integrity of the existing steam and condensate systems for options that include steam heating. Piping in poor condition may necessitate additional pipe removal. The best method to mitigate this risk is to pursue the hot water heating solution as outlined in the heating section above.

Additional Scope Considerations: The following items could be considered for inclusion in the project work scope. These items are not directly related to adding air conditioning but there would be cost efficiency by including them in the project scope and the have added value as noted.

- *Provide new ceilings and lights:* Provide new lay-in ceilings typically throughout with new LED lighting and controls. With the vertical unit ventilator options, new ceilings would allow for the air distribution above the ceiling to reduce the system noise. The ceiling condition likely will require a soffit along the exterior walls to accommodate the existing windows elevations.

Typical Photos:



**Portable – Looking West**

**9 - Central Plant Options:** Centralizing the heating and cooling plants has benefits of replacing aged infrastructure, improving the overall operating efficiency of the building and reducing on-going maintenance cost by reducing the number of failures points in the building systems. The building currently has a centralized steam plant. The building does not have a centralized cooling systems approach. The following options have been considered.

Options Summary:

| Building Area | Cooling Approach | Heating Approach | Option |
|---|---|---|---|
| 9 - Central Plant | A - Air Cooled Chiller | A - STM Distribution | 9-AA |
| | | B - STM w/ HW HX | 9-AB |
| | | C - HW Plant | 9-AC |
| | C - Geo Thermal | D - Geo STM Hybrid | 9-CD |
| | | E - Geo HW Hybrid | 9-CE |
| | | F - Full Size Heat | 9-CF |

Cooling Plant: Centralizing the building cooling plant will improve the overall building operating efficiency and reduce the on-going maintenance requirements. Any centralized solution that has outside equipment will need to be evaluated for the sound levels at the adjacent property line. A 120-ton chiller capacity is assumed for cost estimation purposes based on a square foot estimate. Final load calculations are necessary to determine the final chiller size.

*Air Cooled Chiller: T*he most likely option for locating the chiller is in the parking lot to the South of the boiler room between the East and West classroom wings. West. The impact to the outdoor storage building, trash pick-up, and parking needs to be further analyzed. A study of the chiller sound output at the school property line needs to be completed. For the purposes of estimating, it is assumed that the chiller will have all of the available factory sound attenuation features and will be installed in a masonry enclosure with sound attenuating panels.

*Ground Coupled Geo-thermal:* A ground coupled geothermal solution has considerable advantages in eliminating the risk of a sound impact to the adjacent residential neighbors. The adjacent parking lot and park area to the south appears to have adequate area for a well field. Approximately 27,000 sq. ft. is required based on an assumption of 1 ton of cooling per well at a 15’-0” x 15’-0”. Further study and a test well is necessary to determine the site specific well conditions to optimize the depth, capacity, and cost. Alternate geothermal technologies including Darcy Solutions closed loop systems should be considered to further reduce the cost and size of the well field.

Heating Plant: Two dual fuel steam fire-tube boiler currently serves the entire building for heating. Converting the building to hot water for heating will reduce the overall operating cost of the building, reduce the regular maintenance requirements, and allow greater flexibility in routing piping to terminal heating systems throughout the building.

*Hot Water Boilers:* Includes replacing the existing steam systems with a new high efficiency hot water dual fuel boiler plant. The plant will consist of multiple boilers to provide redundancy in the event of equipment failure. The existing steam and condensate piping will be removed. A variable primary hot water supply and return with multiple supply pumps will be distribute hot water throughout the building.

*Ground Coupled Geo-thermal:* If the ground coupled geo-thermal option is selected for cooling, the plant would also provide heating capacity for the building. Options for geo-thermal would be to increase the size of the well field and deliver all of the building heating needs from the central plant or provide a hybrid plant that includes high efficiency boiler capacity for peak heating loads. Because of the limited site available for the well field, increasing to size to match the building heating loads may not be possible. Further evaluation and a test well is necessary to determine the maximum heating capacity potential.

