

**STR**



## **PROJECT REPORT**

Date: November 14, 2013  
STR Project Number: 13159

**Air Conditioning Study for  
8 Elementary Schools**  
Oak Park, IL 60302

Prepared for:

**Board of Education of  
Oak Park Elementary School  
District 97**  
970 W. Madison Street  
Oak Park, IL 60302

Prepared by:

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For FAC Review

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**AIR CONDITIONING OPTIONS**

CS2 Design Group was asked to develop a report which outlines air conditioning system options for the classrooms that are not currently air-conditioned at Beye, Hatch, Holmes, Irving, Lincoln, Longfellow, Mann, and Whittier Elementary Schools in Oak Park Elementary School District 97. We generated this report with input from the school district's personnel; surveying the existing buildings heating, ventilation, and air conditioning systems; and performing system analysis. While there are many different options for air conditioning systems, we only included those options that are best suited to serve the existing buildings. Systems that would not fit within the existing building architecture such as indoor chillers, and systems that required substantial interior remodeling or structural reinforcing were not considered. We have provided an analysis of ten (10) system options, any of the provided options would be suitable for the eight (8) elementary schools surveyed in the district. We have included a cost opinion for each based on the recent bidding environment and historical information of similar type projects.

**CONTROL SYSTEM UPGRADES**

In addition to air conditioning options, CS2 was also asked to review and evaluate the existing controls of the HVAC system. We visually inspected and observed the operations of the system during our building survey. We have documented our observations and included a separate section discussing control upgrades located near the end of this report.

**END OF INTRODUCTION**

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**AIR CONDITIONING SUMMARY**

As part of this air conditioning report, we reviewed the existing HVAC system at each of the elementary buildings. We reviewed the major pieces of equipment by collecting the manufacturers name plate information, and performing a visual condition assessment. This information can be used as a tool to assist the owner in understanding the major equipment within each facility and helping to prioritize equipment replacement over time.

We have developed 10 air conditioning system options for each of the elementary schools. A spreadsheet is included for each school that identifies the installation cost, annual maintenance cost, annual estimated energy usage, replacement cost, life cycle cost, and a relative sound level comparison for each option. While initial cost is a major factor in determining system selection, other performance factors such as humidity control, sound and type of maintenance should be considered when identifying the best system for the district.

Page 003 is a side by side installation cost and life cycle cost summary for each building.

**CONTROLS SUMMARY**

As part of our survey, we reviewed the existing control systems in each building. The majority of each building's HVAC equipment is controlled by a pneumatic control system. Overall, the systems are older and are experiencing some operational issues. Control issues were observed by noticing the wide range of temperatures throughout the buildings and by observing HVAC systems which were operating after normal occupied hours. Replacement of the pneumatic control system with a direct digital control (DDC) system will increase system operating efficiency and can greatly improve overall control of the HVAC system.

The following spreadsheet (Page 004) identifying replacement control system costs was developed in conjunction with a temperature control contractor who is familiar with both pneumatic and DDC systems. The costs were generated by reviewing each school and the existing components in the HVAC systems.

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**Oak Park Elementary School District 97**  
**Air Conditioning System Options Installation & Life Cycle Cost Summary**

Air Conditioning System Option	Beye		Hatch		Holmes		Irving		Lincoln		Longfellow		Mann		Whittier	
	Installation Cost	Life Cycle Cost														
Option 1: Window Air Conditioners	\$453,477	\$1,270,459	\$365,301	\$1,023,426	\$377,898	\$1,058,716	\$365,301	\$1,023,426	\$403,091	\$1,129,297	\$433,091	\$1,129,297	\$352,705	\$988,135	\$415,687	\$1,164,588
Option 2: Ductless Split System	\$917,419	\$1,993,639	\$739,032	\$1,605,987	\$764,516	\$1,661,366	\$739,032	\$1,605,987	\$766,957	\$1,772,124	\$845,484	\$1,772,124	\$713,548	\$1,550,608	\$840,968	\$1,827,502
Option 3: Ducted Split System	\$1,566,040	\$2,701,890	\$1,261,533	\$2,176,522	\$1,305,034	\$2,251,575	\$1,261,533	\$2,176,522	\$1,392,036	\$2,401,680	\$1,422,036	\$2,401,680	\$1,218,031	\$2,101,470	\$1,435,537	\$2,476,732
Option 4: Under the Window Self-Contained Unit Ventilator	\$1,693,699	\$2,974,262	\$1,364,369	\$2,395,933	\$1,411,416	\$2,478,552	\$1,364,369	\$2,395,933	\$1,505,511	\$2,643,789	\$1,535,511	\$2,643,789	\$1,317,322	\$2,313,315	\$1,552,558	\$2,726,407
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	\$2,526,089	\$3,789,621	\$2,034,905	\$3,052,750	\$2,105,074	\$3,158,018	\$2,034,905	\$3,052,750	\$2,245,412	\$3,368,552	\$2,275,412	\$3,368,552	\$1,964,736	\$2,947,483	\$2,315,582	\$3,473,819
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	\$1,772,773	\$3,125,628	\$1,428,067	\$2,517,867	\$1,477,311	\$2,604,690	\$1,428,067	\$2,517,867	\$1,575,798	\$2,778,336	\$1,605,798	\$2,778,336	\$1,378,823	\$2,431,044	\$1,625,042	\$2,865,159
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	\$2,223,300	\$3,638,769	\$1,790,992	\$2,931,230	\$1,852,750	\$3,032,307	\$1,790,992	\$2,931,230	\$1,976,267	\$3,234,461	\$2,006,267	\$3,234,461	\$1,729,233	\$2,830,153	\$2,038,025	\$3,335,538
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	\$2,570,761	\$3,854,324	\$2,070,891	\$3,104,872	\$2,142,301	\$3,211,936	\$2,070,891	\$3,104,872	\$2,285,121	\$3,426,066	\$2,315,121	\$3,426,066	\$1,999,481	\$2,997,807	\$2,356,531	\$3,533,130
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	\$3,658,702	\$4,981,770	\$2,947,288	\$4,013,093	\$3,048,919	\$4,151,475	\$2,947,288	\$4,013,093	\$3,252,180	\$4,428,240	\$3,282,180	\$4,428,240	\$2,845,657	\$3,874,710	\$3,353,810	\$4,566,623
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	\$3,670,488	\$4,699,355	\$2,956,782	\$3,785,592	\$3,058,740	\$3,916,129	\$2,956,782	\$3,785,592	\$3,262,656	\$4,177,205	\$3,292,656	\$4,177,205	\$2,854,824	\$3,655,054	\$3,364,614	\$4,307,742

While the estimates provided are based on our experience with construction costs of these or similar systems, they are conceptual estimates with only general information known at this point. As we engage on an actual project, more definition of the system and specific field conditions will reveal the true scope of work, potentially resulting in a variance from this Order of Magnitude budget.

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004 REPLACEMENT OF EXISTING PNEUMATIC HVAC CONTROL SYSTEM  
WITH DIRECT DIGITAL CONTROLS COSTS SUMMARY

**Oak Park Elementary School District 97**  
**Replacement of Existing Pneumatic HVAC Control System with Direct Digital Controls**  
**Costs Summary**

<b>School</b>	<b>Total Cost</b>
Beye Elementary School	\$372,164.10
Hatch Elementary School	\$316,753.80
Holmes Elementary School	\$366,900.05
Irving Elementary School	\$357,837.70
Lincoln Elementary School	\$375,108.80
Longfellow Elementary School	\$396,550.00
Mann Elementary School	\$317,963.80
Whittier Elementary School	\$461,243.75

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**1.0 AIR CONDITIONING SYSTEM OPTIONS  
PERFORMANCE & COSTS**

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### Option 1 Provide Window Air Conditioning Units

This option consists of providing a window air conditioning unit in each classroom. Part of the existing window system in each classroom would need to be removed. New electrical branch circuit panelboards will be provided to serve new window air conditioning units.

1. Advantages:
  - a. This is the least expensive first cost option.
  - b. It would be a new independent system and would not require retrofitting the existing heating system.
  - c. This installation could be done one room at a time.
2. Disadvantages:
  - a. A window air conditioner is not capable of providing the code required outside ventilation air to the classrooms. The unit ventilator will have to operate to provide ventilation while the window air conditioning unit is providing cooling. This will result in uneven temperatures and at times can result in high humidity levels in the space.
  - b. Noise levels generated by this system would be the loudest of the options.
  - c. A window unit does not have the capacity to distribute cool air well throughout the classroom.
  - d. Window units are not aesthetically pleasing.
  - e. This system consists of residential grade equipment that has a shorter equipment life expectancy.
  - f. Since the unit ventilator must be operating to provide outside air, there is more equipment that must be maintained.
3. Estimated Service Life:
  - a. 10 years.

### Option 2 Provide New Variable Refrigerant Flow Ductless Split System

This option consists of providing variable refrigerant flow units in each classroom that are either ceiling or wall mounted cassette units. Minor ceiling work is required to accommodate the cassette units and the associated refrigerant piping. New electrical distribution panelboards will be provided to serve the cassette units and roof mounted air cooled condensing units.

1. Advantages:
  - a. This system is quieter than window or self-contained units since the compressor is remote and not in the space.
  - b. Individual room ceiling cassettes create better cooling distribution than a window air conditioning unit or unit ventilator if they can be centrally located in the room.
  - c. It would be a new independent system and would not require retrofitting the existing heating system.
  - d. A variable refrigerant cooling system is the most efficient of the options.
2. Disadvantages:
  - a. A cassette system is not capable of providing the code required outside ventilation air to the classrooms. The unit ventilator will have to operate to provide ventilation while this system is providing cooling. This will result in uneven temperatures and at times result in high humidity levels in the space.
  - b. Roof modifications and penetrations are required for air cooled condensing units and refrigerant piping.
  - c. Structural modifications maybe required to accommodate roof mounted air cooled condensing units.
  - d. Long refrigerant runs are required and the accuracy of the installation is extremely important to match the manufacturer's recommendations.
  - e. This installation has to happen in groups or to the entire building at one time. It cannot be phased in one room at a time.
  - f. Two electrical connections are required with this option.
  - g. Since the unit ventilator must be operating to provide outside air, there is more equipment that must be maintained.
3. Estimated Service Life:
  - a. 15 years.

**Option 3 Provide New Variable Refrigerant Flow Ducted Split System**

This option is the same as Option 2, but the unit is located entirely above the ceiling and has ductwork which is routed to ceiling mounted diffusers.

1. Additional Advantages to Option 2:
  - a. This option has better air distribution since it is a ducted system and is more aesthetically pleasing since the unit is concealed above the ceiling.
2. Additional Disadvantages to Option 2:
  - a. This option requires more ceiling work and in some instances, requires the ceiling to be lowered to accommodate the unit and distribution ductwork.
3. Estimated Service Life:
  - a. 15 years.

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**Option 4 Provide New Under the Window Self-Contained Unit Ventilators**

Remove the existing heating only classroom unit ventilators. Provide new self-contained classroom unit ventilators equipped with heating coils. Reuse the existing heating piping previously serving the unit ventilators. Masonry work would be required to enlarge the outdoor air opening to allow for proper heat rejection of the refrigeration section. Casework and/or pipe enclosures will be modified to accommodate the unit ventilators since the physical size will increase. The existing pneumatic controls will be converted to a direct digital controls system to achieve better overall control. A ventilation exhaust system must be installed to relieve the outside air brought in by the unit ventilators. New electrical distribution panelboards will be provided to serve the new equipment.

1. Advantages:
  - a. No roof penetrations are required for this option for refrigerant piping.
  - b. Minimal ceiling work is required with this option.
  - c. Modifications to the existing heating piping are minimal.
  - d. This installation could be done one room at a time.
  - e. No major structural reinforcing is required.
2. Disadvantages:
  - a. Masonry work will be required to create a new louver or enlarge an existing standard unit ventilator louver opening.
  - b. Air distribution is not as good as ducted systems.
  - c. Since the compressor is located within the unit ventilator, this option generates slightly more noise than the existing unit ventilators.
  - d. Service of the equipment is more difficult due to a tight work area within the unit.
  - e. A new ventilation exhaust system must be installed to relieve the outside air being brought into the classrooms by the unit ventilators.
  - f. This system is less efficient than a variable refrigerant flow system or a central chilled water system.
3. Estimated Service Life:
  - a. 15 years.

## 1.5 Option 5: Chilled Water Plant & Under the Window Unit Ventilators

### Option 5 Provide a Chilled Water Plant and Chilled Water Distribution Piping to Cooling Coils in Under the Window Unit Ventilators

This option consists of providing a chilled water plant and distribution piping to each new classroom unit ventilator. The chiller will be located on the exterior of the building either on the roof or on grade. Each unit ventilator will be equipped with a chilled water cooling and a heating coil. Casework and/or pipe enclosures will be modified to accommodate the unit ventilators since the physical size will increase. Ceilings will need to be removed/replaced and lowered in some locations to accommodate distribution piping. The existing pneumatic controls will be converted to a direct digital controls system to achieve better overall control. A ventilation exhaust system must be installed to relieve the outside air brought by the unit ventilators. The new unit ventilators will be reconnected to the existing power circuits.

1. Advantages:
  - a. The outside air openings can be reused (if replacing a UV at a similar location).
  - b. The existing heating piping can be utilized (if replacing a UV at a similar location).
  - c. A central chilled water plant is more energy efficient and has better control than a self-contained unit ventilator or window air conditioning system.
  - d. Central plant removes compressor noise from occupied space.
  - e. Electrical circuits may be re-used for the unit ventilators.
2. Disadvantages:
  - a. Air distribution is not as good as ducted systems.
  - b. Room temperature variations are higher than ducted systems.
  - c. Casework and/or pipe enclosures will need to be modified to route chilled water distribution piping.
  - d. A new chilled water plant and distribution piping is required.
  - e. If the chiller is located on the roof, substantial structural modifications are required to accommodate the weight of the unit.
  - f. Existing ceilings will need to be lowered in areas to accommodate new chilled water distribution piping. This requires added costs (compared to a new installation) to modify existing lights, speakers, fire alarm devices, etc.
  - g. Acoustical treatment of the chiller will most likely be required, due to the proximity of the school to the neighboring properties.
  - h. A new ventilation exhaust system must be installed to relieve the outside air being brought into the classrooms by the unit ventilators.
  - i. This installation has to happen to the entire building at one time and not one room at a time.
3. Estimated Service Life:
  - a. 20 years.

## 1.6 Option 6: Self-Contained Vertical Stand-Up Unit Ventilators - Free Blow

### Option 6 Provide New Self-Contained Vertical Stand-Up Unit Ventilators – Free Blow

This option consists of providing new self-contained vertical stand-up classroom unit ventilators equipped with a heating coil. The free-blow unit has a top discharge plenum located directly on top of the unit which discharges the air. Masonry work would be required to create a new louver opening. The existing louver opening can either be block-up or abandoned in place and blanked off from the inside. Casework (if present) will have to be modified for new unit ventilator footprint. The existing heating piping will be modified and re-used. An integral exhaust fan relieves the outside air and does not require a separate ventilation relief system. The existing pneumatic controls will be converted to a direct digital controls system to achieve better overall control. New electrical distribution panelboards will be provided to serve the new unit ventilators.

1. Advantages:
  - a. No roof penetrations are required for this option for refrigerant piping.
  - b. Minimal ceiling work is required with this option.
  - c. Modifications to the existing heating piping are minimal.
  - d. No major structural reinforcing is required.
  - e. The unit ventilator's integral exhaust system will relieve the outside air. Therefore, a separate relief system is not required.
  - f. Vertical stand-up unit ventilators are easier to maintain than under the window unit ventilators.
  - g. Vertical stand-up unit ventilators have a smaller foot print than under the windows unit ventilators, thus results in more classroom space.
  - h. This installation could be done one room at a time.
2. Disadvantages:
  - a. Masonry work or removal of windows will be required since the louver is a different size and in a different location.
  - b. Casework will need to be modified to accommodate change in unit location.
3. Estimated Service Life:
  - a. 15 years.

## 1.7 Option 7: Self-Contained Vertical Stand-Up Unit Ventilators – Ducted

### Option 7 Provide New Self-Contained Vertical Stand-Up Unit Ventilators – Ducted Distribution

This option is the same as Option 6, but it has ductwork which is routed to ceiling mounted diffusers in lieu of a free blow plenum which discharges the air.

1. Additional advantages to Option 6:
  - a. A ducted system provides better air distribution.
  - b. A ducted system provides lower noise levels.
  - c. A ducted system provides a more uniform room temperature.
2. Additional disadvantages to Option 6:
  - a. This option requires more ceiling work and in some instances, requires the ceiling to be lowered for distribution ductwork.
3. Estimated Service Life:
  - a. 15 years.

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## 1.8 Option 8: Chilled Water Plant & Vertical Stand-Up Unit Ventilators – Free Blow

### Option 8 Provide a Chilled Water Plant and Chilled Water Distribution Piping to Cooling Coils in Vertical Stand-Up Unit Ventilators – Free Blow

This option consists of providing a chilled water plant and distribution piping to each new classroom vertical stand-up unit ventilator. The chiller will be located on the exterior of the building either on the roof or on grade. Each unit ventilator will be equipped with a chilled water cooling and a heating coil. The free-blow unit has a top discharge plenum located directly on top of the unit that discharges the air. Masonry work would be required to create a new louver opening. The existing louver opening can either be block-up or abandoned in place and blanked off from the inside. Casework (if present) will have to be modified for new unit ventilator footprint. The existing heating piping will be modified and re-used. An integral exhaust fan relieves the outside air and does not require a separate ventilation relief system. The existing pneumatic controls will be converted to a direct digital controls system to achieve better overall control. The new unit ventilators will be reconnected to the existing power circuits.

1. Advantages:
  - a. A central chilled water plant is more energy efficient and has better control than a self-contained unit ventilator or window air conditioning system.
  - b. A central plant removes compressor noise from occupied space.
  - c. Electrical circuits may be re-used for the unit ventilators.
  - d. Vertical stand-up unit ventilators are easier to maintain than under the window unit ventilators.
  - e. Vertical stand-up unit ventilators have a smaller foot print than under the windows unit ventilators, thus results in more classroom space.
  - f. Modifications to the existing heating piping are minimal.
  - g. The unit ventilator's integral exhaust system will relieve the outside air. Therefore, a separate relief system is not required.
2. Disadvantages:
  - a. Masonry work or removal of windows will be required since the louver is a different size and in a different location.
  - b. Casework will need modification to accommodate change in unit location.
  - c. A new chilled water plant and distribution piping is required.
  - d. If the chiller is located on the roof, substantial structural modifications are required to accommodate the weight of the unit.
  - e. Existing ceilings will need to be lowered in areas to accommodate new chilled water distribution piping. This requires added costs (compared to a new installation) to modify existing lights, speakers, fire alarm devices, etc.
  - f. Acoustical treatment of the chiller will most likely be required, due to the proximity of the school to the neighboring properties.
  - g. This installation requires the entire building to undergo the modifications at one time and cannot be performed one room at a time.
3. Estimated Service Life:
  - a. 20 years.

## 1.9 Option 9: Chilled Water Plant & Vertical Stand-Up Unit Ventilators – Ducted Distribution

### Option 9 Provide a Chilled Water Plant and Chilled Water Distribution Piping to Cooling Coils in Vertical Stand-Up Unit Ventilators – Ducted Distribution

This option is the same as Option 8, but it has ductwork which is routed to ceiling mounted diffusers in lieu of a free blow plenum which discharges the air.

1. Additional advantages to Option 8:
  - a. A ducted system provides better air distribution.
  - b. A ducted system provides lower noise levels.
  - c. A ducted system provides a more uniform room temperature.
2. Additional disadvantages to Option 8:
  - a. This option requires more ceiling work and in some instances, requires the ceiling to be lowered for distribution ductwork.
3. Estimated Service Life:
  - a. 20 years.

