# NEW FIRE STATION
# NORTHBOROUGH, MA

MARCH 27, 2024

## AGENDA – COMMITTEE MEETING #10

- LCCA Review
- PV Study Review
- Exterior Materials Meeting Review + Final Comments
- Other Items of Note
- Budget
- Schedule

# HVAC System Options & Lifecycle Cost Analysis (LCCA) Summary

for

## Northborough Fire Station
## Northborough, MA

GGD Consulting Engineers, Inc.

## HVAC System Options Overview

1. **HVAC System Options & LCCA Overview:**
   - **Option 1:Air Source Heat Pump Chiller/Heater with Backup Electric Boiler**
   - **Option 2: Air Source VRF (Variable Refrigerant Flow) Heat Pump HVAC System**
   - **Option 3: Closed Loop Geothermal HVAC System**
   - **Supplemental Heating Systems (Radiant Heating)**
   - **LCCA Results**
2. **Photovoltaic (PV) System**

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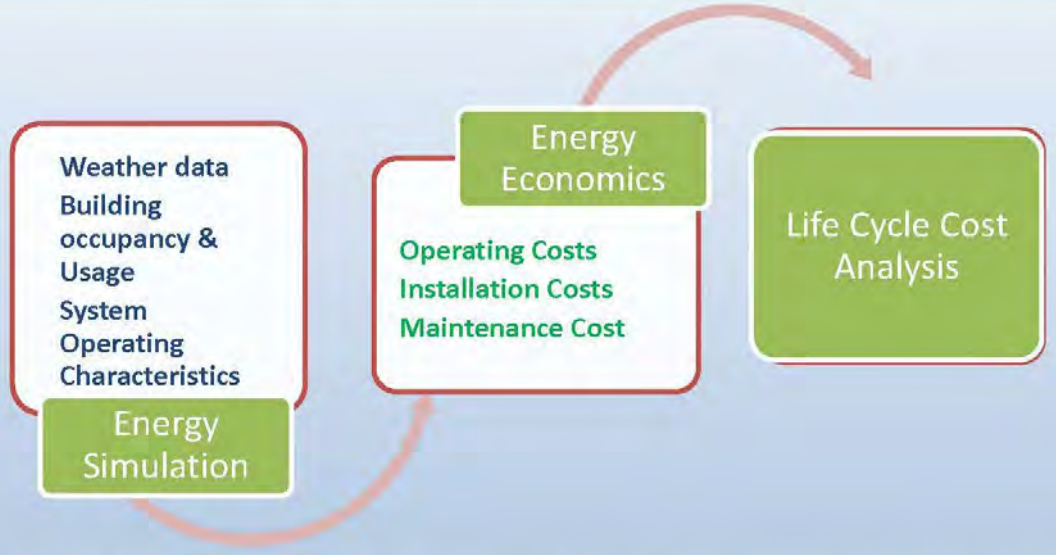
# GOAL OF LIFE CYCLE COST ANALYSIS




- Goal is to assess the performance of various mechanical system options in comparison to a baseline mechanical system.
- Options compared to the baseline system over a 50-year cycle to determine the most advantageous system considering utility costs, maintenance costs, replacement costs, and initial construction costs.
- The Option with the greatest total life-cycle savings is generally recommended.

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# LIFE CYCLE COST ANALYSIS

## *Proposed Design Criteria Temperature Conditions*

*Notes:*
*DB = Dry Bulb*
*RH = Relative Humidity*
*WB = Wet Bulb*

Design Outdoor Temperature Data

Heating @ 5°F Heating

Cooling @ 91°F db, 73°F wb

Design Indoor Temperature Conditions:

**Offices, Day Rooms, Living Areas**:

**Heating @ 70°F db +/- 2 °F**

**Air Conditioning @ 75°F db +/- 2 °F** with 55% RH

**Hallways, Corridors, Entryways, Restrooms: Slightly higher Dry Bulb temp w/ Dehumidification**

**Apparatus Bay, General Storage Areas, Vestibules:**

**Heating & Ventilation Only: 70°F db** for heating

Unoccupied temperature setback is provided for all options that do not have 24/7 occupancy.

