# Engineering Report

# MASTER PLAN FOR EFFICIENCY UPGRADES

# ST. JAMES OF JERUSALEM

220W Penn St., Long Beach, NY 11561

PREPARED FOR

**The Trustees of the Estate Belonging to the Diocese of Long Island**

**The Episcopal Diocese of Long Island**


PREPARED BY

***FPM ENGINEERING AND GEOLOGY, P.C.***

640 Johnson Av. Suite 101, Bohemia, NY 11716


**20 September 2022**

# ENGINEERING REPORT

**Master Plan for Efficiency Upgrades** 20 September 2022
St. James of Jerusalem Episcopal Church
220W Penn St., Long Beach, NY 11561

## REPORT INTENT:

This report was undertaken to develop at 'Master Plan for Efficiency Upgrades' based on review of the prior ASHRAE Level I Energy Audit and Solar Panel Proposals prepared by others and provided by the Parish with further engineering review of the viability, capital cost, and energy savings potential of each item recommended within them to provide a comprehensive plan for moving forward in a cost-effective manner.

## FINDINGS:

**A. General Building Information:** The Building is comprised of the Church and Rectory structures, which share a common interior wall and are served by common utility systems.

Due to the landmark status of the Building (listed as eligible on both the NYS and National Registers), any exterior improvement may require additional review and permitting costs.

Additional information on existing conditions is within the following Site Data Sheet, Photolog, and Existing Conditions Floor Plan.

**B. Base Flood Elevation and Design Flood Elevation Determination:** Based on the latest FEMA map the Building is located in Zone AE with a base flood elevation (BFE) of 14'. The moderate wave action line crosses the property. Chapter 7 of the Code Ordinances of the City of Long Beach NY indicates the design flood elevation (DFE) as 2 feet above the base flood elevation, which equates to 16'. West Penn Street at the driveway curb-cut for the Building has an approximate elevation of 9'. The First Floor of the Church has an approximate elevation of 15'-4", while the First Floor of the Rectory has an approximate elevation of 13'-10". However, there are grade level entries to the Basement of both the Church and the Rectory that raise flood damage risk.

**C. Electric Service Capacity:** The existing 200A/120-240V electric service is sufficient for the current loads plus the additional to be imposed by replacing gas stoves and dryers with electric and adding an electric vehicle charging station. The electric service will need to be updated to 400A/120-240V capacity if conversion to all electric HVAC (heat pump) systems is pursued.

**D. Electric Panelboard Relocations:** The main electrical panel is currently located in the Basement Boiler Room of the Church. To relocate this panel above the flood elevation it would need to be relocated to the Sacristy. The subpanel for the Rectory is located in its Basement along with telecom panels. To relocate these panels above the flood elevation they would need to be relocated to the First-Floor with the power panel being located in the Rectory Dining Room and the telecom panels being located in the Sacristy. There is also a subpanel in the Church basement Kitchen that should be relocated to the Sacristy.

**E. Applicable Codes and Regulatory Requirements Relevant to Construction:** The Building is located within the City of Long Beach and is subject to its Department of Buildings permit requirements, the technical portions of which rely heavily on the Building Codes of NYS. Installation of a solar photovoltaic system is also subject to review and approval by PSEGLI.

The Episcopal Diocese of Long Island
BROOKLYN • QUEENS • NASSAU • SUFFOLK

## PROPERTY INFORMATION

| | |
|---|---|
| Address | 220 W Penn St., Long Beach, NY 11561 |
| Block, Lot | TBD |
| Building Use | Religious - Church & Rectory |
| Year Built | Circa 1938 (varies per building) |
| Lot Area | 20,000 S.F. (estimated) |
| Gross Floor Area | 5,800 S.F. (estimated) |
| No. of Floors | 2 Floors and Basement (varies per building) |
| Heating/Hot Water System<br>Fuel Type | Boilers: Natural Gas<br>DHWs: Natural Gas |
| Main Electric Service Size | 200 AMP, 1 Phase (serves all buildings) |
| Fire Protection Systems | None |
| NYS Landmark | No, listed as eligible |
| National Register of Historic Places | No, listed as eligible |
| EDLI Owned or Leased | Owned |

## SITE AERIAL VIEW

Photo 1: View of the Church and Rectory Building (Building) from West Penn Street.

Photo 2: View of the stairs leading to the main entry of the Church.

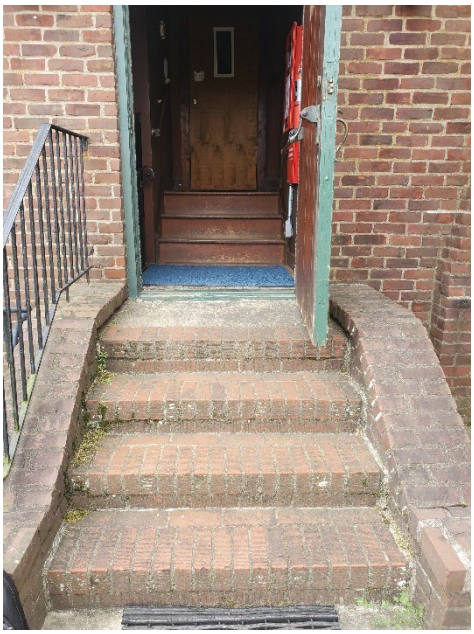


Photo 3: View of the exterior and interior stairs leading to the Church. At the intermediate interior landing, stairs to the left lead down to the Basement.

Photo 4: View of the general rise in grade from West Penn Street to the Church entries. The opening at the edge of the Church is an exterior stair down to the Basement. Note the wall-mounted ACCU – it should be raised.

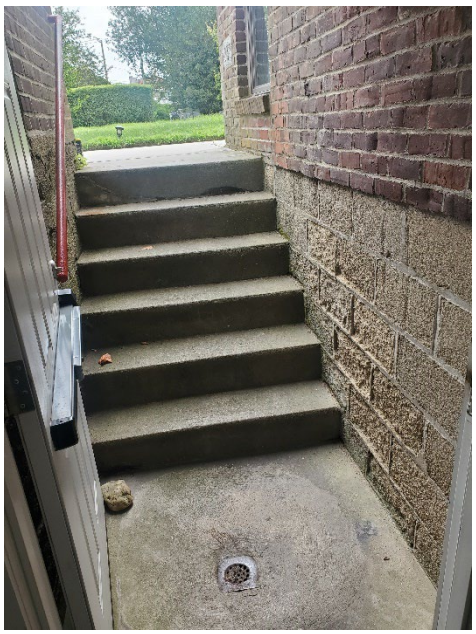


Photo 5: View of the exterior stairs serving the Church Basement. Note the floor drain, which appears to be connected to a dry well.

Photo 6: View of the Rectory portion of the Building. Note its elevated front porch.

Photo 7: Side view of the Rectory showing the stairs to the front porch and the side entry that opens onto a stair landing from which you can go up to the Kitchen or down to the Basement.

Photo 8: View of the rear of the Building. Note the low windows and vent openings. Note also, the wall-mounted ACCU – it should be raised.

Photo 9: View of the electric service transformer serving the Building and others. This is located near the southeast corner of the Building. The transformer will need to be replaced and upgraded 400A capacity to serve new loads.

Photo 10: View of the gas meter, which is located at the southwest corner of the Building.f I retained, the gas meter should be raised to be 48" above the sidewalk.

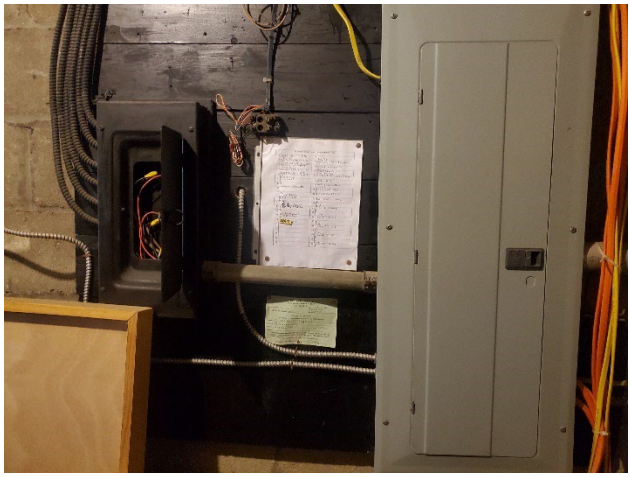


Photo 11: View of the main electric panel, which is located in the Boiler Room of the Church. The incoming service should be located to the 1st Floor of the Church and upgraded to 400A/1-phase capacity.

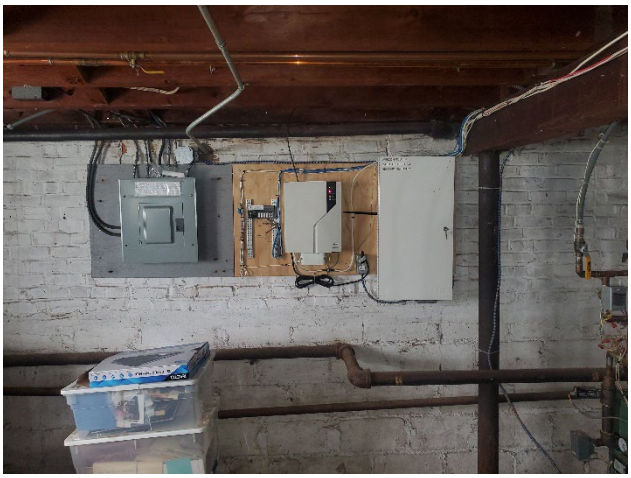


Photo 12: View of the electric subpanel that serves the Rectory portion of the Building and is located in its Basement. Also note the adjacent telecommunications panel. The subpanel should be relocated to the 1st Floor of the Rectory. The telecom equipment should be relocated to the Church due to space considerations.

Photo 13: View of an electrical subpanel within the Kitchen area of the Basement of the Church that should be eliminated. Note also the gas stove, which should be replaced with and electric induction type unit.

Photo 14: View of the gas-fired boiler, its related piping manifolds, and adjacent domestic water heater that serves the Church portion of the Building and is located in the Basement. Such equipment should be relocated to the 1st Floor

Photo 15: View of the gas-fired boiler and domestic water heater that serve the Rectory portion of the Building and are located in its Basement. This equipment should be eliminated and the loads served by new equipment located above the design flood elevation.

Photo 16: View of the gas stove within the Rectory Kitchen. This unit should be replaced with an electric induction type stove.

Photo 17: General view within the Church showing its general construction and interior finishes.

Photo 18: View of a typical high-wall A/C unit and floor-mounted hydronic radiator within the Church.

Photo 19: View of the air-cooled condensing units serving the Church high-wall A/C units and located on the west wall of the Building. These units should be raised.

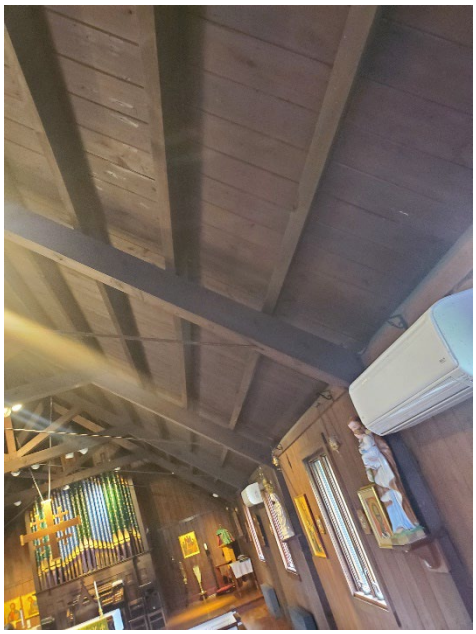


Photo 20: Close-up view of the interior roof-framing of the Church. Adding interior insulation would dramatically affect the aesthetic, and, though more cost effective than adding it to the exterior, is still not recommended.

Photo 21: View of the outside of a typical window in the Church. The windows are in good condition.

Photo 22: View of the inside of a typical window in the Church. There are visible gaps at joints between the window frame and the trim that require sealing to stem air infiltration.

Photo 23: View of a high-wall A/C unit in the Church overcroft.

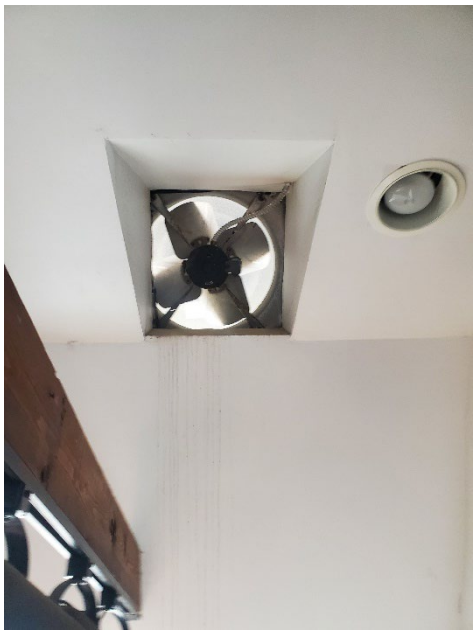


Photo 24: View of an exhaust fan in the Church Overcroft that should be removed and the opening sealed.

Photo 25: View of the Building's domestic water service which is located beneath the lower intermediate landing of the interior stair. Also note the house trap for the Church in the background.

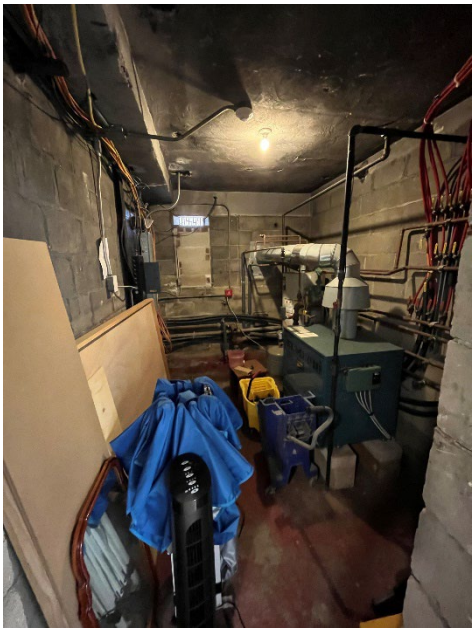


Photo 26: Overall view within the Church Boiler Room. Note the open combustion air vent in the real wall. This opening should be sealed once the replacement equipment (to be located on the 1st Floor) is functional.