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## 1.10 Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils

### Option 10 Provide Packaged Variable Air Volume Rooftop Units with Individual Zone VAV Boxes Heating Coils

This option consists of providing variable air volume (VAV) packaged rooftop units, individual variable air volume boxes with heating coils, and distributions medium and low pressure ductwork. Ceilings will need to be replaced, lowered, and soffits created to accommodate distribution ductwork. The existing unit ventilators will be removed. The unit ventilator louver opening can either be blocked-up or abandoned in place and blanked off from the inside. Casework (if present) will have to be modified due to the removal of the unit ventilator and piping. The existing heating piping will be routed and connected to the new VAV box coils. Gas piping will be routed to the preheat section of the VAV rooftop unit. The existing pneumatic controls will be converted to a direct digital controls system to achieve better overall control. New electrical distribution will be provided to serve the new rooftop units.

1. Advantages:
  - a. A ducted system provides better air distribution.
  - b. A ducted system provides lower noise levels.
  - c. A ducted system provides more uniform room temperature.
  - d. This system provides the best humidity control of all the options.
  - e. Individual room VAV boxes create better occupant comfort and allow simultaneous heating or cooling of adjacent spaces.
2. Disadvantages:
  - a. New ceilings will be required to accommodate distribution ductwork.
  - b. The boilers need to be in operation during certain times of the cooling season to provide heat to the VAV boxes so zones do not sub-cool.
  - c. Roof modifications and larger penetrations are required as compared to the other main system options.
  - d. Substantial structural modifications are required to accommodate the rooftop unit weight.
  - e. Additional heating piping distribution costs are required to serve VAV boxes.
  - f. Roof mounted gas piping is required to serve rooftop units.
  - g. Rooftop unit equipment service may be required during inclement weather.
  - h. This installation has to happen in groups or to the entire building at one time. It cannot be phased in one room at a time.
3. Estimated Service Life:
  - a. 20 years.

## 1.11 Air Conditioning System Options Performance & Costs Overview

### General

An air conditioning summary sheet was developed (this table is located within the tab of each school) from information which was collected or calculated for each of the schools. This summary includes six (6) different categories for each air conditioning system option mentioned and was generated to assist the school district in determining which option is best for them. This summary is divided into the following categories: Installation Cost Opinion, Annual Maintenance Cost, Annual Estimated Energy Usage, Replacement Cost, Life Cycle Cost, and Relative Sound Level Comparison. A description of each category is described below.

### Installation Cost Opinion

A cost opinion was generated for each air conditioning option which includes mechanical, electrical, and general trade's costs. These costs were developed using data collected from the current bidding environment and from historical pricing on similar type projects.

### Annual Maintenance Cost

Annual maintenance cost includes the preventative maintenance, cleaning, and normal repair which is conducted to detect and prevent equipment failure and keep materials and systems in working order. We assembled pricing for this portion of the report consulting with reputable mechanical contractors that regularly work in the school market and are familiar with these types of HVAC systems.

Properly executed maintenance programs that target energy efficiency have been shown to save 5% to 20% on energy bills without significant capital investment. Additionally, preventive maintenance can reduce building operating cost by extending the life of equipment and reduce liability and risk associated with the health and safety of building occupants.

### Annual Estimated Energy Usage

The energy modeling software used was developed by Trane (Trace 700 version 6.2.10.0) for estimating the annual electrical energy usage of the different air conditioning options identified in the report. A simplified building model was created composed of three (3) 800 sq. ft. classrooms one on first floor with a south exterior facing wall, another classroom on the second floor with a west exterior facing wall, and a the last classroom on the third floor with a roof exposure and an east exterior facing wall. Building envelope properties such as the wall, roof, and window construction was assumed based on past experience working in similar buildings. The Trane program defaults such as building occupancy scheduling and room temperatures were used in the model. The total energy usage identified in the report was calculated by averaging the energy usage of all the rooms and then was extrapolated to simulate energy usage for each system option and building. Since each building is different this type of simplified energy modeling is not an accurate way to calculate energy consumption and system efficiency (due to the small sample size of rooms). This estimate was assembled to give a relative energy usage for each system option.

## **Replacement Cost**

Replacement cost reserves are often overlooked in mechanical LCC estimates. For example window air-conditioning units have a 10 year estimated service life, self-contained unit ventilators have an estimated service life expectancy of 15 years, and reciprocating compressors and chillers are expected to operate for 20 years. This should be considered when selecting any system.

The estimated service life is a time value established by the American Society of Heating, Refrigeration and Air-conditioning Engineers that reflects the expected life of a specific component. Equipment life is highly variable because of the diverse equipment applications, the preventative maintenance given, the environment, and the technical advancements of new equipment. Replacement costs along with maintenance costs are real costs of any mechanical installation and are included in the LCC analysis.

## **Life Cycle Cost**

Life Cycle Costing (LCC) is an economic analysis that can be used in the selection of alternatives that impact both pending and future cost. LCC analysis is used to evaluate alternative systems which are evaluated on the basis of cost. The accompanying LCC compares initial investment options and identifies the least cost investment alternative for a thirty year period.

In this case, the LCC method is being evaluated to help choose between alternative air-conditioning systems to cool the classrooms. To be a candidate project for this LCC analysis, the system must meet minimum performance requirements for the occupant, in this case thermal comfort.

Systems with the lowest LCC may have a higher first cost than alternative systems. Systems with lower maintenance costs, longer equipment life, and/or energy savings could prove to be a better value over time. The LCC of the current project alternatives is the sum of its initial investment cost, I, present value of energy cost E, the present value of maintenance cost M, the present value of replacement cost R, minus the present value of salvage S. Salvage value is assumed to be \$0 for current project.

$$LCC = I + E + M + R - S$$

An implicit assumption in the LCC analysis is that all the alternatives considered for a particular project will be capable of satisfying the minimum performance requirements for that project.

The computation comparison is located in the table for each school in the Air Conditioning System Options Performance & Cost Summary. Although LCC is a major factor in decision making the overall system should be considered, things such as potentially high humidity levels in rooms (which will be present at times with Option 1 through Option 3), sound levels, and the type of maintenance required must be considered.

## **Relative Sound Level Comparison**

Cataloging sound performance data is not a requirement for all mechanical equipment. This leads to a difficult task of evaluating or quantifying sound levels for each option. We developed a non-scientific evaluation scheme by researching articles about the equipment, obtaining input provided by equipment manufacturer's representatives, and through our opinions based on previous experiences. We have used this knowledge base to create a scale where we have rated the sound level for each option from 1 through 10, 1 being the quietest operating and 10 being the loudest operating. This scale gives an opinion on the relative noise level of each option. To help in selecting a system option, a site visit can be arranged to visit and observe similar project installations.

**2.0 BEYE ELEMENTARY SCHOOL**

For FAC Review

For FAC Review

## 2.1 Existing Conditions

### A. Description of Existing Conditions

#### 1) Heating System and Distribution:

- a. The majority of the building is heated by two (2) newer steam boilers. The boilers were manufactured by the Weil McLain Company in 2004 and are models 1688. The input capacity for each boiler is 5,100 MBH each. The heating plant is located in the basement level in Boiler Room 001. The estimated service life according to the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) for the boilers is approximately 35 years. They appear to be in good condition.
- b. The main condensate return system is in an adjacent room (Custodian Room 002). The system was manufactured by Domestic and is a model VCD4. There was no visible date when the unit was manufactured. The system is older but has had maintenance recently performed on it. The system appears to be in fair to poor condition.
- c. There are 5 gas fired packaged (heating/cooling) rooftop units located on the roof. They were all manufactured by the Carrier Corporation in 2000 and appear to be in fair condition. These units serve the main office, classrooms 208 and 210, and the media center. The estimated service life for this equipment is about 15 years. The following is the information we obtained from the nameplate data on the units:

RTU-1 (Main Office) – Carrier Model 48JE014

RTU-2 (Multi-purpose Room) – Carrier Model 48GS024

RTU-3 (Main Office –Work Room) – Carrier Model 48JF028

RTU-4 (Classroom 210) – Carrier Model 48JE006

RTU-5 (Classroom 208) – Carrier Model 48JE006

#### 2) Ventilating:

- a. Ventilation to a majority of the classrooms is provided by unit ventilators. These units were manufactured by American Air Filter in 1994. These are floor mounted units model AV and are in fair condition. These units have an estimated service life of 15 to 20 years.
- b. Office 207A, Office 207B, and Work Area 207C located on the second floor have packaged terminal air conditioning units (PTAC) which provide ventilation to the rooms. These units were manufactured in 2007 by McQuay and are model PKHS1012C. These units have an estimated service life of 15 years and appear to be in good condition.
- c. The main office, classrooms 208 and 210, and the media center have rooftop units which provide ventilation to these rooms. The units have distribution ductwork routed above the ceilings and connected to ceiling and wall mounted diffusers. These units appear to be in good to fair condition.

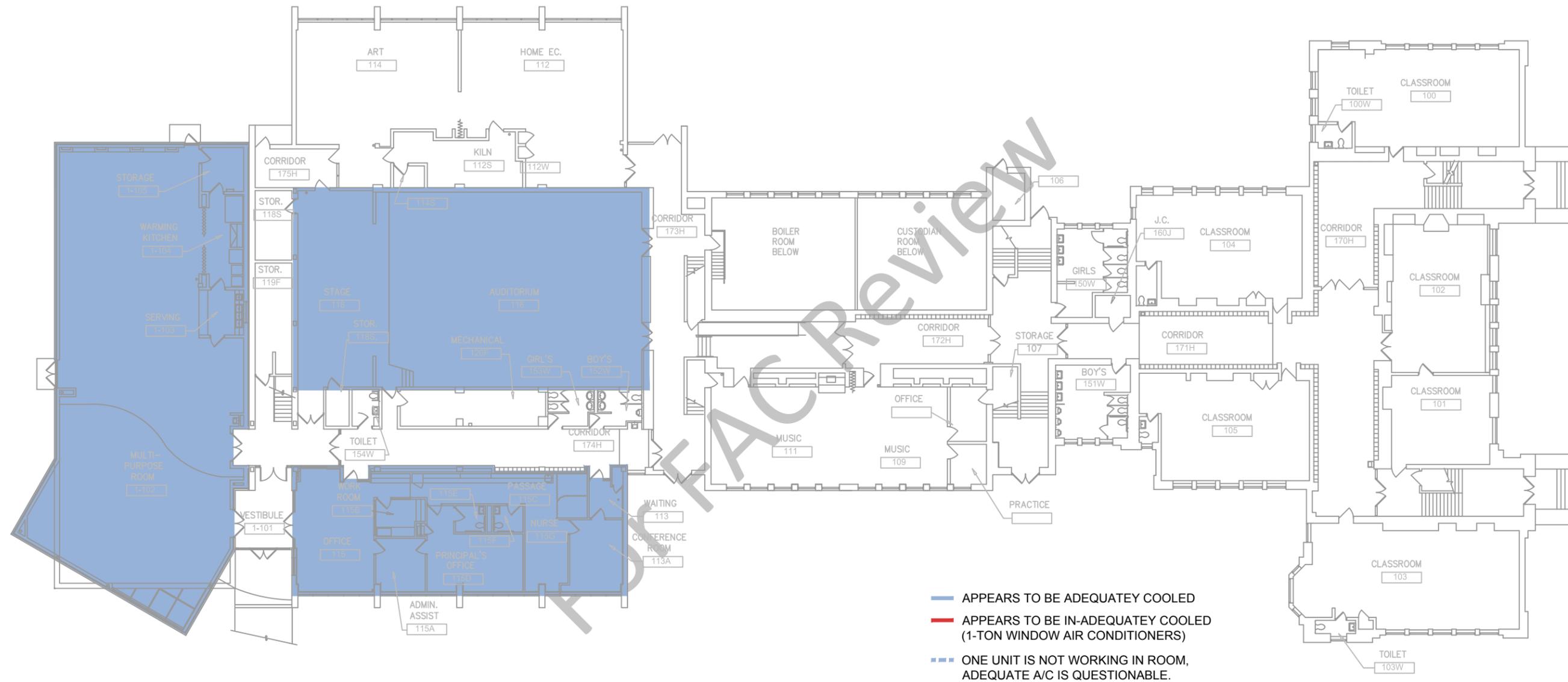
- d. The gymnasium, multi-purpose room, and auditorium have ventilation provided by indoor air handling units. The manufacturer of these units is unknown. The units have distribution ductwork routed above the ceilings and connected to ceiling and wall mounted diffusers. The units are newer, looks like they were installed at the same time, and appear to be in good condition. The estimated service life for this system is about 25 years.
  - e. Classroom/Office 303 and the office south of Classroom 308 rely on the windows to provide natural ventilation. There is no mechanical means to provide ventilation.
- 3) Air-Conditioning:
- a. Classroom 200 has cooling provided by a self-contained unit ventilator which was manufactured by American Air Filter in 1995.
  - b. Office 207A, Office 207B, and Work Area 207C has cooling provided by PTAC.
  - c. Packaged rooftop units provide cooling to the main office, media center and adjacent support rooms, classrooms 208 and 210.
  - d. Multi-Purpose Room 1-102 has an indoor air handling unit which provides cool air that is generated by a remote air cooled condensing unit. The condensing unit was manufactured in 2010 by Trane and is a model TTA150. The estimated service life for this unit is about 20 years. This unit appears to be in good condition.
  - e. The Auditorium 116 is served by an indoor air handling unit which provides cool air that is generated by a remote air cooled condensing unit. The condensing unit was manufactured in 2010 by Trane and is a model TTA150. The estimated service life for this unit is about 20 years. This unit appears to be in good condition.
  - f. There are 6 rooms that have window air conditioning units. These rooms are classrooms, offices, and a reading room. The units are approximately 1 ton of cooling capacity each. The units have an estimated service life of 10 years and range from good to fair condition. (Note: 1 ton of cooling for a typical classroom is not adequate to provide cooling for the space  $\pm 74^{\circ}\text{F}$ ).
- 4) Electrical Service:
- a. The electrical service to the building is 1600 Amps 208Y/120V. 3 Phase 4 Wire. Based on the maximum demand data available from Commonwealth Edison Company, the power demand over a one year period is 158.02 KW. Per the 2008 National Electrical Code Article 220.87 we have calculated the maximum demand to be 645.5 Amps. Based on this information we have 954.5 Amps available to serve the new air conditioning load. The new air conditioning electrical load is estimated to be 669.6 Amps. The existing electrical service appears to be adequate.

5) Controls:

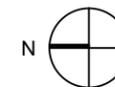
- a. The main control system for the HVAC systems is pneumatic. This system has some operational issues, indicated by the wide range of temperatures throughout the offices and classrooms. This could be caused by thermostats out of calibration, valves not working properly, or pneumatic piping or fittings leaking. During our survey, there were multiple rooms which had open windows in an attempt to cool the rooms. This is not only consuming more energy than necessary, but is a potential security concern.
- b. The temperature control system air compressor is located in Custodian Room 002. It is a 60 gallon duplex compressor system manufactured by Curtis model 6DJ7C. The pneumatic system controls majority of the building devices with the exception of the window air conditioning units (self-contained controls), PTAC units (self-contained controls), newer indoor air handling units, and the rooftop units (direct digital controls (DDC)). The pneumatic control system is older, has some leaking occurring in the piping system, obsolete technology, and in poor condition. Pneumatic controls have an estimated service life of 20 years.
- c. The rooftop units and newer air handling units are controlled by a DDC system. From discussions with the building personnel, the DDC system seems to be controlling adequately and they appear to be pleased with the performance compared to the pneumatic system. All of this equipment is controlled remotely by district maintenance personnel. This system appears to be in good to fair condition.

FOR FAC REVIEW

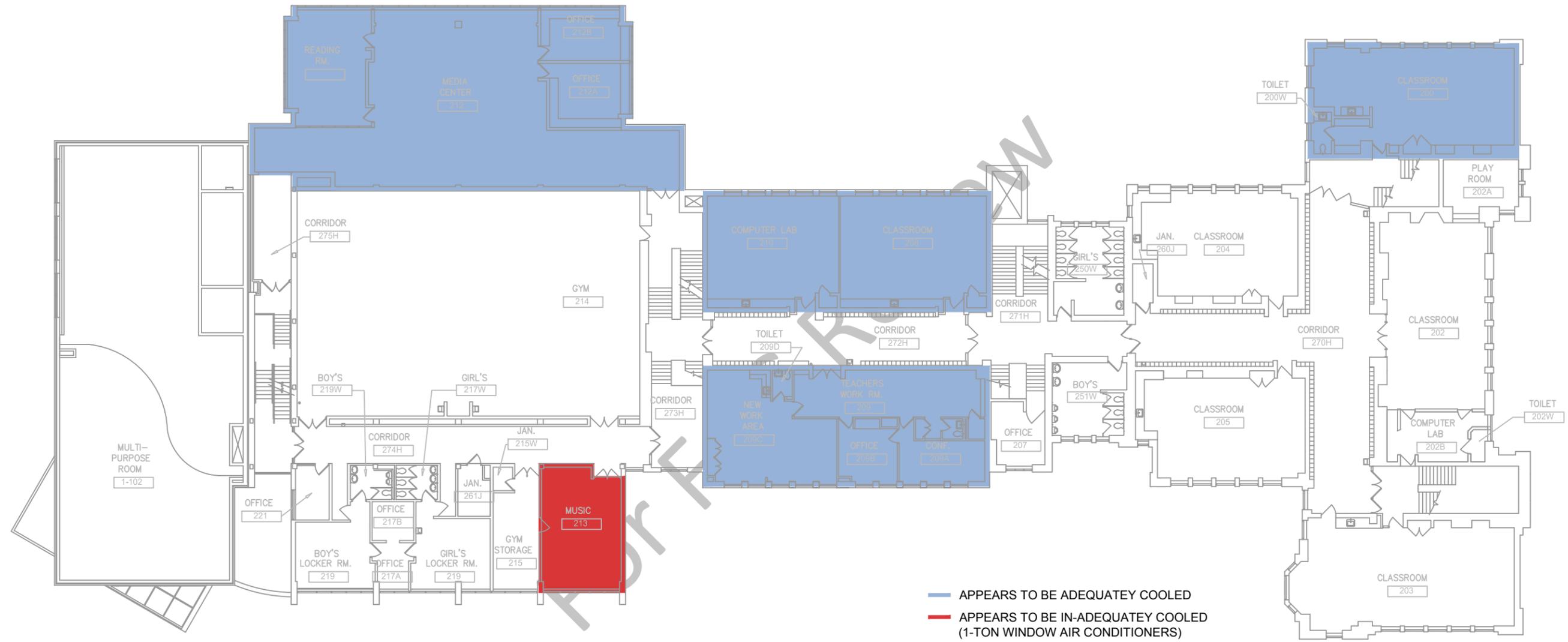
For FAC Review



**BEYE - FIRST FLOOR EXISTING AIR CONDITIONING AREA PLAN**  
 OAK PARK ELEMENTARY SCHOOL DISTRICT 97



For FAC Review



- APPEARS TO BE ADEQUATELY COOLED
- APPEARS TO BE IN-ADEQUATELY COOLED (1-TON WINDOW AIR CONDITIONERS)
- - - ONE UNIT IS NOT WORKING IN ROOM, ADEQUATE A/C IS QUESTIONABLE.

