TABLE OF CONTENTS

Executive Summary ...................................................1
Facility Evaluation Reports ...........................................2
Consultant Reports .....................................................3
Cost Analysis (TBD) ................................................... 4
Appendices ..............................................................5
APPROACH

TruexCullins was hired in 2018 to perform a Facility Evaluation of Winooski School District (WSD) in Winooski, Vermont. For that work, TXC and WSD assembled a team of engineers to help assess the facility condition and make recommendations for improvements.

The design team includes:

- TruexCullins—Architects and Team Leaders
- Engineering Ventures—Civil + Structural Engineers
- LN Consulting—MEP Engineers
- Vermeulens—Cost Estimating Consultants

Over the spring and summer, the design team was tasked with visiting the site, reviewing past studies and issuing reports that discuss the condition of the systems under their purview, in order to make recommendations, as necessary, regarding their upgrade and/or replacement. With this information, our
A brief building history

Winooski School District is a complete school system under one roof, serving Grades Pre-K through Grade 12, in Winooski, Vermont. Currently, the school has approximately 800+ students and 200+ FTE (full time equivalent) faculty and staff. The current building is approximately 140,000 sf, and was built in 6 notable stages from 1957 through 2000.

The original Winooski School was built in 1957 and has a mixture of concrete block walls and steel structure, aluminum windows, and a brick veneer. The classrooms and major spaces are heated with unit ventilators. The most recent central office expansion utilizes Heat Pumps.

In 1964, JFK Elementary School was built on the same parcel of land. The construction was similar to the high school, though instead of a steel deck roof structure, the roof structure consists of steel joists and a material known as tectum was used for the roof deck. In 1969, a significant addition of classrooms was added to the 1964 School. The 1969 addition was of similar construction to the previous buildings. The original high school and both the original JFK elementary school and the 1969 addition appear to have had their windows replaced in 1991.

In 1976, a large addition was made to the northeast corner of the school which included spaces for a vocational school program, including a metal shop and multipurpose room, as well as a second set of locker rooms. Similar to the 1964 construction and 1969 additions, this major addition was built with a combination of structural steel, concrete block, and steel roof decks. The 1976 addition was the first one to incorporate building insulation in the walls.

The cost consultant was able to estimate the probable costs of construction for these upgrades. These amounts were reviewed with the other consultants for scope and accuracy given the current Vermont market.

The items identified were ranked according to category. Category 1 includes those items that affect health, safety or welfare of the students and staff. They may also be items required by building or accessibility codes. A category 2 ranking is for replacement of materials and systems that are at the end of their usable life, or there is a significant energy savings opportunity, or out of compliance with the Vermont Commercial Building Energy Standards (CBES). Category 3 is for those items that would improve the overall experience of being in the school, yet fall short of category 1 and 2 criteria.

This approach establishes a baseline cost for bringing the building up to modern building standards, including life safety, plumbing, building, accessibility and energy codes. This study does not include costs for addressing educational and functional needs, nor does this cover the cost of additions, which are part of a separate concept design investigation. The concept design will also be evaluated for an estimate of probable construction costs. The next step is to work with the Facilities Committee to develop a series of recommendations based on the categorized list of findings, and the estimate of probable construction cost for the renovations of the existing building, as well as the additions planned during the Concept Design Phase.

The scope and costs for these recommendations will be reconciled and incorporated into an overall project budget that includes soft costs, and this project budget will be presented to the board for their consideration of a public bond vote.
Another large addition was constructed in 1991. This addition stitched together the high school and the elementary school and included an auditorium, as well as a kitchen and cafeteria/multipurpose room. The walls were still concrete block infill and brick veneer, with steel columns and beams to support the steel roof structure. This addition also included renovations to much of the rest of the buildings, including (assumed) windows and flooring.

The final major addition was in 2000, and included several expansions of office and support spaces, as well as two additional classrooms. The construction type was similar to the 1991 construction.

Overall, the structure is sound, but the spaces and finishes are showing their age, as many of the finishes and major systems are either original, or were installed or replaced in 1992 and 2000. By the time they are updated, even the newer additions will be 20 to 30 years old, which in most cases, is at or beyond their expected lifespan. Assuming that a public bond is used to raise the funds for this project, the majority of this buildings finishes and systems should not be expected to remain in service (safely) until the end of a standard 20-year bond (projected bond payoff in 2040).

**FACILITY ISSUES—CODE**

As part of the 1991 construction, which combined the two schools together, a 2-hour fire separation barrier was built to separate the different building wings into 3 separate buildings (from a building code standpoint). These three “buildings” are:

- JFK Elementary School and all portions of the 1991 addition to the south of the main lobby
- The 2-story portion of the original 1957 high school building
- The 1-story portion of the original 1957 high school, the vocational school addition, and all of the 1991 addition north of the library

It is assumed that this approach was taken to address building codes (in effect in 1991) which limited the allowable overall area of certain building types. However, the fire separation barriers do not appear to meet the required codes that were in place in 1991 (BOCA), and if built today, would not meet the current Vermont Building and Life Safety codes governing these types of construction (NFPA 221). The building, as arranged internally and on this site, does not meet the minimum standard allowed for schools to be of unlimited size (IBC 507.11).

Codes have changed significantly since this building was constructed. As a result, there are many areas which do not comply with current codes. If the building were to remain in use with no changes or additions, many of these deficiencies would be “grandfathered” and the building would likely be permitted to remain occupied. However, any major project must be considered against the current definitions of Repair, Renovation, Modification, or Reconstruction, as defined by NFPA 101 (life safety code adopted by the State of Vermont). For example, in the absence of any extensive reconfigurations and/or additions, repairs of this building needed to bring it up to current standards would likely be considered a Renovation

However, the AHJ could consider portions of the project to be a Modification, the latter of which puts additional requirements on the replacement systems. More elements will need to be specified as if they are new construction. For example, our experience is that the Fire Alarm system will need to be replaced in it's entirety with a system that complies with the most current code requirements for new buildings.
To be clear, TruexCullins understands the Owners ultimate goals for this project include significant Modification and Reconstruction, as well as some additions, and given those eventualities, it is likely that the AHJ will require most, if not all, of the life safety systems currently in use, to be upgraded so as to comply with codes governing new construction. This is a higher bar than for existing buildings, and typically comes at some increased cost, because more elements must be replaced, and it is sometimes impossible to retain portions of the existing infrastructure and integrate them with new elements in a way which satisfies all parties.

Based on the potential cost impact of these implications, it is recommend that a member of the Ownership team with the Architect meet with the Authority Having Jurisdiction (AHJ) to determine the likely requirements of a major repair and renovation project.

**FACILITY ISSUES—INFRASTRUCTURE**

Over the years there has been some replacement of original materials or building systems. Recently, for example, there has been some limited scope renovations that included upgrading the domestic hot water system and the replacement of a majority of the unit ventilators. However, several major systems and major finishes (floors, ceilings, walls, etc.) have not been replaced since the buildings were constructed. Some systems are original. It appears that the bulk of finish replacement was done during the last major addition in 1991.

The window units throughout the project are double-glazed, but fall well short of meeting current energy codes. The windows are aluminum and contribute to occupant discomfort as well as being leaky and contributing to excessive use of energy for space heating and cooling.

The building envelope is poorly insulated and air-sealed by today's standards. As an example, the walls of the original 1957 building, as well as the original JFK construction and the 1969 expansion of JFK are uninsulated. This presents significant challenges around occupant comfort, as well as requiring excessive amounts of energy to keep the space temperate. There is potential for long term durability issues, particularly at joints between the top of exterior walls and the roof. These areas are concealed and difficult to observe without some demolition. It is recommended that the entire building envelope be brought up to current code minimum levels of insulation, at a minimum. Additional insulation beyond the code minimum levels makes financial sense for many institutional clients, as they are usually committed to their facility, and most plan to occupy the facilities long enough to make long term investments in energy savings. The potential for financial savings is even more dramatic when the primary heating fuel is #2 fuel oil or propane, which have typically higher cost than other fuels, and which have historically more volatile prices, which tend to escalate at a higher rate than electricity or biomass. To better understand what the potential long term impacts of fuel choice and envelope improvements would be on the project budget and operating cost, a computer energy model and financial projection would be needed. Based on our current understanding of the existing envelope, energy modeling is strongly recommended.

Some parts of the building still have original HVAC units and controls, most notably in the gymnasiums and PAC. The original units in the Gym are now 60 years old, and the units serving the Auditorium and Cafeteria are approaching 30. According to ASHRAE, the expected lifespan for commercial HVAC equipment is 20 years, when properly maintained and cleaned annually. While some of the these systems continue to function, they are well past their usable life, are likely operating at low efficiency, are not energy efficient and in some cases, do not supply sufficient fresh air ventilation. In addition, many storage spaces have been retrofitted to become occupied spaces, but
were never supplied with any fresh air ventilation, which the code requires.

In the case of finish materials, there are many areas, such as flooring and ceilings throughout JFK, that are worn out, discolored, or the material itself is failing. The flooring in the cafeteria is not suitable for athletic activities. Also, we have observed wide spread use of Vinyl Composition Tile (VCT) which is a very inexpensive flooring material to install, but which has perhaps the highest cost of maintenance of any commercial flooring system. We would not recommend replacing the VCT floors in kind for reasons related to operating cost.

The lighting systems in use were installed in 1991 and many have been updated to T8 fluorescent fixtures at some point. Today, they are outdated, past their expected lifespan, and do not provide high quality or efficient light. The system likely does not meet current energy codes.

Observations indicate that the school also contains some known hazardous materials which were installed between 1957—1976. Our experience is that most schools have many instances of hazardous materials that are unknown, or are concealed (or both). These hazardous materials should be properly and safely abated by a licensed abatement contractor. TXC cannot determine whether or not hazardous materials are present, nor if they have been properly abated. Our observations are based on two factors. Number one, there is existing signage that notes asbestos containing materials are present. Number two, there are notations within the historic drawings which show the intention was to install asbestos containing materials. Not being able to see these materials is not a guarantee that they have been properly abated. Only a licensed abatement contractor or environmental consultant can make this determination.

It should be noted that Contractors will not remove these (hazardous) materials if they are encountered during construction (typically during demolition), so we strongly recommend that the Owner assemble all the available documentation of previous abatement work and (if one does not already exist) create a comprehensive plan for abatement in all areas of construction/renovation (presumed to be 100% of the building at this time). If records do not exist for some areas of the building, the Owner should hire a environmental consultant to review and test the areas of the building where documentation cannot be provided. It is strongly encouraged that the Owner do this before setting a final project budget. The alternative is to carry a larger contingency and provide for the possibility of change orders during both design and construction.

TO BOND OR NOT TO BOND

To frame the conversation about what to replace and when, one should first consider the two main options for funding facility improvements: a public bond vote vs capital construction budget. Both options have plusses and minuses worth considering. Keep in mind that all of the needs addressed in this report will need to be addressed at some point, so if they are not included in a bonded project, then they need to be incorporated into a capital improvement plan.

When the scope and cost of improvements exceed a school district’s capacity to budget for on a yearly basis, a public bond is often considered to fund the project. Public bonds feature 20 year terms, low interest rates and require a public vote to authorize their use. The advantage of this approach is that it supports larger, long-term projects, administered through a single contract with a general contractor. When compared to a piece-meal approach, there are savings from an economy of scale and from doing more construction at today’s rates. It makes...
sense to pay for long-term investments over a period of time. However, it can be challenging to convince the community of the importance of these long-term investments.

Any scope of work that is not included in a bonded project should be incorporated into a capital plan. These are often 5 to 10 year plans where each item in question is scheduled to be replaced at a specific time. The amount of money required each year is calculated and budgeted on a yearly basis. This places additional strain on the yearly budget in an era of already high property taxes. The districts that are successful with this approach limit the use of the capital budget to only those items on the capital plan.

**CONCLUSION**

While the majority of the building structure and site are sound and can remain in use without significant expenditure, there is a significant number of deferred maintenance and code upgrade items that should be addressed as part of any significant building project, including building envelope, lighting, mechanical, and plumbing systems upgrades. In many areas, the majority of these systems and the space finishes will need to be replaced in the near future and certainly within the 20 year bond period.

Given the challenges of construction activities combined with the need to replace the bulk of the buildings mechanical and plumbing systems, it is very likely that many finishes and systems that otherwise would be acceptable to leave in place will be disturbed. For example, the existing Tel/Data network will likely not survive the removal and reinstallation of mechanical and plumbing systems. This has been a major challenge on other similar projects. It might be more cost effective to plan for complete replacement of these [tangentially affected] systems, despite a lack of serious deficiency. However, these systems typically have a very short life span (5-7 years), so this may not be an additional burden, but rather an opportunity to upgrade the system and make accommodations for future improvements, which will be needed before the rest of the building infrastructure.

The bones of this building are serviceable, but there are many improvements or system replacements that will be needed over the next 5-10 years (some are needed now or are overdue). Given the scope of the needed improvements, a bonded capital improvement project may be an effective way to holistically address the building needs and provide a healthier, safer, more energy efficient learning environment.

1. Renovation per NFPA Chapter 43: The replacement in-kind, strengthening, or upgrading of building elements, materials, equipment, or fixtures, that does not result in a reconfiguration of the building spaces within

2. Modification per NFPA Chapter 43: The reconfiguration of any space; the addition, relocation, or elimination of any door or window; the addition or elimination of load bearing elements; the reconfiguration or extension of any system; or the installation of any additional equipment.
**EXECUTIVE SUMMARY**

**FINDINGS—Summary Table**

Below is a summary of the major facility issues requiring attention at WSD. Please read the full facility evaluation report for further detail.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life Safety</td>
<td>Building generally does not comply with current codes for life safety (over allowable area, no fire walls).</td>
</tr>
<tr>
<td>Security</td>
<td>Entry possible without credentials, classroom doors not on closers or magnetic hold opens.</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>Hazardous materials are known to exist and will require abatement. A licensed environmental consultant should review the facility and perform comprehensive testing before construction begins.</td>
</tr>
<tr>
<td>Traffic</td>
<td>Study traffic patterns at entry from Main Street, entrances are confusing.</td>
</tr>
<tr>
<td>Sidewalks</td>
<td>Some routes are not accessible, &amp; some are insufficiently accessible or failing (asphalt stoops, overgrown)</td>
</tr>
<tr>
<td>Site Lighting</td>
<td>May not provide sufficient coverage, requires additional study.</td>
</tr>
<tr>
<td>Fire Lane</td>
<td>Pave fire lane to the south.</td>
</tr>
<tr>
<td>Wetlands</td>
<td>Site may have wetlands, further study required.</td>
</tr>
<tr>
<td>Soccer Pitch</td>
<td>Environmental Study required at soccer pitch.</td>
</tr>
<tr>
<td>Roofing</td>
<td>Roofing is past end of usable life, replacement of all areas recommended due to age and deterioration.</td>
</tr>
<tr>
<td>Exterior Envelope</td>
<td>Not exterior walls are uninsulated. This contributes to high operating costs &amp; occupant discomfort.</td>
</tr>
<tr>
<td>Doors</td>
<td>Exterior entrances are near end of usable life. Classroom doors in HS are not accessible. Recommend replacement of all classroom doors.</td>
</tr>
<tr>
<td>Windows</td>
<td>Windows are inefficient and leaky (aluminum framed) units that do not meet current codes and contribute to occupant discomfort.</td>
</tr>
<tr>
<td>Casework</td>
<td>Casework throughout facility is worn and should be replaced.</td>
</tr>
<tr>
<td>Flooring</td>
<td>Replace all flooring throughout JFK. Replace tile floors in all bathrooms that need to be re-built.</td>
</tr>
<tr>
<td>Corridors</td>
<td>Replace all flooring in corridors. Replace lockers in JFK.</td>
</tr>
<tr>
<td>Classrooms</td>
<td>Conditions vary. See report(s)</td>
</tr>
<tr>
<td>Folding Partitions</td>
<td>Replace folding partitions that are broken or which are not used due to difficulty of operation, Add folding partitions in areas where they have been removed (JFK).</td>
</tr>
<tr>
<td>Auditorium</td>
<td>Replace seating in auditorium. Replace theatrical lighting system. PAC undersized.</td>
</tr>
<tr>
<td>Bathrooms</td>
<td>Renovate all existing restrooms for accessibility and finishes except where recently renovated.</td>
</tr>
<tr>
<td>Lighting</td>
<td>Current lighting technology is T-8 fluorescent, Replacement of lighting systems and controls could yield energy savings and improve educational outcomes and behaviors.</td>
</tr>
<tr>
<td>Cafeteria</td>
<td>Replace flooring and add acoustic treatments</td>
</tr>
<tr>
<td>Gymnasium</td>
<td>Add acoustic treatments.</td>
</tr>
<tr>
<td>Locker Rooms</td>
<td>Replace flooring and lockers, decommission showers and plan for changing rooms.</td>
</tr>
<tr>
<td>Heating Plant(s)</td>
<td>Boilers in High School are at end of usable life and should be replaced.</td>
</tr>
<tr>
<td>HVAC &amp; Ventilation</td>
<td>Air handlers are at end of usable life. Unit Ventilators are energy intensive. Some spaces are under-ventilated as compared with current codes. Current ventilation is energy intensive.</td>
</tr>
<tr>
<td>HVAC Controls</td>
<td>Old pneumatic controls are beyond useful life. Replace with DDC system for better efficiency and comfort.</td>
</tr>
<tr>
<td>Plumbing</td>
<td>Fixtures do not comply with current plumbing codes (low flow). Piping is old and likely contains lead.</td>
</tr>
</tbody>
</table>
SITE CONDITION SUMMARY (see report by Engineering Ventures for more detailed information)

The school building is located on a large rectangular parcel. The elementary, middle, and high school buildings are contiguously connected and have a singularly connected outline. The western third of the parcel along Main Street (Route 7) contains parking, drop-off loop, and a soccer field. This common building structure extends across the middle third of the parcel. The eastern third of the parcel contains baseball, softball, and track.

Vehicular access to the site is from a one-way looped road from Main Street. Located along Main Street between the entrance and the exit point of the loop road are commercial businesses. On the exit side of the loop road, there is a boulevard that separates multiple exit turn lanes. Due to this boulevard, drivers may be confused where the entrance to the school parcel is located. Additional signage indicating entrance ahead may assist drivers that are not familiar with the campus.

The majority of the parking areas are located to the west of the drop-off loop. There is a limited amount of parking to the north and east of the building, with a remote lot to the south of the building. The elementary portion of the building complex is along the south side of the building. The playground areas are located immediately south of the
elementary school. This layout facilitates segregating the elementary school students from the middle and high school students.

**Site Recommendations:**

- See attached Civil Engineers Report for detailed recommendations.
- Investigate the possibility of improved vehicular signage for the entrance to the school from Main Street.
- Improve field quality and utilization of the most easterly located athletic field area.
- Improve the field quality of the multipurpose athletic field located next to Main Street and north of the exit drive. Investigate environmental factors that may be related to the site use prior to becoming a school.
- Replace deteriorated asphalt and gravel walkways with concrete walkways.
- Replace asphalt pads located outside egress doors with concrete frost-protected pads.
- Extend concrete walkways to areas where asphalt sidewalks have been interrupted or are gravel.
- Replace a pressure treated planter box located at the southwest corner of elementary.
- Remove vegetation from chain-link fencing and make fence repairs.
- Repair the electrical control panel for the pump station and install a lockable hasp.
- Modify perimeter grades and drainage structures to minimize or eliminate stormwater intrusion into building.
- Plan for upcoming Stormwater Rule requirements.
- Verify existence of two 5,000-gallon septic tanks north of the building and remove.
- Verify closure of underground fuel storage tanks comply with ANR requirements.
- Review existence of possible second pump station.
EXTERIOR WALLS

The primary exterior wall construction in the MS/HS wing is spandrel panels, aluminum windows, and painted steel.

A significant amount of structural steel is exposed to the exterior and runs through the insulation to the interior of the building. See the highlighted Red areas on Figure 1. This exposed structural steel contributes significantly to heat loss in the winter and heat gain in the summer, which puts strain on the mechanical system. The exterior envelope is also at risk of accelerated deterioration, due to air leaks, condensation, and thermal expansion and contraction of dissimilar materials at joints.

In addition to being a drain on resources and having potential durability issues, the existing envelope certainly contributes to significant discomfort of the occupants, which carries hidden costs in the form of decreased attentiveness, increased frequency of behavior problems, and which could lead to acute physical illness. Occupants reported temperatures in excess of 100 degrees indoors in the Fall of 2017. That level of heat can be dangerous for certain individuals. Unless this is addressed, complaints about feeling cold in the winter and hot in the late spring and late summer are certain to continue.

The marble panels below the windows in the MS/HS appear to be growing mildew. This should be aggressively treated and the panels sealed to prevent future growth.

The original main entrance systems on the north façade were replaced in 1991. These entrance systems are at the end of their usable life and should be replaced with new and secure entrance systems which includes a vestibule (airlock).

Some of the MS/HS wing building is simple masonry veneer with no insulation. These areas should at least be insulated to current code minimum standards.
In JFK, which was built in 1964 and expanded in 1969, the exterior walls are concrete block with a veneer brick exterior. In the portion built in 1964, the exterior walls are not load bearing, but in the portion built in 1969, they are.

A review of available drawings indicates that all of these exterior walls are uninsulated. The exterior brick veneer in these areas is in reasonable condition given its age of 50—55 years. In order to continue in service, maintenance should be done on the veneer. This maintenance should include cleaning of the exterior walls, repointing of deteriorated mortar joints, and replacement of sealants at wall penetrations and changes in material. All mechanical penetrations that are to remain, such as hose bibs and ventilation grills should be inspected and replaced, if necessary. The mechanical grills are in poor shape. If the Unit Ventilators which are served by these grills are removed, the resulting hole should be patched with new masonry infill or another suitable material.

Additionally, there are numerous acute issues that demand attention. At the top of some exterior walls, the top course of brick has come loose and is no longer bonded to the veneer. These loose bricks are present on multiple facades, and could present a safety risk to students and faculty that might use the area beneath them. A complete inspection by a qualified masonry contractor should be conducted during schematic design, and any construction project should include selective repointing and masonry repair.

JFK also has large areas of stucco in the areas above the windows. The stucco is in the process of failing and in almost all areas is extensively cracked. Stucco is not recommended as an exterior finish for schools as it requires regular painting and maintenance, which is often a challenge on tight budgets. Rather than repairing this system, we would recommend replacing this exterior finish with an insulated system that incorporated metal panels, or a similarly long lasting...
The exterior wall construction from 1976 is similar to that of previous construction, but utilizes a steel frame with concrete block infill between columns. The concrete block is not load bearing. This portion of the building was the first to include insulation in the walls. According to available drawings, there is ~1 1/2” of rigid insulation of unspecified type. The insulation is not continuous. Rigid insulation degrades over time, and this insulation is estimated to have about 2/3—3/4 of it’s original value. The amount of insulation present does not satisfy current energy codes. Additionally, this building has many significant steel roof framing members that go through the insulation. Because metal is a good conductor, these are called ‘thermal bridges’. Thermal bridges act as short circuits for heat energy (heat energy is lost in the winter, and gained during the summer). A review of available drawings indicates that the walls have numerous thermal bridges, which further diminishes the value of what insulation there is. Thermal bridging is also concerning as it provides an opportunity for condensation on interior surfaces during the winter (or in areas that are air conditioned during the summer). This condensation would be hidden inside the walls and ceilings, making inspection for corrosion or other material degradation difficult or impossible. In addition to the potential for corrosion and other material degradations, accumulated moisture in cavities can lead to micro-environments suitable for the growth of mold and/or mildew.