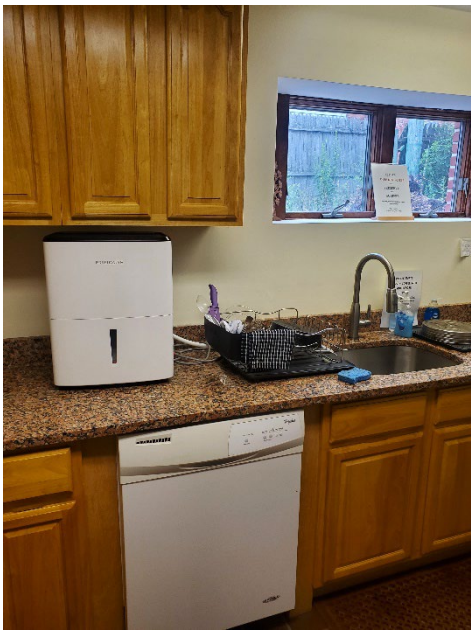


Photo 27: View of a portable dehumidifier that was operating in the Kitchen of the Church. Use of the dehumidifier indicates that the capacity or capacity control of the air conditioners is incorrect.

Photo 28: View of a typical high-wall A/C unit and floor-mounted hydronic radiator within the Church Basement.

Photo 29: General view of the air conditioning supply ductwork and air handler serving the Rectory and located in its Attic. The unit and ductwork should all be within the insulated envelope or much better insulated.

Photo 30: View of the open vent serving the Rectory Attic.

Photo 31: View showing open vents in the roof eaves of the Rectory.

Photo 32: Typical view of the Attic roof framing at area where roof slope changes. Note that both roof sections bear on an interior wall.

Photo 33: View of typical finned-tube hydronic baseboard used to heat the Rectory.

Photo 34: Another view of heating baseboard. Note also the PEX (plastic) tubing used for heating water distribution and routed at the rear of the closet.

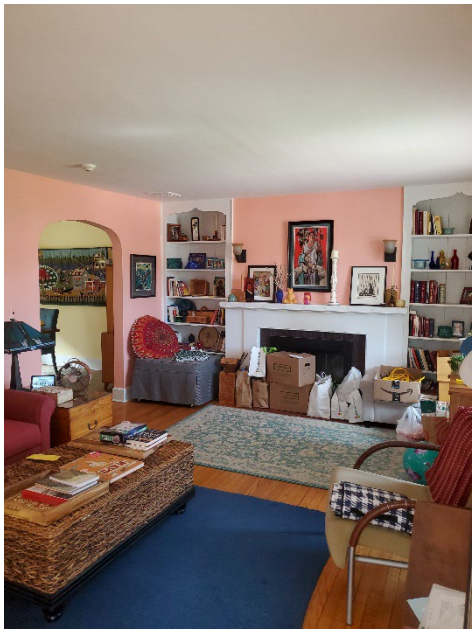


Photo 35: Overall view of the Living Room of the Rectory. Note the single air diffuser and table-mounted fan, which was one of several fans observed throughout.

Photo 36: View of duct risers extending down to 1st Floor through a 2nd Floor closet. Note that the opening is unsealed and the ducts uninsulated.

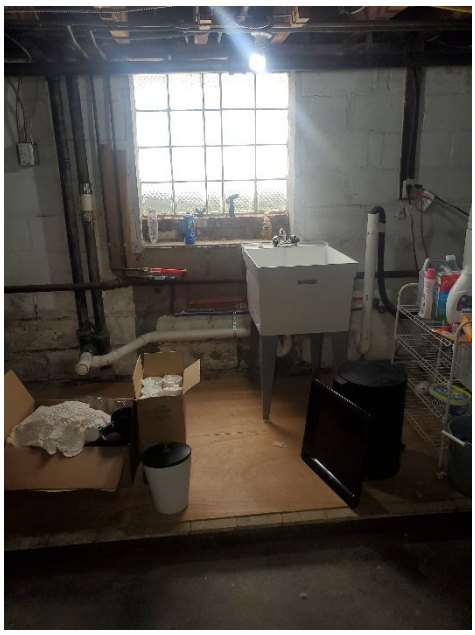
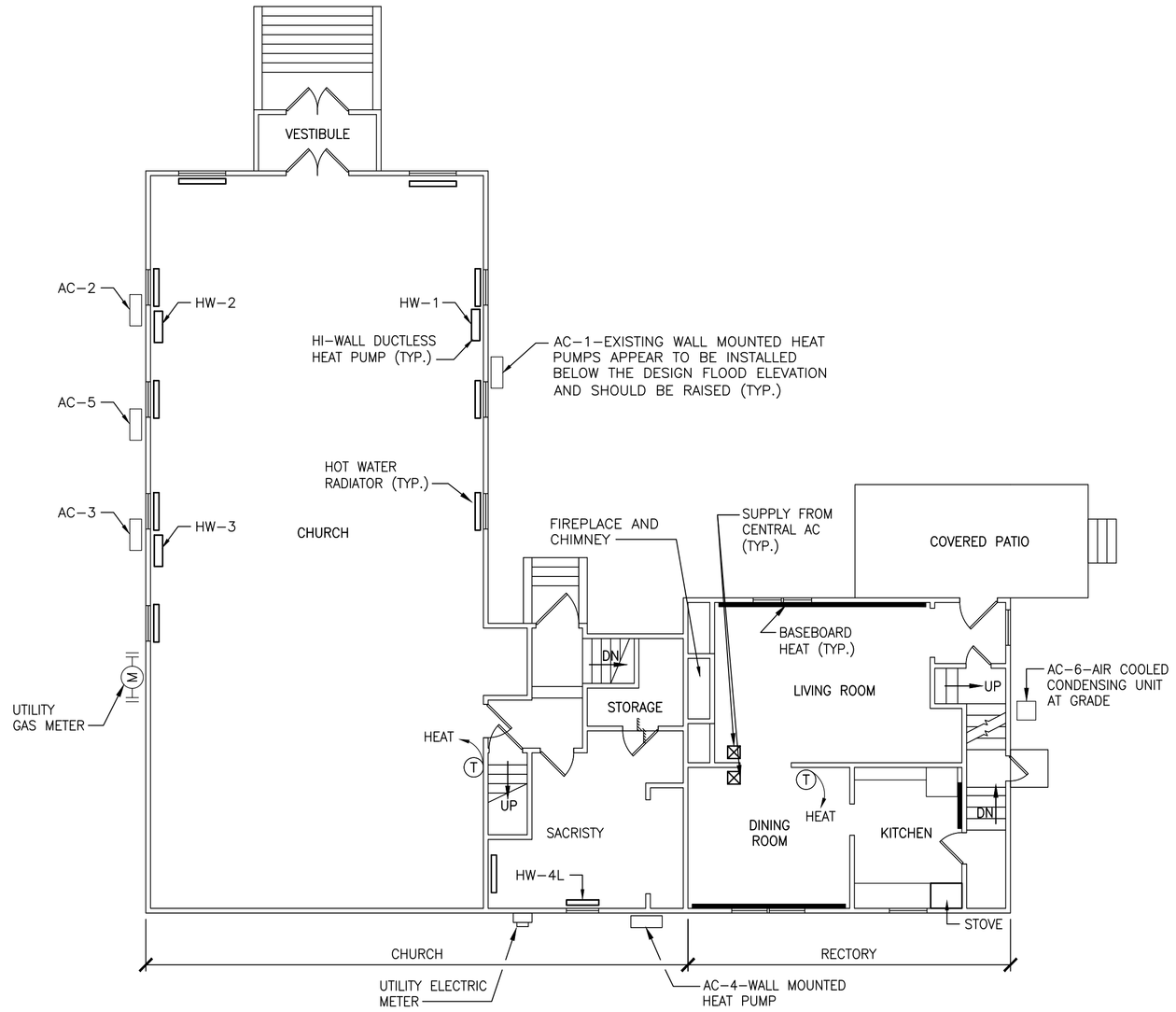


Photo 37: View of the laundry area in the Basement of the Rectory.

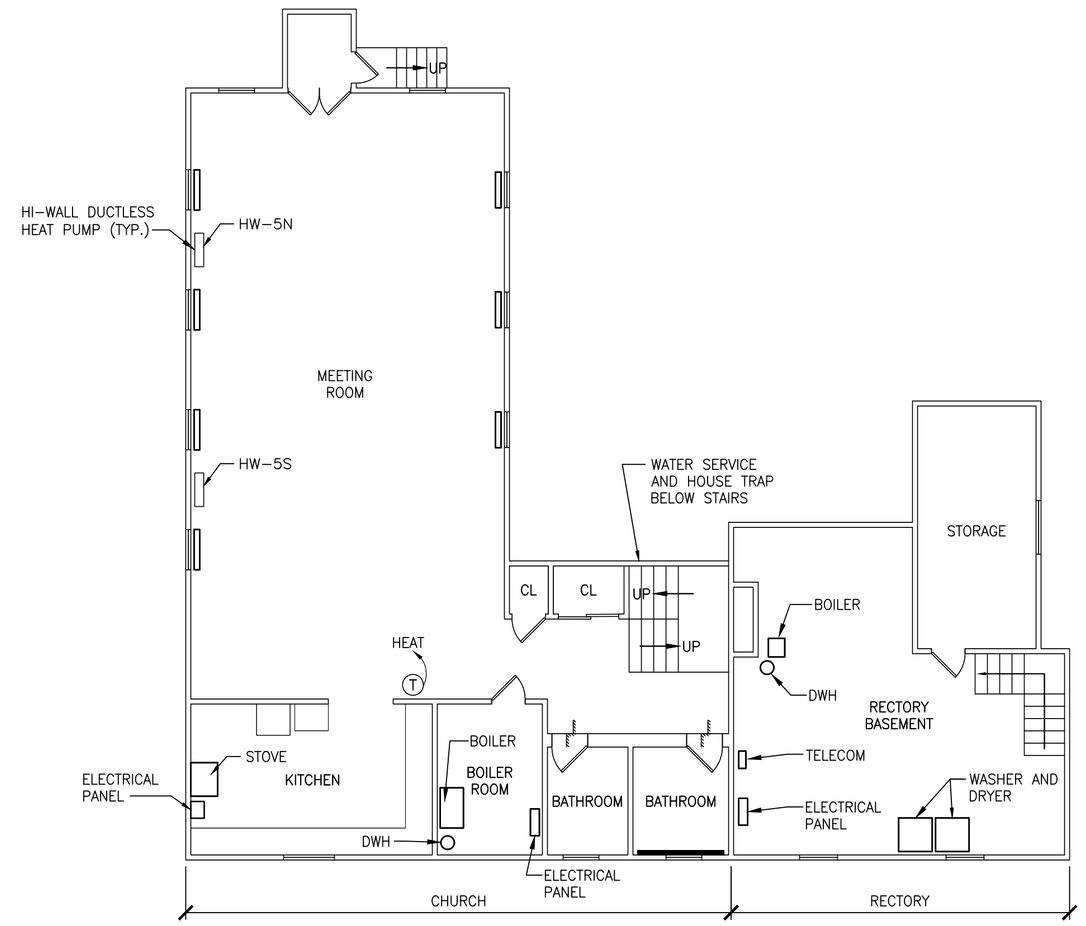
Photo 38: View of Storage Room within the Basement of the Rectory. Note the dehumidifier and floor drain, which appears to be connected to a dry well.

Photo 39: View of an open vent, typical of several. Such vents should be relocated or sealed if not needed.

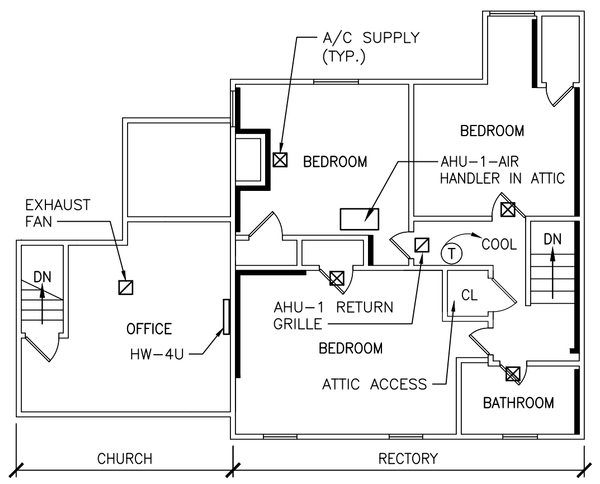
Photo 40: View of the electric meter for the Building. The upgraded replacement should be raised to about 60" above the walkway. Also note the outdoor air intake to the Church Boiler Room referenced in photo 26.