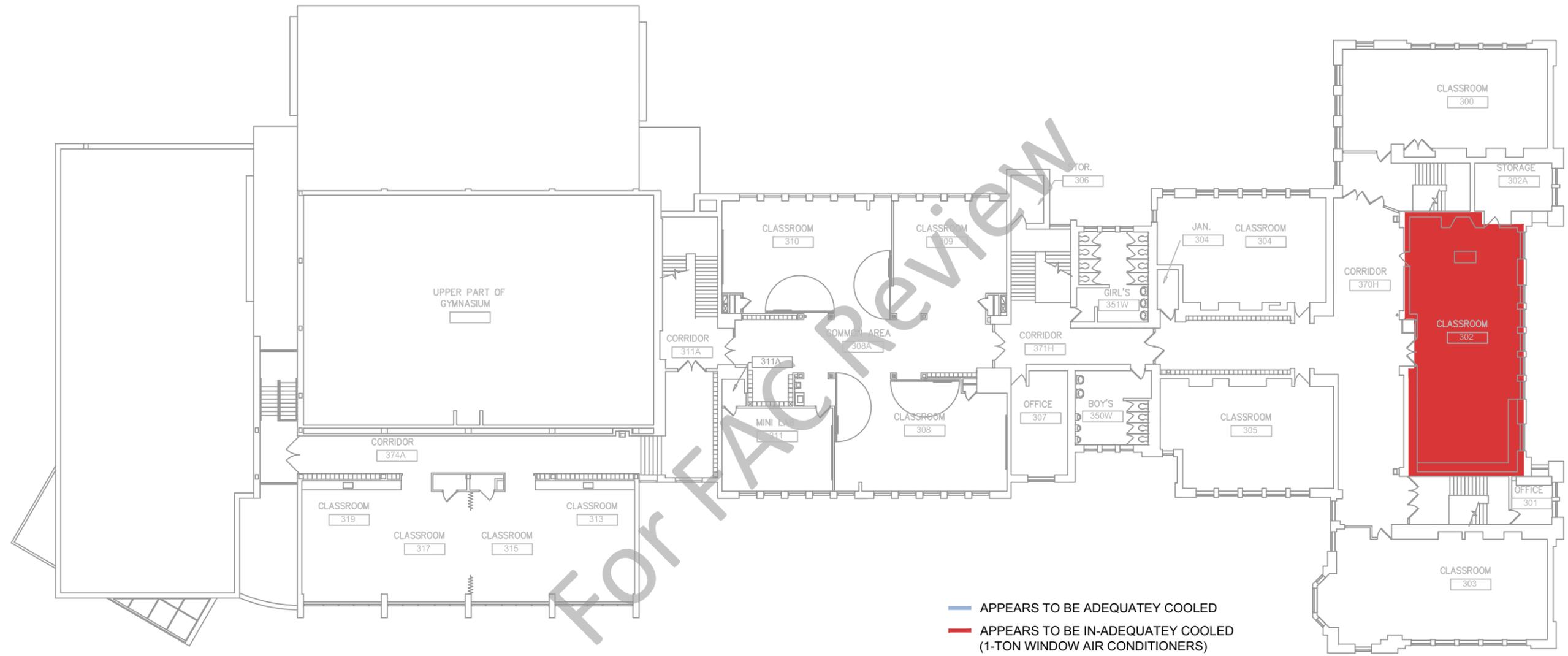
**BEYE - SECOND FLOOR EXISTING AIR CONDITIONING AREA PLAN**

OAK PARK ELEMENTARY SCHOOL DISTRICT 97



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For FAC Review



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For FAC Review

**Oak Park Elementary School District 97**  
**Beye Elementary School**  
**Air Conditioning System Options Performance & Costs Summary**

Air Conditioning System Option	Initial Construction Cost	Annual Maintenance Cost	Annual Estimated Energy Usage	Replacement Cost (over 30 years)	Life Cycle Cost	Relative Sound Level Comparison*
Option 1: Window Air Conditioners**	\$453,477	\$10,800	\$24,600	\$162,344	\$1,270,459	10
Option 2: Ductless Split System**	\$917,419	\$14,400	\$20,004	\$457,036	\$1,993,639	2
Option 3: Ducted Split System**	\$1,566,040	\$14,400	\$21,276	\$491,450	\$2,701,890	1
Option 4: Under the Window Self-Contained Unit Ventilator	\$1,693,699	\$10,800	\$22,116	\$675,167	\$2,974,262	9
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	\$2,526,089	\$12,600	\$24,444	\$584,158	\$3,789,621	8
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	\$1,772,773	\$10,800	\$22,896	\$731,997	\$3,125,628	7
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	\$2,223,300	\$10,800	\$24,000	\$772,725	\$3,638,769	6
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	\$2,570,761	\$12,600	\$23,940	\$614,180	\$3,854,324	5
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	\$3,658,702	\$12,600	\$25,428	\$624,187	\$4,981,770	4
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	\$3,670,488	\$9,900	\$24,492	\$390,284	\$4,699,355	3

\* 1 - 10 (Quietest to Loudest Operating System)

\*\* Since the UV must be in operation to provide outside air, the associated maintenance cost must be included with this option.

For FAC Review

**3.0 HATCH ELEMENTARY SCHOOL**

For FAC Review

For FAC Review

### 3.1 Existing Conditions

#### A. Description of Existing Conditions

##### 1) Heating System and Distribution:

- a. The majority of the building is heated by two (2) newer steam boilers. The boilers were manufactured by Smith Cast Iron Boiler Company in 2003 and are models 28A-SW-16. The input capacity for each boiler is 5,100 MBH each. The heating plant is located in the basement level in Boiler Room 003. The estimated service life according to the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) for the boilers is approximately 35 years. They appear to be in good condition.
- b. The main condensate return system is in an adjacent room. The system was manufactured by Domestic and is a model VCD. There was no visible date when the unit was manufactured. The system is older, but has had maintenance recently performed on it. The system appears to be in fair to poor condition.
- c. There are seven (7) gas fired packaged (heating/cooling) rooftop units located on the roof. They were all manufactured by the Trane Company in 2001 and appear to be in good to fair condition. The estimated service life for this equipment is about 15 years. They serve the main office, multi-purpose room, library, resource room, and the computer lab. We collected model numbers for three (3) of the units. The other rooftop units had electrical disconnects mounted over the nameplate on the units which covered the model numbers of the units. From a visual observation, it appears that all of the units were installed at the same time. The estimated service life for this equipment is about 15 years. The following is the information we obtained from the nameplate data on the units:

RTU-3 – Trane Voyager Model YCD102

RTU-5 – Trane Voyager Model YCD102

RTU-7 – Trane Voyager Model YCH075

##### 2) Ventilating:

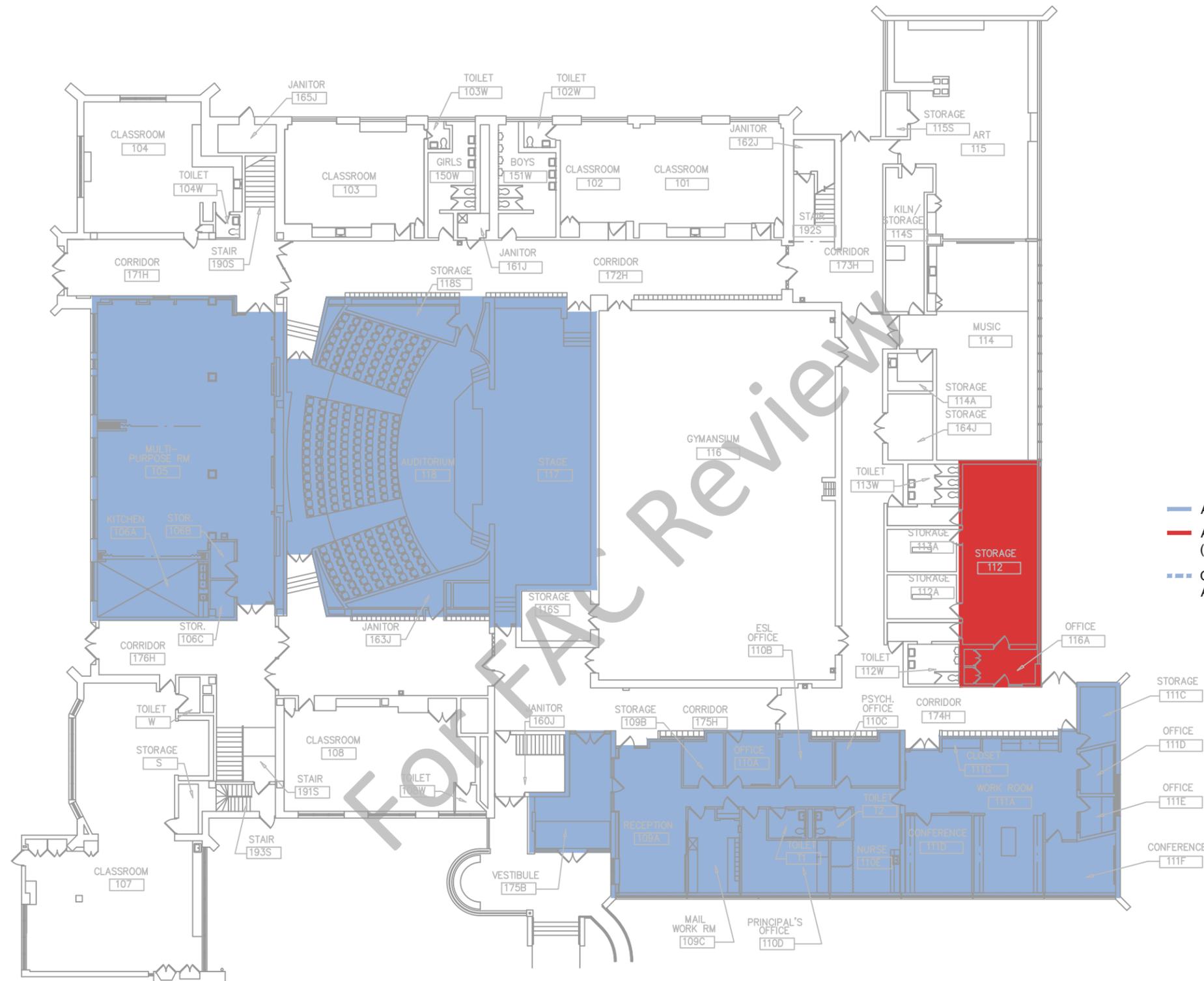
- a. Ventilation to a majority of the classrooms is provided by unit ventilators. These units were manufactured by American Air Filter in 1994. The majority of the units are floor mounted model AV. There is one ceiling mounted unit which is a model AH. These units have an estimated service life of 15 to 20 years and appear to be in good to fair condition.
- b. Two (2) small offices on the third floor (Office 304A and Office 307A) have packaged terminal air conditioning units (PTAC) which provide ventilation to the rooms. These units were manufactured by McQuay and are Series 25. It is assumed that these units were installed at the same time as the unit ventilators. These units have an estimated service life of 15 years and appear to be in fair to poor condition.

- c. The main office, multi-purpose room, library, and the computer lab have rooftop units which provide ventilation to these rooms. The units have distribution ductwork routed above the ceilings and connected to ceiling and wall mounted diffusers.
  - d. The gymnasium and auditorium have ventilation provided by indoor air handling units. The manufacturer of these units is unknown. The units have distribution ductwork routed above the ceilings and connected to ceiling and wall mounted diffusers. The units are older and appear to be in poor condition and have an estimated service life of 25 years.
  - e. There is a group room (Clinic 310) which relies on the windows to provide natural ventilation. There is no mechanical means to provide ventilation.
- 3) Air-Conditioning:
- a. Packaged rooftop units provide cooling to the main office, multi-purpose room, library, resource room, and the computer lab.
  - b. Office 304A and 307A have wall mounted PTAC units which provide cooling.
  - c. The auditorium is served by an indoor air handling unit which provides cool air generated by a remote air cooled condensing unit. The condensing unit was manufactured by Carrier and is a model 38AKS016. This unit has an estimated service life of 20 years and appears to be in fair to poor condition.
  - d. There is a classroom (converted storage room) which has a window air conditioner. It has 1 ton of cooling capacity. The unit has an estimated service life of 10 years and is in good to fair condition. (Note: 1 ton of cooling for a typical classroom is not adequate to provide cooling for the space  $\pm 74^{\circ}\text{F}$ ).
  - e. Clinic 308A which is served by a ceiling mounted unit ventilator with a remote air cooled condensing unit. The condensing unit was manufactured in 1994 by Inter-city Products. This unit has an estimated service life of 15 years and it appears to be in fair to poor condition.
- 4) Electrical Service:
- a. The electrical service to the building is 1600 Amps 208Y/120V. 3 Phase 4 Wire. Based on the maximum demand data available from Commonwealth Edison Company, the power demand over a one year period is 152.2 KW. Per the 2008 National Electrical Code Article 220.87 we have calculated the maximum demand to be 621.5 Amps. Based on this information we have 978.5 Amps available to serve the new air conditioning load. The new air conditioning electrical load is estimated to be 539.1 Amps. The existing electrical service appears to be adequate.

5) Controls:

- a. The main control system for the HVAC systems is pneumatic. This system has some operational issues, indicated by the wide range of temperatures throughout the offices and classrooms. This could be caused by thermostats out of calibration, valves not working properly, or pneumatic piping or fittings leaking. During our survey, there were multiple rooms which had open windows in an attempt to cool the rooms. This is not only consuming more energy than necessary, but is a potential security concern.
- b. The temperature control system air compressor is located in Machine Room 002. It is a 60 gallon, duplex compressor system manufactured by Curtis model 6DJ7C. The pneumatic system controls majority of the building devices with the exception of the PTAC units (self-contained controls), window air conditioning units (self-contained controls), newer air handling equipment, and the rooftop units (direct digital controls (DDC)). The pneumatic control system is older, has excessive leaking (the compressor was cycling frequently during our survey), obsolete, and in poor condition. Pneumatic controls have an estimated service life of 20 years.
- c. Some of the rooftop units are controlled by a DDC system. From discussions with the building personnel, the DDC system seems to be controlling adequately and they appear to be pleased with the performance compared to the pneumatic system. All of this equipment is controlled remotely by district maintenance personnel. This system appears to be in good to fair condition.

For FAC Review

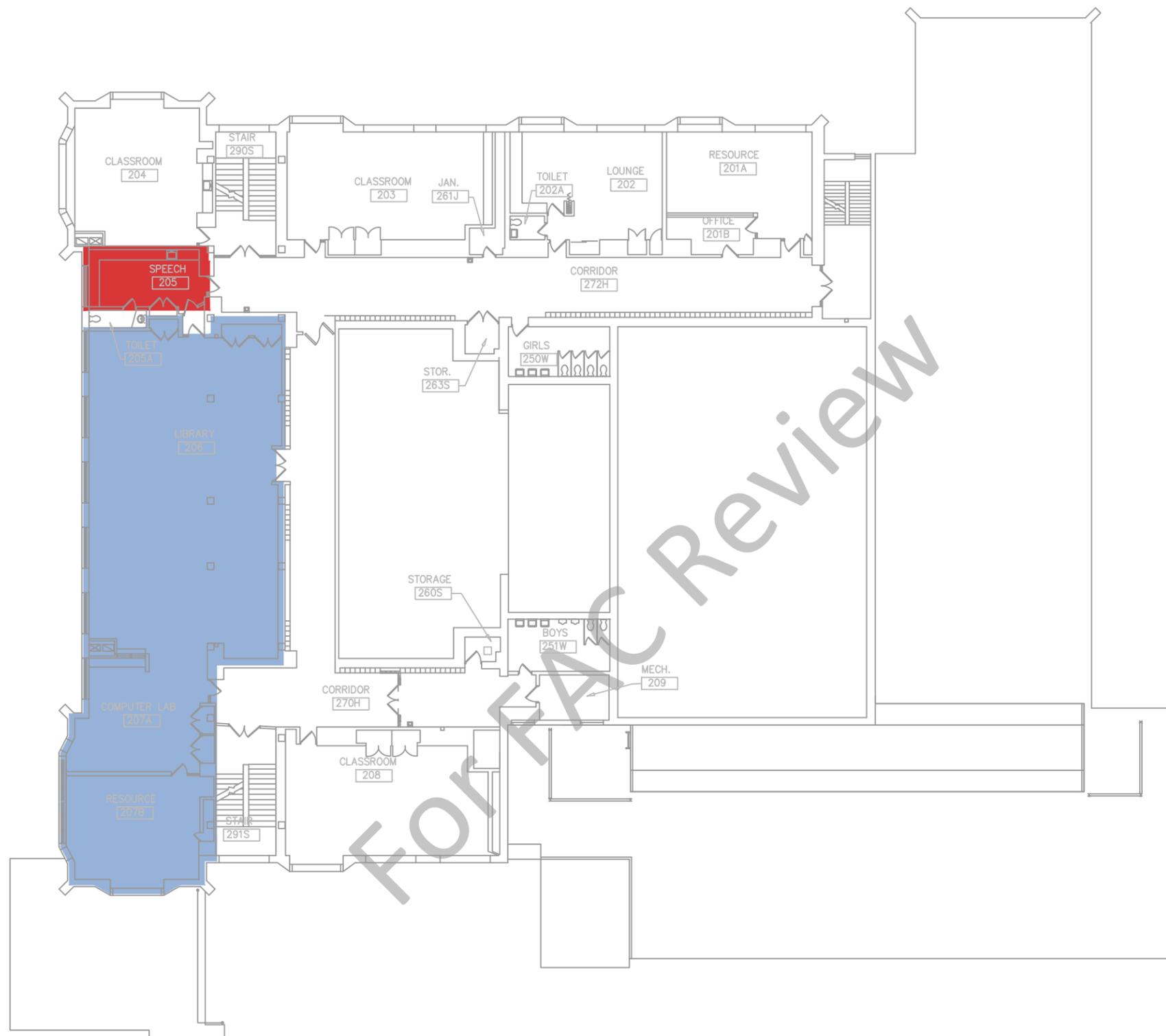


- APPEARS TO BE ADEQUATELY COOLED
- APPEARS TO BE IN-ADEQUATELY COOLED (1-TON WINDOW AIR CONDITIONERS)
- - - ONE UNIT IS NOT WORKING IN ROOM, ADEQUATE A/C IS QUESTIONABLE.