The exterior veneer masonry (brick) on the 1976 walls is 40 years old. While large areas of this veneer are in reasonable shape, the veneer should be maintained in order to remain in service. A complete inspection by a qualified masonry contractor should be conducted during schematic design, and any construction project should include selective repointing and masonry repair.
The construction from 1991 similar to the construction from 1976, but here, the walls have 4” of rigid insulation. This insulation will have degraded some due to age, but is estimated to comply with current energy codes. These exterior walls also have some thermal bridges at the joint between walls and roofs. These areas should be exposed, inspected, sealed against air infiltration, and insulated. The exterior brick and other masonry on the 1991 portion should be inspected by a qualified masonry contractor and some minor selective repointing is likely in order.

The owner may want to conduct an energy audit. Efficiency Vermont is a useful resource for coordinating these tests. A proper energy audit should include a thermal scan and blower door testing. These tests will highlight areas where large amounts of thermal energy are lost (gaps at windows, doors, penetrations thru ceilings/attics, etc.). The blower door test will also help identify the areas where the most opportunity for improvement exists.

**Technical discussion:**

From DOE: *An insulating material's resistance to conductive heat flow is measured or rated in terms of its thermal resistance or R-value -- the higher the R-value, the greater the insulating effectiveness. The R-value depends on the type of insulation, its thickness, and its density.*

Existing wall insulation (1976) = approx. R-7.5
Existing wall insulation (1991) = approx. R-20
Insulation age-degradation factor: 10-25%
Further heat loss through thermal bridges: unknown

Estimated R-value of existing 1976 wall = < R-6
Estimated R-value of existing 1991 wall = < R-16

Current energy code minimums for exterior walls require R-13 of continuous insulation. Exceptions to the energy code may be made in some cases for existing or historically notable buildings, though it is not clear that Winooski School District physical plant meets these...
Facility Evaluation Report

22

Criteria. TruexCullins recommends upgrading walls to current energy code minimums. Addition of insulation should be prioritized at all exterior walls where the interior surface is being disturbed by other work, such as the installation of grounded electrical power, etc.

In all areas, the building is likely to have a poor air barrier. An air barrier is recommended in virtually all new construction. Air sealing using Spray-applied Polyurethane Foam (with a cementitious ignition barrier) is recommended at all thermal bridges, to mitigate potential damage from condensation, and to improve the effective R-Value of the wall assemblies.

Exterior Wall Recommendations:
- Restore/maintain brick veneer (inspections, repointing/repair of brick, etc.)
- Insulate to code minimum standards in all areas being renovated, including air sealing.
- Replace stucco panels above windows
- Remove mildew from marble panels
- Perform an energy audit on the building envelope

Roofs & Overhangs

There are multiple roofs on this building, all in a condition commensurate with their age.

According to existing drawings, the majority of the roofs were replaced with single-ply PVC membranes during the renovations in 1991. There are two areas that were not addressed at that time.

The PVC membranes still in place have exceeded their life expectancy and should be replaced. It is recommended that all single-ply membrane roofing be replaced with a multi-ply system, such as a modified Bitumen (multi-ply) roofing. Modified Bitumen roofing systems have an life expectancy of 50+ years, and can be warranted for up to 40 years. Many multi-ply bitumen roofs have lasted longer than 50 years. These roofs are more expensive than single-ply membranes,
but the increase in unit cost for this system is much less
that the cost of two EPDM membranes (or three PVC or
TPO membranes) needed for that same 50 year span.
This lower life-cycle cost and robust resilient nature of
multiple layers makes this type of roofing system an
ideal choice for public schools.

**Roof Recommendations:**
- Replace all roofs, add tapered insulation (slope to
drains) where sloped steel is not present.

**ENTRANCE CANOPIES**

There are three main entrance canopies. The largest is
at the main entrance. Two smaller canopies are at the
entrances to JFK and the MS/HS wing. These entrances
are primarily used by students during drop-off. These
canopies are in good shape and appear to have no
major issues, but should be repainted as part of their
ongoing maintenance. Any significant project should
include repainting of the exterior entrance canopies.

**Canopy Recommendations:**
- Paint exterior canopies.

**DOORS AND WINDOWS**

Most windows throughout the building have been
replaced. The windows in the MS/HS wing were
replaced in 2000 (when the administrative “wing” was
built), and the windows in JFK were replaced in 1991.

All of the windows are aluminum framed and double
glazed, and are a reasonably high quality product.
They do not meet the current requirements of the
Vermont Energy Code.

These windows can be expected to last 25-30 years.
In the JFK wing and in the areas constructed in 1991,
these windows are now 27 years old and should be

1. *Long-term thermal resistance of closed-cell foam insula-
tion: research update from Canada*, Mukhopadhyaya, P.;
Kumaran, M.K., 2008
replaced. In the MS/HS wing, the windows are newer, but are not expected to last through another bond period. The Owner can elect to retain these windows, but should plan for their replacement. The recommendation from TXC would be to replace these windows with new thermally-broken, triple-pane units that meet the VT energy code. This has the added benefit of increasing occupant comfort and reducing operating costs.

Another common issue at windows in this vintage of construction are hazardous materials. Due to the era of construction, it is assumed that asbestos and/or PCB laden sealant (caulk) was used for the original construction. If these areas were abated, then documentation should be provided. If documentation of proper abatement by a licensed abatement contractor cannot be provided, the Owner should first have all areas of potential replacement tested by an environmental consultant. Any areas that are found to contain residual hazardous materials should be properly abated by a licensed abatement contractor. TruexCullins is not an expert on hazardous material abatement, and cannot direct this work.

Exterior doors are generally in a condition commensurate with their age. From review of available drawings, it appears that during construction in 1991, most exterior entrances were replaced with aluminum entrance systems. These existing entrance systems are not thermally broken and are approaching the end of their usable life. The aluminum entrance systems should all be replaced with new thermally-broken systems. Where vestibules are not present, they should be built, which happens at the northern set of entrance doors between the Gymnasium and the middle school.

Interior doors have three main issues. The first issue is one of accessibility. Many doors into classrooms do not meet the requirements for clear approach areas dictated by ANSI A117.1 (this is the code commonly referred to as ADA, which is an acronym for the
Americans with Disabilities Act, which mandated equal access to public buildings for persons with disabilities. Failure to comply with ANSI A117.1 may open the school district up to civil lawsuits.

The second issue with interior doors is one of comfort and privacy. Many interior doors are observed to be in areas that either: Must be private for legal reasons (example: private conference spaces in the Guidance office) or in areas where privacy is socially desirable (example: private restrooms). Any areas where information is shared that is of a very personal or medical or legal issue should be retrofitted with acoustic gaskets, to increase privacy.

The third issue with interior doors is one of security. It is recommended that interior doors be fitted with hardware that enables the door to remain locked and held open with electromagnets, and that these electromagnets be connected to a central release button located at the point of entry and in the SRO’s office. Pushing of the release button will simultaneously release all the corridor doors throughout the facility and allow faculty and staff to focus on their safety plan, and not spend time locking the door.

Some doors may be worn out. The districts facility staff should participate in a walkthrough with the Architect and determine together which doors are problematic and should be replaced. This is not obvious from a visual inspection, but in our experience, the facility maintenance staff knows which doors are problematic. It is usually a non-trivial number of doors.

**Door and Windows Recommendations:**

- Replace all exterior windows with new energy efficient windows.
- Replace all exterior doors in building
- Replace interior door hardware and install magnetic hold opens on all corridor doors
- Replace interior doors that do not provide...
In the older portion of JFK, it appears that demising walls between some classrooms were originally operable partitions. In the newer portion of JFK, there are still operable partitions between classrooms, but they are older model wooden partitions. Newer sound-attenuating partitions should be installed for acoustics. Based on feedback from faculty, flexibility is desired, so these should be re-installed for flexibility of teaching modes.

It is possible given the age of construction that some areas have lead paint or other hazardous material. Investigation by an environmental consultant should be done prior to setting a final budget for bond vote. Any hazardous materials should be abated prior to construction. Testing and abatement is recommended for all areas that are to be renovated.

**Interior Wall Recommendations:**
- Replace folding partitions.
- Paint interior walls in all areas of construction.
In not already complete, conduct a thorough school lead paint survey to verify lead containing products are properly contained and / or removed. Areas where significant renovations are anticipated, a more thorough review should be conducted prior to any construction.

CEILINGS

The 1949 construction has been retrofitted with acoustic lay-in tile drop ceilings (ACT). These ceilings are worn, but mostly useable. Some tiles have been stained.

Side note: This wing is an excellent example of design for daylighting quality, control, and efficiency. It is a true mid-century modern case study. Unfortunately, the positioning of the aforementioned retro-fitted ceilings cuts off natural light from clerestory and monitor glazing in this wing. When these ceilings are replaced, consider renovating the drop soffits and ceiling systems so as to take full advantage of the excellent natural light characteristics of this area.

The 1954 and 1959 construction has exposed painted tectum deck in the classrooms, and ACT in the hallways. As is true in the 49 wing, the ceiling is mostly serviceable, but a small number of tiles have been stained.

The 1966 wing has exposed concrete and tectum deck in the cafeteria, gymnasium, and classrooms, while the corridors and administrative/guidance areas have ACT. Tectum and concrete deck should be cleaned and selectively repainted. As is true in other areas, some ceiling tiles are stained, and some are “drooping”, presumably due to persistent elevated humidity levels.

The 1991 construction has Suspended ceilings throughout most areas, and a decorative acoustic ceiling in the auditorium. As with other areas, the ACT has some stained and droopy tiles.

In areas where invasive work will take place above the
ceiling (such as the installation of sprinkler systems or other mechanical systems), ACT systems will most likely not be salvageable (except for good tiles). The grid systems will need to be replaced, and the tiles should be consolidated to eliminate drooping or stained tiles. Replace any ceiling systems that are in areas of structural renovations.

Ceiling Recommendations:

- Conduct a thorough school asbestos and PCB (Polychlorinated Biphenyls) containing materials survey to verify suspect products, adhesives and caulking are free of such contaminants. Areas where significant renovations are anticipated, a more thorough review should be conducted prior to any construction.
- Conduct a thorough school lead paint survey to verify lead containing products are properly contained and / or removed. Areas where significant renovations are anticipated, a more thorough review should be conducted prior to any construction.
- Replace ceiling grid and consolidate tile as renovations occur. Replace all water stained or discolored tiles
- To improve appearance, replace deformed tiles.

Floors

The flooring throughout most corridors shows signs of aging. We would recommend replacing the corridor flooring with a new high quality institutional flooring such as terrazzo.

The flooring throughout JFK (south of the entrance lobby) is Vinyl Composition Tile (VCT), installed in 1991, and is showing signs of failure and is now beyond it’s useful life. In many areas the tiles are shrinking and cracking and leaving ragged gaps between the tiles. These are unsightly and illustrate the need for replacement.
Drawings indicate that this area once had Vinyl Asbestos Tile (VAT). The VAT is no longer visible, but documentation of remediation was not readily available. Testing by an environmental consultant is recommended to provide proof positive that no hazardous materials are still present, particularly in the adhesive.

Staff also reports that the red color is jarring to many students that suffer from past trauma, and the would like to avoid reds and oranges in future planning projects.

The Flooring in the Library, the High School, and the Middle School is VCT and appears to be in better condition than in the elementary school. It may have been replaced more recently. The waxing protocol, while expensive, appears to be working very well in the High School and the floors there are in generally excellent shape, except for the science labs.

Drawings indicate that the 1957 construction (HS/MS) utilized asphalt asbestos tile. Again, the asphalt tile is no longer visible, but documentation of remediation was not readily available. Testing by an environmental consultant is recommended to provide proof positive that no hazardous materials are still present.

The Gymnasium floor appears to be in good-fair condition. No work is anticipated on this floors.

The cafeteria has a sheet flooring that is reported as a hazard by PE staff. They are reluctant to use this space for athletic practices because the flooring is not a true sports floor. This floor should be replaced with a multipurpose resilient flooring suitable for athletic activity.

Bathroom floors are generally in poor condition, except in recently renovated bathrooms. In all restrooms that will be renovated for accessibility, flooring should be replaced. Several of the Men’s rooms had a strong smell of urine which was not noticeable in the women’s rooms.
Walk-off grills are observed at some entries. To maintain good indoor air quality, all public entrances should have walk-off grids.

Generally, we do not recommend VCT in classroom settings because of the high cost of maintenance. No-wax resilient flooring such as Marmoleum, Flotex, or quartz tile are marginally more expensive up-front, but cheaper to maintain.

Flooring Recommendations:

- Replacing corridor flooring throughout building.
- Replace classroom flooring throughout JFK.
- Replace any other areas of Red flooring
- Replace carpet throughout central office
- Perform moisture tests on concrete slabs to determine correct adhesive and appropriate flooring products.
- Maintain and provide walk-off grills and mats at main entry for dirt removal.
- Conduct a thorough school asbestos and PCB (Polychlorinated Biphenyls) containing materials survey to verify suspect products, adhesives and caulking are free of such contaminants. Areas where significant renovations are anticipated, a more thorough review should be conducted prior to any construction.
- Hire a licensed hazardous material abatement contractor to abate VAT from facility.

KITCHEN EQUIPMENT

The food service program at Winooski School District is reported to function well and is currently subcontracted to the Abby group. No obvious issues are reported. The Owner has reported that some recent structural work was completed at the kitchen exhaust hood.

The walk-in cooler and freezer have been recently
replaced and are reported to function well. The kitchen layout is reasonable and there appears to be good separation of food delivery, clean areas, and dirty areas, with little opportunity for cross contamination.

A thorough survey of kitchen equipment was not performed, as kitchen and food service consulting was not in the scope of this investigation.

**Kitchen Recommendations:**

- Hire a Kitchen Designer to analyze and make recommendations based kitchen needs and possible new cafeteria layout.

**CASEWORK**

The casework in several areas has started to deteriorate. Plastic laminate casework in the Art Rooms has begun to delaminate at the ends, and it appears there is insufficient quantity of storage.

Cabinetry and equipment (stoves, washer/dryer) in the Family and Consumer Science (FCS) classroom is in fair-poor condition. Winooski should consider replacement of all cabinets, casework, and equipment in these areas should be replaced with new.

In many other areas throughout the school, casework appears in fair to poor condition. Winooski School District should consider replacement of any casework that is in areas of significant renovations. Additionally, there may be issues of accessibility to counters and sinks within classrooms. Any classroom with non-ADA compliant counters or sinks should be retro-fitted with compliant fixtures and counters.

**Casework Recommendations:**

- Replace all casework and shelving in Art classrooms and in Family and Consumer Science classrooms
- Replace casework in all spaces where renovations will take place.
- Selectively replace countertops and sinks in
classrooms in which the only counter/sink is not currently accessible.

**PLUMBING**

See attached report by LN Consulting for Detailed information regarding plumbing systems.

TruexCullins review of plumbing is limited to compliance with codes in regard to the number of required fixtures, and the accessibility of those fixtures.

The occupancy of this building for the purposes of evaluating compliance with the Code is 2414 persons. These are a mix of students, teachers, etc. Though this number is higher than actual occupancy, this is the number assumed as the maximum possible (non-simultaneous) occupancy of the total building. Non-simultaneous occupancy means that we have counted only the classrooms and business offices, and not the assembly spaces (Gym, Auditorium, Cafeteria, etc.). This approach is taken because it is assumed that students will be in one place or the other, but not both, and not all at once. The theoretical maximum is already well above the actual number, and also higher than DOE recommended minimum area per student.

The following table outlines the number of required fixtures, the number of field documented fixtures, and the number of fixtures that will need to be provided as part of a major renovation project:

<table>
<thead>
<tr>
<th>Fixture Type</th>
<th>Code min.</th>
<th>Existing</th>
<th>Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toilet</td>
<td>63</td>
<td>66</td>
<td>0</td>
</tr>
<tr>
<td>Lavatory</td>
<td>61</td>
<td>60</td>
<td>1*</td>
</tr>
<tr>
<td>Drinking Fountain</td>
<td>33</td>
<td>23</td>
<td>3</td>
</tr>
</tbody>
</table>

*if classroom sinks are counted, then the number of existing is higher, and zero new lavatories are required.
Water coolers can be substituted for a percentage of required drinking fountains. This might be a cost effective option for business offices or other administrative areas.

In addition, some older restrooms are observed in the wings older than 1966 to be inaccessible, and not in compliance with the Americans with Disabilities Act (ADA). Both single and multi-stall restrooms are out of compliance. All non-accessible multi-stall restrooms should be renovated to comply with the ADA. In some cases, this may mean removal of a toilet to enlarge an existing stall, but given that there is a surplus of required toilets, this should not be a challenge.

In area where restrooms are to be renovated, it is recommended that all fixtures be upgraded to fixtures that meet modern water conservation standards.

**Plumbing recommendations:**
- Provide the required number of plumbing fixtures.
- See attached report by LN Consulting for recommendations regarding plumbing systems.

**MECHANICAL SYSTEMS**

See attached report by LN Consulting for a detailed review of the existing Mechanical system and proposed replacement options.

Several HVAC components and systems have been identified as having exceeded their expected life span and should be replaced.

Of particular note are the boilers in the north (1957) boiler room. These boilers are at the end of their useful life and should be replaced.

The ventilation system also has many units which are original to the 1991 construction or older. The units in the Gymnasium appear to be original to 1957 and are not functioning properly, and the filters are very clogged. Access to these units is very difficult, which makes proper maintenance nearly impossible. Some
rooms have insufficient ventilation, (such as where rooms have been converted from storage closet to office), or where batteries are being charged without exhaust air. In classrooms there are unit ventilators, which are noted to be an inefficient way of providing fresh air. These units work by heating up outdoor air, and each unit ventilator has a large hole through the building envelope in which untampered air is brought in and blown through radiators. Modern systems temper the incoming air with the conditioned air that is exhausted, in a process known as Heat Recovery (or Energy Recovery).

Any areas without ventilation should have a ventilation system added, as it is a code violation to have unventilated occupied areas. Energy Recovery Ventilation is recommended to provide healthy amounts of fresh air in an energy efficient manner.

The HVAC control system is partially pneumatic, which leaks. This compounds issues of efficiency. Any major investment in new mechanical equipment should include new facility wide control systems and control equipment.

**Mechanical Recommendations:**
- See attached report by LN Consulting for Mechanical recommendations.

**ELECTRICAL AND LIGHTING SYSTEMS**
(See attached report by LN Consulting)

The existing electrical entrance is almost 30 years old and not sufficient size for the planned expansion. It should also be upgraded from 207 volts to 480.

Many of the distribution panels are original to their vintage of construction. Old panel boards should be replaced with new modern panels to accommodate additional branch circuits required for educational spaces to avoid the use of extension cords.

Lighting throughout the school is primarily T-8
fluorescent based lighting systems for internal lighting. A switch to LED may provide some energy savings, but the greater impact will be on the well being of occupants. Modern “Warm-dim” LED systems mimic the natural change in natural daylight, and thus are better at helping occupants maintain a more natural circadian rhythm. WSD should consider replacement of all T-8s with LEDs in occupied areas. A re-light survey by Efficiency Vermont may be helpful in planning these upgrades.

The theatrical lighting system is incandescent/halogen and it appears much of the controls are older, making repairs and replacement difficult. These older system, because they are usually custom made, also tend to be less safe than standard lighting control systems. We recommend hiring a lighting designer that specializes in stage lighting to design the new stage lighting and stage lighting controls.

Extension cords and power strips were observed throughout classrooms and office areas. This is an indication that there is a lack of receptacles installed at this time.

**Electrical and Lighting Recommendations:**

- See report by LN Consulting for electrical system recommendations.
- Contact Efficiency Vermont about conducting a Re-light survey.
- Replace lighting system with modern addressable warm-to-dim LED lighting.
- Hire theatrical lighting designer for stage lighting renovations.
- Replace Electrical Entrance and distribution panels.
- Replace and expand power receptacles in classrooms to accommodate modern classroom needs.

**FIRE ALARM AND FIRE SUPPRESSION**
The existing Simplex 4002 fire alarm system does not comply with current NFPA guidelines for fire alarm installations. As part of any reconstruction the entire fire alarm system and infrastructure would be replaced and a new, addressable fire alarm system with full voice evacuation that complies with local, state and NFPA requirements be installed. The fire alarm would tie into the security and lighting control systems for enhanced safety.

Our experience is that the Vermont Division of Fire Safety, which oversees permits and issues Certificates of Occupancy will require a full upgrade to modern code requirements as would be required for a new school, even though this school is existing.

Fire Alarm and Fire Suppression Recommendations:

- Full replacement of Fire Alarm System.

BUILDING SECURITY

Every building security system has two main components: one is the bricks and mortar system (locks, cameras, and lighting). The other main component is the operations plan, and how well the building occupants abide by this plan.

The reasons for and degree of security at any given school must come from the school’s history and anticipation of possible troubled circumstances. Issues of privacy also get invoked whenever such systems are deployed or considered. TXC and our consultant team is not in a position to recommend any particular degree of security system until specific goals have been articulated or potential threats identified, and agreed upon by the decision making body for the school. Each community will need to set its own comfort level in determining the possibility and likelihood of real threats to students and faculty alike and the means to cope with or mitigate these real or perceived threats to their school.
Some suggested measures for security enhancements might include:

- installation of a “person-trap”, which is an airlock where the inner doors stay locked until a person is checked and given credentials. This usually requires a “transaction window” and a staff person.
- Notification alarms (silent) on all exterior doors so that there is a record of the door opening.
- Additional external and internal cameras
- Classroom doors should have closers, specific locking hardware, and magnetic hold-opens linked to a central release (panic) button.
- Motorized window shades that automatically drop when the panic button is pressed.
- Laminated and tempered glass entrances which will slow down an assailant.

It should be noted that there are many more measures that can be taken, such as a perimeter fence and gate (these are typical at International Schools, but not in Vermont). Ultimately, the largest component of security is operational. Occupants should stop and question people that are not credentialed. Occupants should not open doors and hold them open with blocks or wooden wedges.

In Vermont, the most common security threats (reported) are custodial issues. However, broad cultural awareness of gun violence, particularly over the last 10+ years has changed the conversation, and many communities desire their schools to be “hardened”. For our part, we wish for schools to be open and welcome as much as is deemed appropriate by the community that is being served.

TruexCullins is not a security expert, and it is recommended that a security expert be consulted for things like camera, access systems, and threat assessment.

**Building Security Recommendations**

- Form a committee of faculty and possibly parents and neighbors to determine real and perceived threats and how a security system could alleviate those problems and offer truly enhanced security to occupants and neighbors.
- Hire a security expert to consult on specific issues around camera technology, placement, video capturing, and system integration.
LIFE SAFETY

A code review document is attached as appendix A.

A few major code issues have been identified in this report by TXC and the team of design consultants. Of particular note are issues related to allowable building area in educational occupancies (Table 503, IBC 2015).

According to the 1991 design drawings by Len Duffy and Associates, the building can be broken into three “buildings”. These divisions happen along the north wall of the library separating JFK from the rest of the facility, and also at the east end of the MS/HS corridors, between the lobby and MS corridor on the first floor, and between the Business/FACS classrooms and the HS main corridor.

The issue is that the Fire Walls noted in these locations do not conform with the code requirements in place in 1991 (BOCA) nor do they conform with the codes in place today (NFPA 221).

Given that these walls do not comply with code, the building cannot be truly considered as (3) separate structures, and therefore is far larger than is allowed by code. Buildings of unlimited size are allowed, but this building does not currently meet the requirements for this consideration.

To be fully compliant with current codes, the structure would need to be retrofitted with true fire walls such that it would be broken into multiple independently structured areas, to reduce the building areas of each ‘compartment’ to below the allowable area limits.
It is unlikely that this will be required by the Authority Having Jurisdiction. The building is permitted to remain in use per the 2015 IBC code, which allows for non-compliant buildings to remain occupied.

[2015 IBC] 102.6 Existing structures.
The legal occupancy of any structure existing on the date of adoption of this code shall be permitted to continue without change, except as is specifically covered in this code, the International Property Maintenance Code or the International Fire Code, or as is deemed necessary by the building official for the general safety and welfare of the occupants and the public.