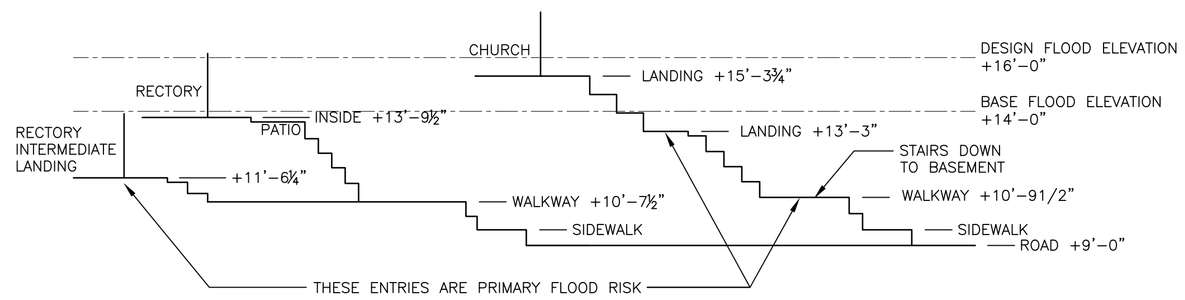

1 FIRST FLOOR
SCALE: 1/8" = 1'-0"




2 BASEMENT
SCALE: 1/8" = 1'-0"




3 SECOND FLOOR
SCALE: 1/8" = 1'-0"




4 BUILDING ELEVATIONS
NTS NOTE: ELEVATIONS SHOWN ARE APPROXIMATE

## HVAC UNIT SCHEDULE

| SYSTEM | SERVICE | OUTSIDE UNIT | INDOOR UNIT/S | SYSTEM COOLING/HEATING (MBH) | REMARKS |
|---|---|---|---|---|---|
| 1 | CHURCH | AC-1 | HW-1 | 30.6/32.0 | BOILER REPORTEDLY USED FOR SUPPLEMENTARY HEATING THESE SYSTEMS |
| 2 | CHURCH | AC-2 | HW-2 | 30.6/32.0 | |
| 3 | CHURCH | AC-3 | HW-3 | 30.6/32.0 | |
| 4 | SACRISTY/OFFICE | AC-4 | HW-4L, HW-4U | 18.0/21.6 | |
| 5 | MEETING ROOM | AC-5 | HW-5N, HW-5S | 31.7/34.9 | |
| 6 | RECTORY | AC-6 | AHU-1 | 30.0/N/A | HEAT VIA BOILER |

3 INCHES WHEN PLOTTED TO SCALE

| NO. | DATE | DESCRIPTION |
|---|---|---|
| | | |
| | | |
| | | |
| – | – | – |

DESIGN CONSULTANT:

**FPM ENGINEERING & GEOLOGY, P.C.**
640 JOHNSON AVENUE, SUITE 101
BOHEMIA, N.Y. 11716
631-737-6200



DESIGNED FOR:
EPISCOPAL DIOCESE OF LONG ISLAND
36 CATHEDRAL AVENUE
GARDEN CITY, NY 11530

PROJECT TITLE AND LOCATION:
MASTER PLAN FOR EFFICIENCY UPGRADES
ST JAMES OF JERUSALEM EPISCOPAL CHURCH
220 W. PENN STREET
LONG BEACH, NY 11561

PROJECT NO: PROJECT #

DRAWING TITLE:
EXISTING CONDITION FLOOR PLANS

| | |
|---|---|
| DESIGN BY: FPM | DRAWING NO. ES-1 |
| DRAWN BY: KC/BF | |
| CHECK BY: CMS | |
| SCALE: AS NOTED | |
| DATE: 9/20/22 | SHEET 1 of 3 |

**F. Evaluation of the Proposed Addition of Insulation to the Thermal Envelope:** The Building and its heating and cooling systems were modeled utilizing Carrier's Hourly Analysis Program. This software is accepted for use by the US Green Building Council for its LEED Rating System. The energy model allows for the analysis and comparison of different system and envelop configurations. Below is a table showing the R value of the wall construction currently as well as after the installation of the recommended insulation from the Energy Audit Report.

| Item | R Value - Church | | R-Value - Rectory | |
|---|---|---|---|---|
| | Current | After | Current | After |
| Basement Walls | 4.0 | 13.0 | 2.5 | 10.0 |
| Walls | 2.9 | 13.0 | 2.9 | 13.0 |
| Ceiling/Roof | 2.9 | 20.3 | 32.9 | 32.9 |

A model of the current Building was developed as well as 5 other models that included the following systems options:

1. Reducing air infiltration while maintaining the existing HVAC systems
2. Option 1 with added insulation
3. Option 1with use of a condensing gas boiler
4. Option 1 with use of all electric HVAC (heat pump) systems
5. Option 4 with added insulation

Adding insulation to the Church will be difficult due to the exposed interior construction. The exposed wood will require detailed work to match/repair any boards and utilities (mostly electric distribution) that would impacted by the work, or a new aesthetic developed.

Providing exterior roof insulation would require re-roofing the entire Church, necessitating reconstruction of all of the fascia boards, gutters, and trim to accommodate the change in thickness of the roofing system.

The Meeting Room walls are finished gypsum board and would need to be demolished and rebuilt to provide additional insulation.

Adding insulation to the Rectory will be difficult due to brick exterior and presumed plaster interior wall construction. The additional insulation would need to be blown-in from the inside of the Rectory and would require wall openings/patching at each of the stud bays.

**G. Utility Cost Analysis of Gas vs. Air-Source Heat Pump:** Utilizing the energy analysis Building models, high efficiency heat pumps were modeled to determine the reductions in energy use between the existing and proposed system with the results shown on the following pages.

**H. Assessment of Removal of Natural Gas Service:** As noted within the table, we recommend continued use of natural gas and the existing hydronic heating systems (radiators and baseboard) during colder (below freezing) weather to assure occupant comfort since the costs for adding insulation are very high and will not result in very appreciable energy use reductions given the base electric use of the Building.

Air-source heat pumps, as currently installed are very efficient on mild winter days but that efficiency drops with lower outdoor air temperatures as the units are effectively absorbing the little heat available from the outside sir. The recommended approach is to reduce natural gas usage through conversion to a high efficiency condensing boilers in combination with utilizing the existing heat pumps for cooling service and during warmer winter weather.

# UTILITY USAGE ANALYSIS - St. James of Jerusalem Episcopal Church, Long Beach, NY

| System Option No. | System Description | Annual Electric Utility Data | | | | Annual Natural Gas Data | | Total Annual Utility Cost |
|---|---|---|---|---|---|---|---|---|
| | | Electric Usage (kWh) | | | Electric Utility Cost | Heating Usage (therms) | Natural Gas Utility Cost | |
| | | HVAC | Other | Total | | | | |
| **Ex.** | Existing Building and HVAC systems | 5,260 | 11,200 | 16,460 | $ 3,185 | 2,390 | $ 2,199 | $ 5,384 |
| **1** | Existing Building and HVAC systems, minimized infiltration | 5,630 | 11,200 | 16,830 | $ 3,260 | 1,655 | $ 1,523 | $ 4,783 |
| **2** | Existing Building and HVAC systems, minimized infiltration, additional insulation | 4,200 | 11,200 | 15,400 | $ 2,965 | 490 | $ 451 | $ 3,416 |
| **3** | Existing Building cooling systems, minimized infiltration, condensing gas boiler | 5,630 | 11,200 | 16,830 | $ 3,260 | 1,360 | $ 1,251 | $ 4,511 |
| **4** | Existing Building, all electric HVAC (heat pumps) | 25,260 | 11,200 | 36,460 | $ 6,825 | 0 | $ - | $ 6,825 |
| **5** | All electric HVAC (heat pumps) with minimized infiltration and additional insulation | 8,670 | 11,200 | 19,870 | $ 3,780 | 0 | $ - | $ 3,780 |

# UTILITY USAGE ANALYSIS - St. James of Jerusalem Episcopal Church, Long Beach, NY

| Annual Utility Data Relative to Existing Building | | | | | | Electric Service Capacity Upgrade Needed? (Yes/No) | Estimated Cost to Construct (less PVS) | Simple Payback (years) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| Electric Usage Difference | | Natural Gas Usage Difference | | Utility Cost Difference | | | | | |
| kWh | % Change | therms | % Change | $ | % Change | | | | |
| Base Case | | Base Case | | Base Case | | No | N/A | | Data for existing building is shown for reference and as a point of comparison for the options. |
| 370 | 2.2% | -735 | -30.8% | $ (601) | -11.2% | No | $ 10,000 | Base Case | Illustrative of how infiltration impacts heating energy use much more than that of cooling. |
| -1,060 | -6.4% | -1,900 | -79.5% | $ (1,968) | -36.6% | No | $ 85,000 | 38.1 | Large capital outlay and little operational savings create long payback and suggest investing in other initiatives. Overall project costs would increase by ~$100,000 (40%) under this option. |
| 370 | 2.2% | -1,030 | -43.1% | $ (873) | -16.2% | No | $ 25,000 | 17.2 | **RECOMMENDED SYSTEM** - Moderate cost for good reduction in natural gas usage when coupled with PVS installation will substantially reduce carbon footprint in a financially prudent manner. |
| 20,000 | 121.5% | -2,390 | -100.0% | $ 1,441 | 26.8% | Yes | $ 50,000 | -27.8 | This option not recommended. Electrical usage increases by a factor of 2.22 and cannot be adequately offset by PVS. Negative payback value indicates operating cost increases. |
| 3,410 | 20.7% | -2,390 | -100.0% | $ (1,604) | -29.8% | Yes | $ 135,000 | 77.9 | Largest capital outlay and minimal operational savings create long payback and suggest investing in other initiatives. Overall project costs would increase by ~$160,000 (56%) under this option. |

I. **Solar Photovoltaic System (PVS) Analysis:** The solar calculator provided by the National Renewable Energy Laboratory was utilized to calculate the available solar capacity as well as the monthly solar output. From this data, a 6.5kW DC system size is possible to be installed on the south facing roof of the Rectory. This system would provide an annual output of 8500 kWh.. Additional panels could be located on other faces of the roof but will provide reduced solar output. Use of the east-facing roof of the Church was modeled and the results yielded an annual output of 4500 kWh.

An image of the layout of the solar arrays and an analysis of their performance is on the following pages.

The solar inverters required to convert the DC solar power into AC power would need to be located above the design flood elevation on the rear of the Building or within the Sacristy near the relocated electrical and telecom panels.

Note that even the output of both arrays is insufficient to offset the annual electric utility usage for any of the system options, including those with additional insulation.

J. **Assessing 'Islanding' or 'Going Off Grid,' versus Remaining Grid-Tied:** . Islanding is not recommended and is not possible given the limits on capacity of the solar panel system. Remaining grid-tied provides a reliable source of power for the Building and also allows any solar that is installed to reduce demand on the grid, helping those consumers without solar while also reducing the need for construction of 'peaking plants' by the utility.

K. **Using Batteries for Standby Power Needs:** This is not recommended since the solar panels cannot produce enough power for the Building, nevermind surplus to charge the batteries, which are expensive, have high embedded costs, and have an ongoing energy use/efficiency effect. Standby power needs would be better met by use of a portable generator.


Approximate Areas of the South (primary, 6.5kW capacity) and East (secondary, 4.5kW capacity and subject to local LPC approvals) solar photovoltaic panel array areas

# SOLAR PHOTOVOLTAIC SYSTEM (PVS) ANALYSIS - St. James of Jerusalem Episcopal Church, Long Beach, NY

| System Option No. | System Description | Utility Electrical Usage Without PVS (kWh) | Electric Service Capacity Upgrade Needed? (Yes/No) | South PVS Data - 6.5 kW DC Array (Used as PVS basis of design, see notes) | | | | | | South & East PVS Data - 11 kW DC Array | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Annual Electrical Data | | | | Estimated Cost to Construct | Simple Payback (years) | Annual Electrical Data | | | | Estimated Cost to Construct | Simple Payback (years) | |
| | | | | AC Output (kWh) | Utility Usage % Reduction | Utility Cost Savings | O&M Costs | | | AC Output (kWh) | Utility Usage % Reduction | Utility Cost Savings | O&M Costs | | | |
| **Ex.** | Existing Building and HVAC systems | 16,460 | No | 8,500 | 51.6% | $ 1,660 | $ 200 | $ 28,000 | 19.2 | 13,000 | 79.0% | $ 2,540 | $ 250 | $ 50,000 | 21.8 | Adding PVS alone to the existing Building will significantly reduce carbon footprint and offer notable reductions in utility costs. |
| **1** | Existing Building and HVAC systems, minimized infiltration | 16,830 | | | 50.5% | | | | | | 77.2% | | | | | Addressing infiltration has a high cost to benefit ratio and should be implemented. |
| **2** | Existing Building and HVAC systems, minimized infiltration, additional insulation | 15,400 | | | 55.2% | | | | | | 84.4% | | | | | The electrical usage reduction is minor because the benefit of the additional insulation is skewed to the winter months. |
| **3** | Existing Building cooling systems, minimized infiltration, condensing gas boiler | 16,830 | | | 50.5% | | | | | | 77.2% | | | | | **RECOMMENDED SYSTEM** - Electrical utility usage reductions are within 5 percentage points of Option 2 and are greater than Option 5, both options having significantly higher capital costs. |
| **4** | Existing Building, all electric HVAC (heat pumps) | 36,460 | Yes | | 23.3% | | | | | | 35.7% | | | | | Significantly increased electrical utility usage and costs relative to other options; requires electric service upgrade increasing overall cost. |
| **5** | All electric HVAC (heat pumps) with minimized infiltration and additional insulation | 19,870 | | | 42.8% | | | | | | 65.4% | | | | | Requires electric service upgrade and relies on adding insulation to the exterior envelope, which markedly increases overall project cost and risk. |

**Notes:**

1. PVS kWh AC outputs are based on data from the NREL estimation program; see appendix.
2. The south PVS array has little impact on the public exterior aesthetic of the Building.
3. It is unlikely that the East PVS array will be allowed by the local AHJ; a west array has less output and may be objected to by the AHJ and the neighboring property.
4. The east array kWh AC output is used as the basis of the recommendations.
5. Even using both solar arrays (11 kW DC total output), PVS production will not meet any option's expected electrical utility usage.

**L. Recommendations:** Based on our analyses, we recommend an energy efficiency upgrade program that substantially reduces the carbon footprint of the Building with limited impacts to its aesthetic and in a financially prudent manner that preserves funds for other worthwhile means to improve the community.

This represents System Option 3 and the recommendations and their associated costs are shown within the table on the following page that includes the rationale for their selection.