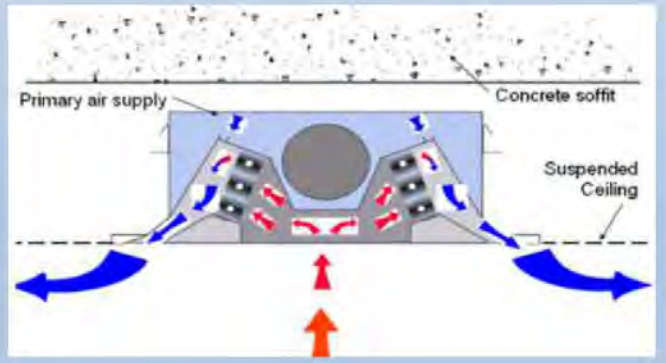
# Option 1 – Air Source to Hydronic (Hot & Chilled Water) Heat Pump Plant w/ Dedicated Outdoor Air Systems (DOAS)

**Pros:**

- High degree thermal comfort control with dedicated terminal unit and thermostat provided for each space
- Boiler and Chiller Plants and distribution systems not required; Supplemental Electric Boiler is recommended in event of ASHP failure or shutdown for service
- Single induction units can be utilized for both heating and cooling applications
- Smaller central ventilation ductwork as only the code required ventilation air is provided to meet occupancy load
- Different indoor unit styles (FCUs, Active Chilled Beams) provide multiple options to fit within architectural ceiling design elements
- Reduced Refrigerant Piping
- Can utilize HW heating for heating only spaces
- Potential Reduced Future Maintenance & Replacement Costs
- Fossil Fuel Free


**Cons:**

- Higher overall installed costs v. Option 2
- Maintenance of equipment is in occupied area
- Quarterly filter changes per unit
- Condensate drain maintenance for terminal units
- Maintenance Cost associated with added HW/CH pumps/accessories

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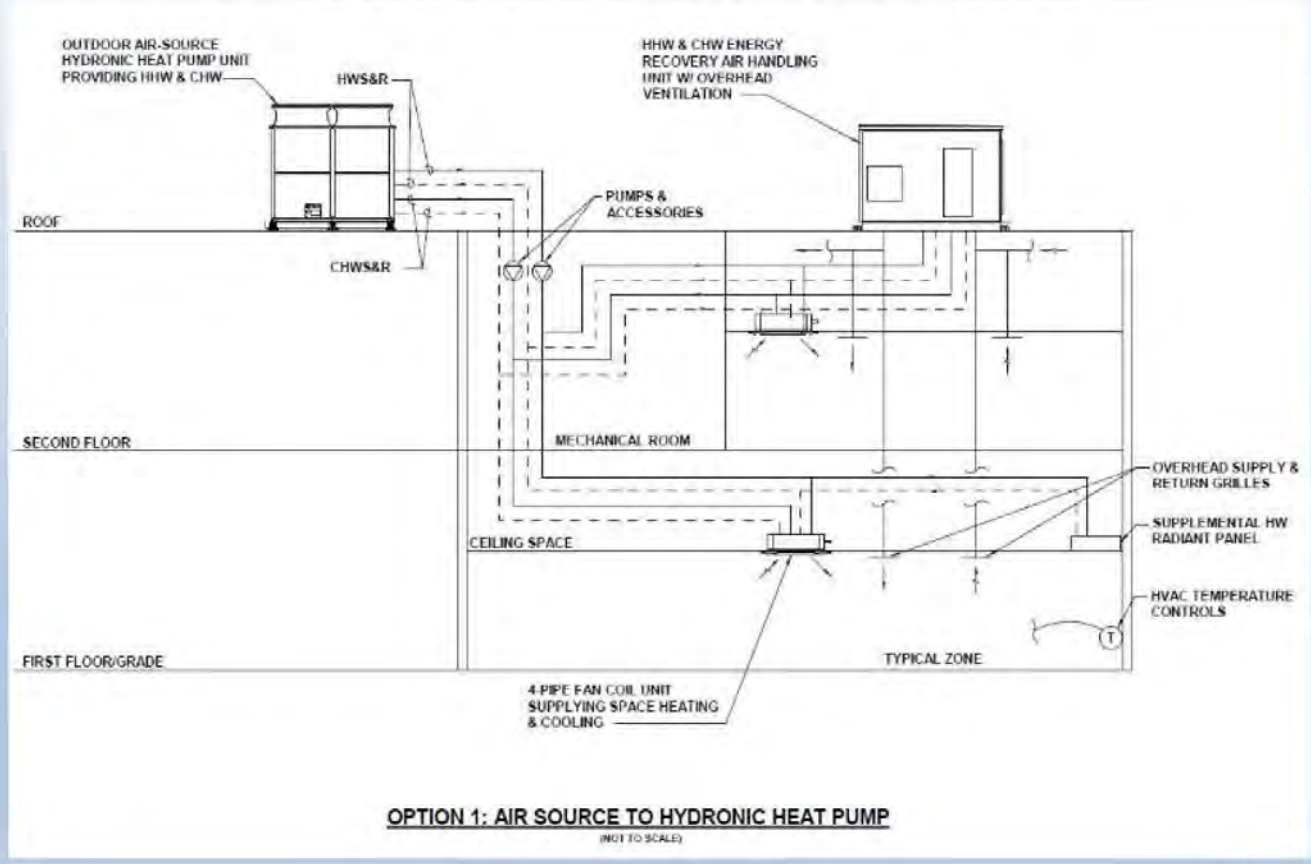
# Option 1 – Air Source to Hydronic (Hot & Chilled Water) Heat Pump Plant w/ Dedicated Outdoor Air Systems (DOAS)