All this is not to say that the building is not safe. TruexCullins is not a Fire Protection Engineer or Specialty Code Consultant, and is not qualified to judge the safety of existing structures. The IBC identifies the building official as the party responsible for making this distinction. Currently the building is legally occupied and there is no legal issue with occupancy.

However, the current legal occupancy will not continue after a construction project of any significance, and the renovated building will require a new certificate of occupancy. To mitigate financial risk of unknown or nebulous requirements imposed by the AHJ, it is recommended that the Owner and Architect schedule a meeting to review these findings and determine what actions would be required as part of a construction project.

It is very likely (and recommended) that any new additions be separated from the existing structure by true high challenge fire walls confirming to current codes.

Building Code Recommendations:

- As part of any major renovation, implement Life Safety improvements as negotiated between the AHJ, the Architect, the Fire Protection Engineer, and the Owner.
FURNITURE, FIXTURES, AND EQUIPMENT

A detailed review of furniture, fixtures, and equipment has not been performed, and is not part of the scope of this investigation. However, three areas of note have been identified by the team.

It has been observed that the folding partitions in many areas are compromised in some way. As noted previously in this report, the folding partitions in JFK are older models, which are assumed to be problematic acoustically. The old multipurpose room, which is now a preschool room, has operable partitions which are reported to be broken.

In the auditorium, the seating was observed to have many seats with torn upholstery, and many others that were not torn were extremely worn, and will be torn soon. These seats are quite old (they were donated by St. Mikes at the time of construction in 1991. Replacement parts are unavailable, and the facilities crew reports having very few spare units available. These seats should be replaced with newer units.

In the gym locker rooms, the existing lockers are worn, several are missing doors and/or have broken doors, and appear to be near the end or past their useable life. If these are a necessary component of the physical education department, they should be replaced with new units.

Many spaces have furniture that has been fitted with tennis balls over the feet. This approach is somewhat common, but we would encourage future furniture purchases to include feet designed by the manufacturers for the intended flooring, to avoid maintenance staff having to retro fit chairs and tables with tennis balls. This will look more intentional, and less haphazard.

FFE Recommendations:

- Replace all folding partitions which are non-operable
• Replace auditorium seating.
• Replace Gym lockers
• Coordinate future furniture purchases with flooring and utilize manufacturers options to prevent damage to the floor.
• Begin a capital plan to replace furniture on a rotating 10-15 year schedule.

ACOUSTICS

Two major spaces are in need of acoustic treatment. The Gymnasium is reported by staff to be much too loud to effectively run two classes at the same time. This could be addressed with sound attenuation panels on the ceiling and walls.

The cafeteria is also reported to be uncomfortably loud during lunch (a phenomenon that we experienced first-hand). This has implications for all users, but is a particular concern for young students and students that have experienced Trauma. It was reported that many students and teachers avoid the cafeteria because of this. Similar to the Gym, this condition could be improved by the installation of sound attenuation panels on the ceiling and/or walls.

It should be noted that TruexCullins is not an acoustic engineer, and to properly design an acoustic solution and achieve a specific target reduction in ambient noise, and acoustic engineer would be required.

Acoustic Recommendations:
• As part of any planned renovations to this building, include an acoustic engineer to review and make recommendations about the Gym and cafeteria. Consider that other spaces may benefit from expert review as well.

ACCESSIBILITY

Site accessibility issues are addressed by the Civil
engineer, and were not reviewed by TruexCullins. The interiors of this facility are (for the most part) connected by accessible routes. However, many spaces, such as several multi-stall restrooms (discussed elsewhere) are not accessible for use. Additionally, the casework in most classrooms has sinks that are not accessible for use by persons in wheelchairs. While not a Life Safety issue, it behooves the school and community to address issues related to equal access to all students with disabilities.

The building is observed to have a 2500 lb hydraulic elevator in place, which serves to provide an accessible route to the second floor. This elevator does not meet current Codes concerning dimensional requirements for passenger elevators, but it is unlikely that the AHJ would require this to be changed.

**Accessibility Recommendations:**

- Replace any non-ADA compliant counters and sinks in classrooms
- Renovate restrooms per plumbing recommendations

**CONCLUSION**

Many components of the facility have served the community well, but have reached or exceeded their expected life span. In some cases, whole systems have reached the end of their life (or they are very near, from a planning perspective).

Given that significant investment would be required to update the facility to modern standards and address code and health, safety, and welfare issues, there is an opportunity at this time to use that significant investment to update the systems and spaces to more closely align with modern educational paradigms and to make the building more efficient.
REPORT BASIS

A preliminary site review was performed for the grounds of Winooski Middle/High School and the JFK Elementary School campus. The purpose of this site visit was to review the exterior portions of the building and to establish the general condition of the site. This review outlines significant deficiencies and issues that would need to be addressed as part of proposed improvements.

The following documents were referenced as part of this review:

- Public records review of Agency of Natural Resources Stormwater Permits: 6643-9015, 6643-9015.1
- Public records review of Agency of Natural Resources Wastewater Permits: ww-4-0440, ww-4-0440-1, ww-4-0440-2
- Facility record drawings, *A Junior-Senior High School for Winooski, Vermont* dated August 31 1957 by Julian W Goodrich Architect
- Facility record drawings, John F Kennedy School by Freeman French Freemen dated April 28, 1964
- Facility record drawings, Addition to John F. Kennedy School by Freeman French Freemen dated May 5, 1969
- Facility record drawings, Community/Vocational Center at Winooski High School by Wiemann – Lamphere, Architects dated Sept 15, 1976
- Facility record drawings, Winooski Educational Center by Wiemann – Lamphere Architects, Inc dated May 24, 2000

A site walk was conducted on May 25th, 2018.

SUMMARY OF RECOMMENDATIONS

The following list is a summary of the recommendations that are contained in this report:

- Investigate the possibility of improved vehicular signage for the entrance to the school from Main Street.
- Improve field quality and utilization of the most easterly located athletic field area.
- Improve the field quality of the soccer field located next to Main Street and north of the exit drive. Investigate environmental factors that may be related to the site use prior to becoming a school.
- Replace deteriorated asphalt and gravel walkways with concrete walkways.
- Replace asphalt pads located outside egress doors with concrete frost-protected pads.
- Extend concrete walkways to areas where asphalt sidewalks have been interrupted or are gravel.
- Replace a pressure treated planter box located at the southwest corner of elementary.
- Remove vegetation from chain-link fencing and make fence repairs.
- Repair the electrical control panel for the pump station and install a lockable hasp.
- Modify perimeter grades and drainage structures to minimize or eliminate stormwater intrusion into building.
- Plan for upcoming Stormwater Rule requirements.
Verify existence of two 5,000-gallon septic tanks north of the building and remove.
Verify closure of underground fuel storage tanks comply with ANR requirements.
Review existence of possible second pump station.

Activities and improvements that may be needed to support building expansion or renovation needs:

- Procure an existing-conditions and topographic survey of the site.
- Consult with a wetland biologist and possibly the ANR Wetlands Section regarding limitations of site development.
- Replace walkways and access ramps to the front of the school.
- Upgrade fire access drive along south side of the building.
- Coordinate water and sewer utility connections with Winooski Public works to simplify connections, provided adequate flow, maintain separations as required, and perform replacements as needed.
- Obtain approval for water supply, hydrants, and access drives from the Authority Having Jurisdiction.

FACILITY LAYOUT

The school building is located on a large rectangular parcel. The elementary, middle, and high school buildings are contiguously connected and have a singularly connected outline. The western third of the parcel along Main Street (Route 7) contains parking, drop-off loop, and a soccer field. This common building structure extends across the middle third of the parcel. The eastern third of the parcel contains Baseball, softball, and track.

Vehicular access to the site is from a one-way looped road from Main Street. Located along Main Street between the entrance and the exit point of the loop road are commercial businesses. On the exit side of
the loop road, there is a boulevard that separates multiple exit turn lanes. Due to this boulevard, drivers may be confused where the entrance to the school parcel is located. Additional signage indicating entrance ahead may assist drivers that are not familiar with the campus.

The majority of the parking areas are located to the west of the drop off loop. There is a limited amount of parking to the north and east of the building, with a remote lot to the south of the building. The elementary portion of the building complex is along the south side of the building. The playground areas are located immediately south of the elementary school. This layout facilitates segregating the elementary school students from the middle and high school students.

There are several athletic fields located immediately behind the school. These athletic fields appear to be the best maintained and can be readily accessed. The athletic areas at the east end of the site may be underutilized. Improvements made to these easterly fields may increase their desirability and usage.

During our review of the site the soccer field located adjacent to Main Street and north of the exit drive was discussed with the facility review team. It was indicated during these discussions that inground debris occasionally surfaces in this field and needs to be removed. It was also indicated in these discussions that the debris may be refuge from prior owners and uses that predate the use of that area of the site as a school. These comments may warrant an Environmental Assessment of this area. Among other issues this assessment should investigate the prior use of the site. We would recommend taking this action prior to making substantial improvements to this portion of the site.

There is the ability of passenger cars and emergency vehicles to travel around the west, north and east sides of the site on asphalt pavement drives.

[Image: Gravel fire lane along south side of the elementary school.]
A gravel drive is located on the south side of the site. A lockable gate blocks the west end of this drive. This gravel drive is useful as a fire-lane along the south side of the school. There may need to be minor improvements to bring this access drive up to current code. Since this fire-lane divides the school from the elementary play area, our initial review indicates that it would not be desirable to upgrade this fire-lane into publicly-used vehicle access drive.

**SIDEWALKS AND PAVEMENTS**

Modifications to the main parking area located in the front of the school likely occurred since the original school construction. This parking area appears to function adequately and does not currently need significant improvements.

Recent construction along the north side of the building has improved pavement areas, parking and drainage.

The rear of the site and the remote parking area to the south of the school shows signs of wear and may be around the 20-year expected life of pavement.

There are several exterior swinging egress doors that currently have an asphalt pavement pad outside the door. The asphalt pad should be removed from outside these doors and a concrete frost-protected pad should be constructed.

There are several pathways around the perimeter of the school that could use improvement. Some of these pathways are gravel, deteriorated, asphalt, or the route is misconfigured.
Site walkway discontinuing prior to reaching driveway.

Asphalt pavement patch on site driveway at northwest corner of building.

Asphalt pavement outside exterior egress door.

Fencing without a gate interrupting site walkways.

Asphalt pavement walkway.

Gravel site walkways to building egress doors.
SITE FEATURES AND ATHLETIC FIELD FACILITIES
An exterior planter box is constructed of pressure treated lumber and is located near the southwest corner of the Elementary School. Replacement of this wall should be considered due to the age and nature of the pressure-treated lumber.

Various fencing material throughout the campus should be repaired. Vegetation should be removed from behind the chain-link fence to limit further damage to the fence.

*Pressure treated timber planter wall.*

*Chain-link fencing along perimeter of site with overgrown vegetation.*
Detailed examination of the baseball and softball fields was not performed. It was expressed to the site review team that the track and field facility should receive improvements. Although the existing gravel track is close to the regulation length, without continual proper measurement, this track cannot be used for qualifying times. Additional lanes would help in hosting track and field competitions. These issues could be addressed with a wider all-season track.

WETLANDS

There may be wetlands located north of the building. Wet areas of standing water were observed north of the north-parking area during the site visit. Activities in and around wetlands are regulated.

Federal wetland regulations are administered by the US Army Corps of Engineers. State wetland and wetland-buffer regulations are administered by the Agency of Natural Resources (ANR) Wetlands Section. Most wetlands are classified either as Class 2 or Class 3 wetlands. Class 2 wetlands have a 50-foot buffer. The regulations that effect the classification of wetlands are updated from time-to-time.

A review of Agency of Natural Resources database records indicate that wetland permits have been obtained for this parcel. Prior to expansion or redevelopment along the north side of the school, input from a wetland specialist and the ANR Wetlands Section regarding limitations of use and expansion in this area of the parcel should be considered.
SITE DRAINAGE AND STORMWATER

The parcel has been filled and leveled from predevelopment contours. Test pits from previous building construction in the northeast corner of the building indicate that the groundwater elevation is within a few feet of the surface.

The site grades along the north, east and south sides of the building tend be flat and have minimal, if any, slope away from the building. The exterior elevation around the building is close to the interior floor elevation. It should be verified with building users that there has not been any evidence of historical surface water intrusion into the building. Also, additional information should be obtained regarding past observations of exterior standing water around the building, especially during spring thaws or intense rainfalls.
Rainwater drains from the parcel in two directions. The northeast portion of the parcel drains to a pond located north of the parcel and then along a stream that passes underneath I-89.

The southern portion of the parcel drains to a ravine located south of the drop-off loop. Record drawings indicate that originally this ravine extended further onsite and under the front of the Elementary School.

A stormwater management basin was constructed in the front of the school between the parking lot area and the drop-off loop. This stormwater management basin was permitted with the Vermont Agency of Natural Resources (ANR) to receive permit coverage under General Permit 3-9010. These stormwater measures were permitted in 2011 and appear to have been constructed shortly after that.

The modifications to the driveway, parking areas, and sheds that are located north of the school was permitted with ANR to receive permit coverage under General Permit 3-9015. These stormwater measures were permitted in 2017 and appear to have been constructed around that time.
The site is believed to be currently in compliance with stormwater regulations. However, there are additional upcoming regulations that will apply to all parcels that contain over 3-acres of impervious area. Since the school parcel contains more than 3-acres of impervious, these additional upcoming regulations will apply to this school parcel.

The statutory requirement has been established that all parcels containing over 3-acres of impervious area are required to obtain a Vermont Agency of Natural Resources Department of Environmental Conservation (VT DEC) issued permit. At the time of this report, the implementing regulations (Stormwater Rule) associated with this VT DEC permit requirement have not been issued. The 3-acre Stormwater Rule was due to be issued in January, 2018. Property owners in the Lake Champlain basin are required to implement the requirements of this Stormwater Rule by 2023.

The Stormwater Rule may require retrofit, maximization of on-site treatment, and compliance with the Stormwater Management Manual. This is both similar to past permitting programs and what the Agency is indicating in their most recent guidance. The Stormwater Management Manual contains requirements for water quality treatment, groundwater recharge, and channel protection standards.

The initial step of the permit process will likely be an Engineering Feasibility Analysis (EFA). The framework and the evaluation criteria that the EFA would follow has not been issued by the VT DEC. The proposed Stormwater Rule will describe the retrofit standards to be incorporated in this new general permit.

There will also be impact fees that will be associated with the degree that a parcel meets the Stormwater Permit requirements. The VT DEC is considering a $50,000 per impervious acre offset fee for parcels that are unable to meet the retrofit requirements of the upcoming Stormwater Rule. This per acre fee does not include associated administrative, legal, design, or maintenance fees.

The specific requirements of the regulatory language of the Stormwater Permit may significantly alter the stormwater measures that should be considered. The District should anticipate the issuance of the Stormwater Rule in the next year and the design, construction and permitting costs that would be associated with it.

**WATER SERVICE CONNECTIONS**

The school is connected to the City of Winooski Municipal water distribution system. This building complex was built over time and initially consisted of multiple separate buildings. It was then combined into a single building through subsequent additions. Separate water service connections served the initial buildings. Subsequent additions received additional water connections. Upgrades occurred to the existing domestic water distribution system to install larger diameter water lines and fire hydrants.

There are water lines that pass around and likely under the existing building and enter the building from multiple points. Any expansion of the building area would need to relocate existing water lines to avoid impacting the water mains or water service lines. Additionally, associated with any expansion, the points of water service should be reviewed with the existing or proposed plans to determine if there are any redundancies, or if additional piping should be upgraded, removed, relocated or consolidated.

Water valves were observed near the rear of the athletic fields. The ownership and purpose of these
valves is not apparent from site observations. These valves may be owned by the School District and serve the school. However, they may also be municipally owned valves that provide service to offsite properties and/or the school. Prior to any expansion or renovation, record drawings should be obtained from the City of Winooski Public Works Department to further investigate.

Reviewing the record drawings from the various building construction projects indicate waterlines:

- along the north edge of the entrance drive that serve the original high school construction.
- along the south side of the northern entrance boulevard and then traveling along the entrance loop to the elementary school addition.
- possibly underneath the elementary school addition.
- possibly beyond the south end of the entrance drive where the record drawing discontinues showing a line.
- connecting the south side of the original elementary school construction to municipal watermains in the western end of George Street.
- connecting the fieldhouse to waterlines behind the school building.
- possibly from an offsite municipal connection east of the site.

If expansion of the school or significant renovations are to occur, it should be verified that the location, spacing and flow rates of hydrants meets the requirements of NFPA 1 and is accepted by the AHJ.

WASTEWATER

The wastewater lines for the original high school construction were constructed along the north side of the exit drive. Also, record drawings of the original high school construction indicate that there may be two 5,000-gallon septic tanks north of the building.

There is a wastewater pump station located near the rear of the school. This pump station is a duplex pump station. A detailed review of this pump station was not performed, however the electrical control panel should be repaired so that it can be properly secured and locked.
There is also an indication of a wastewater pump north of the original high school. During the site visit, the location or existence of this pump station was not apparent.

Wastewater lines surround most of the sides of the building. Any expansion or modification of the building will need to consider the location of the existing wastewater lines and relocate the wastewater lines and pump station if needed.

UNDERGROUND TANKS

Review of school record drawings indicate that the school is currently served by natural gas. However, it also appears that portions of the school were previously served by heating oil stored in underground tanks. Record documents indicate the possibility of a 10,000-gallon UST north of the high school and another UST in the courtyard of the elementary school. It is not apparent that these underground storage tanks have been closed in accordance with the Agency of Natural Resources Underground Storage Tank (UST) Closure and Site Assessment Requirements.

Environmental Assessment, Hazardous Materials or Site Remediation: This report does not address any aspects of an environmental assessment, hazardous materials or site remediation. This report is not a Phase 1 Environmental Assessment as defined by ASTM E1527.

END OF REPORT
I | OVERVIEW
A preliminary structural assessment of the existing buildings at the Winooski Middle/High School and JFK Elementary School was performed on April 4th, 2018. At that time, we walked the complex with you and generally accessed all areas, including the six eras of construction: 1957, 1964, 1969, 1976, 1991, and 2000. We spoke with Mick Muscat about access to the overall complex and what conflicts would need to be avoided. We have reviewed the sizes and spans based on information available on the existing construction drawings.

We have classified our evaluation into three categories and then by each building era:

Priority 1: Code violation; health and safety concern; in need of immediate repair or replacement.
Priority 2: Nearing the end of the product’s expected life and needs attention; energy efficiency upgrade; security issues not tied to codes; other issues of elevated concern but that are not a safety / health concern or a code violation.
Priority 3: Building improvements; general recommendations; future planning, et cetera.

II | 1957 Structure
General:
The two-story core of the complex was built in 1957 and is generally described as steel framed floor and roof construction supported primarily by masonry bearing and shear walls with some steel columns and reinforced concrete beams. The girders are located almost exclusively at the Gym. The floor deck is concrete and the roof is metal roof deck. The masonry bearing and shear walls vary in thickness and are horizontally reinforced.

Priority 1: Code, Health and Safety & Repair
Our walkthrough revealed no structural or Health and Safety concerns, or anything in obvious need of repair. Overall, the building has been well maintained and is in good structural condition.

Existing structural drawings do not indicate any design loads. Current Live Load requirements are 40 psf for Classrooms, 80 psf for Upper Level Corridors and 100 psf for Ground Level Corridors. A floor dead load of 30 psf and superimposed roof dead load of 20 psf were assumed, in accordance with the floor and roof assemblies depicted in the existing drawings. The current Design Snow Load for a flat roof in Winooski, Vermont is 40 psf. The existing framing is suitable to support these loads. The Gym roof joists were not evaluated since they are a custom joist size. In 1991, an addition was constructed adjacent to part of the 1957 structure. At the low portion of the 1957 construction, snow drift accumulates. However, this area was reinforced in 1991 to meet the drifting snow loads.

Priority 2: ‘Maintenance’
Our walkthrough revealed no structural concerns for outdated, obsolete or known ineffective elements or
systems.

Priority 3: Building Improvements

A general concept to keep in mind when planning future use of space is to generally maintain the masonry bearing/shear walls. Eliminating walls in a localized area could require seismic reinforcing which would likely affect the cost of the proposed floor plan alteration. See Part VIII for discussion of new construction in this area.

III | 1964 Structure

General:
The one-story 1964 JFK School structure was built adjacent to the original structure. It is generally described as steel framed roof construction primarily supported by steel girders and masonry bearing and shear walls. The roof is ‘tectum’ roof panels. The masonry bearing and shear walls are reinforced.

Priority 1: Code, Health and Safety & Repair

Our walkthrough revealed no structural or Health and Safety concerns, or anything in obvious need of repair. Overall, the building has been well maintained and is in good structural condition.

Existing structural drawings do not indicate design loads. A superimposed roof dead load of 20 psf was assumed, in accordance with the roof assemblies depicted in the existing drawings. The current Design Snow Load for a flat roof in Winooski, Vermont is 40 psf. The existing framing is suitable to support these loads. There are no higher roofs adjacent to this structure, so the existing framing was not evaluated for drifting snow.

Priority 2: ‘Maintenance’

Our walkthrough revealed no structural concerns for outdated, obsolete or known ineffective elements or systems. The ‘tectum’ roof panels do not provide an effective diaphragm but the distributed shear wall system directly supports the roof and floor framing members making this system acceptable.

Priority 3: Building Improvements

See Part VIII for discussion of new construction in this area.

IV | 1969 Structure

General:
The one-story 1969 JFK School addition was built adjacent to the original 1964 structure. It is generally described as steel framed roof construction primarily supported by steel girders, masonry bearing and shear walls, and some isolated steel columns. The roof is metal roof deck. The masonry bearing and shear walls vary somewhat in thickness and are reinforced.
Priority 1: Code, Health and Safety & Repair

Our walkthrough revealed no structural or Health and Safety concerns, or anything in obvious need of repair. Overall, the building has been well maintained and is in good structural condition.

Notes on the existing structural drawings indicate the following design loads:
- Roof Live Load: 40 psf
- Roof Dead Load: 20 psf

The current Design Snow Load for a flat roof in Winooski, Vermont is 40 psf, which is concurrent with the 1969 design roof live load. The existing framing is suitable to support these loads. There are no higher roofs adjacent to this structure, so the existing framing was not evaluated for drifting snow.

Priority 2: 'Maintenance'

Our walkthrough revealed no structural concerns for outdated, obsolete or known ineffective elements or systems.

Priority 3: Building Improvements

See Part VIII for discussion of new construction in this area.

V | 1976 Structure

General:

The one-story 1976 addition was built adjacent to the original 1957 structure. It is generally described as steel framed roof construction primarily supported by steel girders and columns. The roof is metal roof deck.

Priority 1: Code, Health and Safety & Repair

Our walkthrough revealed no structural or Health and Safety concerns, or anything in obvious need of repair. Overall, the building has been well maintained and is in good structural condition.

Existing structural drawings do not indicate any design loads. A superimposed roof dead load of 20 psf was assumed, in accordance with the roof assembly depicted in the existing drawings. The current Design Snow Load for a flat roof in Winooski, Vermont is 40 psf. The existing framing is generally suitable to support these loads. There are a few steel joists and beams that are slightly overstressed with the assumed roof dead and snow load. Some of the roof framing adjacent to the high 1957 roof are overstressed due to drifting snow loads. We would recommend reinforcing these joists if any changes are made in this area.

Priority 2: 'Maintenance'

Our walkthrough revealed no structural concerns for outdated, obsolete or known ineffective elements or systems.

Priority 3: Building Improvements
See Part VIII for discussion of new construction in this area.

VI | 1991 Structure

General:
The 1991 Renovation and Addition was comprised of multiple one and two-story additions connecting the 1957, 1969, and 1976 structures. In addition, a second story was built over a portion of the 1957 structure. It is generally described as steel framed roof construction primarily supported by steel girders, masonry bearing and shear walls, and some isolated steel columns. The roof is metal roof deck. The masonry bearing and shear walls vary somewhat in thickness and are reinforced.