**HATCH - FIRST FLOOR EXISTING AIR CONDITIONING AREA PLAN**  
 OAK PARK ELEMENTARY SCHOOL DISTRICT 97



For FAC Review



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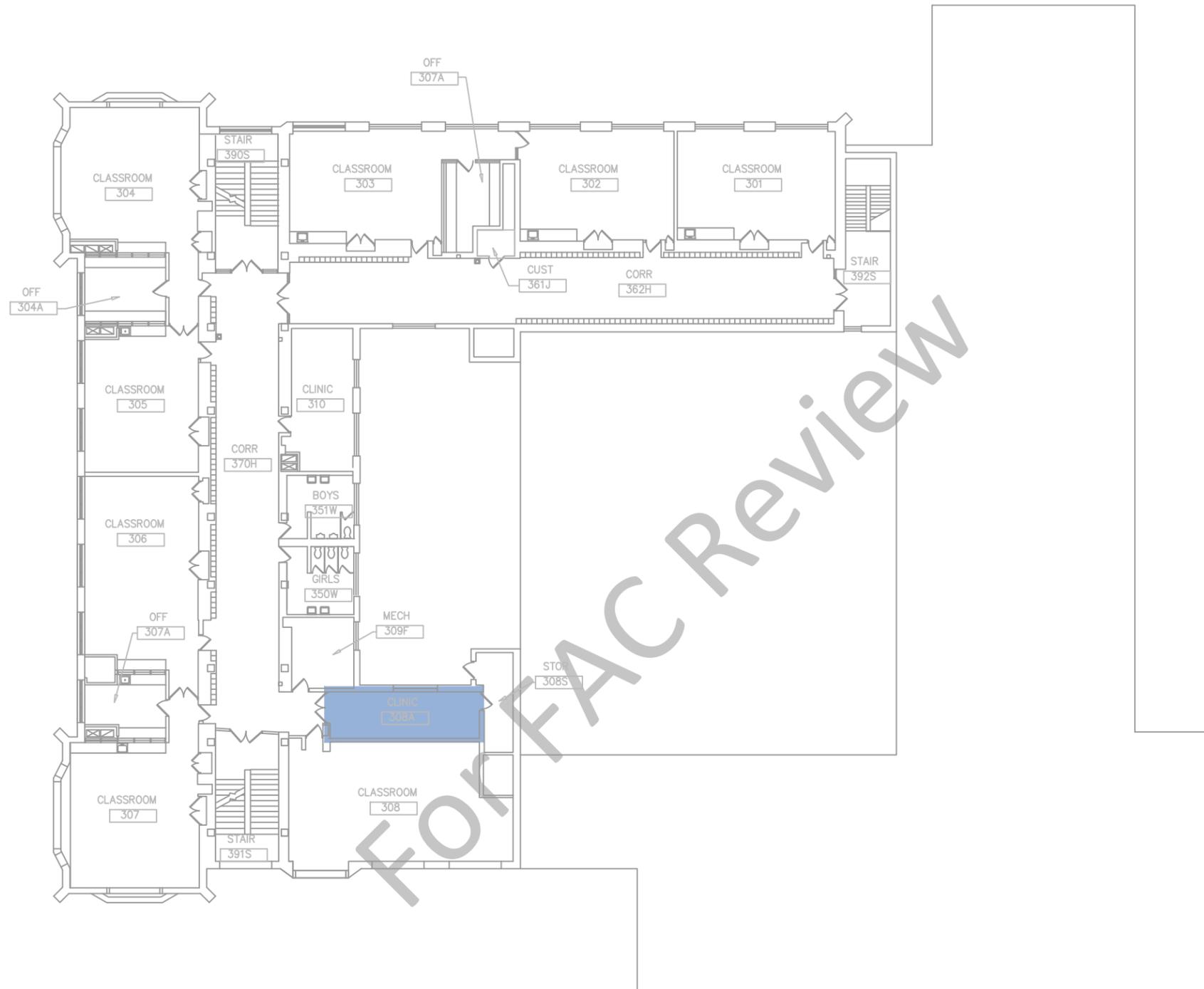
## HATCH - SECOND FLOOR EXISTING AIR CONDITIONING AREA PLAN

OAK PARK ELEMENTARY SCHOOL DISTRICT 97



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For FAC Review



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## HATCH - THIRD FLOOR EXISTING AIR CONDITIONING AREA PLAN

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For FAC Review

**Oak Park Elementary School District 97**  
**Hatch Elementary School**  
**Air Conditioning System Options Performance & Costs Summary**

Air Conditioning System Option	Initial Construction Cost	Annual Maintenance Cost	Annual Estimated Energy Usage	Replacement Cost (over 30 years)	Life Cycle Cost	Relative Sound Level Comparison*
Option 1: Window Air Conditioners**	\$365,301	\$8,700	\$19,817	\$130,777	\$1,023,426	10
Option 2: Ductless Split System**	\$739,032	\$11,600	\$16,114	\$368,168	\$1,605,987	2
Option 3: Ducted Split System**	\$1,261,533	\$11,600	\$17,139	\$395,890	\$2,176,522	1
Option 4: Under the Window Self-Contained Unit Ventilator	\$1,364,369	\$8,700	\$17,816	\$543,885	\$2,395,933	9
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	\$2,034,905	\$10,150	\$19,691	\$470,572	\$3,052,750	8
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	\$1,428,067	\$8,700	\$18,444	\$589,664	\$2,517,867	7
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	\$1,790,992	\$8,700	\$19,333	\$622,473	\$2,931,230	6
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	\$2,070,891	\$10,150	\$19,285	\$494,756	\$3,104,872	5
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	\$2,947,288	\$10,150	\$20,484	\$502,818	\$4,013,093	4
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	\$2,956,782	\$7,975	\$19,730	\$314,395	\$3,785,592	3

\* 1 - 10 (Quietest to Loudest Operating System)

\*\* Since the UV must be in operation to provide outside air, the associated maintenance cost must be included with this option.

For FAC Review

**4.0 HOLMES ELEMENTARY SCHOOL**

For FAC Review

For FAC Review

## 4.1 Existing Conditions

### A. Description of Existing Conditions

#### 1) Heating System and Distribution:

- a. The majority of the building is heated by two (2) newer hot water boilers. The boilers were manufactured by the Weil McLain Company in 2008 and are models 1388. The input capacity for each boiler is 4,100 MBH each. The heating plant is located in the basement level in Boiler Room 001. The estimated service life according to the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) for the boilers is approximately 35 years. They appear to be in good condition.
- b. There four main hot water distribution pumps which were manufactured by Bell & Gossett. Two (2) pumps are primary and two (2) pumps are secondary. All four (4) are series 1510. One (1) set of pumps have 2 horse power (HP) motors and the other have 5 HP motors. There is no date on the pumps, but they look newer and assumed they were installed the same time the boilers were replaced in 2008. The pumps appear to be in good condition and have an estimated service life of 20 years.
- c. There are thirteen (13) gas fired packaged (heating/cooling) rooftop units located on the roof. Twelve (12) of the units were manufactured by York in 2000 and appear to be in good to fair condition. The other rooftop unit was manufactured by the Trane Company in 1994. This unit appears to be in fair to poor condition. The estimated service life for this equipment is about 15 years. These units serve the main office, media center, computer lab, two (2) resource rooms, the lounge, parent/teacher room, art room, teacher's work room, OT/PT room, multi-purpose room, and therapy room. The following is the information we obtained from the nameplate data on the units:

RTU-1 – York Model D3CG102N16525ECG

RTU-2 – York Model D4CG120N16525ECA

RTU-3 – York Model D4CG090N16525ECA

RTU-4 – Trane Voyager Model TCD090D300BA

RTU-5 – York Model D7CG060N07925EBA

RTU-6 – York Model D1NA024N05606C

RTU-7 – York Model D7CG036N07925EBA

RTU-8 – York Model D7CG060N07925EBA

RTU-9 – York Model D7CG048N06025EBA

RTU-10 – York Model D4CG090N16525ECA

RTU-11 – York Model D2CG072N09925EBA

RTU-12 – York Model D2CG240N32025FDF

RTU-13 – York Model D2CG180N32025FDE

2) Ventilating:

- a. Ventilation to a majority of the classrooms is provided by unit ventilators. These units were manufactured by American Air Filter. The unit ventilators were manufactured in 1993 and are floor mounted units model AV. These units appeared to be in good to fair condition. These units have an estimated service life of 15 to 20 years.
- b. The main office, media center, computer lab, two (2) resource rooms, the lounge, parent/teacher room, art room, teacher's work room, OT/PT room, multi-purpose room, and therapy room have rooftop units which provide ventilation to these rooms. The units have distribution ductwork routed above the ceilings and connected to ceiling and wall mounted diffusers.
- c. The gymnasium has ventilation provided by an indoor air handling unit. The manufacturer is unknown. The units have distribution ductwork routed above the ceilings and connected to wall mounted registers. The unit is newer and appears to be in good condition.
- d. There is one rooftop air handling unit which provides ventilation. There is no visible nameplate so manufacturer and manufacturing date is unknown. The unit is newer and appears to be in good condition. This unit appears to be custom and is built more robust than other rooftop equipment. This unit has an estimated service life of 20 to 25 years.

3) Air-Conditioning:

- a. Packaged rooftop units provide cooling to the main office, media center, computer lab, two (2) resource rooms, the lounge, parent/teacher room, art room, teacher's work room, OT/PT room, multi-purpose room, and therapy room.
- b. The rooftop air handling unit provides cool air that is generated by a remote air cooled condensing unit. The condensing unit was manufactured by McQuay in 2013 and is a model 7919F161306088. This unit has an estimated service life of 20 years and appears to be in good condition.
- c. There are nineteen (19) rooms that have window air conditioning units. These rooms are classrooms, offices, the music room, and lounge. These window air conditioning units are manufactured General Electric, LG, and Kenmore. They are approximately 1 ton of cooling capacity each. The units have an estimated service life of 10 years and range from good to fair condition. (Note: 1 ton of cooling for a typical classroom is not adequate to provide cooling for the space  $\pm 74^{\circ}\text{F}$ ).

4) Electrical Service:

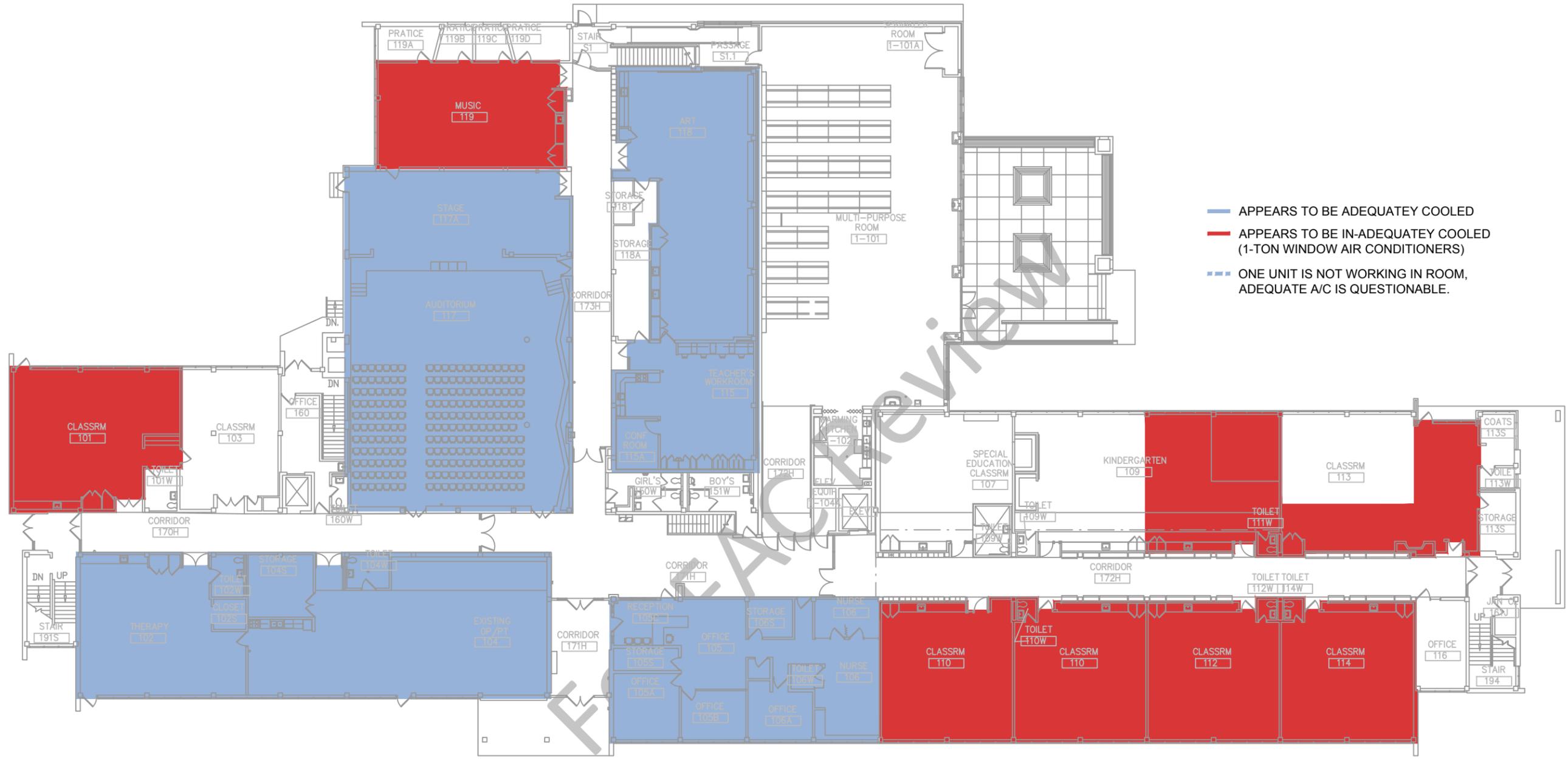
- a. The electrical service to the building is 1600 Amps 208Y/120V. 3 Phase 4 Wire. Based on the maximum demand data available from Commonwealth Edison Company, the power demand over a one year period is 214.3 KW. Per the 2008 National Electrical Code Article 220.87 we have calculated the maximum demand to be 875.5 Amps. Based on this information we have 724.5 Amps available to serve the new air conditioning load. The new air conditioning electrical load is estimated to be 558.0 Amps. The existing electrical service appears to be adequate.

5) Controls:

- a. The main control system for the HVAC systems is pneumatic. This system has some operational issues which were indicated by the wide range of temperatures throughout the offices and classrooms. This could be caused by thermostats out of calibration, valves not working properly, or pneumatic piping or fittings leaking. During our survey, there were multiple rooms which had open windows in an attempt to cool the rooms. This is not only consuming more energy than necessary, but is a potential security concern.
- b. The temperature control air compressor is located in Mechanical Room 002. It is a duplex compressor system manufactured by Curtis model 6DN80. The pneumatic system controls majority of the building devices with the exception of the window air conditioning units (self-contained controls), the packaged rooftop units (direct digital controls (DDC)) and rooftop air handling unit (DDC). The pneumatic control system is older, has some leaking occurring in the piping system, obsolete technology, and in poor condition. Pneumatic controls have an estimated service life of 20 years.
- c. The rooftop units and rooftop air handling units are controlled by a DDC system. From discussions with the building personnel, the system seems to be controlling adequately and they appear to be pleased with the performance compared to the pneumatic system. This system appears to be in good condition.

FOR FAC REVIEW

For FAC Review



- APPEARS TO BE ADEQUATELY COOLED
- APPEARS TO BE IN-ADEQUATELY COOLED (1-TON WINDOW AIR CONDITIONERS)
- - - ONE UNIT IS NOT WORKING IN ROOM, ADEQUATE A/C IS QUESTIONABLE.

**HOLMES - FIRST FLOOR EXISTING AIR CONDITIONING AREA PLAN**  
 OAK PARK ELEMENTARY SCHOOL DISTRICT 97



For FAC Review



**HOLMES - SECOND FLOOR EXISTING AIR CONDITIONING AREA PLAN**  
 OAK PARK ELEMENTARY SCHOOL DISTRICT 97



For FAC Review

**Oak Park Elementary School District 97**  
**Holmes Elementary School**  
**Air Conditioning System Options Performance & Costs Summary**

Air Conditioning System Option	Initial Construction Cost	Annual Maintenance Cost	Annual Estimated Energy Usage	Replacement Cost (over 30 years)	Life Cycle Cost	Relative Sound Level Comparison*
Option 1: Window Air Conditioners**	\$377,898	\$9,000	\$20,500	\$135,286	\$1,058,716	10
Option 2: Ductless Split System**	\$764,516	\$12,000	\$16,670	\$380,864	\$1,661,366	2
Option 3: Ducted Split System**	\$1,305,034	\$12,000	\$17,730	\$409,541	\$2,251,575	1
Option 4: Under the Window Self-Contained Unit Ventilator	\$1,411,416	\$9,000	\$18,430	\$562,639	\$2,478,552	9
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	\$2,105,074	\$10,500	\$20,370	\$486,799	\$3,158,018	8
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	\$1,477,311	\$9,000	\$19,080	\$609,997	\$2,604,690	7
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	\$1,852,750	\$9,000	\$20,000	\$643,937	\$3,032,307	6
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	\$2,142,301	\$10,500	\$19,950	\$511,817	\$3,211,936	5
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	\$3,048,919	\$10,500	\$21,190	\$520,156	\$4,151,475	4
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	\$3,058,740	\$8,250	\$20,410	\$325,237	\$3,916,129	3

\* 1 - 10 (Quietest to Loudest Operating System)

\*\* Since the UV must be in operation to provide outside air, the associated maintenance cost must be included with this option.

For FAC Review

**5.0 IRVING ELEMENTARY SCHOOL**

For FAC Review

For FAC Review

## 5.1 Existing Conditions

### A. Description of Existing Conditions

#### 1) Heating System and Distribution:

- a. The majority of the building is heated by two (2) newer hot water boilers. The boilers were manufactured by the Weil McLain Company in 2006 and are models 1588. The input capacity for each boiler is 4,700 MBH each. The heating plant is located in the basement level in Boiler Room. The estimated service life according to the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) for the boilers is approximately 35 years. They appear to be in good condition.
- b. There two (2) main hot water distribution pumps which were manufactured by Bell & Gossett series 1510. One (1) pump is primary and one (1) pump a secondary. Each of the pumps is powered by a 10 horse power (HP) motor. There is no date on the pumps, but they look newer and assumed they were installed the same time the boilers were replaced in 2006. The pumps appear to be in good condition and have an estimated service life of 20 years.
- c. There are five (5) gas fired packaged (heating/cooling) rooftop units located on the roof. Four (4) of the units were manufactured by Carrier in 2000 and appear to be in good to fair condition. The estimated service life for this style of packaged commercial equipment is about 15 years. The other rooftop unit was manufactured by the Mammoth Company in 2000. Mammoth rooftop units are custom built and are more robust than a typical commercial style rooftop unit. There has been some control issues, but overall this unit appears to be in good to fair condition. The estimated service life for this equipment is about 25 years. These units serve main office, Classroom 113, Classroom 115, Office 117, OT/PT 118, Music 210, Staff Work Room 205, and Conference Room 207. The following is the information we obtained from the nameplate data on the unit:

RTU-1 – Carrier Model 48TJE007

RTU-2 – Carrier Model 48TJE005

RTU-3 – Carrier Model 48TJE004

RTU-4 – Carrier Model 48TJE006

RTU-5 – Mammoth Model DHEBFPC-171-G256-4100-MZ4

#### 2) Ventilating:

- a. Ventilation to a majority of the classrooms is provided by unit ventilators. These units were manufactured by American Air Filter. The unit ventilators were manufactured in 1993 and are floor mounted units model AV. These units appeared to be in fair condition. These units have an estimated service life of 15 to 20 years.
- b. The main office, Classroom 113, Classroom 115, Office 117, OT/PT 118, Music 210, Staff Work Room 205, and Conference Room 207 have rooftop units which provide ventilation to these rooms. The units have distribution ductwork routed above the ceilings and connected to ceiling and wall mounted diffusers.