OPTION 1: AIR SOURCE TO HYDRONIC HEAT PUMP

(NOT TO SCALE)

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# Option 2 – Air Source Variable Flow Refrigerant (VRF) Heat Pump System w/ Dedicated Outdoor Air System (DOAS)

**Pros:**

- Low piping installed costs due to refrigerant piping system only
- Moderate overall installed costs
- Chiller/heater plant and distribution systems not required
- Single cabinet can be utilized for both heating and cooling applications
- Smaller central ventilation ductwork as only the code required ventilation air is provided to meet occupancy load
- Fossil Fuel Free


**Cons:**

- Maintenance of equipment is in occupied area; Quarterly filter changes per unit
- More complex automatic temperature controls; Higher automatic temperature controls installed costs on a per unit basis due to amount of control devices required
- Refrigerant & Condensate drain maintenance for terminal units

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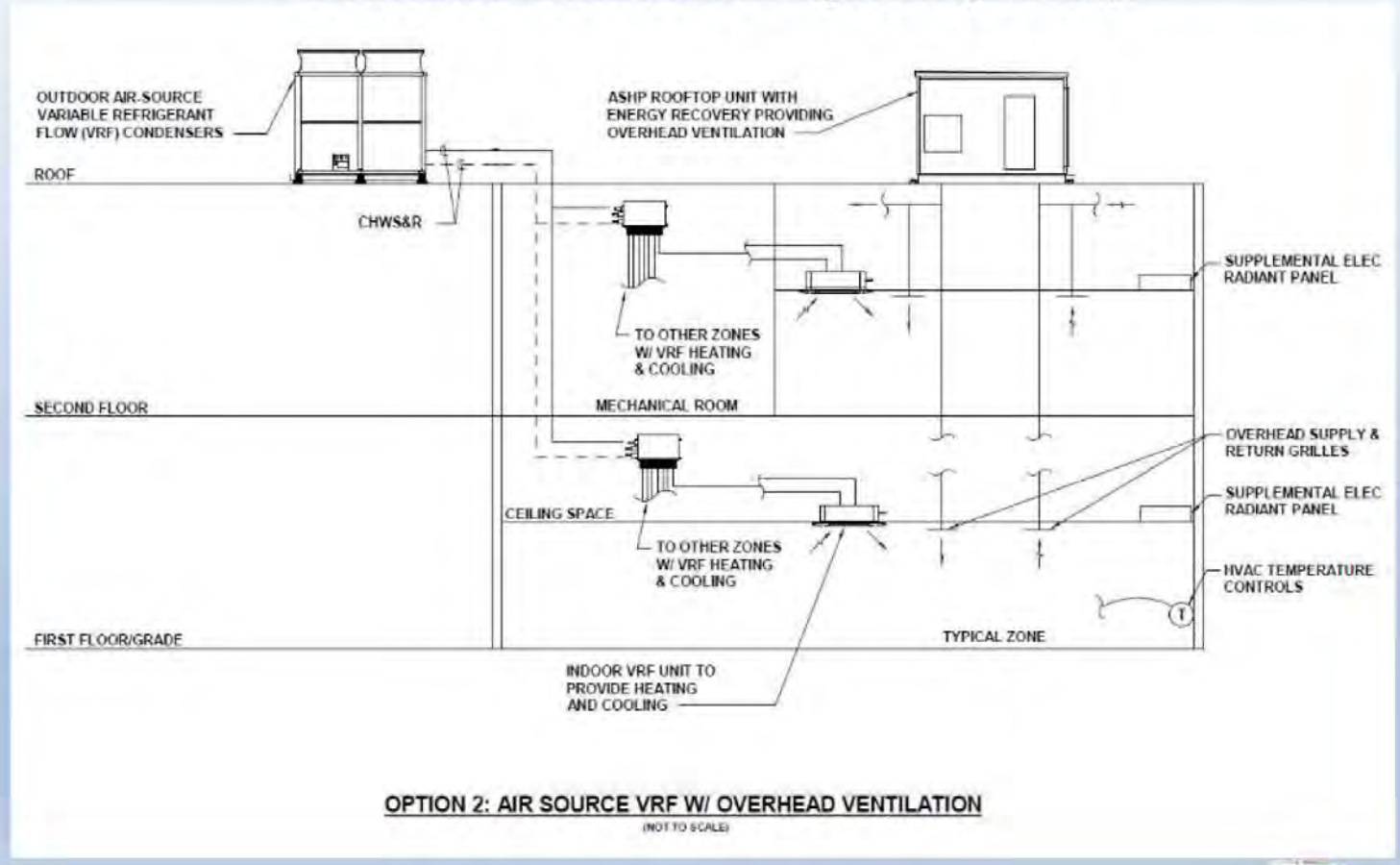