Priority 1: Code, Health and Safety & Repair

Our walkthrough revealed no structural or Health and Safety concerns, or anything in obvious need of repair. Overall, the building has been well maintained and is in good structural condition.

Notes on the existing structural drawings indicate the following design loads:

Ground Snow Load: 40 psf

The current Design Snow Load for a flat roof in Winooski, Vermont is 40 psf, which is concurrent with the 1991 design snow load. Current Live Load requirements are 40 psf for Classrooms, 80 psf for Upper Level Corridors and 100 psf for Ground Level Corridors. A floor dead load of 45 psf and superimposed roof dead load of 20 psf were assumed, in accordance with the floor and roof assemblies depicted in the existing drawings. The existing floor framing is suitable to support these loads. The existing roof framing is generally suitable to support these loads. There are some steel joists and beams that are overstressed with the assumed roof dead and snow loads as well as from drifting snow load. See Part VIII for these locations. We recommend reinforcing these joists if changes are made in this area. The space frame was not evaluated since the existing drawings did not have complete framing information and it is understood that this framing will likely be removed.

Priority 2: ‘Maintenance’

Our walkthrough revealed no structural concerns for outdated, obsolete or known ineffective elements or systems.

Priority 3: Building Improvements

See Part VIII for discussion of new construction in this area.

VII | 2000 Structure

General:
The 2000 Addition was comprised of multiple one-story additions adjacent to the 1957 and 1991 struc-
structures. It is generally described as steel framed roof construction primarily supported by steel girders, masonry bearing and shear walls, and some isolated steel columns. The roof is metal roof deck. The masonry bearing and shear walls vary somewhat in thickness and are reinforced. The addition adjacent to the 1957 structure was designed for a future second story, thus the roof is a concrete slab on metal deck.

Priority 1: Code, Health and Safety & Repair

Our walkthrough revealed no structural or Health and Safety concerns, or anything in obvious need of repair. Overall, the building has been well maintained and is in good structural condition.

Notes on the existing structural drawings indicate the following design loads:

- Roof Dead Load (Area A): 65 psf
- Future Floor Dead Load (Area A): 15 psf
- Roof Dead Load (Area B & C): 15 psf
- Future Floor Live Load (Area A): 40 psf
- Snow Load: 40 psf

The current Design Snow Load for a flat roof in Winooski, Vermont is 40 psf, which is concurrent with the 2000 design snow load. Current Live Load requirements are 40 psf for Classrooms, 80 psf for Upper Level Corridors and 100 psf for Ground Level Corridors. A future second-floor addition on Area A would need to be a classroom, or the framing should be evaluated for any additional loads imposed by a different use. The existing roof framing is suitable to support these loads as well as any snow drift loads imposed by higher adjacent roofs.

Priority 2: ‘Maintenance’

Our walkthrough revealed no structural concerns for outdated, obsolete or known ineffective elements or systems.

Priority 3: Building Improvements

See Part VIII for discussion of new construction in this area.

VIII | Proposed Construction

General:

In addition to the facility analysis discussed in Parts I though VII, we have reviewed 2 possible renovation configurations provided by Truex Cullins Architects. See Attachment 1. We have focused on the interfaces locations and changes to the existing construction. Construction at the new areas will likely be shallow concrete foundations supporting steel beams and columns supporting 1½” roof deck. The lateral systems will be provided by steel moment frames or steel braced frames based on the proposed architecture and sway limitations due to the stiffness of the adjacent existing construction.

Reinforcing will likely be needed at all new mechanical units and roof deck penetrations. The mechanical systems are unknown at this time.

END OF REPORT
L.N. Consulting, Inc. was retained to complete an existing conditions assessment of the mechanical, electrical, plumbing and fire protection systems at the Winooski School (Elementary, Middle, High) building located at 60 Normand St., Winooski, VT 05404. Site visits were conducted on May 21, 22, 24 and 31 and June 15th of 2018. We completed building systems observations of the facility and have developed an overall assessment of the existing systems.

At the end of the existing conditions assessment section of the report (pages 1-28), we have included our recommendations for the mechanical, electrical, plumbing, and fire protection systems for the new building renovation project.

**General Architecture**

The Winooski School is a predominantly single story structure with the middle/high school section (northwest wing) of the building containing a second level. The first level encompasses approximately 120,000 sq.ft. The second level encompasses approximately 20,000 sq.ft. The original middle/high school building was constructed in the late 1950’s (1958). The original elementary school was built in 1964. An addition to the elementary school was constructed in 1969. An addition was completed to the middle/high school in 1976. A large addition and infill project was completed in 1992 which added the Performing Arts Center (PAC), the small gym/cafeteria and kitchen, the main entrance lobby, and connected the (2) schools by also adding classrooms and a library in the elementary school. An addition in 2000 added the district administrative office spaces to the south of the cafeteria, a science classroom and middle/high school administrative office space at the west end of the middle/high school portion of the facility. It also added (2) classrooms to the east of the library wing of the elementary school and renovated the elementary school administrative space along with the Lotus classroom to the east of the Large Gymnasium. There are (2) main boiler rooms in the facility; (1) boiler room is at the north end of the facility near the middle/high school and large gymnasium. This boiler room supplies hot water to the spaces north of the elementary school. The second boiler room is at the south end of the facility which provides heating for the elementary school.

The large spaces in the facility include the large gymnasium of approximately 10,400 sq.ft, the small gym/cafeteria of approximately 5,400 sq.ft, the main kitchen of approximately 1,800 sq.ft, the auditorium of approximately 3,300 sq.ft, the library of approximately 3,600 sq.ft and the main district administrative offices of approximately 3,200 sq.ft.

**Northern Mechanical/Boiler Room (Middle/High School)**

**Mechanical**

The northern portion of the facility is supported by (2) natural gas fired atmospheric cast iron boilers. Both Boilers are Bryan Flexible Tube model RV350-W-FDG0 built in 1991 with 3500 MBH (3.5 million Btu/hr.) maximum input and 1750 MBH minimum input. The boilers are approximately 80% efficient. The boilers each have Gordon Piatt natural gas, forced draft burners. The boilers only have the ability to modulate down to a 50% firing rate. We understand that these boilers have been reliable, however, they are at the end of their useful life and replacement is recommended.

The balance of the middle/high school facility is conditioned with heating hot water. There are a few areas that are conditioned by natural gas fired rooftop air handlers; those areas are indicated in the specific sections below. The hydronic heating system is piped as multiple main primary loops that serve separate portions of the middle/high
school facility. There are (3) sets of duplex pumps to serve (3) separate zones and (2) sets of simplex pumps to serve (2) separate zones. There are a total of (5) separate zones. There are (2) sets of base-mounted duplex pumps (4 total), (1) simplex base-mounted pump, (1) set of vertical inline duplex circulators (2 total), and (1) simplex vertical inline circulator. The east zone (east of the music room and tech room) is served by pumps #1 and #2 which are inline vertical Taco 1636C3E3 with 6.4” impellers with 1.5 HP standard efficiency motors (78.5% efficient). These circulators were installed in 2006 and are rated for 110 GPM at 35 ft. of head. The gymnasium air handling units and the locker room air handling unit are served by circulator pump #3 which is a Taco Fi1507 with a 1.5 HP premium efficiency motor. This circulator was installed in 2013 and is rated for 75 GPM at 35 ft. of head. The original middle/high school wing of the facility is served by circulator pumps #4 and #5 which are a B&G Model 1510-2 1/2AB with 6.625” impeller with 2 HP premium efficiency motor (86.5% efficient). These circulators are older than the Taco circulators (no manufactured date is indicated on the pumps) and are rated for 108 GPM at 42 ft. of head. The 1991 addition which includes the auditorium, cafeteria, kitchen and main entrance lobby, are served by circulators #6 & #7 which are Taco Fi1507 with 1.5 HP premium efficiency motors. The circulators were installed in 2013 and are rated for 75 GPM at 35 ft. of head. Circulator pump #8 is dedicated to serving the music rooms and tech rooms to the east of the boiler room. The nameplate information was not observed, but the pump appears to be an older Taco unit.

The boilers are on a common primary loop where the water is piped through both boilers when the pumps are running, regardless of which boiler is firing. A 3-way valve on each zone (except the zone served by pumps #1 and #2 and the zone served by pump #8) modulate to maintain a loop supply temperature set point. The 3-way valves either send water through the boilers, or recirculate the water back to the system within that specific loop. There are (4) horizontal, non-bladder type expansion tanks suspended from the structure above the boilers. All of the circulator pumps are controlled by motor starters and operate at a constant speed regardless of the heating load. By operating the circulators at a constant speed, regardless of the heating load of the facility, excess energy is consumed. Energy usage can be reduced by operating the circulator pumps to maintain a set differential pressure between the supply and return piping. This is accomplished by installing Variable Frequency Drives (VFDs) on the circulator pumps which enables the pumps to be slowed and their energy consumption reduced when the heating demand is reduced. This would require the piping system to be comprised of 2-way control valves rather than 3-way control valves so that water flow can be reduced or shut off when the heating load is reduced.

The hot water piping was observed to be insulated primarily with fiberglass pipe insulation, however due to the age of the facility, some of the concealed piping that was not observed may also contain asbestos insulation. The pipe insulation in the gymnasium air handling unit rooms and in the elementary boiler room is labeled as containing asbestos. We recommend that the piping insulation be tested by a certified consultant and any asbestos abated. In the mechanical/boiler room, the balance of heating water piping was not insulated.

The general assumption is that the hydronic heating piping will be replaced as part of the building renovation project. If it is determined that portions of the existing hydronic piping may be retained as a means of reducing cost, we recommend that sections of the existing hydronic piping be removed in those portions to inspect the condition of the pipes. Gate valves are installed throughout much of the hydronic system. If any of the existing valve locations are to be retained, we recommend that all of the gate valves be removed and replaced with either butterfly valves (for larger piping) or ball valves (for smaller piping) since older gate valves are prone to leaking and failure when used. There are sections of new piping in the boiler room that are 2 ½” and 3” copper that have been installed with Pro-Press fittings and ball valves.

The building HVAC controls system is a mix of newer Direct Digital Controls (DDC) and older pneumatic controls. An air compressor located in the boiler room provides the control air for the facility. The air compressor consists of a Champion Climate Control tank with duplex compressors with 5 HP motors and 1/5 HP air dryer. The air compressor was cycling quite regularly (especially for such a large tank). There are likely significant leaks in the system which is
causing the cycling. This is consuming considerable energy to run the air compressor and air dryer to maintain pressure in the leaking system.

None of the observed unit heaters or cabinet heaters in the facility contained electronic or pneumatic control valves. All of the unit heaters operate with water flowing continuously through the coils once the heating plant is enabled. Temperature control is accomplished by enabling/disabling the fans to maintain set point. It is possible that the spaces served by these unit heaters overheat during periods of low load as there is heat generated by the coils even with the fans off; this would be using excess energy to heat a space that is already satisfied.

**Plumbing**

There are (4) domestic cold water entrances that serve the full facility with (2) in the Middle/High School and (2) in the Elementary School. A 3" domestic cold water entrance is located in the middle/high school boiler room. The entrance piping is comprised of copper with gate valves for isolation. There was only a check valve observed on the water entrance in the Elementary School boiler room. No other domestic water entrance appears to have backflow protection. Backflow protection is required to prevent contamination of the municipal water supply. It also appears as though the (2) Elementary School water services are tied together. It is critical for backflow preventers to be installed on both of these systems as it appears possible that water could flow in through the boiler room meter and back out through the meter in the elementary storage closet if there is sufficient pressure differences between the (2). There is no pressure reducing valve at the middle/high school boiler room water entrance, nor are there any pressure gauges. The cold water piping is not insulated despite being near the exterior wall. The water piping is heat traced (wrapped in electric resistance heating cables), presumably to prevent the line from freezing overnight when there is little to no water usage. The site observations were completed during a warm day and the piping was sweating considerably. Insulation is needed here to minimize the heat trace heating requirements and to prevent the piping from sweating (developing condensation).

There is a separate 2" water line branch downstream of the water meter that drops to below grade near the air compressor against the exterior wall with a separate older Neptune Trident 2" water meter. It is unclear what this water line serves since there was an isolation valve on the line that was closed at the time of the site visit. This line may provide water to an irrigation system.

Domestic hot water heating is accomplished by (1) State Sandblaster Force SDV7570NE 200 natural gas fired, direct vent water heater. This water heater has a 75 gallon capacity and 70,000 Btu/hr. input. The water heater is a non-condensing atmospheric type that was recently serviced and is operating at 77.7% efficiency. The water heater was manufactured and started in the spring of 2013. A thermostatic mixing valve is installed to supply 120°F water to the portion of the facility serviced by this water heater which is the maximum allowed per code. The piping and fittings were observed to be copper throughout the entire building. Due to the age of the facility we suspect that the solder utilized in these systems contains lead. We understand that some of the plumbing piping serving the middle/high school wing was replaced at some point and may be new enough that lead solder was not used. The domestic hot water recirculation pump (bronze construction) was operating at the time of the site visit. The pump motor was quite loud and there was a tag on the pump indicating that it required service. The pump shaft was still spinning despite the noise the motor was making.

A natural gas regulator and meter outside of the mechanical room supplies gas for the heating plant. The fuel is distributed by a 4" welded steel pipe. The piping should be painted or labeled to aid in identification.

All water closets observed throughout the facility were vitreous china with flushometer valves. The majority of the flush valves observed were manual type, and were not low flow (assumed to be 3.5 GPF). A few sensor operated flush valves have been installed, but there were very few installed. In general the china and flush valves appeared to be in good working condition, however, they are flowing more than twice the current standard flush volume of 1.6 GPF. Some of the urinals in the facility have been updated to waterless type. Most of the lavatories were coun-
ter mounted with manual metered faucets.

Public drinking fountains throughout the building have been recently upgraded to combination bottle filler and fountain. Filters that are capable of removing lead from the water system are recommended at each of these fountain locations (if not already installed) due to the age of the plumbing system.

Rain leader piping in the older portions of the building were observed to be hub and spigot cast iron. Insulation was observed on some of the rain leader pipes. The rain leader in the middle/high school boiler room was not insulated and likely will cause condensation issues in the winter and spring months.

An exterior sump pump motor controller is located in the middle/high school boiler/mechanical room. This motor controller appears to be original to the building and it is not clear if it is still in operation. The breaker in the panel was observed to still be in the on position.

**Electrical**

The main electrical service entrance for the entire school facility is located to the east of the middle/high school large gymnasium. See information regarding the main service entrance below. The 600 Amp, High School MDP and Panels PB-1 and PB-2 are located in the middle/high school boiler/mechanical room and are fed directly from the main electrical service entrance. These panels appear to be original to the building and it is likely difficult to find replacement breakers. The panels are rated for 120/208 volts, three-phase, four-wire.

In general, the exterior wall mounted lighting fixtures appeared to be upgraded to LED wall-packs. The exterior recessed lighting in the canopies appears to still use incandescent light bulbs or CFLs.

Interior lighting was primarily T8 linear fluorescent lamps and consisted of a few pendant mount, surface mount and recessed fixtures. Classrooms appear to be fitted with low voltage, ceiling mounted occupancy sensors.

**Main Electrical Room (East of Large Gymnasium)**

**Mechanical**

There is a hydronic unit heater in the space that provides heating. The unit heater is controlled by a pneumatic thermostat. There is no control valve for the unit heater; the hot water is constantly flowing through the coil and the fan is enabled/disabled by the thermostat. A small exhaust fan is controlled by a separate pneumatic thermostat to cool the room. The fan discharges out through the sidewall.

**Electrical**

The main electrical equipment and service entrance for the entire facility is located in this room. The switchgear is rated at 2,000 amps, 120/208 volts, three-phase, and four-wire. It is a Siemens I-T-E Switchboard Type FC-I, Series 6 manufactured April 1992. The switchboard has a short circuit current rating of 65,000 Amps RMS Symm. at 240 volt. This panel provides power for the entire facility by distributing power underground and above the ceiling to main panels throughout the facility. The following are the panels fed by breakers from this switchgear: 600A-High School MDP, 600A-Elementary School MDP, 500A-Panel A, 400A-Panel B, 300A-Panel C, 200A-Panel D, 200A-Panel E, 200A-Panel H, 100A-Panel F, 50A-Sewage Ejector Pump Panel. There are spaces available for 125A breakers. The electric meter is located on the exterior wall of the main electrical room.

The room has a door that swings inward which does not have a panic bar. Also, the switchgear is over 6’ long and there are not two exits out of this room.

Prior to this main electric room’s construction, it appears the main services to the school were Panel MDP in the South Boiler room and Panel MDP in the North Boiler room, both of which appear to be original equipment dating back to the mid 1960’s. In the South Boiler room, Panel DP, fed via the South Boiler room Panel MDP, appears to
have possibly been an even earlier service entrance. Panel DP appears to be original to its construction period and is well over 50 years old.

**General Vestibule/Corridor and Storage Room Conditioning**

*Mechanical*

Vestibules and corridors are generally conditioned using unit heaters (either ceiling or wall mounted cabinet unit heaters and wall hung horizontal unit heaters). Heating hot water is continuously flowing through the unit heaters when the hot water circulators are operating. Temperature control is maintained by cycling the fan on and off.

**Main Entrance Lobby**

*Mechanical*

The main entrance lobby is conditioned by an air handling unit (AHU-3) located in the second floor fan room which is adjacent to the Performing Arts Center (PAC) and cafeteria/small gymnasium space. This air handling unit contains a filter-mixing box with modulating fresh/return air dampers. The unit is heating only, utilizing a hot water coil that modulates discharge air temperature using a face and bypass damper rather than a control valve. The unit is designed for economizer operation, but is not equipped with cooling capabilities. The unit is operated by the facility pneumatic controls system.

Supply air is discharged into the lobby through exposed spiral ductwork. There are (2) roof mounted exhaust fans that exhaust air for ventilation and/or economizer purposes.

*Electrical*

Lighting in the lobby is generally comprised of indirect fixtures located around the perimeter. There are occupancy sensors to control the light fixtures. A large skylight is centered over the lobby. A photocell was not observed to control the light fixtures, however, the lighting was off during the site visit.

*Fire Alarm*

The main fire alarm panel is located in the main entrance lobby. The entire facility utilizes a Simplex 4002, 6-zone fire alarm panel installed as part of the 1991 addition. The system is a “zoned” type system. The system initiation devices include limited heat and smoke detection and manual pull stations at exits. Flow and tamper switches are also installed on the sprinkler system. Notification devices include wall mounted horn strobes.

In general, it appears that many of the horns and strobes throughout the entire building have been replaced or added since 1991. There are no voice evacuation notification alarms within the school; even in gymnasium and auditorium where the number of occupants can exceed 300. There are some locations, particularly the gymnasium, where alarm coverage is not adequate as dictated by applicable fire codes.

**1991 Water Entrance Room (South of PAC)**

*Plumbing*

The 3” plumbing entrance in this location contains a water meter and pressure reducing valve and a main isolation valve off of the 6” water entrance. A backflow preventer is not installed as previously mentioned and is required.

*Fire Protection*

A 6” main water entrance is installed for the building sprinkler system which also includes a 3” domestic water entrance branch. The fire protection system appears to serve the full facility. There are (3) zone valves. The fire protection entrance appears to have been last serviced in November of 2017. Riser #1 is labeled as Winooski School System #1; it is designed for 0.21 GPM per sq.ft over 1500 sq.ft when supplied with 429.46 GPM at 63.43 psig at the...
base of the riser, including 100 GPM hose allowance. Riser #2 is labeled as 2nd Flr. High School System #2; it is designed for 0.10 GPM per sq.ft over 1500 sq.ft when supplied with 326 GPM at 57 psig at the base of the riser, including 100 GPM hose allowance. Riser #3 is labeled as Library Winoski School System #3; it is designed for 0.19 GPM per sq.ft over 1500 sq.ft when supplied with 429 GPM at 66 psig at the base of the riser, including 100 GPM hose allowance.

The outdoor fire department connection appears to be obstructed by the shrubs and landscaping. We recommend creating an unobstructed path to this connection to aid in the fire department connecting to the system.

**Maintenance Garage (North East Corner of Facility)**

**Mechanical**

The Maintenance Garage is conditioned by (2) hydronic unit heaters. The unit heaters are controlled by the pneumatic control system and a Johnson Controls pneumatic thermostats. There are no control valves on the unit heaters; however, aquastats are installed to control the unit heater fans. The office in the garage is conditioned by fin-tube with a pneumatic valve controlled by a pneumatic thermostat.

There is an abandoned dust collection system with a cyclone separator located outside (Torit Division model 30-10-FB-55, Serial F-5046, 10HP, 3-phase). The dust collection ductwork is mostly still in place, however, the system is no longer used.

There are (3) exhaust fans that serve the Maintenance Garage. There are (2) fans located on the roof (EF-18 and EF-19) and (1) old sidewall exhaust fan which all appear to still be in use.

**Plumbing**

There is a dedicated gas line outside the east wall of the Maintenance Garage that serves RTU-6 on the roof above (see Multi-Purpose room below). There is also a washing machine and clothes dryer located in the maintenance shop.

**Electrical**

The Maintenance Garage utilizes 2L-T8 fixtures with occupancy sensors. There are pull down cord reels located in the garage. A shop panel, PA-2 is located in the Maintenance Garage.

**Multi-Purpose Room (North East Corner of Facility)**

**Mechanical**

The Multi-Purpose room is conditioned by (2) separate systems. There are (2) Unit Ventilators (UV) located above the ceiling that connect to outdoor air intake louvers on the exterior wall. The UV’s discharge to hydronic reheat coils to provide for heating zone control. Each diffuser has a dedicated reheat coil for zone control. A section of fin-tube radiation is located near the exterior door. A rooftop unit RTU-6 (located above the corridor outside of the Maintenance Garage) also feeds into the supply ductwork served by the UV’s. The space contains (4) separate zones with individual pneumatic thermostats. There is a relief hood located on the roof of the space that relieves from the above ceiling plenum. It is not clear how these (2) systems are interconnected to determine which system operates at which time (or if the UV’s are operational). There are (2) bathrooms in the space and neither have any exhaust air which is required.

**Plumbing**

There are (2) bathrooms in the space. The floor mounted toilets have manual flush valves. The lavatories have ADA insulation kits and manual faucets.
Electrical
There are 2x4 light fixtures that utilize (4) T8 lamps. Occupancy sensors control the light fixtures with manual on/off switch. The lighting operates as auto on/auto off controlled by the occupancy sensors when the light switch is in the on position. This control is typical throughout where occupancy sensors are installed.

Classroom/Offices Adjacent to Maintenance Garage

Mechanical
These spaces are also serviced by rooftop unit RTU-6 (located above the corridor outside of the Maintenance Garage). RTU-6 is a RUUD model RRGF-201076CKR which is a gas fired unit with DX cooling (R22 refrigerant is used). The cooling EER is approximately 9.0 and the gas fired efficiency is approximately 79%. This unit was manufactured in January, 1998. The ductwork above the ceiling was noted to be partially disconnected from the duct connection to the unit. This is likely affecting the total system airflow to each zone. The system appears to have fully ducted supply and return ductwork. The small offices have old hydronic unit heaters and transfer ducts to the main classroom for the return. The office that connects to the corridor has a roof mounted exhaust fan which appears to provide the exhaust for these rooms. An electronic thermostat in the classroom appears to control the RTU.

Plumbing
A sink is located in the classroom with a manual faucet. Access to the sink is hindered by a microwave.

Electrical
There are 2x4 prismatic light fixtures with T8 lamps in these spaces. Occupancy sensors were observed in the smaller offices, but not in the main classroom.

There is a microwave and small refrigerator in this room.