# Appendix A:

Existing Systems Diagram

Redacted

# Appendix B:

Proposed Systems Diagrams

Redacted

# Appendix C:

## Dehumidification Capabilities

The recommended solution to provide air conditioning to the classrooms includes providing a high efficiency boiler for summer operation. All areas included in the scope for new air conditioning systems will be capable of active de-humidification.

# Appendix D:

## Cost Estimate Detail

**SSD#1 Minneapolis Public Schools**
**Air Conditioning Cost Estimating**

**Cost Basis - June 2021**

| | | Ventilation Area | Bldg Total |
|---|---|---|---|
| **BUILDING AREA 1 - East Classrooms** | 16,875 | | |
| **BUILDING AREA 2 - West Classrooms** | 15,150 | | |
| **BUILDING AREA 1 - East Classrooms** | 6,280 | | |
| **BUILDING AREA 2 - West Classrooms** | 3,185 | | |
| **BUILDING AREA 2 - West Classrooms** | 4,095 | | |
| **Area - SQ FT** | **45,585** | **45,585** | **61,776** |

| **Specification Division** | | **DOAS / Displacement - Air-colled Chiller, HW Plant** | | | **Add for Ceilings and Lights** | | |
|---|---|---|---|---|---|---|---|
| | | **Sq. Ft. / Qty** | **Unit Cost** | **Cost** | **Sq. Ft. / Qty** | **Unit Cost** | **Cost** |
| **Division 02 - Demolition (excludes Div 21, 22, 23, and 26)** | | | | **$ 45,585** | | | **$ 22,793** |
| Miscellaneous | | 45,585 | $ 1.00 | $ 45,585 | 45,585 | $ 0.50 | $ 22,793 |
| **Division 03 - Concrete** | | | | **$ -** | | | **$ -** |
| Floor Patch and Repair | | | | $ - | | | $ - |
| Cast-in-place / Misc | | | | $ - | | | $ - |
| **Division4 - Masonary** | | | | **$ 80,000** | | | **$ -** |
| Non-bearing Infill | | 1 | $ 80,000 | $ 80,000 | | | $ - |
| Load bearing - new wall construction | | | | $ - | | | $ - |
| **Division 5 - Metals** | | | | **$ 120,000** | | | **$ -** |
| Structural Steel / Misc. Fabrications Allowance | | 6 | $ 20,000 | 120,000 | | | - |
| **Division 6 - Carpentry** | | | | **$ -** | | | **$ -** |
| Rough Carpentry | | | | $ - | | | $ - |
| Casework Modifications | | | | | | | $ - |
| **Division 7 - Thermal / Moisture Protection** | | | | **$ 39,000** | | | **$ -** |
| Roof Patch and Repair | | 6 | $ 6,500 | $ 39,000 | | | $ - |
| Roof New Construction | | | | $ - | | | $ - |
| Fire Stopping / Miscellaneous | | | | $ - | | | $ - |
| **Division 8 - Openings** | | | | **$ -** | | | **$ -** |
| Access Panels | | | | - | | | - |
| Doors / Hardware | | | | - | | | - |
| Windows | | | | - | | | - |
| Louvers | | | | - | | | - |
| **Division - 9 Finishes** | | | | **$ 136,755** | | | **$ 296,303** |
| Soffits / Chases | | 45,585 | $ 2.00 | $ 91,170 | 45,585 | $ 2.00 | $ 91,170 |
| Floor Patch and Repair | | | | $ - | | | $ - |
| Acoustic Ceilings | | | | $ - | 45,585 | $ 3.50 | $ 159,548 |
| Painting | | 45,585 | $ 1.00 | $ 45,585 | 45,585 | $ 1.00 | $ 45,585 |
| **Division 10 - Specialties** | | | | **$ -** | | | **$ -** |