# Option 2 – Air Source Variable Flow Refrigerant (VRF) Heat Pump System w/ Dedicated Outdoor Air System (DOAS)




**OPTION 2: AIR SOURCE VRF W/ OVERHEAD VENTILATION**

(NOT TO SCALE)

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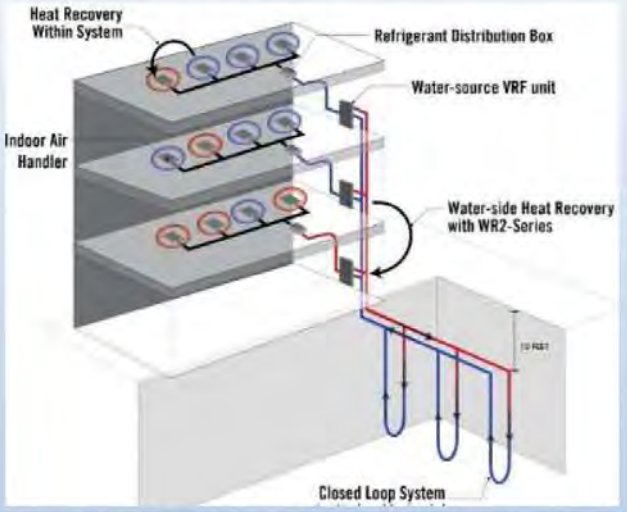
# Option 3 – Closed Loop Geothermal VRF Heat Pump System w/ Dedicated Outdoor Air System (DOAS)

## Geothermal Pros:

- High energy efficiency and lower EUI
- Fossil Fuel Free
- Reduced carbon footprint for environmental considerations
- Low noise levels inside and outside of building as no exterior mounted equipment with condensers or fans are required
- Longer Equipment & Piping Lifespan
- Potential Utility Incentives & Federal Tax Credits
- Can use Geothermal with both WSHP & VRF (Refrigerant) Systems




## Geothermal Cons:

- Increased capital investment for geothermal plant
- Requires increased site coordination for well locations
- Higher automatic temperature controls for geothermal plant equipment
- Requires increased maintenance for geothermal plant equipment (filters, additional pumps, etc.)