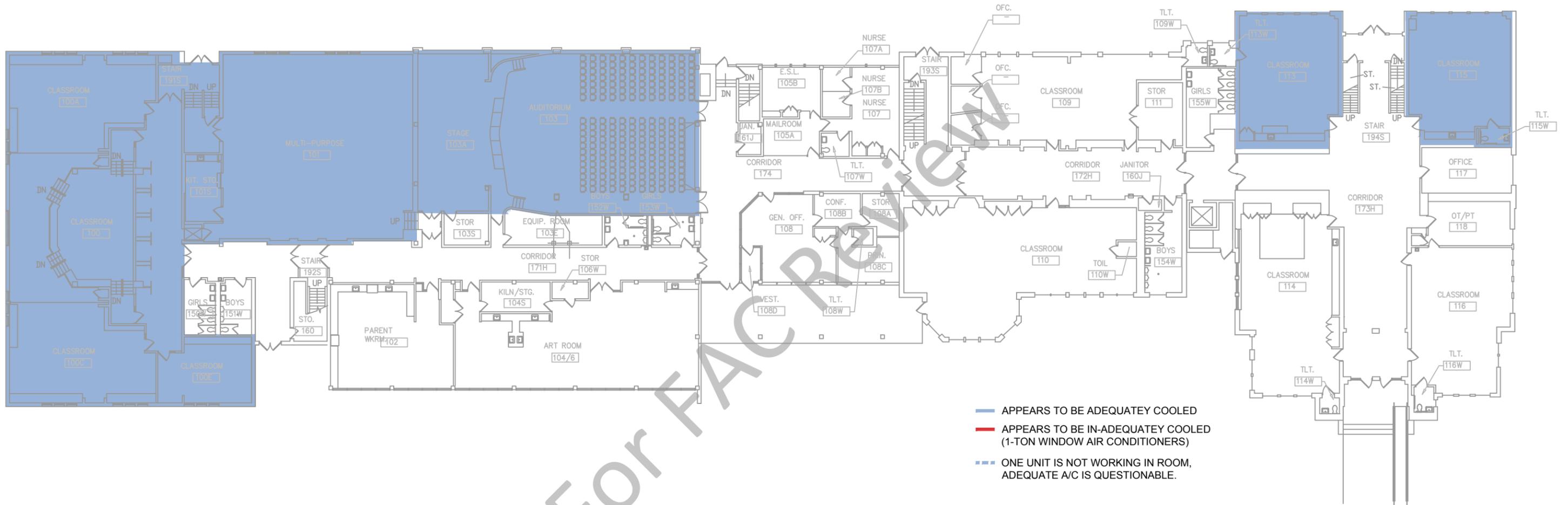
- c. The gymnasium and auditorium have ventilation provided by indoor air handling units located in Equipment Room 103E. There was no visible date when the unit was manufactured. The units have distribution ductwork routed above the ceilings and connected to wall mounted registers. The units are newer and appear to be in good condition. The estimated service life for this equipment is about 25 years.
  - d. The multi-purpose room, library, computer lab, and Classrooms 100 through 100E have ventilation provided by an indoor air handling unit located in a mechanical penthouse. There was no visible date when the unit was manufactured. The units have distribution ductwork routed above the ceilings and connected to wall mounted registers. The unit is newer and appears to be in good condition. The estimated service life for this equipment is about 25 years.
- 3) Air-Conditioning:
- a. Packaged rooftop units provide cooling to the main office, Classroom 113, Classroom 115, Office 117, OT/PT 118, Music 210, Staff Work Room 205, and Conference Room 207.
  - b. The air handling unit which provides cool air auditorium is generated by a remote air cooled condensing unit. The condensing unit was manufactured by McQuay in 2013 and is a model RCS12F150C. This unit has an estimated service life of 20 years and appears to be in good condition.
  - c. The air handling unit which provides cool air to the multi-purpose room, library, computer lab, and Classrooms 100 through 100E is generated by a remote air cooled condensing unit. The condensing unit was manufactured by Carrier in 1993 and is a model 38AH-054. This unit has an estimated service life of 20 years and appears to be in fair condition.
  - d. There are three (3) classrooms on the second floor that have window air conditioning units. These window air conditioning units are manufactured General Electric, and Frigidaire. They are approximately 1 ton of cooling capacity each. The units have an estimated service life of 10 years and range from good to fair condition. (Note: 1 ton of cooling for a typical classroom is not adequate to provide cooling for the space  $\pm 74^{\circ}\text{F}$ ).
- 4) Electrical Service:
- a. The electrical service to the building is 1600 Amps 208Y/120V. 3 Phase 4 Wire. Based on the maximum demand data available from Commonwealth Edison Company, the power demand over a one year period is 177.9 KW. Per the 2008 National Electrical Code Article 220.87 we have calculated the maximum demand to be 727.0 Amps. Based on this information we have 873.0 Amps available to serve the new air conditioning load. The new air conditioning electrical load is estimated to be 539.4 Amps. The existing electrical service appears to be adequate.

5) Controls:

- a. The main control system for the HVAC systems is pneumatic. This system has some operational issues, indicated by the wide range of temperatures throughout the offices and classrooms. This could be caused by thermostats out of calibration, valves not working properly, or pneumatic piping or fittings leaking. During our survey, there were multiple rooms which had open windows in an attempt to cool the rooms. This is not only consuming more energy than necessary, but is a potential security concern.
- b. The temperature control system air compressor is located in the boiler room. It is a duplex compressor system manufactured by Curtis model 8DJ7CD. The pneumatic system controls majority of the building devices with the exception of the window air conditioning units (self-contained controls), the packaged rooftop units (direct digital controls (DDC)) and indoor air handling units (DDC). The pneumatic control system is older, has some leaking occurring in the piping system, obsolete technology, and in poor condition. Pneumatic controls have an estimated service life of 20 years.
- c. The rooftop units and rooftop air handling units are controlled by a DDC system. From discussions with the building personnel, the system seems to be controlling adequately and they appear to be pleased with the performance compared to the pneumatic system. This system appears to be in good condition.

FOR FAC REVIEW

For FAC Review



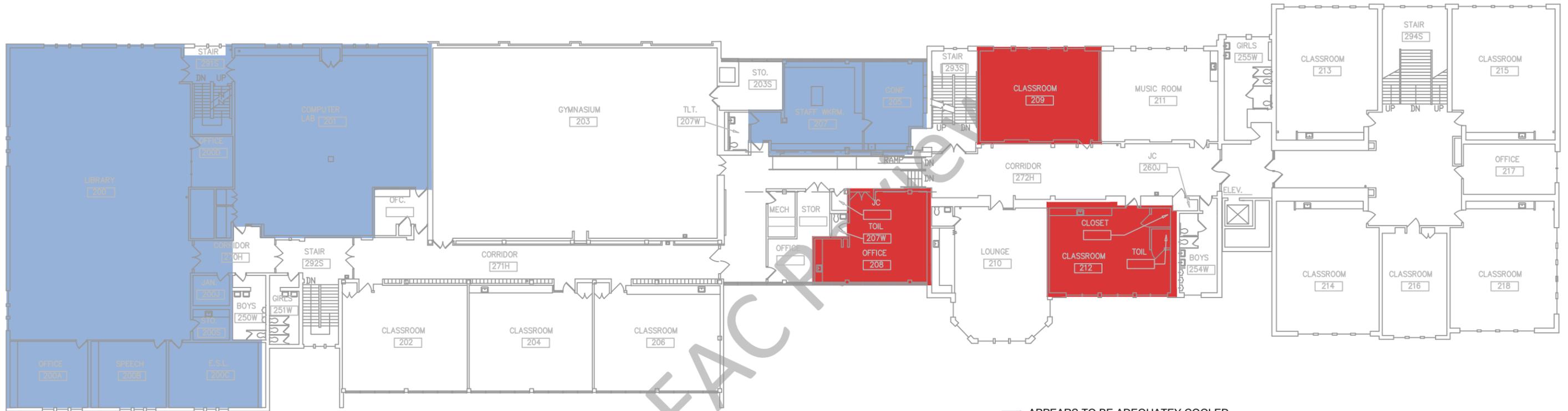
- APPEARS TO BE ADEQUATELY COOLED
- APPEARS TO BE IN-ADEQUATELY COOLED (1-TON WINDOW AIR CONDITIONERS)
- - - ONE UNIT IS NOT WORKING IN ROOM, ADEQUATE A/C IS QUESTIONABLE.

**IRVING - FIRST FLOOR EXISTING AIR CONDITIONING AREA PLAN**

OAK PARK ELEMENTARY SCHOOL DISTRICT 97



For FAC Review



- APPEARS TO BE ADEQUATELY COOLED
- APPEARS TO BE IN-ADEQUATELY COOLED (1-TON WINDOW AIR CONDITIONERS)
- ONE UNIT IS NOT WORKING IN ROOM, ADEQUATE A/C IS QUESTIONABLE.

**IRVING - SECOND FLOOR EXISTING AIR CONDITIONING AREA PLAN**

OAK PARK ELEMENTARY SCHOOL DISTRICT 97



For FAC Review

**Oak Park Elementary School District 97**  
**Irving Elementary School**  
**Air Conditioning System Options Performance & Costs Summary**

Air Conditioning System Option	Initial Construction Cost	Annual Maintenance Cost	Annual Estimated Energy Usage	Replacement Cost (over 30 years)	Life Cycle Cost	Relative Sound Level Comparison*
Option 1: Window Air Conditioners**	\$365,301	\$8,700	\$19,817	\$130,777	\$1,023,426	10
Option 2: Ductless Split System**	\$739,032	\$11,600	\$16,114	\$368,168	\$1,605,987	2
Option 3: Ducted Split System**	\$1,261,533	\$11,600	\$17,139	\$395,890	\$2,176,522	1
Option 4: Under the Window Self-Contained Unit Ventilator	\$1,364,369	\$8,700	\$17,816	\$543,885	\$2,395,933	9
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	\$2,034,905	\$10,150	\$19,691	\$470,572	\$3,052,750	8
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	\$1,428,067	\$8,700	\$18,444	\$589,664	\$2,517,867	7
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	\$1,790,992	\$8,700	\$19,333	\$622,473	\$2,931,230	6
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	\$2,070,891	\$10,150	\$19,285	\$494,756	\$3,104,872	5
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	\$2,947,288	\$10,150	\$20,484	\$502,818	\$4,013,093	4
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	\$2,956,782	\$7,975	\$19,730	\$314,395	\$3,785,592	3

\* 1 - 10 (Quietest to Loudest Operating System)

\*\* Since the UV must be in operation to provide outside air, the associated maintenance cost must be included with this option.

For FAC Review

**6.0 LINCOLN ELEMENTARY SCHOOL**

For FAC Review

For FAC Review

## 6.1 Existing Conditions

### A. Description of Existing Conditions

#### 1) Heating System and Distribution:

- a. The majority of the building is heated by two (2) newer steam boilers. The boilers were manufactured by the Weil McLain Company in 2008 and are models 1994. The input capacity for each boiler is 6,500 MBH each. The heating plant is located in the basement level in Boiler Room 001. The estimated service life according to the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) for the boilers is approximately 35 years. They appear to be in good condition.
- b. There is a steam to hot water shell and tube heat exchanger is located in Boiler Room 001. It is a skid mounted unit with a pump package and expansion tank which was manufactured in 1971 by Bell & Gossett and is a model OHTP1248. The estimated service life for this system is about 20 to 25 years. The system appears to be in fair to poor condition.
- c. The main condensate return system is located Mechanical Room 001. The system was manufactured by Domestic and is a model VCD-C. There was no visible date when the unit was manufactured. The system is older and appears to be in good to fair condition.
- d. There are three (3) gas fired packaged (heating/cooling) rooftop units located on the roof. Two (2) of the units were manufactured by Trane in 2001 and appear to be in good to fair condition. The other rooftop unit was manufactured by the McQuay in 2011. This unit appears to be in good condition. The estimated service life for this equipment is about 15 years. These units serve the main office, the old office (new classrooms 107 and 107A), art room, and resource room. The following is the information we obtained from the nameplate data on the units:

RTU-1 – Trane Model YCD102C3

RTU-2 – McQuay Model MPS005B

RTU-3 – Trane Model YCD0060C3

#### 2) Ventilating:

- a. Ventilation to a majority of the classrooms is provided by unit ventilators. These units were manufactured by American Air Filter. The unit ventilators were manufactured in 1994 and are floor mounted units model AV. These units appeared to be in fair condition. These units have an estimated service life of 15 to 20 years.
- b. Ventilation to the classrooms in the 2012 addition is provided by 4 unit ventilators. These units were manufactured by American Air Filter. The unit ventilators were manufactured in 2012 and are floor mounted units model AV. These units appeared to be in good condition. These units have an estimated service life of 15 to 20 years.
- c. The main office, the old office (new classrooms 107 and 107A), art room, and resource room have rooftop units which provide ventilation to these rooms. The units have distribution ductwork routed above the ceilings and connected to ceiling mounted diffusers.

- d. The gymnasium has ventilation provided by two (2) indoor air handling units. The older unit was manufactured by American Air Filter. There was no visible date when the unit was manufactured. The unit appears to be in poor condition. The other unit is newer, manufactured by Trane, and is an M Series unit. There was no visible date when the unit was manufactured. These units have distribution ductwork routed above the ceilings and connected to wall mounted registers. The unit is newer and appears to be in good condition. These units have an estimated service life of 20 years.
- e. The auditorium has ventilation provided by an indoor air handling unit. The unit is newer and was manufactured by Trane, and is an M Series unit. There was no visible date when the unit was manufactured. The unit is newer and appears to be in good condition. There was no visible date when the unit was manufactured. This unit has distribution ductwork routed above the ceilings and connected to ceiling and sidewall mounted registers. This unit has an estimated service life of 20 years.

3) Air-Conditioning:

- a. Packaged rooftop units provide cooling to the main office, the old office (new classrooms 107 and 107A), art room, and resource room.
- b. There are two (2) air handling units which provide cool air that is generated by remote air cooled condensing units. One condensing unit generates cooling for the air handling unit that serves the media center & support rooms, multi-purpose room, and the computer lab. It was manufactured by Trane in 1994 and is a model RAUCC40GB. The other condensing unit generates cooling for the air handling unit that serves the auditorium. It was also manufactured by Trane in 1994 and is a model RAUCC20GB. These units have an estimated service life of 20 years and appear to be in fair condition.
- c. The art room has a window air conditioning unit that provides cooling. This unit provides approximately 1 ton of cooling. This unit has an estimated service life of 10 years and appears to be in fair condition. (Note: 1 ton of cooling for a typical classroom is not adequate to provide cooling for the space  $\pm 74^{\circ}\text{F}$ ).
- d. The 4 new classrooms in the 2012 addition have unit ventilators which provide cool air that is generated by remote air cooled condensing units. The 4 of the condensing units were manufactured in 2012 by Lennox and are model ZC13-036. These units appear to be in good condition.

4) Electrical Service:

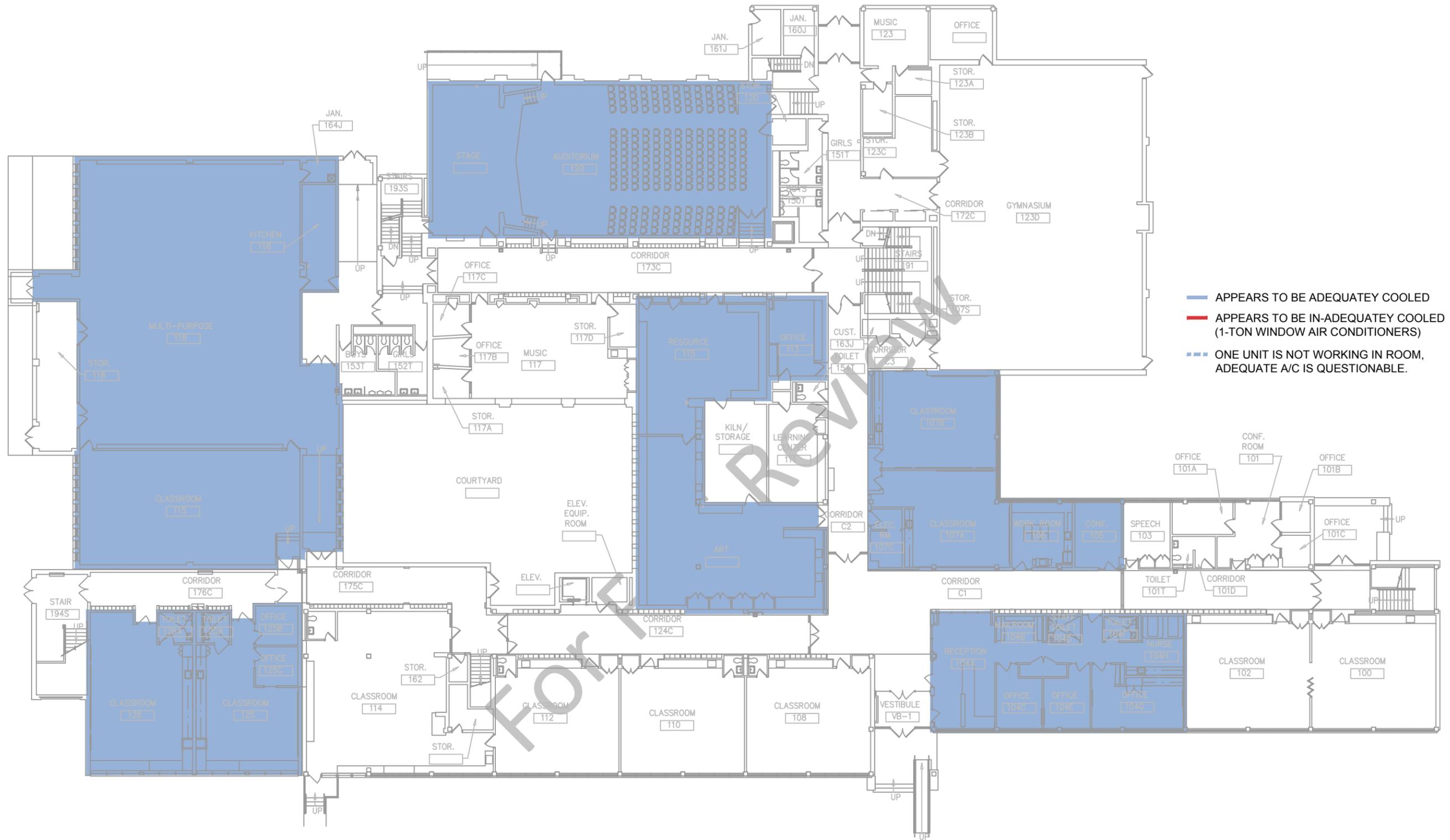
- a. The electrical service to the building is 2000 Amps 208Y/120V. 3 Phase 4 Wire. Based on the maximum demand data available from Commonwealth Edison Company, the power demand over a one year period is 189.79 KW. Per the 2008 National Electrical Code Article 220.87 we have calculated the maximum demand to be 775.3 Amps. Based on this information we have 1224.7 Amps available to serve the new air conditioning load. The new air conditioning electrical load is estimated to be 595.2 Amps. The existing electrical service appears to be adequate.

5) Controls:

- a. The main control system for the HVAC systems is pneumatic. This system has some operational issues, indicated by the wide range of temperatures throughout the offices and classrooms. This could be caused by thermostats out of calibration, valves not working properly, or pneumatic piping or fittings leaking. During our survey, there were multiple rooms which had open windows in an attempt to cool the rooms. This is not only consuming more energy than necessary, but is a potential security concern.
- b. The temperature control system air compressor is located in Boiler Room 001. It is a duplex compressor system manufactured by Curtis model 8DN80. The pneumatic system controls majority of the building devices with the exception of the window air conditioning units (self-contained controls), the packaged rooftop units (direct digital controls (DDC)) and the newer handling units (DDC). The pneumatic control system is older, has some leaking occurring in the piping system (the compressor was frequently cycling during our survey), obsolete technology, and in poor condition. Pneumatic controls have an estimated service life of 20 years.
- c. The rooftop units, the unit ventilators in the 2012 addition, and air handling units are controlled by a DDC system. From discussions with the building personnel, the system seems to be controlling adequately and they appear to be pleased with the performance compared to the pneumatic system. This system appears to be in good to fair condition.