Janitors Office (Near Maintenance Garage)

Mechanical
This space is conditioned by (2) small hydronic unit heaters. These unit heaters do not have control valves so there is constant water flow through them. Space temperature is maintained by enabling/disabling the fans in the unit heaters. Due to the heat generated by the other equipment in this space, it is likely that this space overheats during warmer outdoor temperatures due to the hot water continuing to flow through the unit heater coils and generating heat even when the fan is disabled. Within this room is a sectioned off data closet. The janitorial floor washers are also charged in this room. There is no exhaust air nor ventilation air for this space. Exhaust is required in this room. It is especially critical with batteries being charged in the same room that a data closet is located. Charging batteries can generate hydrogen gas which is flammable and exhaust is required in rooms where batteries are being charged. Exhaust is also required where chemicals are being stored.

Plumbing
The roof of the janitors office near the maintenance shop has a depressed roof section with (2) roof drains. It does not appear as though there is overflow drainage provided for this section of the roof. Both roof drains appeared to be surrounded by debris during the site visit (not yet plugged). If both drains become plugged, this area could accumulate significant water which could compromise the roof structure and possibly cause a roof collapse.

Boys and Girls Athletic Locker Rooms and Adjacent Restrooms

Mechanical
The athletic locker rooms are conditioned by ceiling mounted unit ventilators. The unit ventilators intake outdoor air from rooftop intakes. Each locker room and restroom have (1) relief hood and (2) rooftop exhaust fans. (1) Exhaust fan exhausts from the back storage area in the locker room. (1) Exhaust fan exhausts from the shower areas and the bathroom. The shower area appears to be utilized for storage; the showers do not appear to be in use currently.

The unit ventilators utilize pneumatic face-and-bypass dampers to maintain space temperature. It was observed that there was a noticeable pneumatic controls leak from the control piping at the boy’s locker room unit ventilator.

**Plumbing**

The showers in the locker rooms do not appear to be in use currently. The floor drains appear to still be in place; it is not known if there are trap primers for these floor drains. It is recommended that water is periodically poured into the floor drains (if not already regularly scheduled) to ensure their trap seals are maintained in order to avoid the release of sewer gases into the building.

The boy’s bathroom has (2) water closets with manual, standard flow flush valves. Neither of the toilets appear to be ADA compatible. The urinals have been replaced with waterless urinals. The waterless urinals appear to be installed above recommended height. The urinals may be difficult for all users to utilize.

The faucets in the rest room are metered faucets.

**Electrical**

The lighting in the restroom was prismatic T8 fixtures. There was one 2x4 fixture and one 2x2 fixture. The 2x2 in the boys bathroom appeared to have (1) tube burned out, and (1) tube was generating a pink light at the time of the site visit.

**Small Office South of Multi-Purpose Room**

**Mechanical**

In the small office south of the multi-purpose room, there is both hydronic fintube heating and an older electric resistance heater. Heating is controlled by a pneumatic thermostat. The electric resistance heater fan was running at the time of the site visit despite the space being warm. The electric resistance element was not running.

**Electrical**

The small office contains (2) 2x4 parabolic fixtures with (6) T8 lamps. The lighting power density in this room is significantly higher than allowed by the energy code at approximately 2.7 watts/sq.ft.

**Lotus Room (Theater/Chorus East of Large Gym)**

**Mechanical**

This classroom is heated by a ducted recirculating fan coil unit. A 2-way control valve with a newer electronic actuator controls the water flow through the fan coil unit. Ventilation is provided by a Heat Recovery Unit (HRU) with rooftop intake and exhaust vents with control dampers to isolate the unit when it is disabled. The HRU is labeled as HRU-7 and supply air is ducted to the return plenum of the fan coil unit. This space is controlled by the building Direct Digital Control (DDC) system.

The small office in this room contains a supply transfer grille with a ceiling exhaust grille ducted to the HRU.

**Special Ed Offices and Teachers’ Lounge in Hallway East of Northern Boiler Room**

**Mechanical**

The northeastern offices are conditioned by hydronic fintube with individual thermostatic control valves. Ventilation
CONSULTANT REPORTS

air is provided by a Renewaire EV-200 ERV. The ERV provides supply and exhaust air to the offices and the corridor space as well as the teachers’ lounge. The outdoor air supply contains a reheat coil with a newer 2-way control valve connected to the DDC system. The larger office does not appear to have any ventilation air as it appears the fire dampers have been closed.

There is a copy machine located in the corridor. It is recommended to exhaust from directly over the copy machine to capture the heat, fumes, and odors generated during operation.

The larger office fin tube has had a portion of the cover removed. It appears that some piping repair work has recently been completed. It is recommended that the cover be replaced as there are sharp corners and hot piping located adjacent to occupant desks.

Plumbing

The teachers’ lounge has a kitchenette sink and an ice machine. The ice machine water supply appears to have a water filter.

Electrical

Newer power panels PP, P1 and P2 are located in the Special Ed common corridor. The lounge has (2) microwaves, an ice machine, a K-cup coffee machine, and a refrigerator.

Special Ed, French, and ELL Classrooms east of the Northern Boiler Room

Mechanical

These (3) classrooms are conditioned by a wall mounted unit ventilator with an outdoor air connection to an exterior louver. Each unit ventilator is controlled by a pneumatic thermostat. Relief air is ducted from each room and exhausted through a roof mounted exhaust fan.

The ELL classroom #47 also contains a Daikin split system heat pump to provide air conditioning. The unit also appears to have the ability to provide heating however it was not clear at the time of the site visit (cooling season) if the unit is also utilized for heating.

The refrigerant piping on the roof was insulated with flexible elastomeric foam insulation. This insulation is not rated for direct sunlight (Ultra Violet, UV) exposure and is breaking down. This insulation should be replaced and the new insulation should be protected with either a UV protective coating or with an opaque jacket material.

Electrical

The ELL classroom #47 contains drop-down cord reels.

Gym Class Locker Rooms

Mechanical

The locker rooms and the adjacent bathrooms and janitor closets (along with some office and storage space) are generally conditioned by the vertical Air Handling Unit (AHU) located in the storage room between the (2) locker rooms. The AHU, the heating hot water piping, and the 3-way pneumatic control valve all appears original to the building and have reached the end of their useful lives. The 3-way control valve is utilized to control the discharge air temperature. It did not appear as though the valve is currently operational and may currently be stuck in a set position. The AHU pulls in outdoor air from a roof mounted intake hood; newer electronic outdoor air and return air dampers have been installed on the outdoor air intake and return air ducts. There are (3) roof mounted exhaust fans that exhaust from this area.

Plumbing
The boy's locker room has a waterless urinal and an older, non-ADA toilet. The sink utilizes manual meter faucets and does not appear to be ADA compliant. The boys shower area appears to have been converted to storage spaces. As mentioned above, it is recommended that trap seal maintenance be regularly performed (if not already) by pouring water down any remaining floor drains.

The girl's locker room shower area remains usable, however, it does not appear to receive regular use for showering. The janitors' closet mop sink had a noticeable crack and should be replaced.

**Large Gymnasium**

**Mechanical**

The gymnasium is conditioned and ventilated by (2) air handling units located in fan rooms at the north end of the gym above the storage rooms. The air handling units appear to be original to the facility and have likely reached the end of their useful lives. The easternmost air handling unit fan is rattling noticeably and is in need of servicing. The insulation on the hot water piping that services the (2) AHU’s is indicated to contain asbestos (signage in the fan rooms). Based on the age of the facility and the piping, it is recommended that this piping be tested by a qualified consultant and abated if it contains asbestos. The air handling unit filters were observed to be significantly plugged with dirt. These filters should be replaced as the air handling units appear to be moving very little air. The lack of airflow may affect temperature control and is likely affecting the ventilation capabilities of the units. There are exhaust fans located in each fan room; the exhaust fan in the western fan room was operating at the time of the site visit; the eastern exhaust fan was not operating at the time of the site visit. The AHU’s supply air through sidewall grilles at the walls of the fan rooms, and both AHU’s return air through ductwork from the southern end of the gymnasium. It is recommended that the operation of the controls is verified to ensure the units are operating correctly (it is assumed that both exhaust fans should be operating simultaneously).

The gymnasium air handling unit intake ventilation air and exhaust air louvers are placed too close together which allows for reentrainment of the exhaust air back into the supply.

All of the gymnasium controls appear to be original pneumatic controls, including actuators. There appears to be numerous sections of heating hot water piping that show signs of corrosion. It is likely that there are piping leaks in the heating hot water system.

**Electrical**

The gymnasium is illuminated from suspended 6-lamp T8 fluorescent fixtures. Each half of the gym is controlled via a dedicated occupancy sensors. Several of the fixtures have lamps that appear to be burned out.

A sound system with wireless microphones is provided in the gym. There is also a scoreboard system.

As noted previously, the gymnasium does not appear to have adequate fire alarm coverage. The current code requires the fire alarm system to override the existing sound system. It is not known if the fire alarm is currently interconnected with the gymnasium sound system.

**Fire Protection**

The fire protection riser in the western gymnasium fan room has a leaking fitting. This fitting is leaking on the piping below and is causing excessive corrosion. This fitting should be replaced as well as all corroded piping and pipe fittings. This leak is likely to get worse if left in its existing condition.

**Weight Room**

**Mechanical**
CONSULTANT REPORTS

The weight room is conditioned by (2) hydronic unit heaters. The unit heaters do not have any control valves, and the fans are controlled by pneumatic thermostats. A roof mounted exhaust fan exhausts from the space. There does not appear to be any make-up ventilation air in the room. Ventilation air is likely made up through infiltration of air through the exterior and from the gymnasium which would indicate that the space operates under negative pressure.

Electrical

The lighting in the weight room is comprised of open-tube 2-lamp T-8 fixtures.

Corridor & Original Middle/High School Lobby & Restrooms off of the old lobby

Mechanical

The corridor that connects the northern wing of the building to the middle/high school is conditioned by a hydronic fan coil unit located within the boiler room. The fan coil discharges and intakes air through (2) wall mounted grilles near the corridor door.

The old lobby is conditioned by (2) ceiling mounted cabinet unit heaters. A ceiling mounted unit ventilator outside the northwestern door into the cafeteria provides additional heating capabilities and ventilation for the corridor between the main entrance lobby and the old lobby.

The restrooms have sidewall exhaust grilles behind the toilets (1 per restroom) which is connected to a roof mounted exhaust fan (EF-32).

Plumbing

The restrooms have newer sensor operated flush valves on the toilets. The urinals have been replaced with waterless urinals. The lavatories have manual meter faucets and ADA insulation kits.

Electrical

The corridor that leads to the northern wing of the building from the old lobby is illuminated by 1x4 surface mounted fixtures with 2-lamp T8’s. The old lobby is illuminated with 2x2 prismatic light fixtures with T8 lamps. The corridor from the old lobby to the main entrance lobby is illuminated with 2x4 fixtures. The corridors appear to be over illuminated which is consuming additional electricity. The corridor that connects the northern wing of the facility has skylights which is providing natural daylighting; however, the fixtures were still on despite the daylighting providing sufficient illumination.

The restrooms have newer Dyson Airblade dB hand dryers.

Fire Protection

A 2 ½” sprinkler control valve with tamper switch was observed above the ceiling in the women’s restroom.

Middle/High School Mechanical closet under stairway

Mechanical

The heating hot water system that serves the original Middle/High School is fed from the boiler room as noted previously. The main circulator pumps in the boiler room pipe the hot water around the connecting corridor through the large gymnasium, through the old lobby and around the stairwell just north of the band room. The heating hot water is routed under the firewall in the closet of the band room and is routed to the closet under the stairwell to the northwest of the old lobby. In the closet under the stairwell are (4) Magna3 40-80 circulator pumps. These pumps are high efficiency circulators with Electronically Commutated Motors (ECMs) with internal controls. These pumps are piped in series with the boiler room primary circulators. (1) Circulator appears to serve the band room area with heating hot water. (1) Circulator appears to serve the north half of the Middle/High School, and (1) circulator ap-
pears to serve the south half of the Middle/High School. There is (1) circulator that appears to be redundant with manual isolation valves for either circulator that services the Middle/High School.

**Plumbing**

Hot water for the Middle/High School appears to come from the new water heater located in the second floor fan room adjacent to the Auditorium. The domestic water appears to have been back-fed to serve the Middle/High School as the wing appeared to have previously been serviced from the boiler room via underground services between the boiler room and the under-stair closet.

In conversations with Mick (Facility Director), it was mentioned that the domestic hot water recirculation system does not appear to bring hot water close enough to the fixtures for hot water to reach the fixture during regular use.

Mick also mentioned that much of the domestic water plumbing was recently replaced in the Middle/High School.

**Middle/High School 1st floor southeast offices (near old lobby)**

**Mechanical**

This area of the building is conditioned (heating only) by hot water baseboard radiation. The radiation is controlled by pneumatic control valves and older pneumatic thermostats. Ventilation for this area is provided by a dedicated rooftop Des Champs heat recovery unit HRU-4 (Des Champs PV-MZ-1370). A duct mounted hot water reheat coil is used to condition the air during the winter time after it has been pre-conditioned by the heat recovery core.

**Middle/High School 1st floor Classrooms 112 and 113**

**Mechanical**

These (2) classrooms are conditioned by newer unit ventilators operated by DDC controls and 3-way control valves. A ceiling mounted exhaust fan with motorized control dampers located at the exterior envelope exhausts the air from the space. It was noted that the exhaust fan in Classroom 113 was missing a fan belt.

The pneumatic control valves have been left located above the ceiling (pneumatic valves are disconnected) abandoned in place.

**Plumbing**

There is a sink with a bubbler in Classroom 113.

**Electrical**

These classrooms are illuminated by 2x4 prismatic fixtures with 3-Lamp T8’s. There is AB (dual) switching of the lighting with individual lamps being controlled in the fixtures. An occupancy sensor controls the light fixtures.

**Typical Middle/High School Classroom**

**Mechanical**

The classrooms in this wing are conditioned by newer unit ventilators operated by the DDC system and utilizing 3-way control valves. All of the classrooms are connected to a central ducted exhaust system via sidewall exhaust grilles in each classroom at the corridor walls. A newer Twin City Fan FCV-SW-182 controlled by a Variable Frequency Drive (VFD) is the main exhaust fan that exhausts from all of the spaces. The fan appears to operate at a constant volume and discharges out the roof through what used to be an intake hood.

It was noted that the unit ventilators in the second floor classrooms were powered from the individual classroom lighting switch circuit. This means that whenever the light fixtures are disabled, the unit ventilators are disabled. This is not desirable as ventilation is disabled when the light fixtures are off. This also disables the unit ventilator
fans which reduces the heating capacity of the equipment. This may mean the heating capacity does not meet the demands of the space when the light fixtures are off.

Science Classroom 102 contains a chemical storage cabinet with a PVC vent.

A small exhaust fan is located in the closet within Art Storage Room 203. The Art Storage Room has hydronic fintube heating that is operated by pneumatic controls.

**Plumbing**

Science Classroom 102 contains sinks that discharge to the acid waste system. There is an under sink acid neutralizer and an acid neutralizer buried in the slab. Generally, it appears that the balance of the acid waste piping was completed using Fuseal Piping which is rated for acid waste. There was also some copper and cast-iron waste observed under one of the sinks. The Fuseal waste piping did not appear to have any plumbing vents. Plumbing vents are required by code.

Science Classroom 102 contains an emergency eyewash/shower. The eyewash/shower is connected to the domestic cold water line. Emergency eyewash and emergency showers are required to supply tempered water which requires a mixing valve to mix domestic hot and domestic cold water.

Art Storage Room 203 contains under-counter solids interceptors for each sink.

**Electrical**

The classrooms on the first floor are illuminated with 1x8 pendant fixtures with louvered grille diffusers and 4-Lamps T8 fluorescent tubes. Only (2) lamps are on; the other (2) lamps appear to be disconnected. Occupancy sensors are located in the rooms.

The classrooms on the second floor are illuminated with 1x4 surface mounted fixtures. Occupancy sensors are located in the rooms.

Science Classroom 102 is illuminated by surface mounted 1x4 fixture with 2-lamp T8s.

**Science Classroom 201**

**Mechanical**

This large split classroom is conditioned by (2) newer Daikin unit ventilators with a roof mounted exhaust fan. There was no control damper observed at the exterior building envelope on the exhaust fan. A fume hood is located in the western half of the classroom and does not appear to be currently used. The fume hood appears original to the facility and has a sign indicating that the liner of the hood contains asbestos. We recommend having this tested by a qualified consultant hand having any asbestos abated. The fume hood is connected to a roof mounted exhaust fan which was off during the site visit.

The closet to the east of the classroom appears to be used for storage. A corrosive chemical storage cabinet is located in this room with exhaust connected to a roof mounted exhaust fan. The exhaust fan was not running during the site visit. This fan should be running continuously unless the cabinet is not being used.

**Plumbing**

According to the existing conditions drawings, the Science Classroom 201 sinks discharge to an acid neutralizer located in a closet of the classroom below. The closet was locked at the time of the site visit so this could not be verified.

There is an Emergency Power Off (EPO) button near the eastern door of the classroom to disable the gas to the classroom. A manual isolation valve is located just outside the eastern door in the corridor to isolate the classroom gas.
upstream of the electronic isolation valve.

**Middle/High School Corridor/Restrooms**

*Mechanical*

The restrooms are ventilated with roof mounted exhaust fans. The restrooms are conditioned by hot water cabinet unit heaters and fintube. The heating water flow is controlled by pneumatic 2-way control valves.

*Plumbing*

The domestic hot water was not tempered at the faucets and came out quite hot. The International Plumbing Code requires the water to be tempered for all public lavatories which is below 110 degrees F.

*Electrical*

The corridors are illuminated by surface mounted 1x4 prismatic fixtures with 2-T8 lamps. The corridor appears to be over illuminated compared to Illuminating Engineering Society (IES) guidelines.

**Science Classroom 1st Floor Northwest Corner of Middle/High School**

*Mechanical*

This science classroom is conditioned by a ducted fan coil unit with a hydronic heating coil for heating. Ventilation is provided by an above ceiling mounted heat recovery unit which is ducted to louvered on the exterior east wall with control dampers. The ventilation air is ducted to the return plenum of the fan coil unit.

There were numerous sections of piping observed in this room that were missing insulation. There were also duct fittings that were leaking air on the fan coil unit duct system.

*Plumbing*

The sinks in this room discharge to under sink acid neutralizers.

There is a newer eyewash/shower unit in this room.

*Electrical*

The classroom is illuminated by recessed 2x4 prismatic fixtures.

**Middle/High School Administrative Offices**

*Mechanical*

The administrative offices are conditioned by a rooftop air handling unit with a natural gas fired heater (natural gas piping is run across the roof from a gas meter just outside of the old entrance lobby) and a DX refrigerant based cooling system. An above ceiling heat recovery unit provides ventilation air for the space.

There is a small wall mounted data cabinet enclosure located in the main office area. The cabinet has filters on the bottom and an exhaust fan which discharges into the ceiling space to continuously draw air into the cabinet for conditioning.

There is hydronic fintube heating in (2) offices. Controls are newer Distech DDC controls.

**Computer Classroom 211**

*Mechanical*

The computer classroom is conditioned by a newer unit ventilator (powered by the lighting circuit, downstream of
the switch) with a roof mounted exhaust fan located above the corridor. A 3-ton split system Mitsubishi PKA-A36KA4 heat pump also conditions the space. The outdoor heat pump unit is located on the roof above. It is not clear if these (2) systems are interconnected to ensure they are not operating simultaneously in opposition to one another.

The heat pump exterior refrigerant piping is insulated with elastomeric foam; however, the insulation does not contain any UV protection and is breaking down.

A small store has been added to this room. There is a small section of fintube radiation and some ceiling transfer grilles for conditioning of the small store.

**FACS Room 214**

*Mechanical*

The FACS room is conditioned by a unit ventilator and the exhaust is connected to the roof mounted exhaust fan serving room 211. There is a small ceiling exhaust fan that exhausts from the adjacent bathroom and storage rooms and discharges to an exterior wall cap. There is a clothes dryer in this room and the dryer exhaust duct discharges to an exterior wall cap adjacent to the small exhaust fan wall cap.

The kitchen range hoods are all connected to a single above ceiling exhaust fan which discharges out the sidewall. This fan does not appear to have adequate exhaust capacity for removing the cooking vapors if all (4) ranges are in use simultaneously. The small exhaust grilles also do not appear adequate to properly contain the cooking vapors as they are also located well above the cooking surface.

*Plumbing*

The cooking ranges are residential style gas ranges. A manual valve is located in the room to manually shutoff the gas to the room.

**Performing Arts Center (Auditorium)**

*Mechanical*

The Performing Arts Center is conditioned by an air handling unit (AHU-2) located in the second floor fan room. This air handling unit contains a filter-mixing box with modulating fresh/return air dampers. The unit is heating only, utilizing a hot water coil that modulates discharge air temperature using a face and bypass damper rather than a control valve. The unit is designed for economizer operation, but is not equipped with cooling capabilities. A return/relief fan draws air back to the unit or exhausts it during economizer operation. The units are operated by the facility pneumatic controls system. The supply air is distributed to the auditorium through ceiling mounted supply diffusers. The air is returned through low return grilles at the back of the auditorium. The fans do not have VFDs and appear to operate at a fixed speed.

The stage is conditioned by (2) ceiling mounted vertical (downward) throw hydronic unit heaters controlled by a dedicated pneumatic thermostat.

*Electrical*

The auditorium is generally illuminated with T8 fluorescent fixtures. The stage lighting appears to be generally incandescent/halogen fixtures.

**Cafeteria**

*Mechanical*

The Cafeteria/Multi-Purpose Room is conditioned by an air handling unit (AHU-1) located in the second floor fan room.
room. This air handling unit contains a filter-mixing box with modulating fresh/return air dampers. The unit is heating only, utilizing a hot water coil that modulates discharge air temperature using a face and bypass damper rather than a control valve. The unit designed for economizer operation, but is not equipped with cooling capabilities. The unit is operated by the facility pneumatic controls system. The supply air is distributed to the ceiling of the cafeteria through ceiling mounted supply diffusers. The air is returned through low return grilles at the back (west end) of the cafeteria. The fan does not have a VFD and appears to operate at a fixed speed.

There are (3) roof mounted exhaust fans that exhaust air from ceiling grilles in the cafeteria. These are utilized for economizer operation as the fans were not operating at the time of the site visit.

Electrical

The cafeteria is illuminated by recessed 6-Lamp T8 fluorescent fixtures with parabolic lenses. There are also multiple recessed ceiling light fixtures around the perimeter of the space. The recessed fixtures were not on during the site visit. They appear to be incandescent/halogen type.

Kitchen/Kitchen Storage

Mechanical

The Kitchen area is conditioned by (2) suspended hydronic unit heaters and (1) ceiling cabinet unit heater near the exterior door operated by pneumatic controls. There are (2) wall mounted range hoods serving the cooking equipment. The hoods are 9 feet long and 7 feet long. The 9 foot hood contains an Ansul fire protection system. This hood does not appear wide enough for the equipment located underneath it (equipment sticks out beyond the 9 foot hood). The kitchen hood fans are roof mounted upblast fans (EF-8 and EF-9) that appear to be rated for grease exhaust. There are (2) roof mounted intake fan units with unit mounted filters that enable when the exhaust fans are switched on to bring in make-up air. There is no tempering device (no hot water coil or gas fired heater) to condition the incoming outdoor air which is distributed to the range hood supply grilles and kitchen ceiling diffusers. The exhaust fans and make-up air fan units are controlled by a manual wall switch.

It is recommended that make-up air be tempered to within 10 degrees of the space temperature as this is required by current mechanical code. The untempered make-up air will also create cold drafts which are uncomfortable to the kitchen staff.

The dishwasher is a conveyor type unit with exhaust duct connections on either end. The exhaust is ducted up through the roof to a roof mounted exhaust fan.

The bathroom in the kitchen area has a small ceiling mounted exhaust fan.

The kitchen dry storage room is conditioned by a hydronic unit heater. There is no ventilation for this room. There is a water heater room connected to the dry storage room. A high efficiency sealed combustion water heater is installed in the small room. The ductwork for a previous non-sealed combustion water heater is still installed and is boarded up with cardboard even though the older heater has been removed. It is recommended that the existing ductwork and wall/roof penetrations be removed and capped/insulated over.