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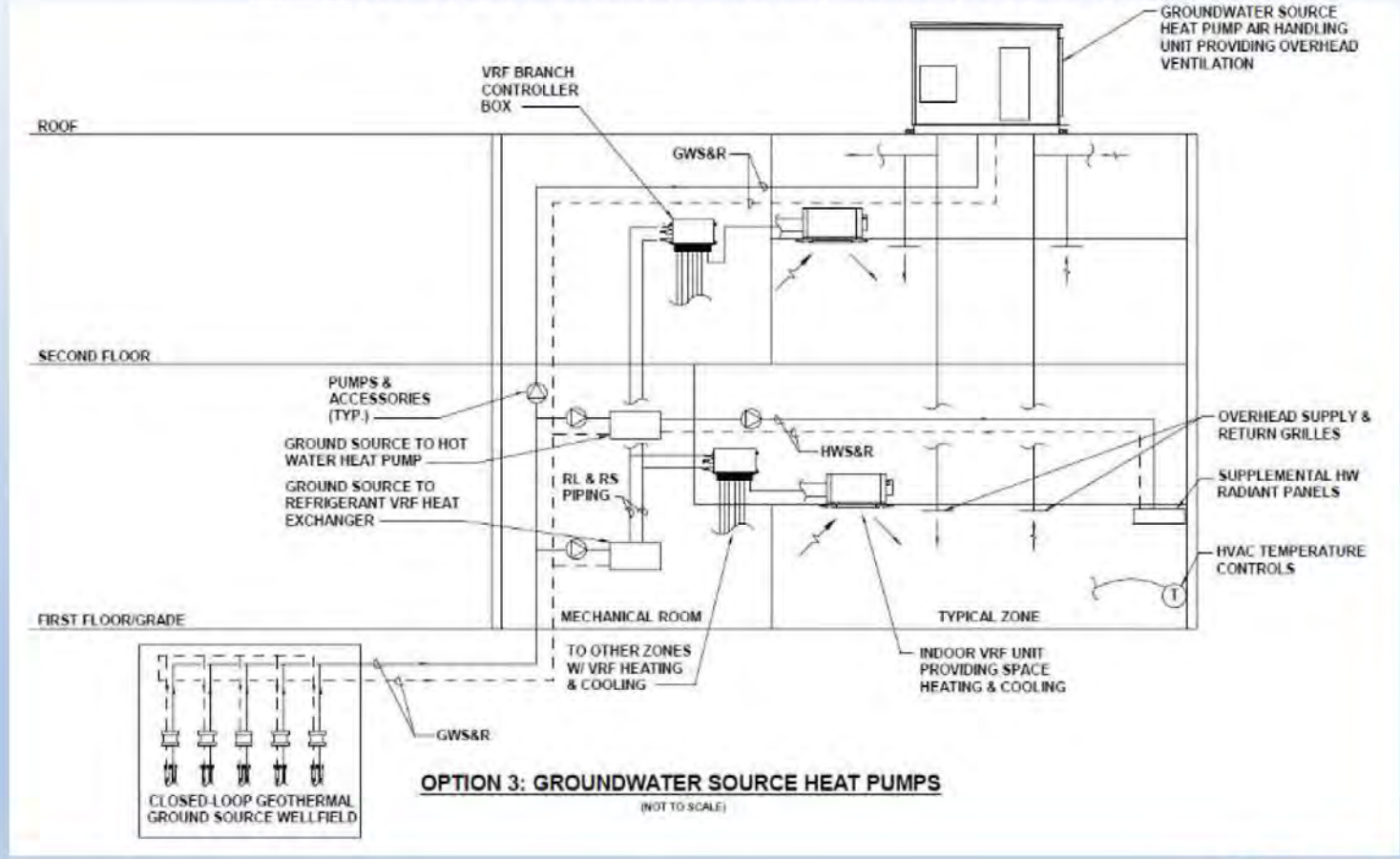
# Option 3 – Closed Loop Geothermal VRF Heat Pump System w/ Dedicated Outdoor Air System (DOAS)