FOR FAC REVIEW

For FAC Review

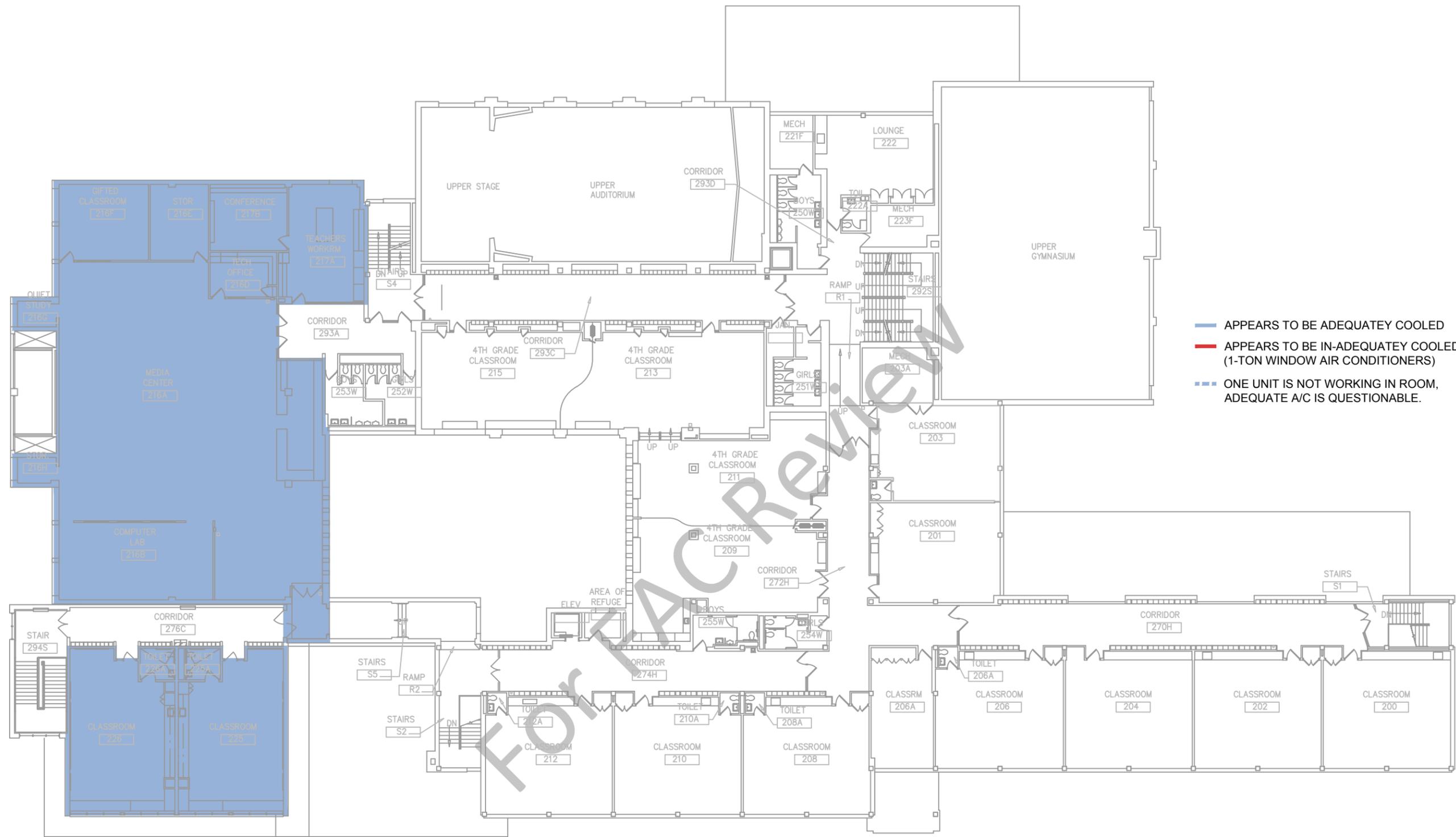


- APPEARS TO BE ADEQUATELY COOLED
- APPEARS TO BE IN-ADEQUATELY COOLED (1-TON WINDOW AIR CONDITIONERS)
- - - ONE UNIT IS NOT WORKING IN ROOM, ADEQUATE A/C IS QUESTIONABLE.

**LINCOLN - FIRST FLOOR EXISTING AIR CONDITIONING AREA PLAN**  
 OAK PARK ELEMENTARY SCHOOL DISTRICT 97



For FAC Review



- APPEARS TO BE ADEQUATELY COOLED
- APPEARS TO BE IN-ADEQUATELY COOLED (1-TON WINDOW AIR CONDITIONERS)
- - - ONE UNIT IS NOT WORKING IN ROOM, ADEQUATE A/C IS QUESTIONABLE.

**LINCOLN - SECOND FLOOR EXISTING AIR CONDITIONING AREA PLAN**  
 OAK PARK ELEMENTARY SCHOOL DISTRICT 97



For FAC Review

**Oak Park Elementary School District 97**  
**Lincoln Elementary School**  
**Air Conditioning System Options Performance & Costs Summary**

Air Conditioning System Option	Initial Construction Cost	Annual Maintenance Cost	Annual Estimated Energy Usage	Replacement Cost (over 30 years)	Life Cycle Cost	Relative Sound Level Comparison*
Option 1: Window Air Conditioners**	\$403,091	\$9,600	\$21,867	\$144,305	\$1,129,297	10
Option 2: Ductless Split System**	\$815,484	\$12,800	\$17,781	\$406,254	\$1,772,124	2
Option 3: Ducted Split System**	\$1,392,036	\$12,800	\$18,912	\$436,844	\$2,401,680	1
Option 4: Under the Window Self-Contained Unit Ventilator	\$1,505,511	\$9,600	\$19,659	\$600,149	\$2,643,789	9
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	\$2,245,412	\$11,200	\$21,728	\$519,252	\$3,368,552	8
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	\$1,575,798	\$9,600	\$20,352	\$650,664	\$2,778,336	7
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	\$1,976,267	\$9,600	\$21,333	\$686,866	\$3,234,461	6
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	\$2,285,121	\$11,200	\$21,280	\$545,938	\$3,426,066	5
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	\$3,252,180	\$11,200	\$22,603	\$554,833	\$4,428,240	4
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	\$3,262,656	\$8,800	\$21,771	\$346,919	\$4,177,205	3

\* 1 - 10 (Quietest to Loudest Operating System)

\*\* Since the UV must be in operation to provide outside air, the associated maintenance cost must be included with this option.

For FAC Review

**7.0 LONGFELLOW ELEMENTARY SCHOOL**

For FAC Review

For FAC Review

## 7.1 Existing Conditions

### A. Description of Existing Conditions

#### 1) Heating System and Distribution:

- a. The majority of the building is heated by three (3) newer steam water boilers. The boilers were manufactured by the Weil McLain Company in 2002 and are models 1488. The input capacity for each boiler is 4,500 MBH each. The heating plant is located in the basement level in Boiler Room 014. The estimated service life according to the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) for the boilers is approximately 35 years. They appear to be in good condition.
- b. A steam to hot water shell and tube heat exchanger is located in an adjacent mechanical room. It is an older heat exchanger which was insulated. There was no visible manufacturer's information on the heat exchanger. The two (2) distribution pumps which circulated building hot water were manufactured by Bell & Gossett and are series 1510. There was no visible manufacturer's information on the pumps. The estimated service life for this system is about 20 to 25 years. The system appears to be in fair condition.
- c. The main condensate return system is in the same room as the heat exchanger. The system was manufactured by Domestic and is a model VCD4. There was no visible date when the unit was manufactured. Seals are leaking, there are rust stains on the unit, and water was on the floor. The system appears to be in poor condition.
- d. There are two (2) gas fired packaged (heating/cooling) rooftop units located on the roof. They were both manufactured by McQuay in 2011 and serves main office area on the first floor. The estimated service life for this equipment is about 15 years. The following is the information we obtained from the nameplate data on the units:

RTU-1 – McQuay Model MPS005

RTU-2 – McQuay Model MPS004

#### 2) Ventilating:

- a. Ventilation to a majority of the classrooms is provided by unit ventilators. These units were manufactured in 1994 by American Air Filter. These units appeared to be in fair condition. These units have an estimated service life of 15 to 20 years.
- b. The main office has rooftop units which provide ventilation to the rooms. The units have distribution ductwork routed above the ceilings and connected to ceiling and wall mounted diffusers. These units appear to be in good condition.
- c. The southwest portion of the building is served by three (3) separate constant volume, multi-zone indoor air handling units. These units were manufactured by American Air Filter and had no manufacturing date. The majority of the rooms in this area consist of the media center, 4<sup>th</sup> grade classrooms, computer lab, math lab, staff lounge, multi-purpose room, kindergarten rooms, and pre-kindergarten rooms. The units have distribution ductwork routed above the ceilings and connected to ceiling and wall mounted diffusers. These units are older and appear to be in poor condition. The estimated service life for these units is about 25 years.

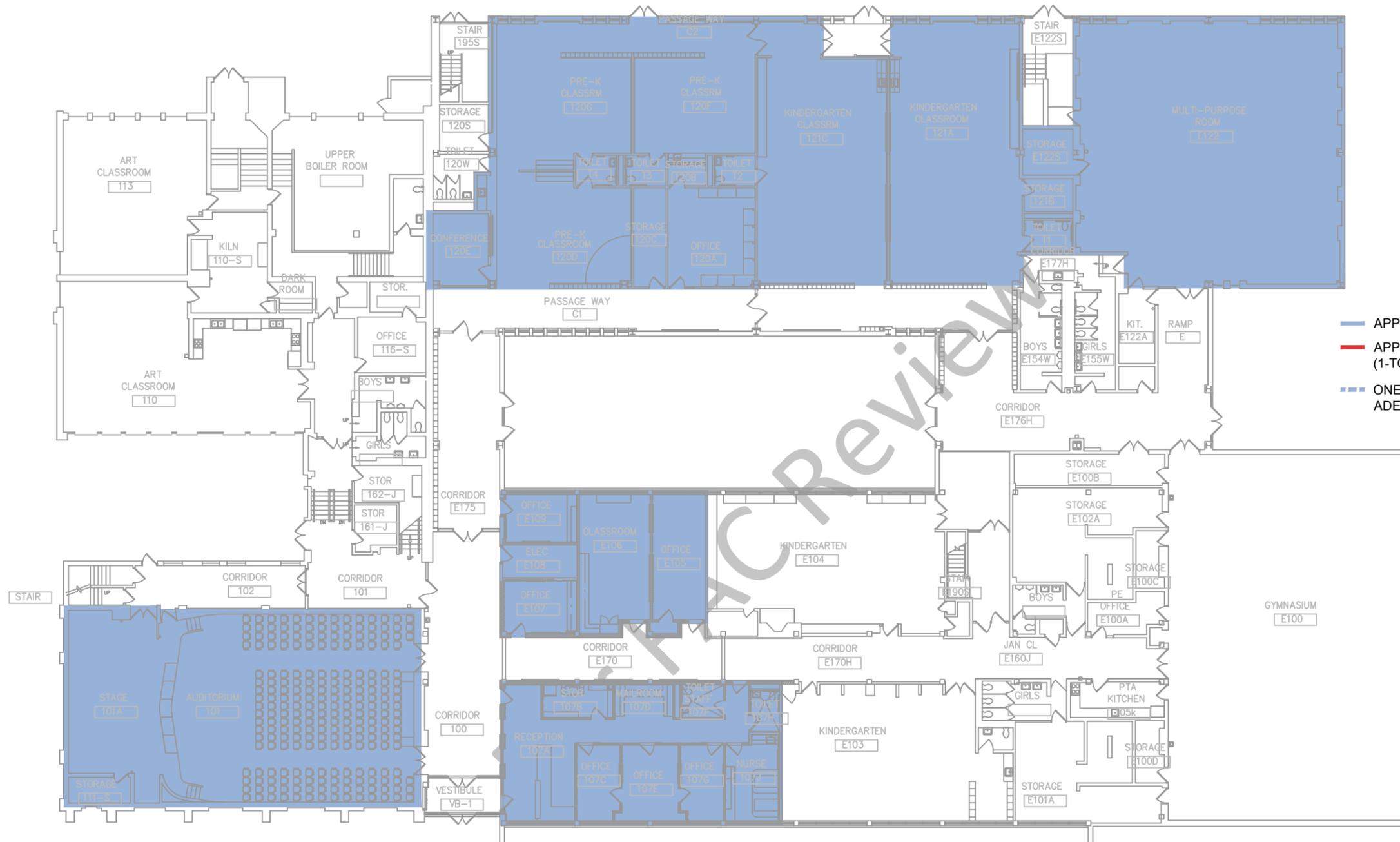
- d. The gymnasium, locker rooms, and auditorium have ventilation provided by single zone, constant volume indoor air handling units. These units were manufactured by McQuay. The units are newer and are assumed they were installed at the same time the McQuay rooftop units were installed in 2011. The units appear to be in good condition. The estimated service life for these units is about 25 years.
  - e. Classroom 207 located on the second floor has two (2) packaged terminal air conditioning units (PTACs) which provide ventilation to the rooms. These units were manufactured in 1995 by McQuay and are model ENR015A. These units have an estimated service life of 15 years and appear to be in good condition.
- 3) Air-Conditioning:
- a. Packaged rooftop units provide cooling to the main office area.
  - b. The three (3) multi-zone indoor air handling units provide cool air generated by a remote air cooled condensing units. The condensing units were all manufactured in 1994 by Trane and are model RAUCC40. The estimated service life for these units is about 20 years. These units appear to be in fair condition.
  - c. The auditorium is served by an indoor air handling unit which provides cool air generated by a remote air cooled condensing unit. The condensing unit was manufactured in 1994 by Trane Carrier and is a model RAUCC20. The estimated service life for this unit is about 20 years. This unit appears to be in fair to poor condition.
  - d. Computer Lab 220 has a ceiling mounted duct-free split system. The roof mounted air cooled unit was manufactured by Goodman. There is no visible nameplate data on the unit. This is a smaller light commercial unit with an estimated service life of about 15 years. The condensing unit system is older and appears to be in poor condition.
  - e. Classroom 207 has wall mounted PTAC units which provide cooling.
  - f. Office 302 has a window air conditioning unit that provides cooling. This unit was manufactured by southerner and provides approximately 1 ton of cooling. This unit has an estimated service life of 10 years and appears to be in fair condition.
- 4) Electrical Service:
- a. The electrical service to the building is 1600 Amps 208Y/120V. 3 Phase 4 Wire. Based on the maximum demand data available from Commonwealth Edison Company, the power demand over a one year period is 248.76 KW. Per the 2008 National Electrical Code Article 220.87 we have calculated the maximum demand to be 1016.2 Amps. Based on this information we have 583.8 Amps available to serve the new air conditioning load. The new air conditioning electrical load is estimated to be 595.2 Amps. The existing electrical service will need to be updated

5) Controls:

- a. The main control system for the HVAC systems is pneumatic. This system has some operational issues, indicated by the wide range of temperatures throughout the offices and classrooms. This could be caused by thermostats out of calibration, valves not working properly, or pneumatic piping or fittings leaking. During our survey, there were multiple rooms which had open windows in an attempt to cool the rooms. This is not only consuming more energy than necessary, but is a potential security concern.
- b. The pneumatic system controls majority of the building devices with the exception of the duct-free split system, the rooftop units (direct digital controls (DDC)), and the newer air handling units (direct digital controls (DDC)). The pneumatic control system is older, has some leaking occurring in the piping system, obsolete technology, and in poor condition. Pneumatic controls have an estimated service life of 20 years.
- c. The rooftop units and newer air handling units are controlled by a DDC system. From discussions with the building personnel, the system seems to be controlling adequately and they appear to be pleased with the performance compared to the pneumatic system. This system appears to be in good to fair condition.

FOR FAC REVIEW

For FAC Review

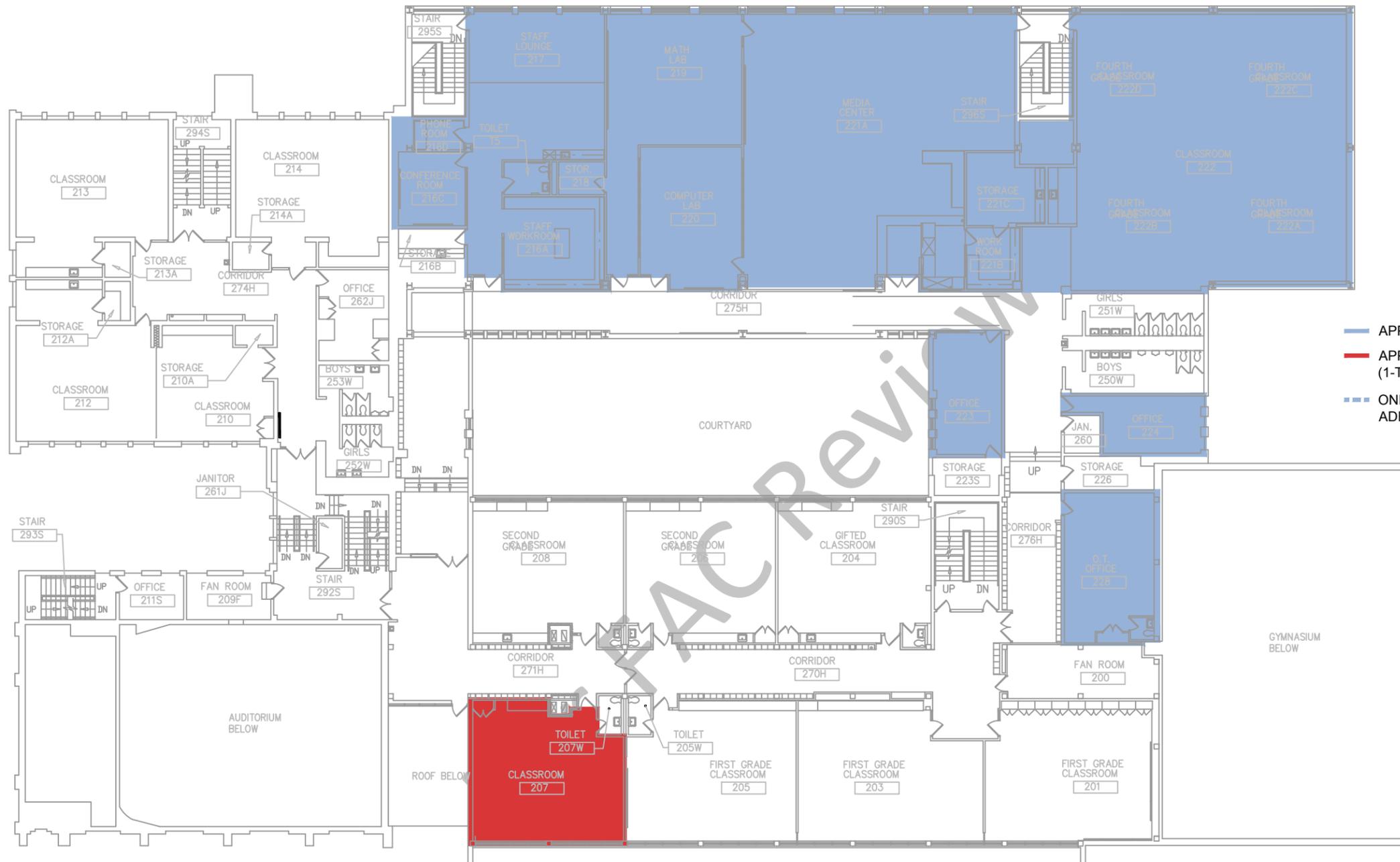


- APPEARS TO BE ADEQUATELY COOLED
- APPEARS TO BE IN-ADEQUATELY COOLED (1-TON WINDOW AIR CONDITIONERS)
- - - ONE UNIT IS NOT WORKING IN ROOM, ADEQUATE A/C IS QUESTIONABLE.