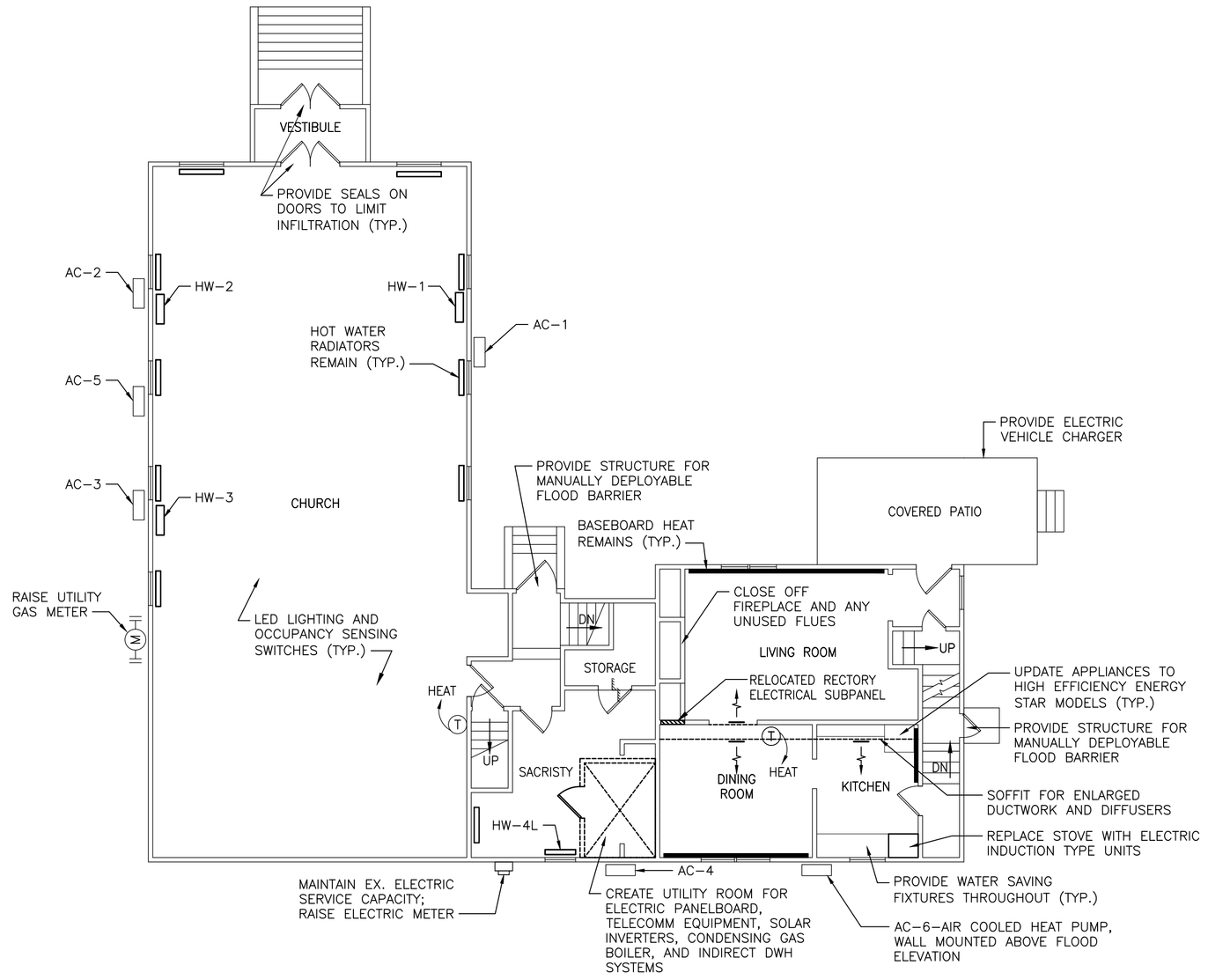
A plan with further information on the recommendations follows the table.

After the plan of the recommended option, is a plan showing the requirement for System Option 5, which was indicated as preferred for its energy savings/emissions reducing potential and was determined to be the most energy efficient option.

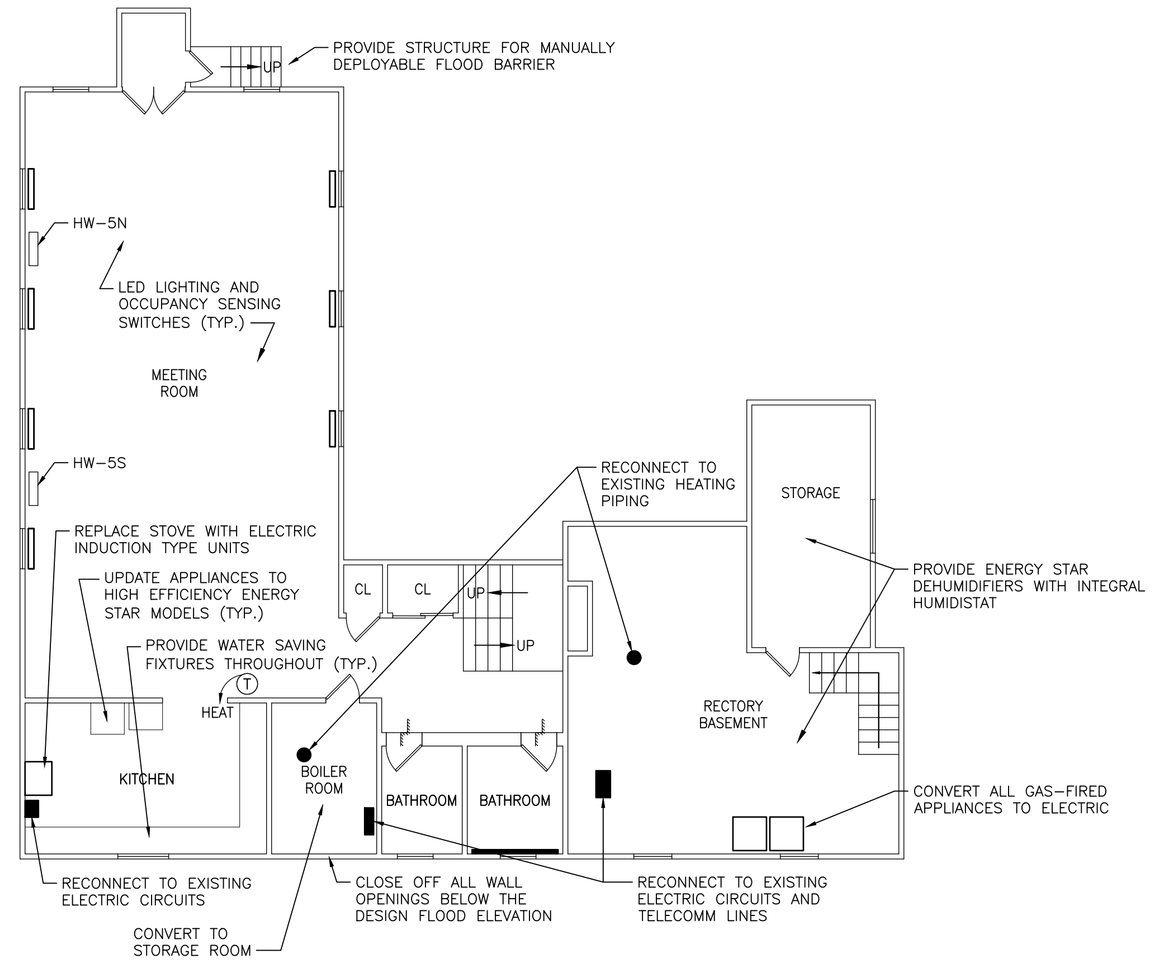
Finally, there is a table that compares the recommended system, System Option 3, versus the most energy efficient option, System Option 5, to explain the rationale behind the recommendation.

## RECOMMENDED SCOPE OF WORK AND RELATED CONSTRUCTION COSTS - St. James of Jerusalem Episcopal Church, Long Beach, NY

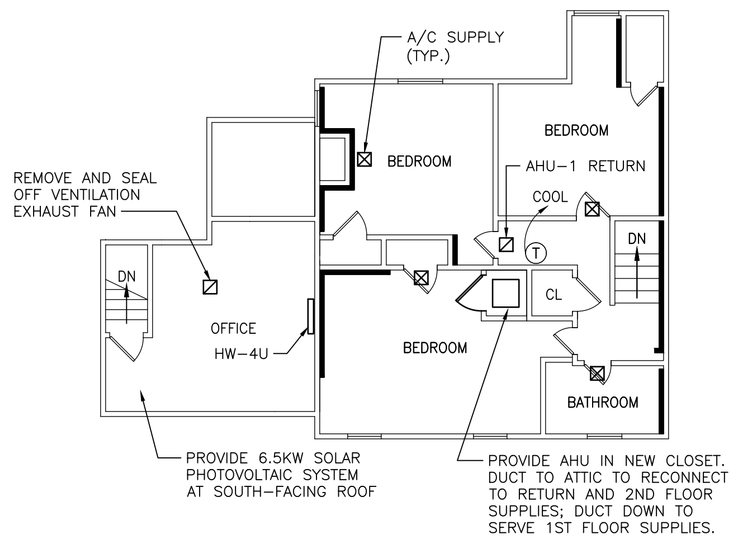
| Item No. | Work Item Description | Estimated Construction Cost | Remarks |
|---|---|---|---|
| 1 | Address exterior air infiltration issues - repair gaps at windows, add door sweeps and seals, close unused flues, etc. | $12,500 | Cost includes a blower door test to assist in identifying the repair areas and then to assess the improvement achieved. |
| 2 | Create Utility Room in Church for: Main panelboard and Basement subpanel, PVS related equipment, telecomm panels, boiler, and domestic water heater; provide new subpanel in Rectory. | $30,000 | Cost includes refeeding all loads from the new panelboards. |
| 3 | Raise eletric and gas meters to make them less prone to damage from flooding | $7,000 | Electric service upgrade is not required unless moving to an all electric HVAC system, which is not recommended due to capital and operating costs, and that occupant comfort, particularly in the Rectory, would be poor in cold weather. |
| 4 | Appliance upgrades: replace stoves with electric induction units, change to electric dryer, LED lighting, and replace refrigerators | $17,000 | Includes costs for new electric circuits to stoves and dryer. |
| 5 | Replace Rectory air conditioning: Provide vertical air handler within new closet on 2nd Floor, outside heat pump ACCU, ducts to attic for 2nd Floor service and new duct to 1st Floor with common return | $17,500 | The existing air-conditioning unit is poorly installed and has operational deficiencies. The new unit will offer better comfort, improved energy efficiency, and better maintenance access. |
| 6 | Provide condensing gas boiler and indirect domestic water heater in the Church Utility Room | $15,000 | The boiler efficiency is ~93% and will reuse the existing gas service and hydronic radiation systems, which will provide better comfort than air systems. An electric service upgrade is avoided and emmissions are minimized in a cost effective manner. |
| 7 | Provide an EV charging station at Rectory | $3,500 | Cost includes a level 2 charging station and required electric circuit. Depending on the vehicle usage, this improvement may outweigh the environmental benefits of many of the HVAC-related upgrades. |
| 8 | Install a 6.5 kW DC solar photvoltaic array at the south-facing roof of the Rectory | $28,000 | This array size offers a good offset of electric utility energy use and limits the impact on the exterior aesthetic of the Church. An additional array is possible on the east-facing roof of the Church, but may not be permitted by the local LPC. |
| 9 | Provide flood-proofing measures for the outside Basement entries and eliminate low vents/openings in the exterior walls | $35,000 | The Basement areas are the most at risk, even during mild flooding events and preventing flooding damage conserves the costs, embedded and capital, that would be needed to replace finishes and equipment ruined by a flood. |
| 10 | DESIGN CONTINGENCY - ~20% | $32,500 | This value accounts for the possibility of encountering unexpected conditions as the designs are developed and the construction performed. |
| | **Construction Cost Subtotal** | **$198,000** | This estimate is expected to be valid through June 2023. |
| 11 | Expediting/Permitting Fees | $12,000 | Costs for filing permits with the City of Long Beach and utility coordination fees. |
| 12 | Design and Construction Phase Services Fee | $40,000 | Estimated value for the above scope. |
| | **TOTAL ESTIMATED PROJECT COST** | **$250,000** | |




1 FIRST FLOOR
SCALE: 1/8" = 1'-0"




2 BASEMENT
SCALE: 1/8" = 1'-0"




3 SECOND FLOOR
SCALE: 1/8" = 1'-0"

## HVAC UNIT SCHEDULE – OPTION 3

| SYSTEM | SERVICE | OUTSIDE UNIT | INDOOR UNIT/S | SYSTEM COOLING/HEATING (MBH) | REMARKS |
|---|---|---|---|---|---|
| 1 | CHURCH | AC-1 | HW-1 | 30.6/32.0 | CONDENSING GAS BOILER USED FOR SUPPLEMENTARY HEATING AT OUTDOOR TEMPERATURES BELOW FREEZING |
| 2 | CHURCH | AC-2 | HW-2 | 30.6/32.0 | |
| 3 | CHURCH | AC-3 | HW-3 | 30.6/32.0 | |
| 4 | SACRISTY/OFFICE | AC-4 | HW-4L, HW-4U | 18.0/21.6 | |
| 5 | MEETING ROOM | AC-5 | HW-5N, HW-5S | 31.7/34.9 | |
| **6** | **RECTORY** | **AC-6** | **AHU-1** | **36.0/38.2** | |

EXISTING UNITS REMAIN

NEW UNIT

3 INCHES WHEN PLOTTED TO SCALE

| NO. | DATE | DESCRIPTION |
|---|---|---|
| – | – | – |

DESIGN CONSULTANT:

**FPM ENGINEERING & GEOLOGY, P.C.**
640 JOHNSON AVENUE, SUITE 101
BOHEMIA, N.Y. 11716
631-737-6200



DESIGNED FOR:

EPISCOPAL DIOCESE OF LONG ISLAND

**36 CATHEDRAL AVENUE**
**GARDEN CITY, NY 11530**

PROJECT TITLE AND LOCATION:

MASTER PLAN FOR EFFICIENCY UPGRADES

**ST JAMES OF JERUSALEM EPISCOPAL CHURCH**
**220 W. PENN STREET**
**LONG BEACH, NY 11561**

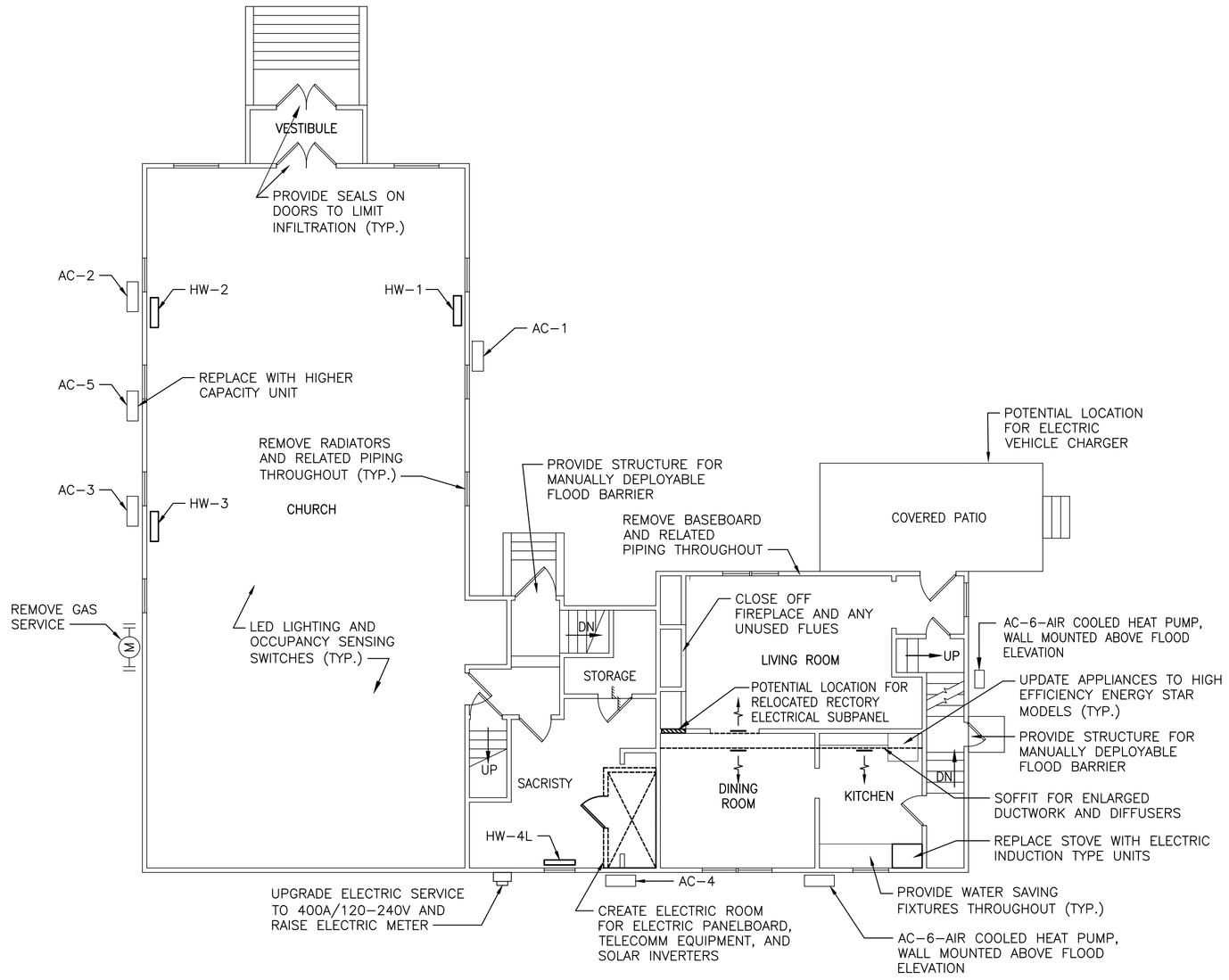
PROJECT NO:

**PROJECT #**

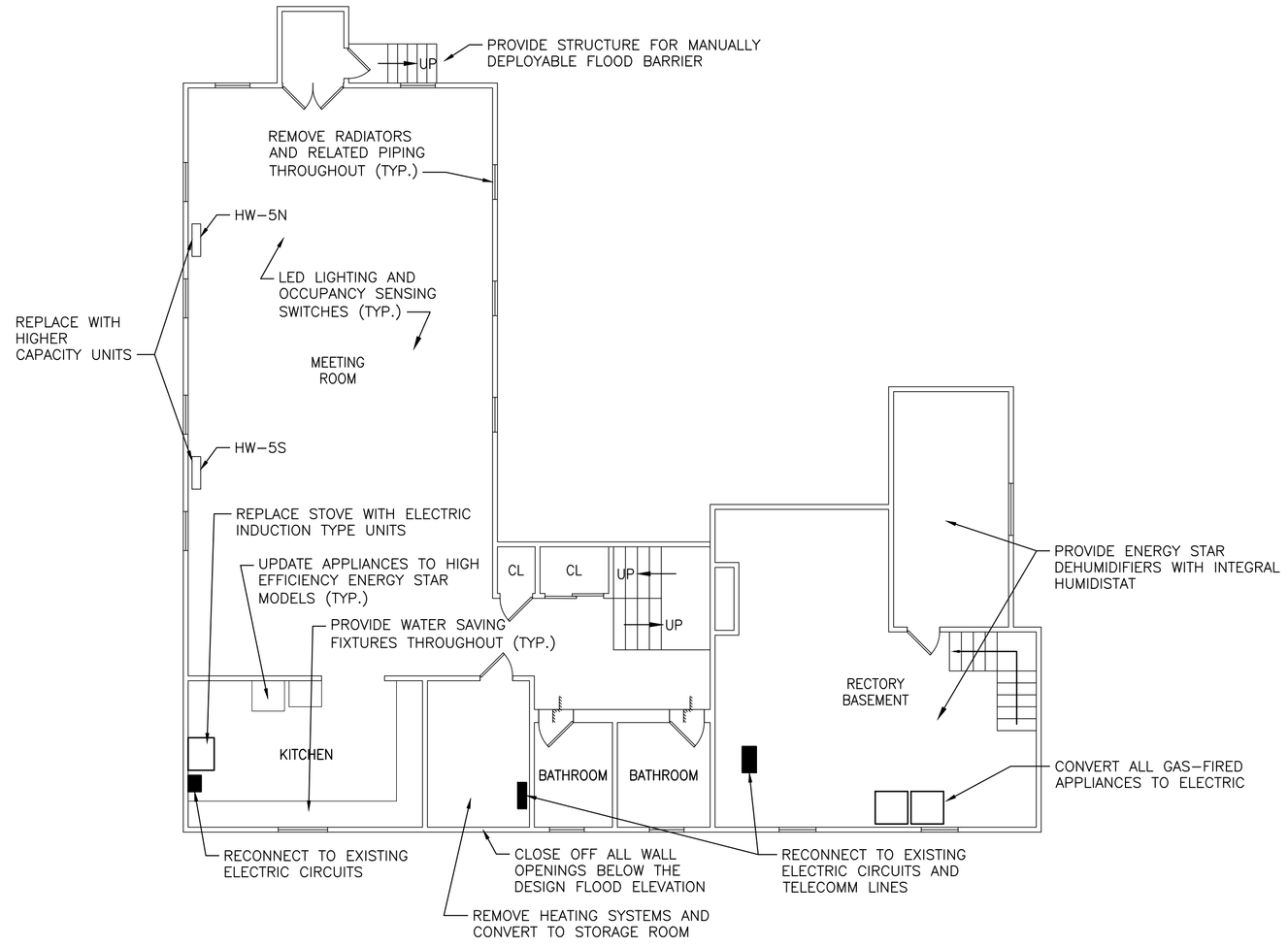
DRAWING TITLE:

RECOMMENDED MODIFICATIONS SYSTEM NO. 3

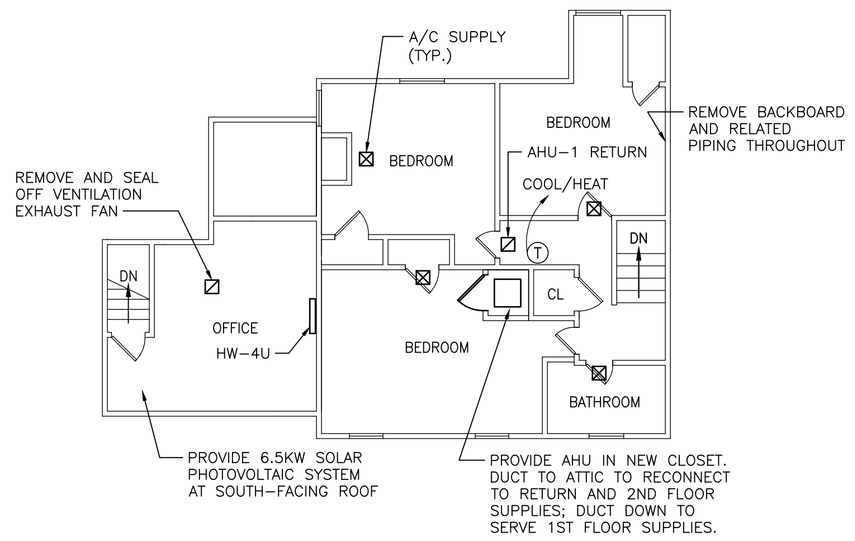
| | |
|---|---|
| DESIGN BY: FPM | DRAWING NO. ES-2 |
| DRAWN BY: KC/BF | |
| CHECK BY: CMS | |
| SCALE: AS NOTED | |
| DATE: 9/20/22 | SHEET 2 of 3 |




1 FIRST FLOOR
SCALE: 1/8" = 1'-0"




2 BASEMENT
SCALE: 1/8" = 1'-0"




3 SECOND FLOOR
SCALE: 1/8" = 1'-0"

## HVAC UNIT SCHEDULE – OPTION 5

| | SYSTEM | SERVICE | OUTSIDE UNIT | INDOOR UNIT/S | SACRISTY COOLING/HEATING (MBH) | REMARKS |
|---|---|---|---|---|---|---|
| EXISTING UNITS REMAIN | 1 | CHURCH | AC-1 | HW-1 | 30.6/32.0 | SUPPLEMENTARY UNIT MAY BE NEEDED |
| | 2 | CHURCH | AC-2 | HW-2 | 30.6/32.0 | |
| | 3 | CHURCH | AC-3 | HW-3 | 30.6/32.0 | |
| | 4 | SACRISTY/OFFICE | AC-4 | HW-4L, HW-4U | 18.0/21.6 | – |
| | 5 | MEETING ROOM | AC-5 | HW-5N, HW-5S | 31.7/34.9 | SUPPLEMENTARY UNIT MAY BE NEEDED |
| NEW UNIT | **6** | **RECTORY** | **AC-6** | **AHU-1** | **48.0/50.0** | **UPSIZED FOR HEATING SERVICE** |

3 INCHES WHEN PLOTTED TO SCALE

| NO. | DATE | DESCRIPTION |
|---|---|---|
| – | – | – |

DESIGN CONSULTANT:

**FPM ENGINEERING & GEOLOGY, P.C.**
640 JOHNSON AVENUE, SUITE 101
BOHEMIA, N.Y. 11716
631-737-6200



DESIGNED FOR:

EPISCOPAL DIOCESE OF LONG ISLAND

**36 CATHEDRAL AVENUE**
**GARDEN CITY, NY 11530**

PROJECT TITLE AND LOCATION:

MASTER PLAN FOR EFFICIENCY UPGRADES

**ST JAMES OF JERUSALEM EPISCOPAL CHURCH**
**220 W. PENN STREET**
**LONG BEACH, NY 11561**

PROJECT NO:

**PROJECT #**

DRAWING TITLE:

ALL ELECTRIC OPTION SYSTEM NO. 5

| | |
|---|---|
| DESIGN BY: FPM | DRAWING NO. ES-3 |
| DRAWN BY: KC/BF | |
| CHECK BY: CMS | |
| SCALE: AS NOTED | |
| DATE: 9/20/22 | SHEET 3 of 3 |

## COMPARISON OF RECOMMENDED SCOPE OF WORK TO MOST ENERGY EFFICIENT OPTION
## St. James of Jerusalem Episcopal Church, Long Beach, NY

| System Option No. | System Description | System Performance Data | | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Annual Utility Electrical Usage (kWh) with 6.5 kW DC PVS | Electrical Usage % Reduction from Existing Building | Annual Natural Gas Usage (therms) | Natural Gas Usage % Reduction from Existing Building | Annual Total Utility Costs | Annual % Utility Cost Reduction from Existing Building | Estimated Total Project Cost | Simple Payback (years) [used as a measure of financial prudence] | |
| **3** | Existing Building cooling systems, minimized infiltration, condensing gas boiler | 8,330 | 49.4% | 1,360 | 43.1% | $2,851 | 47.0% | $250,000 | 87.7 | **RECOMMEDNED SYSTEM** - While still using natural gas, its usage is reduced by 43% (not counting stove and dryer usage reductions), while still meeting comfort and DHW production requirements; electrical utility usage is reduced by over 50%. Includes use of 6.5kW DC PVS. Despite the extended payback, the emissions reductions are achieved in a cost effective manner by focusing on items with a good cost/benefit ratio and avoiding high risk items (i.e. adding insulation). |
| **5** | All electric HVAC (heat pumps) with minimized infiltration and additional insulation | 11,370 | 30.9% | 0 | 100% | $2,120 | 60.6% | $410,000 | 193.4 | Although this system minimizes emissions from the site, the 35% increased utility electrical usage relative to the recommend system contributes to off-site emissions equivalent to ~200 therms. Includes use of 6.5kW DC PVS. The overall cost of the project may be of concern, regardless of the difference in payback between the options. Furthermore, this scope relies on the installation of additional insulation which has aesthetic impacts and is 'high risk' in that its expected construction range is $50,000 to $100,000+ and it has diminishing returns. |

**APPENDIX:**

1. NREL Solar Array Output Data Sheets
2. Energy Model Output Data
3. Condensing Gas Boiler Information

Technical questions regarding this report should be directed to:

Facilities Department

**FPM Group, Ltd.**

640 Johnson Ave, Suite 101
Bohemia, NY 11716
631-737-6200

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Caution: Photovoltaic system performance predictions calculated by PVWatts® include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by PVWatts® inputs. For example, PV modules with better performance are not differentiated within PVWatts® from lesser performing modules. Both NREL and private companies provide more sophisticated PV modeling tools (such as the System Advisor Model at https://sam.nrel.gov) that allow for more precise and complex modeling of PV systems.