The walk-in cooler and freezer were recently replaced. The new units have a Beacon II smart controller system.

Plumbing

A high efficiency A.O. Smith Cyclone Xi water heater rated for 250,000 btu/hr. input provides hot water to the kitchen. An electric resistance Hatco booster heater provides high temperature water to the dishwasher. The piping in this room generally appears new, although the piping is uninsulated.

A grease trap is located in the dishwasher room recessed in the floor. Generally, it appears that the kitchen plumb-
ing waste indirectly discharges into floor sinks or floor drains as is required by code.

The kitchen has a dedicated natural gas service and meter located outside the east wall of the kitchen.

**Electrical**

The kitchen is illuminated with 2x4 prismatic fluorescent fixtures. These fixtures do not appear to be sealed and/or wipe down rated. We recommend that kitchen fixtures be sealed/gasketed to enable easier cleaning.

The kitchen electrical panel is located just inside the exterior door. The kitchen appears to be fed from a dedicated electrical meter located outside the east wall of the dry storage room.

**School District Administrative Area**

**Mechanical**

The eastern portion of the administrative area is conditioned by a gas fired rooftop air handling unit with DX refrigerant based cooling (RTU-5). The unit is a York D2EG048N09925EBE. This unit provides heating and cooling and uses R-22 refrigerant. The western administrative area is conditioned by a gas fired rooftop air handling unit with DX refrigerant based cooling (RTU-4). The unit is a York DH090N15N2AAA1A. This unit provides heating and cooling and uses R-22 refrigerant.

Ventilation air is provided by a dedicated rooftop Des Champs heat recovery unit ERU-2 (Des Champs PV-MZ-1370). A duct mounted hot water reheat coil with an electronic 2-way control valve is used to condition the air during the winter after it has been pre-conditioned by the heat recovery core. The unit exhausts from the bathrooms and the corridor, and ventilation air is supplied to the return plenums of the (2) rooftop air handling units.

The cabinet unit heaters in the vestibules and corridor in this area are served by the northern boiler room hot water system. There is a secondary (piped in series) circulator pump on this line that appears to operate based on an aquastat (according to existing drawings). It is unclear as to the specific purpose of this pump unless there is inadequate pressure in the system generated by the main circulator pumps.

The lobby copy room is conditioned by a Daikin RXS12LVJU heat pump split system. The outdoor heat pump unit is located on the roof. The refrigerant piping insulation is not protected from UV and is deteriorating. An exhaust fan provides ventilation for the copy room and discharges out through the roof.

**Plumbing**

The (2) administrative office areas have a dedicated natural gas service meter to provide gas to the rooftop air handling units. This meter is located outside the east wall of the kitchen. The gas piping is run along the roof.

The administrative water closets have manual flush valves and are not low flow.

**Electrical**

Lighting in the eastern office area is with 2x2 prismatic fixtures with T8 lamps. Lighting in the western office area is with 2x2 prismatic fixtures with 4-Lamp T8s. The fixtures have AB switching where the different tubes in the fixture are switched. The conference room is illuminated with 2x4 fixtures.

**Health/Nurses Office #38**

**Mechanical**

There are (2) HVAC systems that condition the health office. There is an in-ceiling ducted fan coil unit with a hot water coil that is controlled by the pneumatic control system. A separate split system heat pump with a Mitsubishi MSZ-FH18NA2 indoor head and a MUZ-FH18NA2 hyper heat outdoor heat pump unit also conditions the nurse’s
area. This is a nominal 1.5 ton unit with low ambient heating capabilities. It is not clear how the (2) systems are interconnected and whether they could potentially both operate at the same time.

There appears to be a ceiling mounted exhaust fan that discharges out the exterior sidewall of the building which provides the ventilation for this area. An additional above ceiling exhaust fan located in the restroom also discharges out the exterior sidewall.

**Plumbing**

The nurse’s restroom has a single water closet with a manual flush valve. There is also a sink which appears as though it may be used for hair washing. The shower in this room does not appear to be currently utilized. There is a stacked clothes washer and dryer in this room as well. A small sink is located in the counter of the nurse’s area.

**Restrooms off of Main Entrance Lobby**

**Mechanical**

The restrooms are conditioned by fin-tube radiators controlled by the pneumatic control system. A roof mounted exhaust fan exhausts from the (2) restrooms as well as the adjacent janitor’s closet.

**Plumbing**

The men’s restroom has (2) waterless urinals. The water closets in both restrooms are sensor operated but do not appear to be low flow. The faucets in these restrooms are all metered faucets.

The domestic water for these restrooms is supplied by the auditorium water entrance and the domestic water heater located in the second floor fan room.

**Southern Boiler Room (Elementary School)**

**Mechanical**

The boiler room in the elementary school has signage indicating that asbestos is present in the room. We recommend having the area tested by a qualified consultant and have any asbestos discovered be abated.

The elementary school is heated by (2) natural gas fired PK Thermific N-1700-2 atmospheric boilers. These boilers are natural gas fired and rated for 1,700,000 btu/hr. input and 1,445,000 btu/hr. output (85% efficient). These boilers were manufactured in August of 2000. Each boiler has a dedicated vertical inline circulator that pulls from a common header through an air separator. The boilers are piped so that boiler B-1 is upstream of boiler B-2. This arrangement is acceptable if the boilers operate in a lead/lag sequence where only (1) boiler is firing at a time. If both boilers are firing simultaneously, boiler B-2 will have warmer entering water, which has already been heated by boiler B-1. The boiler primary heat injection connections are both piped backwards. The circulators pull from the common header downstream of the boiler discharge pipe. This is causing some water recirculation (short circuiting) through the boilers. We recommend having these re-piped to correct this piping arrangement.

The hydronic system in the elementary school is composed of (2) secondary pumping loops. The first loop has (2) base-mounted end suction circulators (B&G 1510 model 1.5AB rated for 60 GPM at 30 feet of head with 1 horsepower standard efficiency motors). These circulators supply hot water to the original elementary school wing through trenches. The circulators are piped in a reverse return configuration and use a 3-way control valve to modulate the loop temperature by either recirculating the water or sending the water to the boiler to be heated. The circulators appear to operate at constant speed. The second loop has (2) base-mounted end suction circulators (B&G 1510 model 1.25AD rated for 50 GPM at 40 feet of head with 1.5 and 2 horsepower standard efficiency motors). These circulators supply hot water to the additions to the original elementary school which includes everything south of the main entrance lobby. The circulators are piped in a reverse return configuration and use a 3-way control valve.
to modulate the loop temperature. The circulators appear to operate at constant speed.

An intake louver with (2) fans supply combustion air to the boiler room for the boilers and water heater.

The hydronic system has a bladder-less type expansion tank.

**Plumbing**

A separate natural gas entrance and meter with a 4” natural gas main supplies gas to the boilers and water heater. A branch off of this service entrance goes across the roof and feeds the elementary administrative area rooftop unit.

The 2” domestic cold water entrance for the original elementary school is located in the boiler room. There is a check valve downstream of the water meter as well as a pressure reducing valve. The water entrance in the elementary school addition is tied into this water entrance with a 3” line that reduces to 2” at the tie-in. Insulation is missing on the cold water piping and the pipe is sweating.

A natural gas fired 65 gallon water heater provides hot water to the elementary school. The water heater is atmospheric vented and is a RUUD model G65-360A with 360,000 btu/hr. input.

**Electrical**

The main electrical panel MDP in the electrical room adjacent to the boiler room is a 600A 120/208v 3-phase panel which is fed from the main switchboard. This panel appears to be original equipment from when the building was constructed.

In the adjacent panels, it appears there were a number of conduits with multiple circuits sharing neutral conductors.

**Elementary Pre-K and Kindergarten Classrooms #36 and #41**

**Mechanical**

These classrooms are conditioned by ducted fan coil units located above the ceiling. The rooms are controlled by the DDC system. The fan coils have hydronic heating coils. Ventilation is provided by a dedicated rooftop Des Champs heat recovery unit (labeled ERU-1) (Des Champs PV-MZ-1370). A duct mounted hot water reheat coil with an electronic 2-way control valve is used to condition the air during the winter time after it has been pre-conditioned by the heat recovery core. The unit exhausts from the bathrooms, closets and classrooms and supplies ventilation air to the return plenums of the (2) fan coil units.

The heating hot water for these rooms is fed from a dedicated branch off of the main heating hot water lines in the corridor. A dedicated small above ceiling circulator pump (outside rooms #32 and #34) supplies heating hot water to these spaces.

**Plumbing**

These classrooms contain restrooms with a single low height water closet and sink. The faucet and flush valve are both manual. The flush valve does not appear to be low flow.

**Electrical**

These classrooms are illuminated by 2x4 prismatic fluorescent fixtures with 4-L T8s. There are (2) zones of fixture groups controlled by (2) switches. The lighting is controlled by an occupancy sensor.

**Elementary Kindergarten Classrooms #32, #34, and #39**

**Mechanical**

These classrooms are conditioned by newer AAF unit ventilators and controlled by the DDC system. There does not
Due to the age of the facility, the heating hot water piping insulation in this area may contain asbestos. We recommend having the insulation tested by a qualified consultant and having any asbestos abated.

**Electrical**

These classrooms are illuminated by 2x4 prismatic fluorescent fixtures with 4-L T8s and surface mounted 2-L T8 prismatic fixtures. There are (2) zones of fixture groups controlled by (2) switches. The lighting is controlled by an occupancy sensor.

**Elementary Corridor East of IT Office**

**Mechanical**

This corridor is conditioned and ventilated by an above ceiling unit ventilator. The ventilator is controlled by the pneumatic thermostat and controls. The unit ventilator brings in outdoor air through an intake hood on the roof.

**Electrical**

The corridor is illuminated by surface mounted 2-Lamp T8 fixtures spaced 4 feet apart. This corridor is over illuminated according to the recommendations by the IES.

**Elementary Library and Surrounding Rooms**

**Mechanical**

The library is conditioned by (2) ceiling mounted unit ventilators (fresh air is brought in from roof mounted intakes) and (2) exterior wall mounted unit ventilators (fresh air is brought in from exterior wall louvers). The units are controlled by the DDC system. The unit ventilators are supplied with heating hot water. The heating hot water to the wall mounted unit ventilators appears to be supplied from below according to the original drawings. There does not appear to be any relief vents for the library and the surrounding spaces. Without sufficient relief air, it is unlikely that the library unit ventilators are capable of providing code required ventilation air. The unit ventilators are powered by the lighting circuit downstream of the light switch.

The (2) rooms off of the library (#33 and #35) are conditioned by a rooftop air handling unit (RTU-3) which is a Carrier Weathermaster model 48HJE006 which is a gas fired unit with 115,000 btu/hr. input and is 81% efficient. This unit uses a refrigerant based DX cooling system with R-22 refrigerant and has an economizer intake for economizer cooling. It doesn't appear as though there is any ventilation for these spaces.

The adjacent small storage rooms west of room #33 do not appear to have any ventilation air or space conditioning.

The classroom west of the library is conditioned with a wall mounted unit ventilator. There does not appear to be any relief air. Without sufficient relief air, it is unlikely that the unit ventilator in this room is capable of providing code required ventilation air. The unit ventilator is powered by the lighting circuit downstream of the light switch. The hot water is fed from above down a pipe chase with exposed isolation ball valves.

The western exterior room north of classroom #31 is conditioned by a wall mounted unit ventilator. This room appears to have a roof mounted exhaust fan for relief.

Due to the age of the facility, the heating hot water piping insulation in this area may contain asbestos. We recommend having the insulation tested by a qualified consultant and having any asbestos abated.

**Plumbing**

Due to the age of the facility, the rain leader piping and domestic water piping insulation in this area may contain...
asbestos. We recommend having the insulation tested by a qualified consultant and having any asbestos abated.

There is a 4" domestic cold water entrance in a storage closet to the south west of the library (west of room #33). The water entrance transitions to a 2" line with a 1" water meter. There does not appear to be a pressure reducing valve on this water line nor was there a backflow preventer observed which is required.

**Electrical**

The library is illuminated with surface mounted 2-Lamp T8 prismatic fixtures to the east of room #35, and surface mounted 4-Lamp T8 prismatic fixtures for the balance of the rest of the library.

**IT Office Room #30 and Surrounding Offices and Corridor**

**Mechanical**

The IT offices are conditioned by a rooftop air handling unit (RTU-2) which is a Carrier Weathermaster model 48HJE006 which is a gas fired unit with 115,000 btu/hr. input and is 81% efficient. This unit uses a refrigerant based DX cooling system with R-22 refrigerant and has an economizer intake for economizer cooling. It doesn't appear as though there is any ventilation for these spaces. This unit is controlled by the DDC system. The unit has ducted supply air and plenum return.

There are fintube radiators on the exterior walls (including the server room) which are controlled by pneumatic thermostats. It is unclear if there is any interconnection between the (2) systems.

The server room is conditioned by a split system cooling unit. The unit is a Daikin split system with a RZG36PVJU9 nominal 3-ton outdoor unit with wind baffles for low ambient cooling. The refrigerant piping does not have a protective UV coating and is deteriorating.

**Electrical**

The corridor is illuminated by surface mounted 2-Lamp T8 fixtures spaced 4 feet apart. This corridor is over illuminated according to the recommendations by the IES.

Removing a corridor receptacle cover appeared to reveal the lack of ground wires being run to 3-prong receptacles in the 1969 building. It is likely that ground wires may not have been installed for the older buildings.

**Elementary School Typical Classrooms**

**Mechanical**

The typical classroom spaces are conditioned by wall mounted unit ventilators controlled by the DDC system. The relief air discharges to grilles through the corridor walls with fire dampers to the gravity relief vents above the ceiling in the corridor. There are (3) relief hoods on the roof above the east-west southern elementary school corridor. The (2) relief hoods in the north-south corridor appear to be blocked off/sealed which would result in reduced ventilation.

The art room contains an electric kiln (Easy-Fire-Kiln model e23T-208 rated for 208volt, single phase, 48A, 9980 watts). The kiln has a ducted exhaust through a PVC vent through the roof. There is an exhaust fan in the vent line with a 1/25hp motor. A drain at the bottom of the vent riser drains into a condensate pump.

The heating hot water piping insulation in this area, due to the age of the facility may contain asbestos. We recommend having the insulation tested by a qualified consultant and having any asbestos abated.

The (2) restrooms to the west of office #30 did not appear to have any exhaust operational at the time of the site visit. The exhaust fan was either not operating or there is an issue with the fan.

Interior room #22 has a wall mounted unit ventilator with a roof top intake hoods. There is no insulation on the
outdoor air intake ductwork.

The art storage room does not have any ventilation.

Bathrooms are ventilated with either rooftop exhaust fans, or, in the original elementary school restrooms, the exhaust fans discharge through the roof relief hoods. The ducted exhaust fan located in the janitor's room to the north of the elementary boiler room exhausts from the adjacent rooms to the north and east including room #12 and discharges out through the roof mounted relief hood.

**Plumbing**

It appears that the majority of the classrooms have sinks with bubbler type drinking fountains.

The domestic cold water piping in the corridor was missing insulation. This could sweat and stain/damage ceiling tiles. There were stained ceiling tiles noted in the corridor.

**Electrical**

The classrooms are typically illuminated with surface mounted 2x4 prismatic light fixtures with either 2-Lamp or 4-Lamp T8s. There are generally (2) switches for (2) zones of fixtures all controlled by occupancy sensors.

The occupancy sensor in interior room #22 does not appear sensitive enough to register normal movement. The lighting turned off while we were in the room.

The data cabling above the ceiling in the elementary corridor was noted as being CMR and MPR rated. These are rated for commercial risers, however they are not rated for plenum installation which is currently where they are located.

There does not appear to be any photocell control to disable or dim light fixtures in the corridor that are adjacent to the skylights. This could save energy if implemented.

**Elementary School Administrative Offices**

**Mechanical**

The administrative elementary offices to the lower south-west of the facility are conditioned by a rooftop air handling unit (RTU-1). The unit is a York DH090N15N2AAA1A with a gas fired heating section and DX cooling using R-22 refrigerant. This unit has an economizer intake hood and is controlled by the DDC system. An above ceiling heat recovery unit HRU-1 exhausts from the toilet room and room the east of office #2. The ventilation supply air is discharged into the return plenum of RTU-1. The outdoor air intake and exhaust connect to a rooftop gooseneck and exterior wall louver respectively through motorized dampers.

RTU-1 also serves the counseling offices #1 and #3 across the hall. There is finteube radiation in office #1 with a thermostatic control valve.

There is a data closet to the north of the toilet room that does not appear to have any dedicated cooling.

**Plumbing**

The toilet room has manual fixtures and does not appear to be ADA compliant. The water closet appears to have a standard flow (not low-flow) flush valve.

**Electrical**

The lighting in this area are by 2x2 and 2x4 prismatic light fixtures. The room to the east of the main office #2 has 4-Lamp T8 2x4 fixtures.
Recommendations

Heating Ventilating and Air Conditioning – General

The existing HVAC systems in the facility are a mix of older original equipment, older non-original equipment, and recently updated equipment. Generally, the air handling equipment including the locker room air handling unit, the gymnasium air handling units, the 2nd floor fan room air handling units serving the Auditorium, the Cafeteria, and the main entrance lobby are older and have reached the end of their useful lives. The balance of the classroom unit ventilators throughout the facility have been recently upgraded. The facility boilers have either reached or are about to reach the end of their useful lives. Generally, the existing facility and infrastructure is not configured for the proposed facility expansion, nor is it configured to provide cooling to the entire facility. Because of the age of the facility and the extensive renovations planned, we recommend removing the existing HVAC system.

For the proposed facility renovation and expansion we recommend installing one of the (3) options indicated below for a new HVAC system. Option #1 (which includes options #1a and #1b) and #2 provide cooling for the balance of the facility. Option #3 is a heating only option (with the exception of administrative areas).

We recommend removing all of the remaining existing pneumatic controls system and replacing it with a Direct Digital Controls (DDC) system. The facility currently has a mixture of older pneumatic controls and a newer DDC system. We recommend having a single controls vendor for the entire facility and it is recommended this vendor be selected through an open bidding process. A DDC system is electronic based and is operated by software and computers. The DDC system will have internet connectivity to enable monitoring and control of the system remotely. Web connected DDC systems can be programmed to send alerts to operators and maintenance personnel when there is an equipment failure. A DDC system will enable the new HVAC system and components to operate efficiently and as designed.

Currently the existing facility has (2) main mechanical rooms; (1) mechanical room is located in the original middle/high school and (1) mechanical room is located in the original elementary school. Unless there is a budgeting reason to have these facilities separated and separately metered, we recommend combining the HVAC systems into a single mechanical space located at the northern end of the facility.

HVAC Option #1 – Water Source Heat Pump (Heating & Cooling Provided)

L.N. Consulting recommends the Winooski School install a complete water source heat pump HVAC system with central Energy Recovery Ventilators (ERVs) and Heat Recovery Ventilators (HRVs) throughout the facility. The water source heat pumps would be utilized to condition (both heat and cool) the balance of the facility. The ERVs and HRVs will be utilized to provide fully ducted ventilation air to each space. The ventilation system will be designed and sized per ASHRAE 62.1 requirements. Option #1 indicates the space conditioning and ventilation equipment which will be the same whether Option #1a or Option #1b is selected. Options #1a and #1b represent whether the heating and cooling energy is predominantly supplied by a ground source geothermal system in Option #1a or via a fossil fuel fired boiler and a closed circuit evaporative cooling tower in Option #1b.

Water source heat pumps utilize the refrigeration cycle to both heat and cool air. They accomplish this through the use of a refrigerant reversing valve allowing the equipment to run the cycle as an air conditioner or reverse the cycle to operate as a heater. The water source heat pump can extract heat from the air and transfer it to a water loop when in cooling mode or transfer heat from the water loop to the air in heating mode. The units are very efficient with Energy Efficiency Ratio (EER) values of 15-25 in cooling mode and the Coefficient Of Performance (COP) values for heat pumps are in the range of 3.0-4.5. A COP value of 3.0 indicates that for every 1 unit of energy used to run
the heat pump, 3 units of heat energy is transferred to the air. This represents a 300% increase in efficiency when compared to electric resistance heating and over 300% more efficient than any fuel fired heating equipment. A water source heat pump system has the added benefit of energy “sharing”. Spaces that are in cooling mode can reject heat into the common water loop which can be used by spaces in heating. This condition can be common during shoulder seasons when the spaces with southern exposure require cooling while the spaces with northern exposure require heating. This can save significant amounts of energy in facilities that have many different exposures and variable occupancies such as this facility.

An ERV utilizes a continuously revolving wheel coated with an absorbent desiccant surface to transfer both heat and moisture from the exhaust air leaving the building to the incoming outdoor air. An HRV utilizes a plate heat exchanger where the incoming outdoor air and outgoing exhaust air flow through in a cross or counter flow pattern to transfer heat energy between the (2) airstreams. Both ERV’s and HRV’s significantly reduce the heating and cooling loads required to condition the outdoor air that is distributed throughout the building. The ventilation air will be controlled by CO2 sensors, occupancy sensors, and schedule to vary the ventilation air delivered to each space. Variable Air Volume (VAV) boxes will be utilized to modulate the ventilation air flow to each zone. The ventilation unit fans will modulate to deliver only as much ventilation air as necessary to satisfy space demands, which significantly reduces energy consumption. The ventilation units will have integral water source heat pumps to both heat the ventilation air in the winter and cool/dehumidify the ventilation air during the summer. The water source heat pumps will utilize modulating compressors to more precisely control the discharge temperatures out of the units. All units will be capable of 100% economizer operation to save energy when permitted by outdoor air conditions.

**HVAC Option #1a – Heating/Cooling Plant for Geothermal System-Recommended**

A heat pump system uses a glycol and water fluid mixture as a medium to transfer energy to and from the heat pumps located throughout the facility. L.N. Consulting recommends the installation of a geothermal closed-loop ground source heat exchanger be installed on the site in order to condition the fluid. The closed-loop heat exchanger will be a series of 700 ft. deep boreholes with 1½” HDPE (High Density Poly-Ethylene plastic) piping loops that utilize the near constant ground temperature to both heat and cool the facility. Our initial estimate is that the system will require (150), 700 ft. deep boreholes to condition the facility throughout the year. This estimate will be refined following the completion of an energy model and based on the proposed envelope design. The final borehole field design will also require the drilling of a test borehole to better understand the subsurface characteristics of this specific site. We recommend installing a buried vault so that each geothermal circuit can be isolated and balanced. A geothermal heat pump system utilizes only electricity to heat and cool the facility and the ventilation air. This will significantly reduce the school’s use of fossil fuels. The heat pump loop piping interior to the building for this type of system is required to be insulated due to low temperature fluid temperatures that occur when the system is in heating mode.

The geothermal borehole field will be sized to meet the facility cooling loads and the majority of the building heating loads. We recommend installing backup natural gas fired high efficiency boilers to provide backup heating during peak demand periods.

The natural gas fired boilers will be condensing type with stainless steel heat exchangers and have operating efficiencies of approximately 95%. The boilers will be high efficiency sealed combustion type with a 15:1 or 20:1 turndown ratio. The facility will require multiple boilers during peak demand. (1) Redundant boiler will installed to provide backup capabilities in the event of a boiler failure. The new combined mechanical room will likely require an increase in natural gas meter size and internal natural gas piping. This may also require an upgraded natural gas service for the facility. Each boiler will have a dedicated primary circulator with an Electronically Commutated Motor (ECM).
The hydronic system will utilize a propylene glycol solution for freeze protection. The geothermal borehole fluid will be circulated by multiple high efficiency circulator pumps (1 circulator will be provided for redundant backup). The borehole circulators will inject into the internal building secondary heat pump loop which will be circulated by multiple high efficiency circulator pumps (1 circulator will be provided for redundant backup). All of the new circulator pumps will have either ECM’s or premium efficiency motors with pump mounted Variable Frequency Drives (VFDs) to modulate the speed of the pumps to match the building heating or cooling loads. The DDC system will modulate the pumps to maintain a differential pressure set point in the heat pump hydronic system. This significantly reduces pumping energy as the pumps reduce speed as the facility heating or cooling demand decreases.