**LONGFELLOW - FIRST FLOOR EXISTING AIR CONDITIONING AREA PLAN**  
 OAK PARK ELEMENTARY SCHOOL DISTRICT 97



For FAC Review

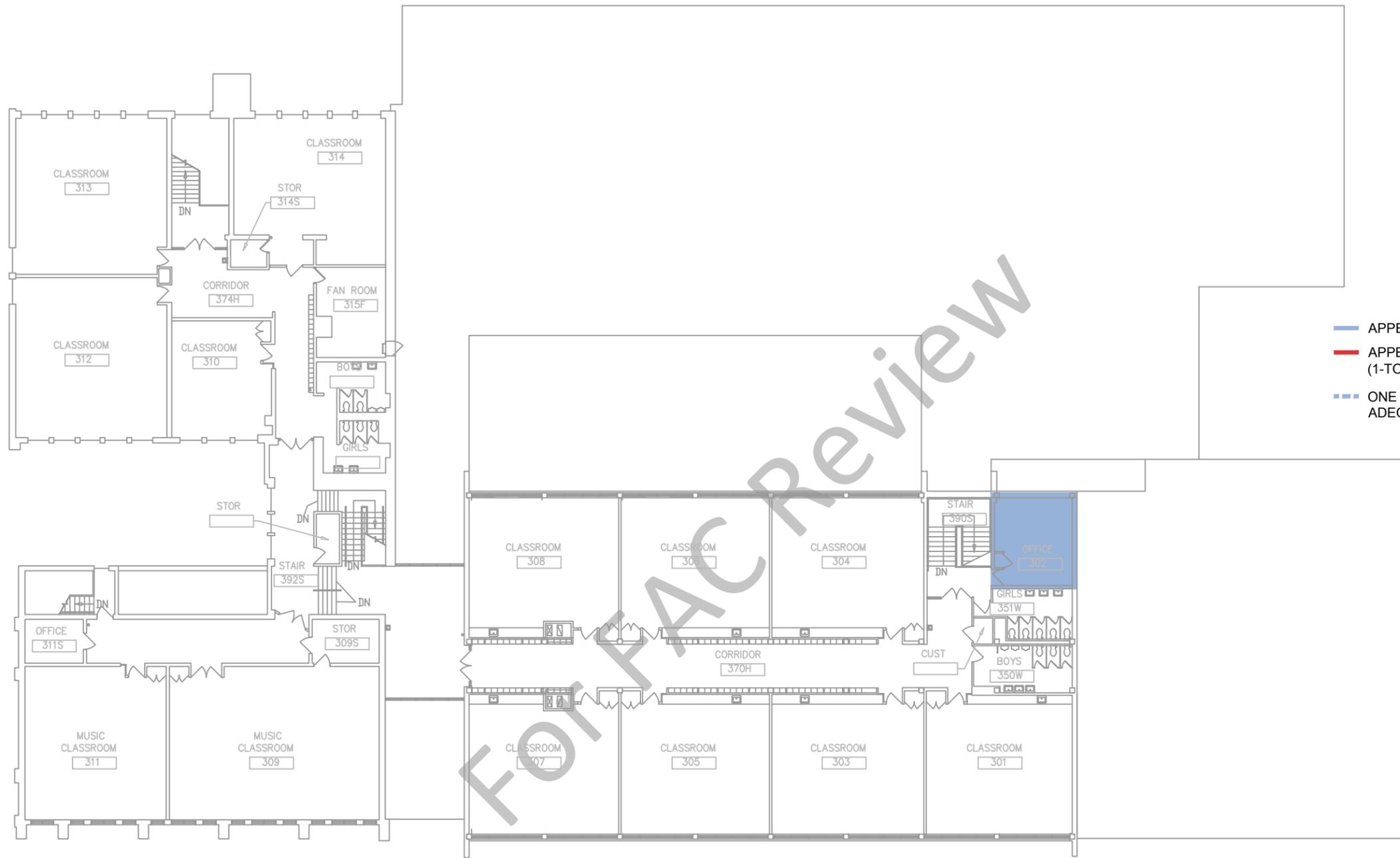


- APPEARS TO BE ADEQUATELY COOLED
- APPEARS TO BE IN-ADEQUATELY COOLED (1-TON WINDOW AIR CONDITIONERS)
- - - ONE UNIT IS NOT WORKING IN ROOM, ADEQUATE A/C IS QUESTIONABLE.

**LONGFELLOW - SECOND FLOOR EXISTING AIR CONDITIONING AREA PLAN**  
 OAK PARK ELEMENTARY SCHOOL DISTRICT 97



For FAC Review



- APPEARS TO BE ADEQUATELY COOLED
- APPEARS TO BE IN-ADEQUATELY COOLED (1-TON WINDOW AIR CONDITIONERS)
- ONE UNIT IS NOT WORKING IN ROOM, ADEQUATE A/C IS QUESTIONABLE.

**LONGFELLOW - THIRD FLOOR EXISTING AIR CONDITIONING AREA PLAN**  
 OAK PARK ELEMENTARY SCHOOL DISTRICT 97



For FAC Review

**Oak Park Elementary School District 97**  
**Longfellow Elementary School**  
**Air Conditioning System Options Performance & Costs Summary**

Air Conditioning System Option	Initial Construction Cost	Annual Maintenance Cost	Annual Estimated Energy Usage	Replacement Cost (over 30 years)	Life Cycle Cost	Relative Sound Level Comparison*
Option 1: Window Air Conditioners**	\$433,091	\$9,600	\$21,867	\$144,305	\$1,129,297	10
Option 2: Ductless Split System**	\$845,484	\$12,800	\$17,781	\$406,254	\$1,772,124	2
Option 3: Ducted Split System**	\$1,422,036	\$12,800	\$18,912	\$436,844	\$2,401,680	1
Option 4: Under the Window Self-Contained Unit Ventilator	\$1,535,511	\$9,600	\$19,659	\$600,149	\$2,643,789	9
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	\$2,275,412	\$11,200	\$21,728	\$519,252	\$3,368,552	8
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	\$1,605,798	\$9,600	\$20,352	\$650,664	\$2,778,336	7
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	\$2,006,267	\$9,600	\$21,333	\$686,866	\$3,234,461	6
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	\$2,315,121	\$11,200	\$21,280	\$545,938	\$3,426,066	5
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	\$3,282,180	\$11,200	\$22,603	\$554,833	\$4,428,240	4
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	\$3,292,656	\$8,800	\$21,771	\$346,919	\$4,177,205	3

\* 1 - 10 (Quietest to Loudest Operating System)

\*\* Since the UV must be in operation to provide outside air, the associated maintenance cost must be included with this option.

For FAC Review

**8.0 MANN ELEMENTARY SCHOOL**

For FAC Review

For FAC Review

## 8.1 Existing Conditions

### A. Description of Existing Conditions

#### 1) Heating System and Distribution:

- a. The majority of the building is heated by two (2) newer steam boilers. The boilers were manufactured by the Weil McLain Company in 2002 and are models 1688. The input capacity for each boiler is 5,100 MBH each. The heating plant is located in the basement level in Boiler Room 014. The estimated service life according to the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) for the boilers is approximately 35 years. They appear to be in good condition.
- b. A steam to hot water shell and tube heat exchanger is located in Storage Room 015. It is a smaller and newer system. The two (2) distribution pumps were manufactured by Bell & Gossett and are series 60 with 1/2 HP motors. The estimated service life for this system is about 20 to 25 years. The system appears to be in good condition.
- c. The main condensate return system is in an adjacent room (Mechanical Room 016). The system was manufactured by Domestic and is a model VCD4. There was no visible date when the unit was manufactured. The system is older but has had maintenance recently performed on it. The system appears to be in fair to poor condition.
- d. There are four (4) gas fired packaged (heating/cooling) rooftop units located on the roof. Three (3) units serve the main office and one (1) serves the computer lab and associated office. These units appear to be in good to fair condition. The estimated service life for this equipment is about 15 years. The following is the information we obtained from the nameplate data on the units:

RTU-1 (Computer Room) – Trane Voyager Model YCD120 (Mfg. 2001)

RTU-2 (South portion of the office) – McQuay Model MPS003 (Mfg. 2012)

RTU-3 (Middle portion of the office) – McQuay Model MPSA006 (Mfg. 2012)

RTU-4 (North portion of the office) – York Model DC2G072 (Mfg. Unknown)

#### 2) Ventilating:

- a. Ventilation to a majority of the classrooms is provided by unit ventilators. These units were manufactured by American Air Filter. The unit ventilators were installed at 2 separate times. One group was manufactured in 2000 and are floor mounted units model AV. These units appeared to be in good to fair condition. The other units did not have visible nameplate data, but were floor mounted units as well. They are older than 2000 (thought to be 1970s vintage) and appear to be in fair to poor condition. These units have an estimated service life of 15 to 20 years.
- b. Two (2) small offices on the second floor (Office 200A and Office 201A) have packaged terminal air conditioning units (PTAC) which provide ventilation to the rooms. These units were manufactured by McQuay and are series 25. From a visual assessment, it is assumed that these units were installed at the same time as the newer unit ventilators. These units have an estimated service life of 15 years and appear to be in fair to poor condition.

- c. The main office and the computer lab have rooftop units which provide ventilation to these rooms. The units have distribution ductwork routed above the ceilings and connected to ceiling and wall mounted diffusers. These units appear to be in good to fair condition.
  - d. The cafeteria, classrooms 216A through 216D, classrooms 116A and 116B, has an indoor air handling unit which provide ventilation to these rooms. The unit has distribution ductwork routed above the ceilings and connected to ceiling and wall mounted diffusers. This unit appears to be in fair condition.
  - e. The gymnasium, locker rooms, and auditorium have ventilation provided by indoor air handling units. The manufacturer of the gymnasium and locker room unit is Clarage Fan Company and the manufacturer of the auditorium units is unknown. The units have distribution ductwork routed above the ceilings and connected to ceiling and wall mounted diffusers. The units are older and appear to be in poor condition. The estimated service life for these units are about 25 years
  - f. Classroom/Office 218, Office 300A, and Resource Room 304 rely on the windows to provide natural ventilation. There is no mechanical means to provide ventilation.
- 3) Air-Conditioning:
- a. Packaged rooftop units provide cooling to the main office and the computer lab.
  - b. The cafeteria, classrooms 216A through 216D, classrooms 116A and 116B, has an indoor air handling unit which provides cool air that is generated by a remote air cooled condensing unit. The condensing unit was manufactured in 1995 by Carrier and is a model 38AKS044. The estimated service life for this unit is about 20 years. This unit appears to be in fair to poor condition.
  - c. The auditorium is served by an indoor air handling unit which provides cool air that is generated by a remote air cooled condensing unit. The condensing unit was manufactured in 1995 by Carrier and is a model 38AKS016. The estimated service life for this unit is about 20 years. This unit appears to be in fair to poor condition.
  - d. Classroom/Office 218 has a wall mounted duct-free split system manufactured by Mitsubishi and is a Mr. Slim model. There is no visible nameplate data on the unit. This is a smaller light commercial unit with an estimated service life of about 15 years. The system is newer and appears to be in good condition.
  - e. The new Art Room and Classroom 107B have unit ventilators which provide cool air that is generated by remote air cooled condensing units. The two (2) of the condensing units were manufactured in 2012 by Lennox and are model ZC13-036. These units appear to be in good condition. The third unit was manufactured by Payne in 2005 and is a model PA10JA036. This unit appears to be in fair condition. These are smaller light commercial units with an estimated service life of about 15 years. The system is newer and appears to be in good to fair condition.

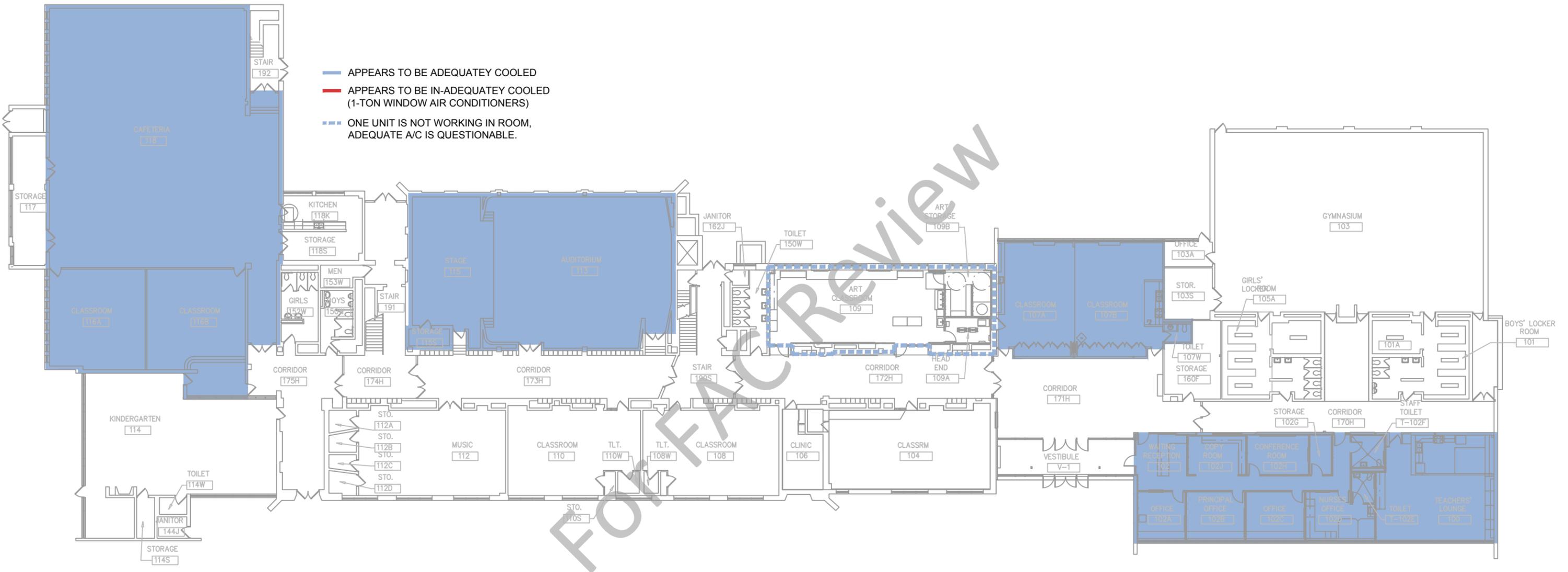
4) Electrical Service:

- a. The electrical service to the building is 1600 Amps 208Y/120V. 3 Phase 4 Wire. Based on the maximum demand data available from Commonwealth Edison Company, the power demand over a one year period is 182.02 KW. Per the 2008 National Electrical Code Article 220.87 we have calculated the maximum demand to be 743.5 Amps. Based on this information we have 856.5 Amps available to serve the new air conditioning load. The new air conditioning electrical load is estimated to be 520.8 Amps. The existing electrical service appears to be adequate.

5) Controls:

- a. The main control system for the HVAC systems is pneumatic. This system has some operational issues, indicated by the wide range of temperatures throughout the offices and classrooms. This could be caused by thermostats out of calibration, valves not working properly, or pneumatic piping or fittings leaking. During our survey, there were multiple rooms which had open windows in an attempt to cool the rooms. This is not only consuming more energy than necessary, but is a potential security concern.
- b. The temperature control air compressor is located in Mechanical Room 016. It is an 80 gallon, duplex compressor system manufactured by Curtis model 8DJ7CD. The pneumatic system controls majority of the building devices with the exception of the PTAC units (self-contained controls), duct-free split system, and the rooftop units (direct digital controls (DDC)). The pneumatic control system is older, has some leaking occurring in the piping system (the compressor was frequently cycling during our survey), obsolete technology, and in poor condition. Pneumatic controls have an estimated service life of 20 years.
- c. The rooftop units and newer air handling units are controlled by a DDC system. From discussions with the building personnel, the system seems to be controlling adequately and they appear to be pleased with the performance compared to the pneumatic system. This system appears to be in good to fair condition.

For FAC Review

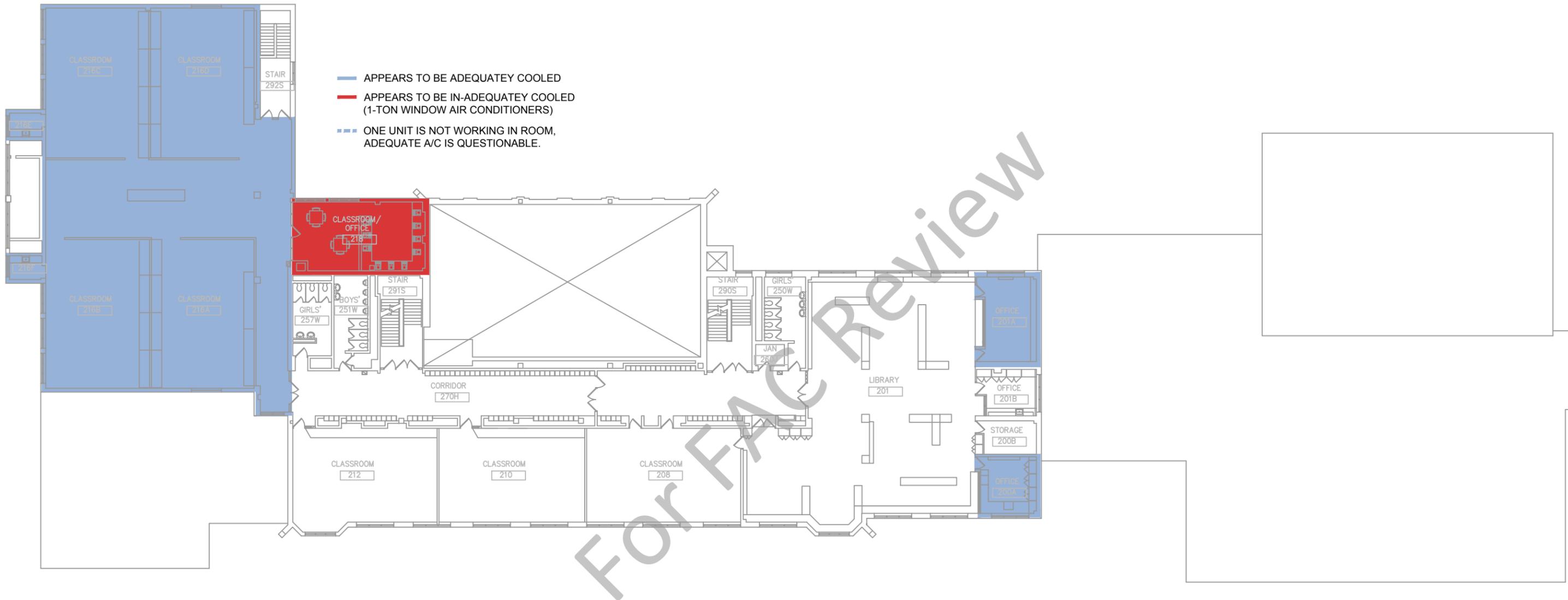


**MANN - FIRST FLOOR EXISTING AIR CONDITIONING AREA PLAN**

OAK PARK ELEMENTARY SCHOOL DISTRICT 97



For FAC Review



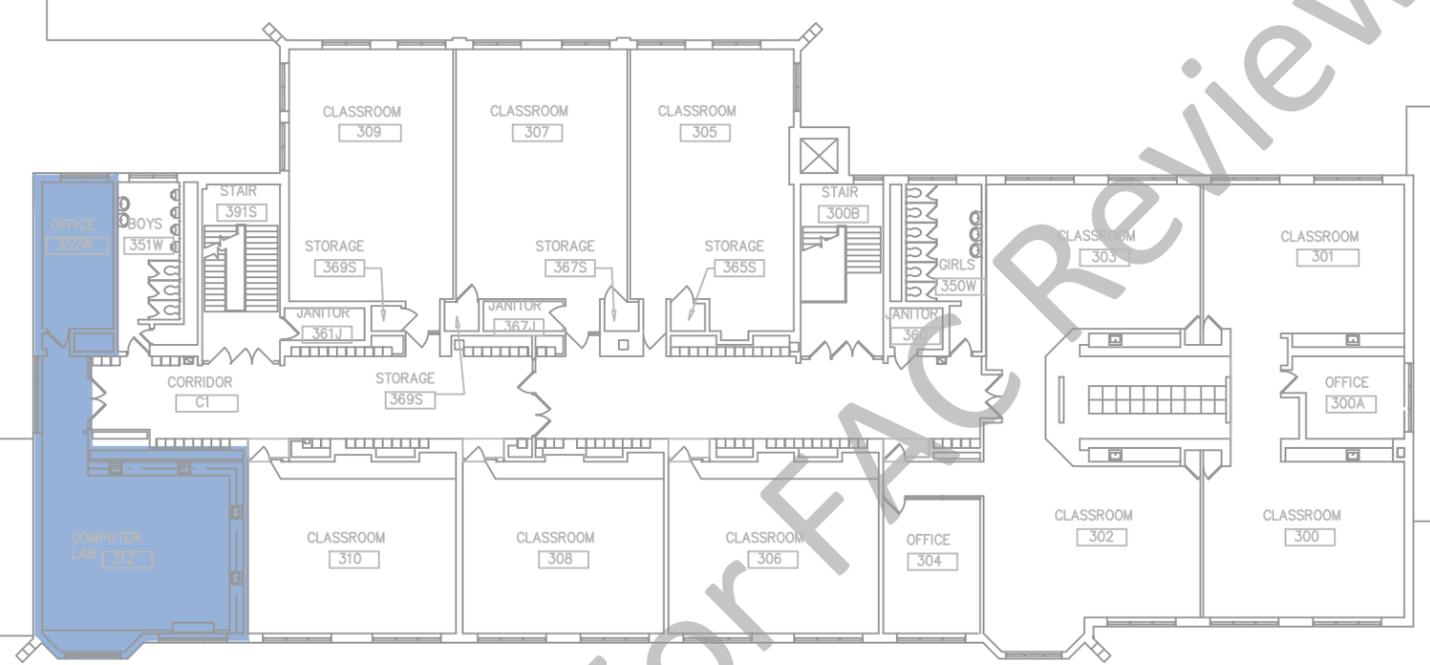
**MANN - SECOND FLOOR EXISTING AIR CONDITIONING AREA PLAN**

OAK PARK ELEMENTARY SCHOOL DISTRICT 97



For FAC Review

- APPEARS TO BE ADEQUATELY COOLED
- APPEARS TO BE IN-ADEQUATELY COOLED (1-TON WINDOW AIR CONDITIONERS)
- ONE UNIT IS NOT WORKING IN ROOM, ADEQUATE A/C IS QUESTIONABLE.