The expected range is based on 30 years of actual weather data at the given location and is intended to provide an indication of the variation you might see. For more information, please refer to this NREL report: The Error Report.



The energy output range is based on analysis of 30 years of historical weather data, and is intended to provide an indication of the possible interannual variability in generation for a Fixed (open rack) PV system at this location.

# RESULTS

Rectory South Roof Exposure

**8,720 kWh/Year***

*System output may range from 8,370 to 9,012 kWh per year near this location.*

| Month | Solar Radiation ( kWh / m$^2$ / day ) | AC Energy ( kWh ) |
|---|---|---|
| January | 3.45 | 599 |
| February | 4.32 | 656 |
| March | 4.74 | 782 |
| April | 5.13 | 796 |
| May | 5.34 | 834 |
| June | 5.39 | 796 |
| July | 5.64 | 829 |
| August | 5.70 | 842 |
| September | 5.22 | 761 |
| October | 4.56 | 720 |
| November | 3.69 | 591 |
| December | 3.02 | 516 |
| **Annual** | **4.68** | **8,722** |

## Location and Station Identification

| | |
|---|---|
| Requested Location | 220 W Penn St, Long Beach, NY 11561 |
| Weather Data Source | Lat, Lng: 40.57, -73.66 1.2 mi |
| Latitude | 40.57° N |
| Longitude | 73.66° W |

## PV System Specifications

| | |
|---|---|
| DC System Size | 6.5 kW |
| Module Type | Standard |
| Array Type | Fixed (roof mount) |
| Array Tilt | 45° |
| Array Azimuth | 180° |
| System Losses | 14.08% |
| Inverter Efficiency | 96% |
| DC to AC Size Ratio | 1.2 |

## Performance Metrics

| | |
|---|---|
| Capacity Factor | 15.3% |

Church East Roof Exposure

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

# RESULTS

4,569 kWh/Year*

*System output may range from 4,386 to 4,722 kWh per year near this location.*

| Month | Solar Radiation ( kWh / m$^2$ / day ) | AC Energy ( kWh ) |
|---|---|---|
| January | 1.66 | 196 |
| February | 2.60 | 276 |
| March | 3.31 | 383 |
| April | 4.33 | 471 |
| May | 4.81 | 524 |
| June | 5.32 | 547 |
| July | 5.44 | 559 |
| August | 4.90 | 508 |
| September | 3.97 | 408 |
| October | 2.84 | 313 |
| November | 2.02 | 224 |
| December | 1.40 | 162 |
| Annual | 3.55 | 4,571 |

## Location and Station Identification

| | |
|---|---|
| Requested Location | 220 W Penn St, Long Beach, NY 11561 |
| Weather Data Source | Lat, Lng: 40.57, -73.66 1.2 mi |
| Latitude | 40.57° N |
| Longitude | 73.66° W |

## PV System Specifications

| | |
|---|---|
| DC System Size | 4.5 kW |
| Module Type | Standard |
| Array Type | Fixed (roof mount) |
| Array Tilt | 45° |
| Array Azimuth | 90° |
| System Losses | 14.08% |
| Inverter Efficiency | 96% |
| DC to AC Size Ratio | 1.2 |

## Performance Metrics

| | |
|---|---|
| Capacity Factor | 11.6% |

Caution: Photovoltaic system performance predictions calculated by PVWatts® include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by PVWatts® inputs. For example, PV modules with better performance are not differentiated within PVWatts® from lesser performing modules. Both NREL and private companies provide more sophisticated PV modeling tools (such as the System Advisor Model at https://sam.nrel.gov) that allow for more precise and complex modeling of PV systems.

The expected range is based on 30 years of actual weather data at the given location and is intended to provide an indication of the variation you might see. For more information, please refer to this NREL report: The Error Report.



The energy output range is based on analysis of 30 years of historical weather data, and is intended to provide an indication of the possible interannual variability in generation for a Fixed (open rack) PV system at this location.

Existing Church and Rectory

**Table 1. Annual Costs**

| Component | Existing-Church and Rectory ($) |
|---|---|
| **HVAC Components** | |
| Electric | 1,060 |
| Natural Gas | 2,200 |
| Fuel Oil | 0 |
| Propane | 0 |
| Remote HW | 0 |
| Remote Steam | 0 |
| Remote CW | 0 |
| **HVAC Sub-Total** | **3,260** |
| **Non-HVAC Components** | |
| Electric | 2,124 |
| Natural Gas | 0 |
| Fuel Oil | 0 |
| Propane | 0 |
| Remote HW | 0 |
| Remote Steam | 0 |
| **Non-HVAC Sub-Total** | **2,124** |
| **Grand Total** | **5,384** |

**Table 2. Annual Energy Consumption**

| Component | Existing-Church and Rectory |
|---|---|
| **HVAC Components** | |
| Electric (kWh) | 5,253 |
| Natural Gas (Therm) | 2,391 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| Remote CW (na) | 0 |
| | |
| **Non-HVAC Components** | |
| Electric (kWh) | 11,196 |
| Natural Gas (Therm) | 0 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| | |
| **Totals** | |
| Electric (kWh) | 16,449 |
| Natural Gas (Therm) | 2,391 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| Remote CW (na) | 0 |

# Billing Details - Electric - Existing-Church and Rectory

## 1. Component Charges

| Billing Period | Energy Charges ($) | Demand Charges ($) | Customer Charges ($) | Taxes ($) | Total Charge ($) |
|---|---|---|---|---|---|
| Jan | 185 | 0 | 0 | 0 | 185 |
| Feb | 168 | 0 | 0 | 0 | 168 |
| Mar | 185 | 0 | 0 | 0 | 185 |
| Apr | 177 | 0 | 0 | 0 | 177 |
| May | 228 | 0 | 0 | 0 | 228 |
| Jun | 402 | 0 | 0 | 0 | 402 |
| Jul | 540 | 0 | 0 | 0 | 540 |
| Aug | 436 | 0 | 0 | 0 | 436 |
| Sep | 315 | 0 | 0 | 0 | 315 |
| Oct | 183 | 0 | 0 | 0 | 183 |
| Nov | 179 | 0 | 0 | 0 | 179 |
| Dec | 185 | 0 | 0 | 0 | 185 |
| **Totals** | 3,184 | 0 | 0 | 0 | 3,184 |

## 2. Totals

| Billing Period | Total Charges ($) | Total Consumption (kWh) | Avg Price ($/kWh) |
|---|---|---|---|
| Jan | 185 | 1,018 | 0.1820 |
| Feb | 168 | 921 | 0.1820 |
| Mar | 185 | 1,019 | 0.1820 |
| Apr | 177 | 971 | 0.1820 |
| May | 228 | 1,253 | 0.1820 |
| Jun | 402 | 1,959 | 0.2050 |
| Jul | 540 | 2,634 | 0.2050 |
| Aug | 436 | 2,129 | 0.2050 |
| Sep | 315 | 1,538 | 0.2050 |
| Oct | 183 | 1,008 | 0.1820 |
| Nov | 179 | 985 | 0.1820 |
| Dec | 185 | 1,014 | 0.1820 |
| **Totals** | 3,184 | 16,449 | 0.1935 |

Existing Church and Rectory

## 3. Consumption Totals

| Billing Period | Peak (kWh) | Mid-Peak (kWh) | Normal Peak (kWh) | Off-Peak (kWh) | Overall (kWh) |
|---|---|---|---|---|---|
| Jan | 0 | 0 | 0 | 0 | 1,018 |
| Feb | 0 | 0 | 0 | 0 | 921 |
| Mar | 0 | 0 | 0 | 0 | 1,019 |
| Apr | 0 | 0 | 0 | 0 | 971 |
| May | 0 | 0 | 0 | 0 | 1,253 |
| Jun | 0 | 0 | 0 | 0 | 1,959 |
| Jul | 0 | 0 | 0 | 0 | 2,634 |
| Aug | 0 | 0 | 0 | 0 | 2,129 |
| Sep | 0 | 0 | 0 | 0 | 1,538 |
| Oct | 0 | 0 | 0 | 0 | 1,008 |
| Nov | 0 | 0 | 0 | 0 | 985 |
| Dec | 0 | 0 | 0 | 0 | 1,014 |
| **Totals** | 0 | 0 | 0 | 0 | 16,449 |

**Table 1. Annual Costs**

| Component | Existing-Low Infil - Church and Rectory ($) |
|---|---|
| **HVAC Components** | |
| Electric | 1,137 |
| Natural Gas | 1,522 |
| Fuel Oil | 0 |
| Propane | 0 |
| Remote HW | 0 |
| Remote Steam | 0 |
| Remote CW | 0 |
| **HVAC Sub-Total** | **2,659** |
| **Non-HVAC Components** | |
| Electric | 2,124 |
| Natural Gas | 0 |
| Fuel Oil | 0 |
| Propane | 0 |
| Remote HW | 0 |
| Remote Steam | 0 |
| **Non-HVAC Sub-Total** | **2,124** |
| **Grand Total** | **4,783** |

Existing Church and Rectory with Reduced Infiltration System Option 1

**Table 2. Annual Energy Consumption**

| Component | Existing-Low Infil - Church and Rectory |
|---|---|
| **HVAC Components** | |
| Electric (kWh) | 5,637 |
| Natural Gas (Therm) | 1,655 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| Remote CW (na) | 0 |
| | |
| **Non-HVAC Components** | |
| Electric (kWh) | 11,196 |
| Natural Gas (Therm) | 0 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| | |
| **Totals** | |
| Electric (kWh) | 16,833 |
| Natural Gas (Therm) | 1,655 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| Remote CW (na) | 0 |

## 1. Component Charges

| Billing Period | Energy Charges ($) | Demand Charges ($) | Customer Charges ($) | Taxes ($) | Total Charge ($) |
|---|---|---|---|---|---|
| Jan | 182 | 0 | 0 | 0 | 182 |
| Feb | 165 | 0 | 0 | 0 | 165 |
| Mar | 183 | 0 | 0 | 0 | 183 |
| Apr | 175 | 0 | 0 | 0 | 175 |
| May | 247 | 0 | 0 | 0 | 247 |
| Jun | 428 | 0 | 0 | 0 | 428 |
| Jul | 542 | 0 | 0 | 0 | 542 |
| Aug | 453 | 0 | 0 | 0 | 453 |
| Sep | 335 | 0 | 0 | 0 | 335 |
| Oct | 191 | 0 | 0 | 0 | 191 |
| Nov | 177 | 0 | 0 | 0 | 177 |
| Dec | 182 | 0 | 0 | 0 | 182 |
| **Totals** | 3,261 | 0 | 0 | 0 | 3,261 |

## 2. Totals

| Billing Period | Total Charges ($) | Total Consumption (kWh) | Avg Price ($/kWh) |
|---|---|---|---|
| Jan | 182 | 1,002 | 0.1820 |
| Feb | 165 | 907 | 0.1820 |
| Mar | 183 | 1,008 | 0.1820 |
| Apr | 175 | 964 | 0.1820 |
| May | 247 | 1,359 | 0.1820 |
| Jun | 428 | 2,089 | 0.2050 |
| Jul | 542 | 2,642 | 0.2050 |
| Aug | 453 | 2,208 | 0.2050 |
| Sep | 335 | 1,634 | 0.2050 |
| Oct | 191 | 1,051 | 0.1820 |
| Nov | 177 | 971 | 0.1820 |
| Dec | 182 | 998 | 0.1820 |
| **Totals** | 3,261 | 16,833 | 0.1937 |

Existing Church and Rectory with Reduced Infiltration System Option 1

## 3. Consumption Totals

| Billing Period | Peak (kWh) | Mid-Peak (kWh) | Normal Peak (kWh) | Off-Peak (kWh) | Overall (kWh) |
|---|---|---|---|---|---|
| Jan | 0 | 0 | 0 | 0 | 1,002 |
| Feb | 0 | 0 | 0 | 0 | 907 |
| Mar | 0 | 0 | 0 | 0 | 1,008 |
| Apr | 0 | 0 | 0 | 0 | 964 |
| May | 0 | 0 | 0 | 0 | 1,359 |
| Jun | 0 | 0 | 0 | 0 | 2,089 |
| Jul | 0 | 0 | 0 | 0 | 2,642 |
| Aug | 0 | 0 | 0 | 0 | 2,208 |
| Sep | 0 | 0 | 0 | 0 | 1,634 |
| Oct | 0 | 0 | 0 | 0 | 1,051 |
| Nov | 0 | 0 | 0 | 0 | 971 |
| Dec | 0 | 0 | 0 | 0 | 998 |
| **Totals** | 0 | 0 | 0 | 0 | 16,833 |

**Table 1. Annual Costs**

| Component | Add Insul & Low Infil-Church and Rectory ($) |
|---|---|
| **HVAC Components** | |
| Electric | 843 |
| Natural Gas | 450 |
| Fuel Oil | 0 |
| Propane | 0 |
| Remote HW | 0 |
| Remote Steam | 0 |
| Remote CW | 0 |
| **HVAC Sub-Total** | **1,293** |
| **Non-HVAC Components** | |
| Electric | 2,124 |
| Natural Gas | 0 |
| Fuel Oil | 0 |
| Propane | 0 |
| Remote HW | 0 |
| Remote Steam | 0 |
| **Non-HVAC Sub-Total** | **2,124** |
| **Grand Total** | **3,417** |

Existing Church and Rectory with Reduced Infiltration and Increased Insulation System Option 2