**HVAC Option #1b – Heating/Cooling Plant for Boiler/Cooling Tower - Reduced Cost**

A lower cost alternative to the geothermal system will utilize the fossil fuel fired boilers and an external closed circuit evaporative cooling tower to condition the heat pump water system. The heat pump loop piping in this system does not need to be insulated. For this option, we recommend the main mechanical room be located near where the external cooling tower will be located in order to reduce the amount of piping required.

We recommend installing the same high efficiency boilers with dedicated circulator pumps as indicated in Option #1a. These boilers will provide all of the heating capabilities for the facility.

An external cooling tower, sized for peak demands will be utilized to cool the heat pump water loop during the cooling season. This cooling tower will be a closed circuit evaporative cooler with low sound fans and water silencers, full water treatment system, the ability to run wet or dry, with welded stainless steel basin and modulating fans and pumps. The internal heat pump loop will circulate water (the water will be treated). The cooling tower hydronic system will circulate a propylene glycol solution for freeze protection and the piping will be insulated. The internal heat pump loop will reject the heat to the cooling tower hydronic system through a plate and frame heat exchanger. The cooling tower fluid will be circulated by multiple high efficiency circulator pumps (1 circulator will be provided for redundant backup). All of the new circulator pumps will have either ECM’s or premium efficiency motors with pump mounted Variable Frequency Drives (VFDs) to modulate the speed of the pumps to match the building heating or cooling loads as indicated in Option #1a above.

This system is less efficient than the geothermal system and relies on fossil fuels to condition the facility. The system still provides the ability for energy sharing between zones in cooling and zones in heating.

**Facility Conditioning and Ventilating Equipment**

**Typical Classroom**

The classrooms throughout the facility would be conditioned using water source heat pumps. A typical classroom would be provided with a small closet located in a corner of the room that would house the heat pump. This will provide each classroom a dedicated heating/cooling zone.

Our initial estimate is that a 2-ton heat pump with 2-stages of capacity control will be installed in the closet in the vertical position on a stand for all classrooms 1,000 sq.ft and smaller. The heat pump will have variable speed EC fan motors, low sound package, insulated coils, MERV13 filters and BACnet controls package. The heat pump supply will be ducted to above the ceiling (where applicable) or through the structure (where applicable). A return grille would be located in the face of the closet to return the air back to the unit. Each heat pump would be equipped with a 2-way modulating control valve with high and low capabilities to match zone load along with a balance valve to control water flow through the unit. If space provides, the heat pump will be suspended above the ceiling with the heat pump return ducted to ceiling grilles.

Classrooms that are larger than 1,000 sq.ft, based on our initial heat load estimates, will be conditioned by a 3-ton
variable capacity heat pump with variable speed EC fan motors, low sound package, insulated coils, MERV13 filters, modulating control valve and BACnet controls package.

Each classroom will have a supply and return VAV (Variable Air Volume box) to control the ventilation air. Outdoor air and exhaust will be ducted to each classroom. Each classroom will be a single ventilation zone with Carbon Dioxide (CO2) monitoring; the VAVs will modulate as necessary to maintain CO2 levels below set point values in each zone.

Typical Science Classroom
The science classrooms will be conditioned by the same heat pumps indicated above for the typical classrooms. The science classrooms will also have dedicated VAV zones for each classroom. The science classrooms will be ventilated by HRV’s with epoxy coated exhaust components. The HRV that serves each science classroom will also exhaust any proposed fume hoods. Each fume hood will have a modulating damper/valve which will enable the flow through the fume hoods to be modulated and shut.

The exhaust air ductwork for the science classrooms will be constructed of welded stainless steel. Bubble-tight dampers will be used to ensure that if the exhaust fans in the HRV’s are disabled that no fume hood exhaust can migrate out other branches of the exhaust ductwork. The exhaust will be discharged straight up after passing through the HRV’s.

Typical Office/Administrative and Meeting Spaces
The offices in the facility will be conditioned using either a fully ducted heat pump or exposed console style (free standing) heat pump depending on the specific application. Each heat pump will be equipped with a 2-way control valve and balance valve to control water flow through the unit. The ducted heat pumps will have the same options indicated for the classroom units where applicable. Ducted heat pumps will typically serve 2-3 offices. Console heat pumps will be installed in each office where applicable. Typical office heat pumps will be single stage units.

The office spaces will have a supply and return VAV (Variable Air Volume box) to control the ventilation air to each zone. The ventilation supply air shall be ducted to the heat pump returns (where applicable) and an exhaust grille shall be located in each space. Typical office ventilation zones will be for adjacent 4-5 offices on a single zone with large open office areas and conference/meeting rooms being dedicated ventilation zones. Outdoor air and exhaust will be ducted to each space. Where multiple spaces are served by a single VAV unit, each normally occupied space will have CO2 monitoring; the VAVs will modulate as necessary to maintain CO2 levels below set point values in each zone.

Typical Gymnasium
The gymnasiums shall each be conditioned and ventilated by roof mounted air handling units (AHU) with an integral ERV section and economizer cooling function. The air handling units shall utilize a water source heat pump to condition the supply air distributed to the space. The units will have fully ducted supply and return systems. CO2 sensors shall be located throughout the space to modulate the ventilation air as necessary to maintain space CO2 levels below set point. The units will have EC fan motors where applicable or premium efficiency motors with VFDs where EC motors are not available. The units will also have modulating compressors, modulating hot gas reheat for dehumidification, dedicated return fan and modulating recirculation dampers.

Auditorium/PAC
The auditorium would be conditioned and ventilated by roof mounted or indoor (second floor fan room) air handling unit (AHU) with an integral ERV section and economizer cooling function. If the unit is mounted inside, it will have ducted outdoor air intake and exhaust air connections to exterior louvers with insulated isolation dampers. The air handling units shall utilize a water source heat pump to condition the supply air distributed to the space. The unit
CONSULTANT REPORTS

The existing grease laden kitchen hood (left hood) did not appear large enough for the equipment that is currently located underneath it. We recommend replacing both kitchen hoods with hoods that are sized for the specific equipment that will be located underneath them (including if there are any equipment or programming changes made as part of the renovation). We recommend replacing both kitchen exhaust fans with new upblast fans rated for grease laden vapor (complying with U.L. 762 requirements) with variable speed EC motors. It appears that (1) hood may not be rated for grease exhaust; we recommend combining cooking equipment that does not produce grease together under a separate Type 2 heat exhaust hood. We also recommend installing variable volume hood controls which vary the airflow through the kitchen hoods based on the amount of heat produced by the cooking equipment. The new kitchen hoods shall have LED lighting to reduce electrical usage.

Cafeteria/Kitchen

The kitchen/cafeteria shall each be conditioned and ventilated by a new roof mounted make-up air units (MAU) with an integral ERV section and economizer cooling function. The make-up air unit shall utilize a water source heat pump to condition the supply air distributed to the space. A modulating gas fired heater section upstream of the heat pump heating coil will pre-condition the air prior to the heat pump coil. The units will have fully ducted supply and return systems. The cafeteria and kitchens shall be separate heating/cooling zones. Each zone shall have a separate supply VAV’s, however there will be (1) return zone. CO2 sensors shall be located throughout the space to modulate the ventilation air as necessary to maintain space CO2 levels below set point. The units will have EC fan motors where applicable or premium efficiency motors with VFDs where EC motors are not available. The units will also have modulating compressors, modulating hot gas reheat for dehumidification, dedicated return fan and modulating recirculation dampers.

The make-up air unit shall modulate the return/exhaust air to match the combined kitchen exhaust hood air flow and provide the necessary make-up air to maintain the cafeteria/kitchen space at a neutral pressure.

2nd Floor FACS Room

We recommend replacing the exhaust system for the residential ranges in this space. We recommend installing dedicated range hoods for each range with Ansul fire protection systems tied to the fire alarm system. Each hood will be ducted out the sidewall of the facility.

Entrance Lobby

The main entrance lobby will be conditioned by ducted variable speed heat pumps. Our initial estimate is that the lobby will need (3) 4-ton heat pumps. The lobby will have a dedicated ventilation zone with supply and exhaust VAVs.

The main entrance vestibule will be conditioned by (2) 1.5-ton console heat pumps based on our initial estimates. The vestibule will not get any ventilation air and will only be heated to 50 degrees per Vermont Commercial Energy Code requirements.

Library

The library will be conditioned by ducted variable speed heat pumps. Our initial estimate is that the library will need (2) 3-ton heat pumps based on our initial estimates. The library will have a dedicated ventilation zone with supply
and exhaust VAVs.

Corridors
The corridors will be conditioned by either ducted or console type heat pumps located throughout the facility. Heat pumps will be predominantly located near exterior entrances or exterior exposures. The corridors will have dedicated ventilation zones that are tied into the ventilation for restrooms off of the corridors.

Kitchen off of Lobby
The small kitchen located off of the main entrance lobby may contain cooking equipment that requires an exhaust hood. If this type of equipment is installed, we recommend installing a compliant exhaust hood (either Type 1 for grease laden vapor exhaust or Type 2 for heat exhaust) with a variable speed roof mounted exhaust fan and variable speed hood controls. The roof mounted ERV serving this space will provide the necessary make-up air through the ventilation ductwork. We recommend installing an Ansul system for the kitchen hood that is tied into the building fire alarm system.

Ventilation Unit Zones
Below are the preliminary zones that each ventilation unit is anticipated to serve based on preliminary designs and initial estimates. Potential unit locations are also indicated below. Both the unit locations, zones served, and quantities are subject to change with further refinement of the design.

ERV-1
This ERV is expected to be located on the roof the western portion of the original middle/high school wing. The unit will serve that portion of the building including the new HS Sped offices and adjacent Art Room. This unit will not serve the science classrooms on the second floor of this wing. It is expected to serve approximately (7) standard classrooms on the first floor and approximately (4) classrooms on the second floor.

ERV-2
This ERV is expected to be located on the roof the eastern portion of the original middle/high school wing. The unit will serve that portion of the building including the new Special Ed offices and meeting rooms, the Middle/High School administrative offices along with the band and choir rooms to the north of the new lobby area and west of the large gymnasium. This includes approximately (2) classrooms on the first floor and approximately (6) classrooms on the second floor which includes the business center and the FACS rooms.

ERV-3
This ERV is expected to be located in a second floor fan room above the most north-western classroom pod in the addition, north of the original middle/high school. This unit will serve the entire pod area (except for the central science classroom) which includes approximately (5) classrooms, the central area, the surrounding meeting and ELL rooms, the adjacent MS Art room, and the Wellness center.

ERV-4
This ERV is expected to be located in a second floor fan room above the eastern new classroom pod in the addition, north of the original middle/high school. This unit will serve the entire pod area (except for the central science classroom) which includes approximately (5) classrooms, the central area, the surrounding special education offices and meeting room, and ELL rooms.

ERV-5
This ERV is expected to be located on the roof to the north of the large gymnasium. This unit will provide ventilation for all areas to the north and east of the large gymnasium with the exception of the small gymnasium. This includes
the alternative classrooms, the Lotus room, the staff lounge, all of the locker rooms, the kitchen storage areas and the maintenance staff areas.

ERV-6
This ERV is expected to be located on the roof above the library area of the facility. This unit will provide ventilation for the lobby area and surrounding work rooms and restroom facilities, the library, the health offices and the elementary school administrative areas.

ERV-7
This ERV is expected to be located on the roof the central offices to the south of the Performing Arts Center. This unit will provide ventilation for the central administrative offices including the superintendent’s offices, the surrounds corridors and the Pre-K classrooms 34, 36, 39 and 41.

ERV-8
This ERV is expected to be located on the roof of the corridor outside the Newcomer 29 classroom and the Art 28 classroom. This unit will provide ventilation for the western portion of the elementary school including the Maker Space 32, the IT Offices, the wester classrooms 25, 27, 29, and 31, Art 28, Music 24, and the western elementary special education offices to the west of the men’s and women’s rooms that are west of classrooms 05 and 08.

ERV-9
This ERV is expected to be located on the roof of the original elementary school corridor. This unit will provide ventilation for the original elementary school spaces including the grades 3, 4, and 5 classrooms (4 classrooms per grade) along with the restrooms, meeting rooms and additional support spaces in this wing.

ERV-10
This ERV is expected to be located on the roof of the corridor outside the grade 1 pod area. This unit will provide ventilation for the kindergarten, 1st grade and 2nd grade pod areas and the adjacent support spaces.

HRV-1
This HRV will be dedicated to provide ventilation for the northwestern middle school science classroom. This unit will be located in a second floor fan room located above the science classroom.

HRV-2
This HRV will be dedicated to provide ventilation for the eastern middle school science classroom in the new northern addition (west of the existing middle/high school mechanical room). This unit will be located in a second floor fan room located above the science classroom.

HRV-3
This HRV will be located at the western end of the 2-story wing of the facility. This unit will provide ventilation to the (3) second floor science classrooms and the adjacent science preparation room and restrooms.

**HVAC Option #2 – Variable Flow Refrigeration (VRF) Heat Pump System with Variable Volume Central Ventilation (Heating and Cooling Provided)**

This option utilizes multiple VRF air-source heat pumps located throughout the facility to provide both cooling and the balance of the heating for the facility. Air-source heat pumps are similar in principle to the water-source heat pumps indicated in Options #1a and #1b indicated above; however, air-source heat pumps exchange heat energy
between the interior space and the exterior air rather than a water loop. To accomplish this, the heat pumps compressor/condenser sections are located outdoors and the indoor units contain only a fan and heat transfer coil. VRF units have variable speed inverter driven compressors that modulate the compressors to match the load of the facility which reduces compressor cycling and increases the unit efficiency. Indoor units can be ducted fan coils or wall/ceiling mounted heads that do not require ductwork. These units can provide both heating and cooling capabilities using only electricity, however, we recommend having a backup source of heating for the coldest days of the year.

The air-source heat pumps will have low ambient heating capabilities and will also have the ability to provide simultaneous heating and cooling. Simultaneous heating and cooling will enable adjacent spaces to be in different modes (either heating or cooling depending on load). This will also enable energy sharing between spaces that are in cooling mode and spaces that are in heating mode similar to the water source heat pump system. The difference between the two systems is that energy sharing will only be between units that are on a single heat pump system rather than the entire facility.

The outdoor heat pump units will need to be located either on the ground or on the roof of the facility as centrally located to the spaces served as is feasible to reduce the amount of refrigeration piping. Coordination will be needed to locate these units.

We recommend installing a backup natural gas fired hot water system to provide heating during the coldest days of the year. We recommend installing the same high efficiency boilers with dedicated circulator pumps as indicated in Options #1a and #1b. These boilers will provide full backup heating capabilities for the facility. The current facility utilizes heating hot water throughout. Due to the age of the facility and the configuration of the new addition/renovation, we recommend replacing all of the heating hot water piping with a new system that has single heating plant. The hydronic heating system is to be piped as a primary-secondary system with multiple duplex circulator pump sets to circulate the heating hot water to the different wings of the building. Our preliminary estimates are that there will be (5) duplex pump sets for the facility with dedicated piping systems. All of the new circulator pumps will have either ECM’s or premium efficiency motors with pump mounted Variable Frequency Drives (VFDs) to modulate the speed of the pumps to match the building heating load by maintaining individual hydronic system differential pressure set points. The hydronic system will employ a differential pressure reset control strategy that increases the differential pressure set point when the most open valve reaches approximately 90%; the differential pressure set point will reset down when the most open valve is approximately 70%.

This system provides full facility cooling and the balance of the heating load of the facility using the electrically powered heat pump system rather than using fossil fuel fired boilers. This system also provides the ability for energy sharing between zones in cooling and zones in heating on each individual heat pump system.

Facility Conditioning and Ventilating Equipment

Typical Classroom

The classrooms throughout the facility shall be predominantly conditioned using the VRF air-source heat pumps. A typical classroom shall have a ceiling suspended fan coil indoor heat pump unit. Our initial estimate is that a nominal 2-ton indoor heat pump will be required for all classrooms 1,000 sq.ft and smaller. The indoor heat pumps will have variable speed EC fan motors, MERV8 filters and BACnet controls package. The heat pump supply shall be ducted to above the ceiling (where applicable) or through the structure (where applicable). The return ductwork shall be connected to ceiling return grilles.

Our initial estimate is that a nominal 3-ton indoor heat pump will be required for all classrooms larger than 1,000 sq.ft.

Backup hot water heating will be provided for each zone. All of the new spaces, and the spaces with older unit ventilators (or spaces that did not have previously contain unit ventilators) will have duct mounted hot water heating
coils installed downstream of the heat pump fan coil units. The reheat coils will have 2-way modulating control valves controlled by the DDC system and balance valves to maintain space temperature when the heat pump cannot provide the necessary capacity. Spaces with newer existing unit ventilator may utilize the existing unit ventilators for backup hot water heating. To be converted for backup heating capabilities, the outdoor air components of the unit ventilators will be removed, and the control valves will be replaced with 2-way modulating control valves.

Each classroom will have a supply and return VAV (Variable Air Volume box) to control the ventilation air. Outdoor air and exhaust will be ducted to each classroom. Each classroom will be a single ventilation zone with Carbon Dioxide (CO2) monitoring; the VAVs will modulate as necessary to maintain CO2 levels below set point values in each zone.

**Typical Science Classroom**

The science classrooms will be conditioned by the same heat pumps indicated above for the typical classrooms. See Options #1a and #1b for science classroom ventilation.

**Typical Office/Administrative and Meeting Spaces**

The offices in the facility will be conditioned using either a fully ducted heat pump fan coil unit or exposed wall or ceiling mount heat pump indoor unit depending on the specific application. Backup heating will be provided for each heat pump zone. Ducted heat pumps will have duct mounted hot water reheat coils as indicated for the typical classrooms above. All spaces that have individual wall/ceiling mounted heat pumps will have wall mounted fintube radiators equivalent to Runtal sized for low temperature water. Ducted heat pumps indoor fan coil units will typically serve 2-3 offices. Wall/ceiling mounted indoor heat pumps will be installed in each office where applicable.

The office spaces will have a supply and return VAV (Variable Air Volume box) to control the ventilation air to each zone. The ventilation supply air shall be ducted to the heat pump returns (where applicable) and an exhaust grille shall be located in each space. Typical office ventilation zones will be for adjacent 4-5 offices on a single zone with large open office areas and conference/meeting rooms being dedicated ventilation zones. Outdoor air and exhaust will be ducted to each space. Where multiple spaces are served by a single VAV unit, each normally occupied space will have CO2 monitoring; the VAVs will modulate as necessary to maintain CO2 levels below set point values in each zone.

**Typical Gymnasium**

The gymnasiums shall each be conditioned and ventilated by roof mounted air handling units (AHU) with an integral ERV section and economizer cooling function. The air handling units shall utilize an air-source heat pump to condition the supply air distributed to the space. A hot water heating coil with modulating 2-way valve and balance valve will be installed for backup heating capabilities. The units will have fully ducted supply and return systems. CO2 sensors shall be located throughout the space to modulate the ventilation air as necessary to maintain space CO2 levels below set point. The units will have EC fan motors where applicable or premium efficiency motors with VFDs where EC motors are not available. The units will also have modulating compressors, modulating hot gas reheat for dehumidification, variable speed condenser fans with EC motors and head pressure controls, dedicated return fan and modulating recirculation dampers. The hot water piping through the roof will be fully insulated and jacketed and will have heat trace in the piping to prevent the water from freezing.

**Auditorium/PAC**

The auditorium shall be conditioned and ventilated by roof mounted or indoor (second floor fan room) air handling unit (AHU) with an integral ERV section and economizer cooling function. If the unit is mounted inside, it will have ducted outdoor air intake and exhaust air connections to exterior louvers with insulated isolation dampers. The air handling units shall utilize an air-source heat pump to condition the supply air distributed to the space. If the unit is
mounted on the roof, the air-source heat pump will be integral to the unit. If the air handling unit is located inside, the air-source heat pump will be located on the roof with refrigerant lines running from the outdoor condensing (air-source heat pump) unit to the indoor air handling unit DX and hot gas reheat coils. A hot water heating coil with modulating 2-way valve and balance valve will be installed for backup heating capabilities. The unit will have fully ducted supply and return systems. CO2 sensors shall be located throughout the space to modulate the ventilation air as necessary to maintain space CO2 levels below set point. The unit will have EC fan motors where applicable or premium efficiency motors with VFDs where EC motors are not available. The unit will also have modulating compressors, modulating hot gas reheat for dehumidification, variable speed condenser fans with EC motors and head pressure controls, dedicated return fan and modulating recirculation dampers. If the unit is located on the roof, the hot water piping through the roof will be fully insulated and jacketed and will have heat trace in the piping to prevent the water from freezing.

Kitchen
See Options #1a and #1b for kitchen hoods.

Cafeteria/Kitchen
The kitchen/cafe teria shall each be conditioned and ventilated by a new roof mounted make-up air units (MAU) with an integral ERV section and economizer cooling function. The make-up air unit shall utilize an air-source heat pump to condition the supply air distributed to the space. A modulating gas fired heater section upstream of the heat pump heating coil will pre-condition the air prior to the heat pump coil. The units will have fully ducted supply and return systems. The cafeteria and kitchens shall be separate heating/cooling zones. Each zone shall have a separate supply VAV’s with duct mounted hot water reheat coils with individual 2-way modulating control valves with balance valves, however there will be (1) return zone. CO2 sensors shall be located throughout the space to modulate the ventilation air as necessary to maintain space CO2 levels below set point. The units will have EC fan motors where applicable or premium efficiency motors with VFDs where EC motors are not available. The units will also have modulating compressors, modulating hot gas reheat for dehumidification, variable speed condenser fans with EC motors and head pressure controls, dedicated return fan and modulating recirculation dampers.

The make-up air unit shall modulate the return/exhaust air down to match the combined kitchen exhaust hood air flow and provide the necessary make-up air to maintain the cafeteria/kitchen space at a neutral pressure.

2nd Floor FACS Room
See Options #1a and #1b for 2nd Floor FACS exhaust recommendations.

Entrance Lobby
The main entrance lobby will be conditioned by ducted indoor heat pump fan coil units. Backup heating will be provided by hot water reheat coil installed in the ductwork downstream of the fan coil unit. A 2-way modulating control valve with balance valve will be installed to vary the hot water flow to match the heating load. Our initial estimate is that the lobby will need (3) nominal 4-ton ducted fan coil heat pumps based on our initial estimates. The lobby will have a dedicated ventilation zone with supply and exhaust VAVs.

The main entrance vestibule will be conditioned by (2) recessed ceiling mounted hot water cabinet unit heaters. The vestibule will not get any ventilation air and will only be heated to 50 degrees per Vermont Commercial Energy Code requirements.

Library
The library will be conditioned by ducted indoor heat pump fan coil units. Backup heating will be provided by hot water reheat coil installed in the ductwork downstream of the fan coil unit. A 2-way modulating control valve with balance valve will be installed to vary the hot water flow to match the heating load. Our initial estimate is that the
library will need (2) nominal 3-ton ducted fan coil heat pumps based on our initial estimates. Although the library
currently has (2) unit ventilators, it does not appear as though they will fit in their current locations based on the pre-
liminary design drawings. These unit ventilators may be relocated and reused elsewhere in the facility (for heating
only, not for ventilation) if there is a suitable location.

The library will have a dedicated ventilation zone with supply and exhaust VAVs.

**Corridors**

The corridors will be conditioned by either ducted heat pump fan coils with duct mounted hot water reheat coils or
ceiling mounted indoor heat pumps with hydronic fintube equivalent to Runtal. Heat pumps and/or fintube will be
predominantly located near exterior entrances or exterior exposures. The corridors will have dedicated ventilation
zones that are tied into the ventilation for restrooms off of the corridors.