**MANN - THIRD FLOOR EXISTING AIR CONDITIONING AREA PLAN**

OAK PARK ELEMENTARY SCHOOL DISTRICT 97



For FAC Review

**Oak Park Elementary School District 97**  
**Mann Elementary School**  
**Air Conditioning System Options Performance & Costs Summary**

Air Conditioning System Option	Initial Construction Cost	Annual Maintenance Cost	Annual Estimated Energy Usage	Replacement Cost (over 30 years)	Life Cycle Cost	Relative Sound Level Comparison*
Option 1: Window Air Conditioners**	\$352,705	\$8,400	\$19,133	\$126,267	\$988,135	10
Option 2: Ductless Split System**	\$713,548	\$11,200	\$15,559	\$355,473	\$1,550,608	2
Option 3: Ducted Split System**	\$1,218,031	\$11,200	\$16,548	\$382,239	\$2,101,470	1
Option 4: Under the Window Self-Contained Unit Ventilator	\$1,317,322	\$8,400	\$17,201	\$525,130	\$2,313,315	9
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	\$1,964,736	\$9,800	\$19,012	\$454,345	\$2,947,483	8
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	\$1,378,823	\$8,400	\$17,808	\$569,331	\$2,431,044	7
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	\$1,729,233	\$8,400	\$18,667	\$601,008	\$2,830,153	6
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	\$1,999,481	\$9,800	\$18,620	\$477,696	\$2,997,807	5
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	\$2,845,657	\$9,800	\$19,777	\$485,479	\$3,874,710	4
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	\$2,854,824	\$7,700	\$19,049	\$303,554	\$3,655,054	3

\* 1 - 10 (Quietest to Loudest Operating System)

\*\* Since the UV must be in operation to provide outside air, the associated maintenance cost must be included with this option.

For FAC Review

**9.0 WHITTIER ELEMENTARY SCHOOL**

For FAC Review

For FAC Review

## 9.1 Existing Conditions

### A. Description of Existing Conditions

#### 1) Heating System and Distribution:

- a. The majority of the building is heated by two (2) newer steam boilers. The boilers were manufactured by the Weil McLain Company in 2005 and are models 2294. The input capacity for each boiler is 7,600 MBH each. The heating plant is located in the basement level in Boiler Room 002. The estimated service life according to the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) for the boilers is approximately 35 years. They appear to be in good condition.
- b. A steam to hot water shell and tube heat exchanger is located in Mechanical Room 001. It was manufactured by Bell & Gossett and is a Model SU 128-4. The hot water distribution system has four (4) distribution pumps that were also manufactured by Bell & Gossett (two (2) are primary and two (2) are secondary). Two (2) are a series 60 with 3/4 HP motors and the other two (2) are a series 1510 with 3 HP motors. There was no visible date when the unit was manufactured, but they are older. The estimated service life for this system is 20 to 25 years. The system appears to be in fair to poor condition.
- c. The main condensate return system is also located Mechanical Room 001. The system was manufactured by Mepco. There was no visible date when the unit was manufactured or its model number. The system appeared to be newer. The system appears to be in good condition.
- d. There are three (3) gas fired packaged (heating/cooling) rooftop units located on the roof. There are two (2) standard commercial units. One was manufactured by Trane in 2001 and is in fair condition. The second one was built by McQuay in 2012 and is in good condition. The estimated service life for this style of packaged commercial equipment is about 15 years. The other two rooftop units were manufactured by the Mammoth Company in 2001. Mammoth rooftop units are custom built and are more robust than a typical commercial style rooftop unit. This unit appears to be in fair condition. The estimated service life for this equipment is about 25 years. These units serve the main office, art room, multi-purpose room (MPR), offices adjacent to the MPR, Classroom 214, Library 201, Computer Lab, Classroom 200, Classroom 301A, Classroom 302, Classroom 303A and Classroom 305. The following is the information we obtained from the nameplate data on the unit:

RTU-1 – Mammoth Model CDHEBFP-592-G800-N600-MZ12

RTU-2 – Mammoth Model DHEBFC-212-G320-N100-MZ4

RTU-3 – Trane Model YCD075C

#### 2) Ventilating:

- a. Ventilation to a majority of the classrooms is provided by unit ventilators. These units were manufactured by American Air Filter. They were manufactured in 2001 and are floor mounted units model AV. These units appeared to be in good to fair condition. These units have an estimated service life of 15 to 20 years.

- b. The main office, art room, multi-purpose room (MPR), offices adjacent to the MPR, Classroom 214, Library 201, Computer Lab, Classroom 200, Classroom 301A, Classroom 302, Classroom 303A and Classroom 305 has rooftop units which provide ventilation to these rooms. The units have distribution ductwork routed above the ceilings and connected to ceiling and wall mounted diffusers. These units appear to be in good to fair condition.
  - c. The gymnasium and auditorium have ventilation provided by indoor air handling units. There was no visible date of the manufacturer or its model numbers. The units have distribution ductwork routed above the ceilings and connected to ceiling and wall mounted diffusers. The units are newer and appear to be in good condition. The estimated service life for this system is about 25 years.
  - d. Gymnasium Office 2221K, Resource Space 215, and the office/small group room between Classroom 310 and 312 relies on the windows to provide natural ventilation. There is no mechanical means to provide ventilation.
- 3) Air-Conditioning:
- a. Packaged rooftop units provide cooling to the main office, art room, multi-purpose room (MPR), offices adjacent to the MPR, Classroom 214, Library 201, Computer Lab, Classroom 200, Classroom 301A, Classroom 302, Classroom 303A and Classroom 305.
  - b. The auditorium is served by an indoor air handling unit which provides cool air that is generated by a remote air cooled condensing unit. The condensing unit was manufactured in 2012 by McQuay and is a model RCS12F150C. The estimated service life for this unit is about 20 years. This unit appears to be Good condition.
  - c. Faculty Work Room 100A has a wall mounted duct-free split system manufactured by Sanyo and is a model TS3632. This is a smaller light commercial unit with an estimated service life of about 15 years. The system is newer and appears to be in good condition.
  - d. There are fourteen (14) rooms that have window air conditioning units. These rooms are classrooms, resource, music room, and art room. These window air conditioning units are manufactured Air Temp, Amana, LG, and Kenmore. They are approximately 1 ton of cooling capacity each. The units have an estimated service life of 10 years and range from good to fair condition. (Note: 1 ton of cooling for a typical classroom is not adequate to provide cooling for the space  $\pm 74^{\circ}\text{F}$ )
- 4) Electrical Service:
- a. The electrical service to the building is 2000 Amps 208Y/120V. 3 Phase 4 Wire. Based on the maximum demand data available from Commonwealth Edison Company, the power demand over a one year period is 220.18 KW. Per the 2008 National Electrical Code Article 220.87 we have calculated the maximum demand to be 899.4 Amps. Based on this information we have 1100.6 Amps available to serve the new air conditioning load. The new air conditioning electrical load is estimated to be 899.4 Amps. The existing electrical service appears to be adequate.

5) Controls:

- a. The main control system for the HVAC systems is pneumatic. This system has some operational issues, indicated by the wide range of temperatures throughout the offices and classrooms. This could be caused by thermostats out of calibration, valves not working properly, or pneumatic piping or fittings leaking. During our survey, there were multiple rooms which had open windows in an attempt to cool the rooms. This is not only consuming more energy than necessary, but is a potential security concern.
- b. The temperature control system air compressor is located in Mechanical Room 001. It is a duplex compressor system manufactured by Curtis model 6DH6C. The pneumatic system controls majority of the building devices with the exception of the duct-free split system, new air handling units, and the rooftop units (direct digital controls (DDC)). The pneumatic control system is older, has some leaking occurring in the piping system, is obsolete technology, and in fair condition. Pneumatic controls have an estimated service of 20 years.
- c. The rooftop units and newer air handling units are controlled by a DDC system. From discussions with the building personnel, the system seems to be controlling adequately and they appear to be pleased with the performance compared to the pneumatic system. This system appears to be in good to fair condition.

FOR FAC REVIEW

For FAC Review



- APPEARS TO BE ADEQUATELY COOLED
- APPEARS TO BE IN-ADEQUATELY COOLED (1-TON WINDOW AIR CONDITIONERS)
- - - ONE UNIT IS NOT WORKING IN ROOM, ADEQUATE A/C IS QUESTIONABLE.

**WHITTIER - FIRST FLOOR EXISTING AIR CONDITIONING AREA PLAN**

OAK PARK ELEMENTARY SCHOOL DISTRICT 97

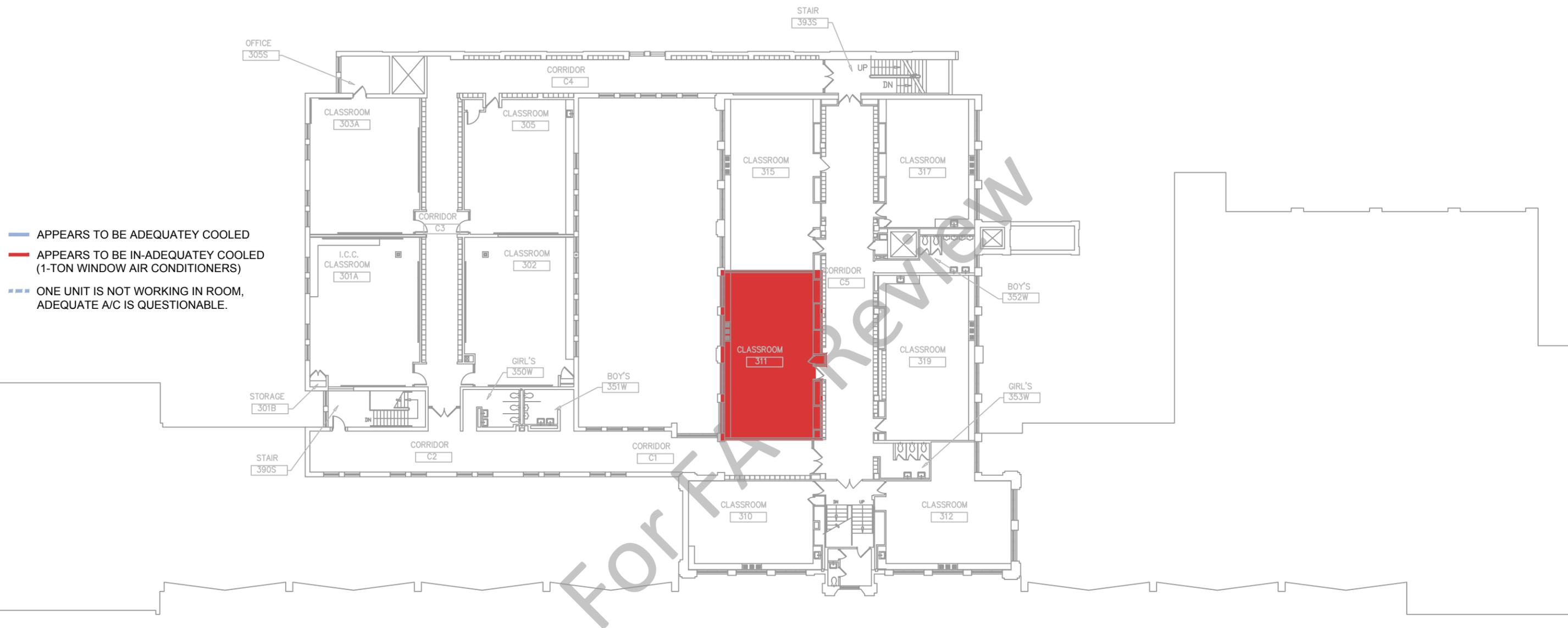


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For FAC Review



For FAC Review



**WHITTIER - THIRD FLOOR EXISTING AIR CONDITIONING AREA PLAN**

OAK PARK ELEMENTARY SCHOOL DISTRICT 97



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For FAC Review

**Oak Park Elementary School District 97**  
**Whittier Elementary School**  
**Air Conditioning System Options Performance & Costs Summary**

Air Conditioning System Option	Initial Construction Cost	Annual Maintenance Cost	Annual Estimated Energy Usage	Replacement Cost (over 30 years)	Life Cycle Cost	Relative Sound Level Comparison*
Option 1: Window Air Conditioners**	\$415,687	\$9,900	\$22,550	\$148,815	\$1,164,588	10
Option 2: Ductless Split System**	\$840,968	\$13,200	\$18,337	\$418,950	\$1,827,502	2
Option 3: Ducted Split System**	\$1,435,537	\$13,200	\$19,503	\$450,496	\$2,476,732	1
Option 4: Under the Window Self-Contained Unit Ventilator	\$1,552,558	\$9,900	\$20,273	\$618,903	\$2,726,407	9
Option 5: Chilled Water Plant and Under the Window Unit Ventilators	\$2,315,582	\$11,550	\$22,407	\$535,478	\$3,473,819	8
Option 6: Self-contained Vertical Stand-up Unit Ventilators - Free Blow	\$1,625,042	\$9,900	\$20,988	\$670,997	\$2,865,159	7
Option 7: Self-contained Vertical Stand-up Unit Ventilators - Ducted Distribution	\$2,038,025	\$9,900	\$22,000	\$708,331	\$3,335,538	6
Option 8: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Free Blow	\$2,356,531	\$11,550	\$21,945	\$562,998	\$3,533,130	5
Option 9: Chilled Water Plant and Vertical Stand-up Unit Ventilators - Ducted Distribution	\$3,353,810	\$11,550	\$23,309	\$572,172	\$4,566,623	4
Option 10: Packaged VAV Rooftop Unit with Individual VAV Boxes Heating Coils	\$3,364,614	\$9,075	\$22,451	\$357,760	\$4,307,742	3

\* 1 - 10 (Quietest to Loudest Operating System)

\*\* Since the UV must be in operation to provide outside air, the associated maintenance cost must be included with this option.

For FAC Review

## **10.0 BUILDING CONTROLS**

For FAC Review

For FAC Review

### Existing Building Controls Upgrades

During our survey it was observed that the majority of the buildings HVAC systems are controlled by pneumatics. Pneumatic control systems are older obsolete technology. A pneumatic system would not be considered for a new school application. Pneumatic control systems inefficient compared to newer direct digital control (DDC) systems. Temperature control air compressors are used in pneumatic systems to generate air pressure to operate valves and dampers. This is the heart of a pneumatic system. When a leak develops in the air system due to a pipe break or leaking valves, the compressor will operate more and work harder to try to maintain system pressure. This not only increases energy usage, but could result in higher maintenance (i.e. time and expense locating the air leak). Calibration of devices such as thermostats is another maintenance cost that should occur on an annual basis.

During our survey we observed various temporary measures which are indications that there are problems with pneumatic systems. It includes such items as open windows to cool rooms down (this occurred at every school and is a potential security concern), rooms which were extremely warm, rooms where unit ventilator were operating, and mechanical systems that were in operation. Please note that **all** of these observations took place after normal student occupied hours.

Reduced energy usage and occupant comfort could increase greatly by implementing a DDC system. When used correctly, a DDC system can save the school district money in operational costs by implementing control strategies such as demand control ventilation, use of occupancy sensors, detailed occupied/unoccupied schedules, etc. In addition to energy savings, more precise control can be achieved which directly results in occupant comfort. A DDC system can also assist in trouble shooting issues by utilizing computerized data to diagnose an issue in advance of school district personnel going to the school to remediate system problems. This can make better use of the maintenance staff's time and can help resolve the problem quicker.

The following spreadsheet identifying replacement control system costs was developed in conjunction with a temperature control contractor who is familiar with both pneumatic and DDC systems. The costs were generated by reviewing each school and the components in the HVAC systems.

For FAC Review

**Oak Park Elementary School District 97**  
**Replacement of Existing Pneumatic HVAC Control System**  
**with Direct Digital Controls Costs**

<b>School</b>	<b>Total Cost</b>
Beye Elementary School	\$372,164.10
Hatch Elementary School	\$316,753.80
Holmes Elementary School	\$366,900.05
Irving Elementary School	\$357,837.70
Lincoln Elementary School	\$375,108.80
Longfellow Elementary School	\$396,550.00
Mann Elementary School	\$317,963.80
Whittier Elementary School	\$461,243.75

FOR FAC Review

For FAC Review

**11.0 APPENDIX**

For FAC Review

For FAC Review

## 11.1 Appendix A: Mechanical Equipment Service Life

### APPENDIX A: MECHANICAL EQUIPMENT SERVICE LIFE

This report utilizes information obtained from building surveys as compared to published industry standard data.

The American Society of Refrigeration and Air Conditioning Engineers (ASHRAE) 2011 HVAC Applications Book was used to determine the service life of the equipment. Service life is defined as the time during which a particular system or component remains in its original service application.

<b>Estimates of Service Life of Various Mechanical Components</b>	
<b>Equipment Item</b>	<b>Median Years</b>
<b>Air Conditioners</b>	
Window Unit	10
Commercial through-the-wall	15
<b>Air Terminals</b>	
VAV and double-duct boxes	20
<b>Boilers, hot water (steam)</b>	
Cast Iron	35
<b>Coils</b>	
DX, water, or steam	20
<b>Fans</b>	
Centrifugal	25
Axial	20
<b>Heat Exchangers</b>	
Shell and Tube	24
<b>Package Chillers</b>	
Reciprocating	20
<b>Pumps</b>	
Base mounted	20
<b>Standard Roof-top Air Conditioners</b>	
Single-zone	15
<b>Non-Referenced ASHRAE Equipment</b>	
*Air Handling Unit	25
*Rooftop Units (Custom)	25
*Self-Contained Unit Ventilators	15

\*ASHRAE does not specifically mention the useful life for this equipment. The years were developed by speaking with contractors, equipment representatives, and through our experience.

**DEFINITIONS OF ECONOMIC TERMS**

Life-Cycle Cost (LCC): The sum of all discounted costs of acquiring, owning, operating, maintaining, and disposing of a building project over the study period. Comparing life-cycle costs among mutually exclusive projects of equal performance is one way of determining relative cost effectiveness.

Present Value: The time-equivalent value at a specified base time (the present) of past, present, and future cash flows.

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