**Table 2. Annual Energy Consumption**

| Component | Add Insul & Low Infil-Church and Rectory |
|---|---|
| **HVAC Components** | |
| Electric (kWh) | 4,203 |
| Natural Gas (Therm) | 489 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| Remote CW (na) | 0 |
| | |
| **Non-HVAC Components** | |
| Electric (kWh) | 11,196 |
| Natural Gas (Therm) | 0 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| | |
| **Totals** | |
| Electric (kWh) | 15,400 |
| Natural Gas (Therm) | 489 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| Remote CW (na) | 0 |

### 1. Component Charges

| Billing Period | Energy Charges ($) | Demand Charges ($) | Customer Charges ($) | Taxes ($) | Total Charge ($) |
|---|---|---|---|---|---|
| Jan | 176 | 0 | 0 | 0 | 176 |
| Feb | 159 | 0 | 0 | 0 | 159 |
| Mar | 181 | 0 | 0 | 0 | 181 |
| Apr | 180 | 0 | 0 | 0 | 180 |
| May | 249 | 0 | 0 | 0 | 249 |
| Jun | 354 | 0 | 0 | 0 | 354 |
| Jul | 414 | 0 | 0 | 0 | 414 |
| Aug | 381 | 0 | 0 | 0 | 381 |
| Sep | 316 | 0 | 0 | 0 | 316 |
| Oct | 208 | 0 | 0 | 0 | 208 |
| Nov | 173 | 0 | 0 | 0 | 173 |
| Dec | 176 | 0 | 0 | 0 | 176 |
| **Totals** | 2,967 | 0 | 0 | 0 | 2,967 |

### 2. Totals

| Billing Period | Total Charges ($) | Total Consumption (kWh) | Avg Price ($/kWh) |
|---|---|---|---|
| Jan | 176 | 967 | 0.1820 |
| Feb | 159 | 875 | 0.1820 |
| Mar | 181 | 995 | 0.1820 |
| Apr | 180 | 988 | 0.1820 |
| May | 249 | 1,369 | 0.1820 |
| Jun | 354 | 1,729 | 0.2050 |
| Jul | 414 | 2,020 | 0.2050 |
| Aug | 381 | 1,857 | 0.2050 |
| Sep | 316 | 1,542 | 0.2050 |
| Oct | 208 | 1,140 | 0.1820 |
| Nov | 173 | 949 | 0.1820 |
| Dec | 176 | 968 | 0.1820 |
| **Totals** | 2,967 | 15,399 | 0.1927 |

Existing Church and Rectory with Reduced Infiltration and Increased Insulation System Option 2

### 3. Consumption Totals

| Billing Period | Peak (kWh) | Mid-Peak (kWh) | Normal Peak (kWh) | Off-Peak (kWh) | Overall (kWh) |
|---|---|---|---|---|---|
| Jan | 0 | 0 | 0 | 0 | 967 |
| Feb | 0 | 0 | 0 | 0 | 875 |
| Mar | 0 | 0 | 0 | 0 | 995 |
| Apr | 0 | 0 | 0 | 0 | 988 |
| May | 0 | 0 | 0 | 0 | 1,369 |
| Jun | 0 | 0 | 0 | 0 | 1,729 |
| Jul | 0 | 0 | 0 | 0 | 2,020 |
| Aug | 0 | 0 | 0 | 0 | 1,857 |
| Sep | 0 | 0 | 0 | 0 | 1,542 |
| Oct | 0 | 0 | 0 | 0 | 1,140 |
| Nov | 0 | 0 | 0 | 0 | 949 |
| Dec | 0 | 0 | 0 | 0 | 968 |
| **Totals** | 0 | 0 | 0 | 0 | 15,399 |

Existing Building with Reduced Infiltration and Condensing Gas Boiler System Option 3

**Table 1. Annual Costs**

| Component | Low Infil/Cond Boiler- Church and Reco ($) |
|---|---|
| **HVAC Components** | |
| Electric | 1,137 |
| Natural Gas | 1,252 |
| Fuel Oil | 0 |
| Propane | 0 |
| Remote HW | 0 |
| Remote Steam | 0 |
| Remote CW | 0 |
| **HVAC Sub-Total** | **2,389** |
| **Non-HVAC Components** | |
| Electric | 2,124 |
| Natural Gas | 0 |
| Fuel Oil | 0 |
| Propane | 0 |
| Remote HW | 0 |
| Remote Steam | 0 |
| **Non-HVAC Sub-Total** | **2,124** |
| **Grand Total** | **4,513** |

**Table 2. Annual Energy Consumption**

| Component | Low Infil/Cond Boiler- Church and Reco |
|---|---|
| **HVAC Components** | |
| Electric (kWh) | 5,637 |
| Natural Gas (Therm) | 1,361 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| Remote CW (na) | 0 |
| | |
| **Non-HVAC Components** | |
| Electric (kWh) | 11,196 |
| Natural Gas (Therm) | 0 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| | |
| **Totals** | |
| Electric (kWh) | 16,833 |
| Natural Gas (Therm) | 1,361 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| Remote CW (na) | 0 |

# Billing Details - Electric - Low Infil/Cond Boiler- Church and Reco

## 1. Component Charges

| Billing Period | Energy Charges ($) | Demand Charges ($) | Customer Charges ($) | Taxes ($) | Total Charge ($) |
|---|---|---|---|---|---|
| Jan | 182 | 0 | 0 | 0 | 182 |
| Feb | 165 | 0 | 0 | 0 | 165 |
| Mar | 183 | 0 | 0 | 0 | 183 |
| Apr | 175 | 0 | 0 | 0 | 175 |
| May | 247 | 0 | 0 | 0 | 247 |
| Jun | 428 | 0 | 0 | 0 | 428 |
| Jul | 542 | 0 | 0 | 0 | 542 |
| Aug | 453 | 0 | 0 | 0 | 453 |
| Sep | 335 | 0 | 0 | 0 | 335 |
| Oct | 191 | 0 | 0 | 0 | 191 |
| Nov | 177 | 0 | 0 | 0 | 177 |
| Dec | 182 | 0 | 0 | 0 | 182 |
| **Totals** | 3,261 | 0 | 0 | 0 | 3,261 |

## 2. Totals

| Billing Period | Total Charges ($) | Total Consumption (kWh) | Avg Price ($/kWh) |
|---|---|---|---|
| Jan | 182 | 1,002 | 0.1820 |
| Feb | 165 | 907 | 0.1820 |
| Mar | 183 | 1,008 | 0.1820 |
| Apr | 175 | 964 | 0.1820 |
| May | 247 | 1,359 | 0.1820 |
| Jun | 428 | 2,089 | 0.2050 |
| Jul | 542 | 2,642 | 0.2050 |
| Aug | 453 | 2,208 | 0.2050 |
| Sep | 335 | 1,634 | 0.2050 |
| Oct | 191 | 1,051 | 0.1820 |
| Nov | 177 | 971 | 0.1820 |
| Dec | 182 | 998 | 0.1820 |
| **Totals** | 3,261 | 16,833 | 0.1937 |

Existing Building with Reduced Infiltration and Condensing Gas Boiler System Option 3

## 3. Consumption Totals

| Billing Period | Peak (kWh) | Mid-Peak (kWh) | Normal Peak (kWh) | Off-Peak (kWh) | Overall (kWh) |
|---|---|---|---|---|---|
| Jan | 0 | 0 | 0 | 0 | 1,002 |
| Feb | 0 | 0 | 0 | 0 | 907 |
| Mar | 0 | 0 | 0 | 0 | 1,008 |
| Apr | 0 | 0 | 0 | 0 | 964 |
| May | 0 | 0 | 0 | 0 | 1,359 |
| Jun | 0 | 0 | 0 | 0 | 2,089 |
| Jul | 0 | 0 | 0 | 0 | 2,642 |
| Aug | 0 | 0 | 0 | 0 | 2,208 |
| Sep | 0 | 0 | 0 | 0 | 1,634 |
| Oct | 0 | 0 | 0 | 0 | 1,051 |
| Nov | 0 | 0 | 0 | 0 | 971 |
| Dec | 0 | 0 | 0 | 0 | 998 |
| **Totals** | 0 | 0 | 0 | 0 | 16,833 |

**Table 1. Annual Costs**

| Component | HP-Ex-Church & Rectory ($) |
|---|---|
| **HVAC Components** | |
| Electric | 4,702 |
| Natural Gas | 0 |
| Fuel Oil | 0 |
| Propane | 0 |
| Remote HW | 0 |
| Remote Steam | 0 |
| Remote CW | 0 |
| **HVAC Sub-Total** | **4,702** |
| **Non-HVAC Components** | |
| Electric | 2,124 |
| Natural Gas | 0 |
| Fuel Oil | 0 |
| Propane | 0 |
| Remote HW | 0 |
| Remote Steam | 0 |
| **Non-HVAC Sub-Total** | **2,124** |
| **Grand Total** | **6,826** |

Existing Building With All Electric HVAC System Option 4

**Table 2. Annual Energy Consumption**

| Component | HP-Ex-Church & Rectory |
|---|---|
| **HVAC Components** | |
| Electric (kWh) | 25,263 |
| Natural Gas (na) | 0 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| Remote CW (na) | 0 |
| | |
| **Non-HVAC Components** | |
| Electric (kWh) | 11,196 |
| Natural Gas (na) | 0 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| | |
| **Totals** | |
| Electric (kWh) | 36,459 |
| Natural Gas (na) | 0 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| Remote CW (na) | 0 |

## 1. Component Charges

| Billing Period | Energy Charges ($) | Demand Charges ($) | Customer Charges ($) | Taxes ($) | Total Charge ($) |
|---|---|---|---|---|---|
| Jan | 1,246 | 0 | 0 | 0 | 1,246 |
| Feb | 912 | 0 | 0 | 0 | 912 |
| Mar | 678 | 0 | 0 | 0 | 678 |
| Apr | 336 | 0 | 0 | 0 | 336 |
| May | 242 | 0 | 0 | 0 | 242 |
| Jun | 402 | 0 | 0 | 0 | 402 |
| Jul | 540 | 0 | 0 | 0 | 540 |
| Aug | 436 | 0 | 0 | 0 | 436 |
| Sep | 317 | 0 | 0 | 0 | 317 |
| Oct | 245 | 0 | 0 | 0 | 245 |
| Nov | 535 | 0 | 0 | 0 | 535 |
| Dec | 936 | 0 | 0 | 0 | 936 |
| **Totals** | 6,826 | 0 | 0 | 0 | 6,826 |

## 2. Totals

| Billing Period | Total Charges ($) | Total Consumption (kWh) | Avg Price ($/kWh) |
|---|---|---|---|
| Jan | 1,246 | 6,849 | 0.1820 |
| Feb | 912 | 5,012 | 0.1820 |
| Mar | 678 | 3,724 | 0.1820 |
| Apr | 336 | 1,847 | 0.1820 |
| May | 242 | 1,328 | 0.1820 |
| Jun | 402 | 1,959 | 0.2050 |
| Jul | 540 | 2,634 | 0.2050 |
| Aug | 436 | 2,129 | 0.2050 |
| Sep | 317 | 1,545 | 0.2050 |
| Oct | 245 | 1,349 | 0.1820 |
| Nov | 535 | 2,940 | 0.1820 |
| Dec | 936 | 5,143 | 0.1820 |
| **Totals** | 6,826 | 36,459 | 0.1872 |

Existing Building With All Electric HVAC System Option 4

## 3. Consumption Totals

| Billing Period | Peak (kWh) | Mid-Peak (kWh) | Normal Peak (kWh) | Off-Peak (kWh) | Overall (kWh) |
|---|---|---|---|---|---|
| Jan | 0 | 0 | 0 | 0 | 6,849 |
| Feb | 0 | 0 | 0 | 0 | 5,012 |
| Mar | 0 | 0 | 0 | 0 | 3,724 |
| Apr | 0 | 0 | 0 | 0 | 1,847 |
| May | 0 | 0 | 0 | 0 | 1,328 |
| Jun | 0 | 0 | 0 | 0 | 1,959 |
| Jul | 0 | 0 | 0 | 0 | 2,634 |
| Aug | 0 | 0 | 0 | 0 | 2,129 |
| Sep | 0 | 0 | 0 | 0 | 1,545 |
| Oct | 0 | 0 | 0 | 0 | 1,349 |
| Nov | 0 | 0 | 0 | 0 | 2,940 |
| Dec | 0 | 0 | 0 | 0 | 5,143 |
| **Totals** | 0 | 0 | 0 | 0 | 36,459 |

All Electric HVAC with Reduced Infiltration and Additional Insulation System Option 5

**Table 1. Annual Costs**

| Component | Add Insul-HP-Church & Rectory ($) |
|---|---|
| **HVAC Components** | |
| Electric | 1,655 |
| Natural Gas | 0 |
| Fuel Oil | 0 |
| Propane | 0 |
| Remote HW | 0 |
| Remote Steam | 0 |
| Remote CW | 0 |
| **HVAC Sub-Total** | **1,655** |
| **Non-HVAC Components** | |
| Electric | 2,124 |
| Natural Gas | 0 |
| Fuel Oil | 0 |
| Propane | 0 |
| Remote HW | 0 |
| Remote Steam | 0 |
| **Non-HVAC Sub-Total** | **2,124** |
| **Grand Total** | **3,779** |

**Table 2. Annual Energy Consumption**

| Component | Add Insul-HP-Church & Rectory |
|---|---|
| **HVAC Components** | |
| Electric (kWh) | 8,666 |
| Natural Gas (na) | 0 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| Remote CW (na) | 0 |
| | |
| **Non-HVAC Components** | |
| Electric (kWh) | 11,196 |
| Natural Gas (na) | 0 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| | |
| **Totals** | |
| Electric (kWh) | 19,862 |
| Natural Gas (na) | 0 |
| Fuel Oil (na) | 0 |
| Propane (na) | 0 |
| Remote HW (na) | 0 |
| Remote Steam (na) | 0 |
| Remote CW (na) | 0 |