| Miscellaneous | | | | - | | | - |
| **Division 11 - Equipment** | | | | **$ -** | | | **$ -** |
| Miscellaneous | | | | $ - | | | $ - |
| **Division 12 - Furnishings** | | | | **$ -** | | | **$ -** |
| Casework | | | | $ - | | | $ - |
| Miscellaneous | | | | $ - | | | $ - |
| **Division 21 - Fire Protection** | | | | **$ 91,170** | | | **$ 113,963** |
| Demolition | | - | | $ - | | | $ - |
| New / Modify Existing | | 45,585 | $ 2.00 | $ 91,170 | 45,585 | $ 2.50 | $ 113,963 |
| **Division 22 - Plumbing** | | | | **$ -** | | | **$ -** |
| Demolition | | | | $ - | | | $ - |
| Plumbing Fixtures | | | | $ - | | | $ - |
| Micellaneous | | | | $ - | | | $ - |
| **Division 23 - HVAC** | | | | **$ 3,677,858** | | | **$ -** |
| Air Handling Equipment (VUV's / AHU's / RTU's) | | 6 | $ 60,000 | $ 360,000 | | | $ - |
| Cooling Plant Equipment (Chiller / DX / Heat Pump) | | 1 | $ 120,000 | $ 120,000 | | | $ - |
| Heating Plant Equipment (Boiler) | | 1 | $ 35,000 | $ 35,000 | | | $ - |
| Demolition | | 45,585 | $ 1.00 | $ 45,585 | | | $ - |
| AHU Equipment Installation / Start-up | | 6 | $ 10,000 | $ 60,000 | | | $ - |
| Cooling Plant Equipment Installation | | 1 | $ 30,000 | $ 30,000 | | | $ - |
| Heating Plant Installation | | 1 | $ 100,000 | $ 100,000 | | | $ - |
| Chilled Water Distribution | | 61,776 | $ 5.50 | $ 339,768 | | | $ - |
| Steam / Condensate Distribution | | | | $ - | | | $ - |
| Hot Water Distribution | | 61,776 | $ 12.00 | $ 741,312 | | | $ - |
| Ductwork Distribution Misc. (VAV's / Exhaust) | | 45,585 | $ 32.00 | $ 1,458,720 | | | $ - |
| Controls | | 45,585 | $ 7.50 | $ 341,888 | | | $ - |
| Test and Balance | | 45,585 | $ 1.00 | $ 45,585 | | | $ - |
| **Division 26 - Electrical** | | | | **$ 323,510** | | | **$ 296,303** |
| Demolition | | 45,585 | $ 0.50 | $ 22,793 | 45,585 | $ 1.00 | $ 45,585 |
| Electrical Service | | 1 | $ 50,000 | $ 50,000 | | | $ - |
| Power Connections | | 45,585 | $ 4.50 | $ 205,133 | | | $ - |
| Lighting and Controls | | 45,585 | $ 1.00 | $ 45,585 | 45,585 | $ 5.50 | $ 250,718 |
| **Division 27 - Technology** | | | | **$ 45,585** | | | **$ -** |
| Demolition Allowance | | | | $ - | | | $ - |
| Fire / Sound / Data Allowance | | 45,585 | $ 1.00 | $ 45,585 | | | $ - |
| **DIVISION SUB-TOTAL** | | | | **$ 4,559,463** | | | **$ 729,360** |
| **Division 1 - General Conditions** | | | | **$ 797,906** | | | **$ -** |
| OH & P | 10% | | | $ 455,946 | | | $ - |
| Liability Insurance | 1% | | | $ 45,595 | | | $ - |
| Performance Bond | 2% | | | $ 68,392 | | | $ - |
| General Contractor Misc. | 5% | | | $ 227,973 | | | $ - |
| **CONSTRUCTION SUB-TOTAL** | | | | **$ 5,357,368** | | | **$ 729,360** |
| **CONTINGENCY** | 15% | | | **$ 803,605** | | | **$ -** |
| **CONSTRUCTION GRAND-TOTAL** | | | | **$ 6,160,974** | | | **$ 729,360** |
| **COST per SQ FT** | | | | **$ 99.73** | | | **$ 16.00** |