**Kitchen off of Lobby**

See Options #1a and #1b for the exhaust/make-up air recommendations for this kitchen.

**Ventilation Unit Zones**

Below are the preliminary zones that each ventilation unit is anticipated to serve based on preliminary designs and
initial estimates. Potential unit locations are also indicated below. Both the unit locations, zones served, and quanti-
ties are subject to change with further refinement of the design.

**ERV-1**

See Options #1a and #1b for the areas served and the possible unit location. This unit will have an integral air-
source heat pump with modulating compressors, modulating hot gas reheat coil and controller, variable speed cond-
denser fans with EC motors and head pressure controls and a backup hot water heating coil with a 2-way modulat-
ing control valve and balance valve. The hot water piping will be insulated and jacketed with electric heat trace in-
stalled to prevent the piping from freezing.

**ERV-2**

See Options #1a and #1b for the areas served and the possible unit location. This unit will have an integral air-
source heat pump with modulating compressors, modulating hot gas reheat coil and controller, variable speed cond-
denser fans with EC motors and head pressure controls and a backup hot water heating coil with a 2-way modulat-
ing control valve and balance valve.

**ERV-3**

This ERV is expected to be located in a second floor fan room above the most north-western classroom pod in the
addition, north of the original middle/high school as indicated in Options #1a and #1b. The indoor unit will have a
backup heating hot water coil with a 2-way modulating control valve and balance valve. The unit will have a DX
cooling/heating coil, a hot gas reheat coil and modulating EC fan motors.

A separate air-source heat pump condensing unit will need to be located outside. The exact location of the unit will
need to be coordinated to minimize noise and aesthetic impact. The unit will have modulating compressors, modu-
lating condensers fans with EC motors and head pressure control and a low sound package. The heat pump and hot
gas reheat coil refrigerant piping will be run from the indoor ERV coils to the condensing unit.

**ERV-4**

This ERV is expected to be located in a second floor fan room above the eastern new classroom pod in the addition,
north of the original middle/high school as indicated in Options #1a and #1b. The indoor unit will have a backup
heating hot water coil with a 2-way modulating control valve and balance valve. The unit will have a DX cooling/
heating coil, a hot gas reheat coil and modulating EC fan motors.
See ERV-3 above for outdoor remote condensing unit options.

ERV-5
See Options #1a and #1b for the areas served and the possible unit location. See ERV-1 above for options regarding air-source heat pump with backup hot water heating.

ERV-6
See Options #1a and #1b for the areas served and the possible unit location. See ERV-1 above for options regarding air-source heat pump with backup hot water heating.

ERV-7
See Options #1a and #1b for the areas served and the possible unit location. See ERV-1 above for options regarding air-source heat pump with backup hot water heating.

ERV-8
See Options #1a and #1b for the areas served and the possible unit location. See ERV-1 above for options regarding air-source heat pump with backup hot water heating.

ERV-9
See Options #1a and #1b for the areas served and the possible unit location. See ERV-1 above for options regarding air-source heat pump with backup hot water heating.

ERV-10
See Options #1a and #1b for the areas served and the possible unit location. See ERV-1 above for options regarding air-source heat pump with backup hot water heating.

HRV-1
This HRV will be dedicated to provide ventilation for the northwestern middle school science classroom. This unit will be located in a second floor fan room located above the science classroom. The indoor unit will have a backup heating hot water coil with a 2-way modulating control valve and balance valve. The unit will have a DX cooling/heating coil, a hot gas reheat coil and modulating EC fan motors.

A separate air-source heat pump condensing unit will need to be located outside. The exact location of the unit will need to be coordinated to minimize noise and aesthetic impact. The unit will have modulating compressors, modulating condensers fans with EC motors and head pressure control and a low sound package. The heat pump and hot gas reheat coil refrigerant piping will be run from the indoor ERV coils to the condensing unit.

HRV-2
This HRV will be dedicated to provide ventilation for the eastern middle school science classroom in the new northern addition (west of the existing middle/high school mechanical room). This unit will be located in a second floor fan room located above the science classroom. The indoor unit will have a backup heating hot water coil with a 2-way modulating control valve and balance valve. The unit will have a DX cooling/heating coil, a hot gas reheat coil and modulating EC fan motors.

A separate air-source heat pump condensing unit will need to be located outside. The exact location of the unit will need to be coordinated to minimize noise and aesthetic impact. The unit will have modulating compressors, modulating condensers fans with EC motors and head pressure control and a low sound package. The heat pump and hot
C O N S U L T A N T  R E P O R T S

gas reheat coil refrigerant piping will be run from the indoor ERV coils to the condensing unit.

HRV-3

See Options #1a and #1b for the areas served and the possible unit location. See ERV-1 above for options regarding air-source heat pump with backup hot water heating.

HVAC Option #3—Hot Water Heating with Variable Volume Central Ventilation (Heating Only Provided; Heating and Cooling Provided in Offices/Administration)

Option #3 is a cost effective alternative to the water source heat pump and air-source VRF system that provides only heating for the balance of the facility by utilizing only hot water to heat the facility. This option still retains the central Energy Recovery Ventilators (ERV) and Heat Recovery Ventilators (HRV) specified in Option #2 with air-source heat pumps and backup hot water heating coils. Heating shall be provided by fin-tube radiation and/or hot air using duct mounted reheat coils.

We recommend installing the heating hot water hydronic system including multiple high efficiency natural gas fired boilers along with (5) duplex secondary circulator pump zones as indicated in Option #2.

The ERVs, HRVs, and AHUs sizes will be the same as in Option #2 indicated above. Generally, the facility would not have cooling capabilities in this option with the exception of the office and administrative areas. For the balance of the spaces that do not have cooling, the ERVs and HRVs will be utilized to provide some dehumidification of the spaces by overcooling the incoming ventilation and then using hot gas reheat to heat the air back to the desired neutral air temperature. This process reduces the moisture content in the air which will aid in occupant comfort. Dehumidifying the ventilation air will not cool the space though, it only helps to reduce the humidity levels. The air-source heat pumps in all of the units will be utilized for all of the cooling and heating for outdoor air temperatures above a predetermined value. Typically, hot water heating will be utilized for the ERVs/HRVs and AHUs when the outdoor temperatures drop below 20°F.

Variable Refrigerant Flow (VRF) air-to-air heat pump systems will be installed to provide cooling and heating for the administration areas and computer labs. The VRF systems will utilize a single outdoor unit to serve one (1) or multiple indoor units. Simultaneous heating and cooling (enabling energy sharing) capabilities will be provided for the VRF systems. The spaces served by the VRF systems will have backup hot water heating, either via duct mounted reheat coils or fin-tube radiation. Insulated and jacketed refrigerant lines shall be run from the outdoor unit to the indoor units. The VRF systems will be connected to the building DDC system to enable coordination between VRF heating and backup hot water heating.

Facility Conditioning and Ventilating Equipment

Typical Classroom

Classrooms throughout the facility Spaces with newer existing unit ventilator may utilize the existing unit ventilators for backup hot water heating. To be converted for backup heating capabilities, the outdoor air components of the unit ventilators will be removed, and the control valves will be replaced with 2-way modulating control valves. Spaces that do not currently have existing unit ventilators or if there is a desire to remove the unit ventilators will either be heated by fin-tube radiation equivalent to Runtal radiators sized for low water temperature heating, or via ducted hot water fan coil units.

Each classroom will have a supply and return VAV (Variable Air Volume box) to control the ventilation air. Outdoor air and exhaust will be ducted to each classroom. Each classroom will be a single ventilation zone with Carbon Dioxide (CO2) monitoring; the VAVs will modulate as necessary to maintain CO2 levels below set point values in each zone.
Typical Science Classroom
The science classrooms will be conditioned by the same hot water fintube radiation, ducted fan coil units, or unit ventilators where existing are to remain indicated above for the typical classrooms.

See Option #2 for science classroom ventilation.

Typical Office/Administrative and Meeting Spaces
See Option #2 for typical office/administrative meeting space conditioning with VRF heat pumps and hot water backup heating.

See Option #2 for typical office/administrative meeting space ventilation.

Typical Gymnasium
See Option #2 for typical gymnasium conditioning via air handling units with integral energy recovery sections for ventilation.

Auditorium/PAC
See Option #2 for auditorium/PAC conditioning via air handling unit with integral energy recovery sections for ventilation. As indicated in Option #2, this unit may be a packaged rooftop unit with integral air-source heat pump and hot water backup heating, or it may be a separate indoor air handling unit with a split system outdoor air-source heat pump condensing unit.

Kitchen
See Options #1a and #1b for kitchen hoods.

Cafeteria/Kitchen
See Option #2 for Cafeteria/Kitchen conditioning and ventilation air (including kitchen exhaust make-up air).

2nd Floor FACS Room
See Options #1a and #1b for 2nd Floor FACS exhaust recommendations.

Entrance Lobby
The main entrance lobby will be conditioned by ducted hot water fan coil unit(s). The fan coil unit(s) heating capacity will be controlled by a 2-way modulating control valve with balance valve to vary the hot water flow to match the heating load. The lobby will have a dedicated ventilation zone with supply and exhaust VAVs.

The main entrance vestibule will be conditioned by (2) recessed ceiling mounted hot water cabinet unit heaters as indicated in Option #2. The vestibule will not get any ventilation air and will only be heated to 50 degrees per Vermont Commercial Energy Code requirements.

Library
See Option #2 for library conditioning with VRF heat pumps with hot water backup heating.

The library will have a dedicated ventilation zone with supply and exhaust VAVs.

Corridors
The corridors will be conditioned by hydronic fintube radiation equivalent to Runtal radiators sized for low temperature water, or ducted hot water fan coil units, or ceiling mounted cabinet unit heaters depending on the specific location. Heating will be predominantly located near exterior entrances or exterior exposures. The corridors will have dedicated ventilation zones that are tied into the ventilation for restrooms off of the corridors.
Kitchen off of Lobby
See Options #1a and #1b for the exhaust/make-up air recommendations for this kitchen.

Ventilation Unit Zones
Below are the preliminary zones that each ventilation unit is anticipated to serve based on preliminary designs and initial estimates. Potential unit locations are also indicated below. Both the unit locations, zones served, and quantities are subject to change with further refinement of the design.

ERV-1
See Option #2 for this unit’s location, options, and potential area served.

ERV-2
See Option #2 for this unit’s location, options, and potential area served.

ERV-3
See Option #2 for this unit’s location, options, and potential area served.

ERV-4
See Option #2 for this unit’s location, options, and potential area served.

ERV-5
See Option #2 for this unit’s location, options, and potential area served.

ERV-6
See Option #2 for this unit’s location, options, and potential area served.

ERV-7
See Option #2 for this unit’s location, options, and potential area served.

ERV-8
See Option #2 for this unit’s location, options, and potential area served.

ERV-9
See Option #2 for this unit’s location, options, and potential area served.

ERV-10
See Option #2 for this unit’s location, options, and potential area served.

HRV-1
See Option #2 for this unit’s location, options, and potential area served.

HRV-2
See Option #2 for this unit’s location, options, and potential area served.

HRV-3
See Option #2 for this unit’s location, options, and potential area served.
Electrical – General

Power

The existing electrical infrastructure in much of the facility varies between approximately 25 and 60 years old. There have been some revisions and upgrades in the older portion of the building, such as a new main electrical entrance located at the eastern end of the facility. However, there still appears to be many original panels throughout the facility which may be difficult to acquire replacement breakers for. It was noted that some classrooms and offices did not appear to have an adequate quantity of receptacles. Those classrooms and offices utilized power strips and extension cords to satisfy the power the devices located in each room.

Based on the size of the addition and the age of the existing infrastructure, upgrading the entire electrical infrastructure and installing a new code compliant electrical system that meets the program requirements for each space will be required. The service entrance voltage would be revised to 277/480 volts to accommodate proposed HVAC system improvements and to enable reduced conductor sizing. Existing electrical systems from the era of much of the facility usually contains shared neutrals which are not permitted per code. A new electrical system will utilize multiple smaller transformers in a few smaller electrical rooms in centrally located areas of the facility to provide 120/208 volt power for that area of the facility only. Most of the new HVAC system will be powered by the 277/480 volt system to reduce the size of the transformers and the electric losses. Using 277/480 volts also reduced infrastructure costs by reducing equipment sizing.

There are a number of locations where it appears neutral conductors were shared, or in older portions of the building ground wires were not provided. The lack of ground wires occurred in feeders to panelboards as well as branch circuits to receptacles. It also appears that in some locations conduits and armored cable was not installed as required per code within ceilings. As a result of all these, it will most likely be required to run all new circuiting within the school. To save on costs, armored (MC or AC) cable would be used for branch circuits where feasible.

Provided more receptacles throughout the school is recommended.

Lighting

The balance of the existing facility utilizes 32W T8 fluorescent lamps for lighting. The current fixtures are a mix of 2x2, 2x4, 1x4, and 1x8 sizes in both recessed and surface mounted installations. We recommend contacting Efficiency Vermont to determine the savings and incentives available to change lighting as part of the reconstruction. The current lighting is also typically direct lighting which tends to have more glare. There are new lighting technologies that can improve the lighting quality and reduce the glare to make the lighting more comfortable.

There are currently occupancy sensors installed for a significant portion of the existing facility. The occupancy sensors are predominantly located in classroom spaces, and it was noted that many storage rooms and some offices did not have occupancy sensor control. It is also recommended to install occupancy sensors with manual on/auto off functionality to reduce unoccupied illumination. We recommend installing occupancy sensors in the locations that currently do not have them and all of the new addition spaces.

We recommend working with Efficiency Vermont to discuss further incentives for using network lighting controls that may result in further energy savings.

As part of any lighting upgrades in the auditorium or stage areas, the stage lighting control system should be replaced. The existing control system likely would not work well with newer lighting technologies. It appears much of the controls are older, making repairs and replacement difficult. These older system, because they are usually custom made, also tend to be less safe than standard lighting control systems. We recommend hiring a lighting designer that specializes in stage lighting to design the new stage lighting and stage lighting controls.

As part of the new construction, new LED light fixtures would be used throughout the facility. LED lighting provides
for significantly less maintenance as the fixtures do not use lamps or bulbs. New LED fixtures generally last 50,000+ hours before needing to be replaced. This is particularly economical in locations with high ceilings such as the gymnasiums and the auditorium where lamp changes can be expensive due to the requirement of renting or owning a man lift. LED lighting enables spaces to utilize dimming control. Dimming can significantly reduce electrical consumption as fixtures can be dimmed to provide only the amount of lighting the specific occupant requires. The dimming function is also useful in locations with exterior exposure; daylight harvesting control can dim rows of fixtures as daylight enters through exterior glazing. We recommend installing pendant mounted direct/indirect lighting for the balance of the classrooms in the facility. Where pendant mounted fixtures are not feasible, we recommend installing recessed 2x2 fixtures with a direct/indirect style of illumination. A new lighting technology that is becoming more prevalent is the ability to alter the color temperature of the fixtures. This has the benefit of matching a circadian rhythm by varying the lighting color temperature with the time of the day. This may be particularly beneficial for locations where trauma victims are anticipated to occupy. The lighting color temperature can be reduced to a warmer light in areas to provide aid in providing a calmer atmosphere, while cooler color temperature lighting can be used to provide for better illumination for more visual tasks.

All exterior exit locations shall be provided with emergency egress lighting. Much of the existing facility is illuminated with building mounted LED wall packs. We recommend continuing this installation strategy by installing building mounted LED wall packs with either integral battery backup power or a central inverter to provide power to multiple fixtures for the addition, and replacing all of the non-LED existing exterior fixtures.

With all lighting being replaced, the lighting system will be fed via the 277/480 volt system to reduce infrastructure costs, transformer sizes and electric losses.

Fire Alarm

The existing Simplex 4002 fire alarm system does not comply with current NFPA guidelines for fire alarm installations. As part of any reconstruction the entire fire alarm system and infrastructure would be replaced and a new, addressable fire alarm system with full voice evacuation that complies with local, state and NFPA requirements be installed. The fire alarm would tie into the security and lighting control systems for enhanced safety.

Telecom/Security

Reuse of the existing data/phone infrastructure is impractical and replacement of all data circuits is recommended. The older phone lines would be removed entirely and the use of VOIP phones recommended. The existing IT equipment would be reviewed as to whether it could be reused. It is recommended the school district’s IT department start to develop a plan for how a new telecommunication infrastructure should be designed.

The existing security system vendor should also be contacted to determine what, if any, existing equipment can be utilized as part of a building reconstruction. It is expected the existing cabling infrastructure would be replaced due to it being impractical to attempt to reuse it.

Plumbing - General

We recommend replacing the balance of the domestic water piping in the facility. Based on the age of the facility, it is likely that there is lead in the piping solder used in the older areas of the facility. There are also multiple water service entrances for the facility. We recommend consolidating to (2) domestic water service entrances; (1) entrance would be located at the fire department entrance and will serve the northern half of the facility, and (1) entrance would remain in the elementary school boiler room area to serve the southern half of the facility. The new water service entrances will have backflow preventers. We recommend having a cross-tie with an isolation valve between the (2) domestic water services to enable either service to provide water to the entire facility in the case of a shutdown of either service.

We recommend reusing the (2) high efficiency natural gas fired water heaters currently located in the facility. Cur-
rently the kitchen water heater and the second floor fan room water heater are both high efficiency condensing type. We recommend relocating the second floor fan room water heater to the new main boiler room to serve the northern half of the facility and keeping the kitchen water heater to continue serving the kitchen. The northern half of the facility may require an additional water heater depending on the final fixtures quantities and types. A new high efficiency natural gas fired water heater (or (2) water heaters for redundancy) will be installed in the existing elementary mechanical room to provide hot water to the southern portion of the facility. As an add-alternate, if Option #1a or #1b is selected, we recommend installing an approximately 250 gallon domestic hot water thermal storage tank (final sizing will depend on final fixture quantities and types) to function as a preheat tank for the gas fired water heater in each mechanical room for the water heater(s) serving the northern half of the facility and the water heater(s) serving the southern half of the facility. A 15-ton (final sizing TBD) water-to-water heat pump that connects to the facility heat pump loop will heat the domestic hot water through a brazed plate (domestic water rated) heat exchanger for each preheat tank.

A new domestic hot water recirculation system will be install for each domestic hot water system in the facility. The new domestic hot water recirculation systems will bring hot water close to each fixture and will use balance valves throughout to enable accurate control of flow to the branches. The domestic hot water recirculation systems will be tied into the new building DDC system so that they can be monitored and controlled.

We recommend consolidating the natural gas entrances at the facility from (5) to (2), (1) entrance for the balance of the facility located near the new main boiler room at the northern end of the facility and (1) entrance for the kitchen and kitchen make-up air unit. The natural gas piping will be run to the natural gas fired equipment throughout the facility such as the water heaters, boilers, ranges in the FACS room, make-up air unit etc.

The existing facility generally has older, manually operated fixtures with just a few newer sensor operated water closets and a few newer waterless urinals. The balance of the fixtures in the facility do not conform to current low flow requirements of the International Plumbing Code. We recommend replacing all fixtures (except for the waterless urinals if the owner would prefer to keep them) with low flow versions conforming to the plumbing code where applicable. For sanitary purposes, we recommend replacing all manual faucets and flush valves in public areas with sensor operated faucets.

We recommend replacing all roof drains for the sections of roof that will be replaced with renovation. All new roof drains will be located in low points established by the new roof system, and sized per the current edition of the International Plumbing Code. We recommend installing overflow drainage for all locations where there isn’t scuppers or another means of overflow provided. This is especially important in the recessed roof area over the existing janitor’s office space near the locker room area of the facility.

Due to the age of the facility, we recommend having the underslab waste/vent piping inspected and scoped to determine the condition of the piping. We recommend planning on replacing all of the underslab waste piping unless it is determined to be in good condition following the inspection. Coordination will be required with the site/civil designer to determine where the waste piping is to be discharged from the facility.

Fire Protection - General

Currently, it appears as though the existing facility is has complete fire protection coverage from a water service entrance to the west of the existing auditorium. This water service entrance location will be required to be relocated due to the programming changes proposed for the renovations. We recommend installing a new water service entrance sized to provide a complete NFPA 13 fire protection system in the facility. We also recommend installing complete fire protection coverage for the additions to the facility that complete with NFPA 13 requirements. We recommend hydraulic calculations and hydrant flow testing be performed to ensure the existing water service is capable of supporting the new facility addition.

END OF REPORT

103
APPENDICES
MEMORANDUM

DATE: 6-14-18

TO: Project

FROM: TAC

PROJECT: Winooski School District

TC NO: A2018002

RE: Building Code Summary

This code review is based on the following codes:
2015 Vermont Fire & Building Safety Code
2015 Fire Code - NFPA 1
2015 International Building Code (IBC)
2015 International Plumbing Building Code
2012 Vermont Access Rules
2010 ADA Standards for Accessible Design

This Code Review is an explanation of the existing building as currently configured and identifies relative to current codes and assumes no reconfiguration of interior spaces. Additions will trigger additional requirements, and any planned reconfigurations of any spaces should be reviewed against NFPA Chapter 49 to determine the extent of required upgrades.

Building description: predominantly single story (except areas of two stories at original 1957 high school and 1991 PAC addition).

Building area: approx. 141,330 sf

Classroom Year - serves second story in 1957 wing.

Assumed Construction type: 2B

Sprinkler system: Present. Covers entire building, installed in 1992 and assumed to be designed to applicable standards at time of construction.

Occupancy Type: IBC Educational Group F (206.1)

Associated Group F Occupancies - Assembly occupancies associated with Group F are not considered a separate occupancy IBC 303.1.3

Table 506.2. Height and Area:

The area of the existing building is over the allowable area limitation by approximately 73,000 sf. 2 hr Fire Barriers are noted on drawings by Leonard Duffy and Associates (dated 1991). These do not appear to meet the requirements of a 2hr high challenge fire wall as would be required by current Vermont Fire Safety and Building Codes.

508.2.3 Aggregate accessory occupancies shall not occupy more than 10% of the floor area

VT Fire & Building Safety Code - delete and replace section 706 Fire Wells: In accordance with NFPA 1 and NFPA 221 - High Challenge Fire Wells shall be installed for educational occupancies with 250 or more pupils (per table 1604.5 IBC)

209 BATTERY STREET BURLINGTON VERMONT 05401 USA 802.863.2775
10.1.3.3 Assembly spaces shall comply with Chapter 13 Existing Assembly occupancies.

15.2.5.2 Doors -- and corridors: 50 ft max (sprinklers)

15.2.5.3.1. Education and Storage: Common Path of Travel: 100 ft max (sprinklers).

15.2.5.4 Rooms over 1000 sf or 50 occupants require two exit access doors, each providing access to two separate exits. Both doors can open to the same corridor, provided the corridor leads in two opposite directions to two separate exits.

15.2.5.5 Classrooms doors must exit directly into a corridor; they are not permitted to exit through an intervening space, except:

   5) Approved existing arrangements shall be permitted to continue in use.

15.2.6.2 Travel distance: 200 ft max (sprinklers).

15.2.9.1 Emergency lighting -- required.

15.2.11.1.1 Rescue windows - not required in sprinklered buildings.

15.3.1.3 Stairways do not need to be enclosed provided they serve only one adjacent floor, the stairway is not connected to stairways serving other floors, and the stairway is not connected with corridors serving other than the zero floors involved.

15.3.4.1.1 Fire alarm -- required.

15.3.4.2 Initiation - Manual and upon sprinkler activation.

15.3.4.2.3.1 Manual pull stations may be eliminated under certain circumstances.

15.3.4.3.1.1 Occupant notification shall be automatic per 9.8.3

15.3.6 Corridors

15.3.6.2 Corridor walls are required to be smoke partitions. (sprinklers)

15.3.7 Smoke Compartment

15.3.7.2.2 Subdivision into smoke compartments is not required in buildings with an approved sprinkler system.