### 1. Component Charges

| Billing Period | Energy Charges ($) | Demand Charges ($) | Customer Charges ($) | Taxes ($) | Total Charge ($) |
|---|---|---|---|---|---|
| Jan | 468 | 0 | 0 | 0 | 468 |
| Feb | 332 | 0 | 0 | 0 | 332 |
| Mar | 277 | 0 | 0 | 0 | 277 |
| Apr | 196 | 0 | 0 | 0 | 196 |
| May | 249 | 0 | 0 | 0 | 249 |
| Jun | 354 | 0 | 0 | 0 | 354 |
| Jul | 414 | 0 | 0 | 0 | 414 |
| Aug | 381 | 0 | 0 | 0 | 381 |
| Sep | 316 | 0 | 0 | 0 | 316 |
| Oct | 212 | 0 | 0 | 0 | 212 |
| Nov | 230 | 0 | 0 | 0 | 230 |
| Dec | 349 | 0 | 0 | 0 | 349 |
| **Totals** | 3,779 | 0 | 0 | 0 | 3,779 |

### 2. Totals

| Billing Period | Total Charges ($) | Total Consumption (kWh) | Avg Price ($/kWh) |
|---|---|---|---|
| Jan | 468 | 2,569 | 0.1820 |
| Feb | 332 | 1,825 | 0.1820 |
| Mar | 277 | 1,525 | 0.1820 |
| Apr | 196 | 1,078 | 0.1820 |
| May | 249 | 1,371 | 0.1820 |
| Jun | 354 | 1,729 | 0.2050 |
| Jul | 414 | 2,020 | 0.2050 |
| Aug | 381 | 1,857 | 0.2050 |
| Sep | 316 | 1,542 | 0.2050 |
| Oct | 212 | 1,167 | 0.1820 |
| Nov | 230 | 1,264 | 0.1820 |
| Dec | 349 | 1,916 | 0.1820 |
| **Totals** | 3,779 | 19,862 | 0.1903 |

All Electric HVAC with Reduced Infiltration and Additional Insulation System Option 5

### 3. Consumption Totals

| Billing Period | Peak (kWh) | Mid-Peak (kWh) | Normal Peak (kWh) | Off-Peak (kWh) | Overall (kWh) |
|---|---|---|---|---|---|
| Jan | 0 | 0 | 0 | 0 | 2,569 |
| Feb | 0 | 0 | 0 | 0 | 1,825 |
| Mar | 0 | 0 | 0 | 0 | 1,525 |
| Apr | 0 | 0 | 0 | 0 | 1,078 |
| May | 0 | 0 | 0 | 0 | 1,371 |
| Jun | 0 | 0 | 0 | 0 | 1,729 |
| Jul | 0 | 0 | 0 | 0 | 2,020 |
| Aug | 0 | 0 | 0 | 0 | 1,857 |
| Sep | 0 | 0 | 0 | 0 | 1,542 |
| Oct | 0 | 0 | 0 | 0 | 1,167 |
| Nov | 0 | 0 | 0 | 0 | 1,264 |
| Dec | 0 | 0 | 0 | 0 | 1,916 |
| **Totals** | 0 | 0 | 0 | 0 | 19,862 |

WEIL-McLAIN®
Weil-McLain.com

# EVERGREEN® PRO

## HIGH-EFFICIENCY CONDENSING BOILER

Water | Natural or Propane Gas | 110–399 MBH | 5 Sizes
Direct Exhaust or Direct Vent | Up to 95.1% AFUE†


UPDATED EXTERIOR
Same Trusted Interior

EASY HEAT, EFFORTLESS COMFORT

# EVERGREEN® Pro

Commercial-Grade Controls for Residential and Light-Commercial Applications

AHRI CERTIFIED™

ENERGY STAR

†Model Dependent

## SPECIFICATIONS

| MODEL | EVG 110 | EVG 155 | EVG 220 | EVG 299 | EVG 399 |
|---|---|---|---|---|---|
| CSA INPUT (MBH) | 110 | 155 | 220 | 299 | 399 |
| DOE HEATING CAPACITY (MBH) | 101 | 143 | 206 | 280 | 383* |
| NET AHRI (MBH) | 88 | 124 | 179 | 243 | 333 |
| DOE AFUE | 95.0% | 95.1% | 95.0% | 95.0% | 96.5%* |
| VENT MATERIAL | PVC, CPVC, PP, SS (AL29-4C) | PVC, CPVC, PP, SS (AL29-4C) | PVC, CPVC, PP, SS (AL29-4C) | PVC, CPVC, PP, SS (AL29-4C) | PVC, CPVC, PP, SS (AL29-4C) |
| VENT/COMBUSTION AIR CONNECTION DIAMETER | 3″ | 3″ | 4″ | 4″ | 4″ |
| VENT/COMBUSTION AIR PIPE SIZE | 3″ | 3″ | 3″ or 4″ | 4″ | 4″ |
| VENTING LENGTH | 100′ | 100′ | 100′ | 100′ | 100′ |
| MIN. RECOMMENDED PIPE SIZE | 1″ | 1¼″ | 1¼″ | 1½″ | 1½″ |
| SUPPLY/RETURN TAPPING | 1″ | 1¼″ | 1½″ | 1½″ | 1½″ |
| GAS CONNECTION SIZE | ½″ | ½″ | ¾″ | ¾″ | ¾″ |
| APPROX. SHIPPING WEIGHT (Lbs.) | 125 | 145 | 215 | 260 | 260 |
| WATER VOLUME (Gal.) | 2.5 | 3.2 | 4.6 | 7.0 | 6.7 |

**Evergreen Pro 399 ratings are gross output and combustion efficiency*

## FEATURES:

### BOILER

- Stainless steel firetube heat exchanger
- Non-metallic heat exchanger base
- Floor standing or wall-mount
- Natural or LP gas
- Negative regulated combustion
- 5 to 1 turndown ratio (110–155)
- 10 to 1 turndown ratio (220–399)
- Boiler circulator
  - Taco ECM 007e (110)
  - Taco ECM 0015e (155)
  - Taco 0014 (220/299)
  - Taco 0013 (399)
- Low water cut-off

### VENTING*

- Direct vent 100 ft. for intake and 100 ft. for vent
- Dual pressure zones (sidewall air intake, roof vent)
- Common combustion air
- Direct exhaust

### CONTROL FEATURES

- Easy installation with Setup Wizard
- Zone and/or priority based control
- Three thermostat inputs
- Outdoor reset for each priority
- Rate adjustable per priority
- 0-10V input (modulation or setpoint)
- Four total outputs
  - 1 dedicated boiler circulator output
  - 3 additional outputs can be used with circulators, dampers, or system aux
- Aux inputs—flow switch or end switch
- Aux outputs—system pump or damper
- Modbus® connectivity
- Additional heat demand contact

### JACKET ASSEMBLY

- Fully removable jacket front door
- Adjustable boiler legs
- On/off power switch (220–399)
- Line voltage service receptacle (220–399)
- Mounting bracket ready for wall-mount kit
  - Shipped standard with 110–155
  - Optional kit for 220–399
- Condensate trap

## OPTIONAL EQUIPMENT:

- Wall-mount kit (220–399)
- Concentric vent kit
- Condensate neutralizer kit
- Sidewall vent/air termination kit
- Maintenance kits
- Water treatment—inhibitor & test kit
- Propane conversion kit

## WARRANTY:

*Transferable, Non-Prorated*

### RESIDENTIAL

- 12-year heat exchanger limited warranty
- 2 years on parts without registration or **5 years on parts with registration**

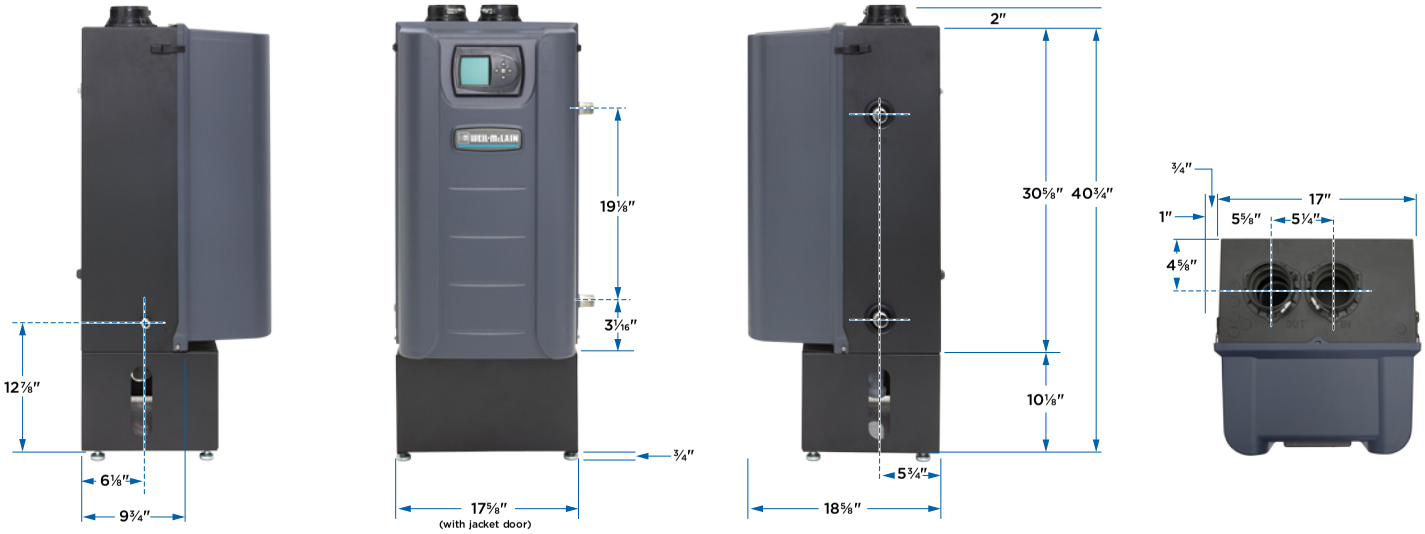
### COMMERCIAL

- 10 years on primary heat exchanger
- 1 year on parts

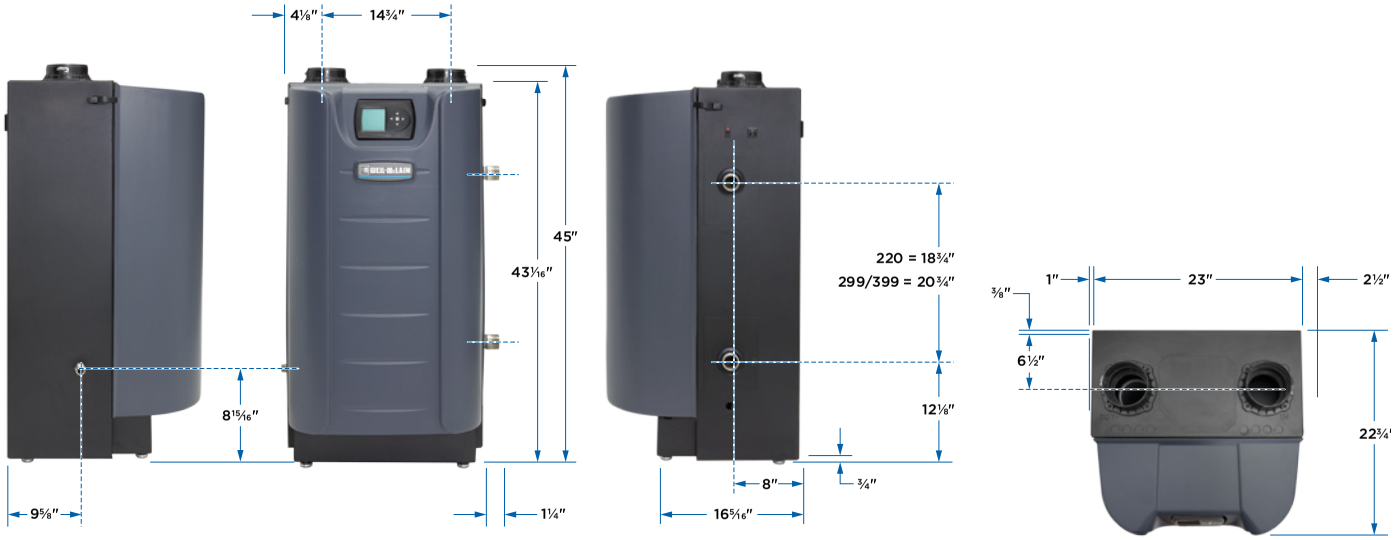
In the interest of continual improvements in product and performance, Weil-McLain reserves the right to change specifications without notice.

# DIMENSIONS

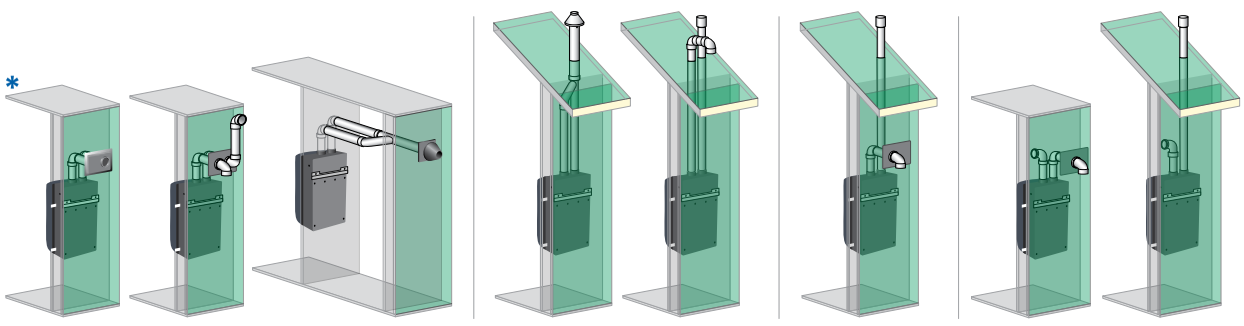
## MODEL 110–155




## MODEL 220–399




# MULTIPLE VENTING OPTIONS



Sidewall direct vent | Through-the roof direct vent | Dual pressure zones | Direct exhaust

*Cannot be used on the 110 size

**FPM Engineering and Geology, P.C.**
640 Johnson Avenue, Suite 101
Bohemia, NY  11716