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# SUPPLEMENTAL HEATING SYSTEMS

**Supplemental Heating (Radiant Panels) (HW for Option 1&2, Elec for Option 2)**

**Pros:**

- Provide system redundancy and resiliency if Airside system fails and needs service or repair
- Energy Efficient when used with Efficient Heating Source system as it provides night setback unoccupied heating without the use of airside equipment.
- Improved thermal comfort
- With VRF (Option 2) Systems - Electric Resistance Type Heating Systems typically used as backup only due to high operational cost.
- Ceiling mounted – does not interfere with program area and furniture layout and has a good aesthetic compared to other terminal heating options.

**Cons:**

- Higher First Cost
- For All electric resistance systems – high operational cost (recommended only for back-up)

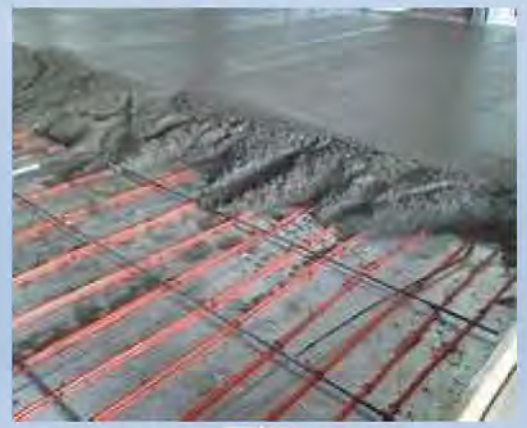
**Supplemental Apparatus Bay Heating (Floor Slab Radiant Heating) – HW For Option 1 & 3, Electric for Option 2**

**Pros:**

- Provide system redundancy if Airside system needs service or repair.
- Energy Efficient when used with Efficient Heating Source – Lower Space Temperature setpoints are typically required.
- Improved thermal comfort
- Improved snow/ice melt for Apparatus

**Cons:**

- Higher First Cost
- For All electric systems – high operational cost (recommended only for back-up).
- Still requires Airside system (such as VRF or Unit Heaters) to handle cold temperature infiltration associated with Apparatus Bay door operation during cold weather



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## Northborough Central Fire Station - Mechanical System Payback Summary

| Baseline | System | Gross Capital Investment* | Annual Elec. Cons. (kWh) | Annual Electric Cost | Combined Utility Cost | Annual Utility $/s.f. | Annual kBTU/s.f. (EUI) | Annual Maint. Cost | 20 Year Equipment Replacement Cost | 30 Year Equipment Replacement Cost | 40 Year Equipment Replacement Cost | Combined Annual Expense | Combined Expense Savings** | Total Life-Cycle Savings*** | Discounted Payback (Years)**** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1. Chilled/Hot Water Fan Coil Units<br>2. Chilled/Hot Water VAV Dedicated Outdoor Air Systems (DOAS) w/ ERV & Terminal VAV Boxes with DCV<br>3. Supplemental Hot Water Heating<br>4. Air-to-Water Packaged Heat Pump Chiller/Heater Plant | $2,859,734 | 349,496 | $86,205 | $86,205 | $2.79 | 38.7 | $23,383 | $432,000 | $516,675 | $432,000 | $109,588 | - | - | - |

| Option | System | Gross Capital Investment* | Annual Elec. Cons. (kWh) | Annual Electric Cost | Combined Utility Cost | Annual Utility $/s.f. | Annual kBTU/s.f. (EUI) | Annual Maint. Cost | 20 Year Equipment Replacement Cost | 30 Year Equipment Replacement Cost | 40 Year Equipment Replacement Cost | Combined Annual Expense | Combined Expense Savings** | Total Life-Cycle Savings*** | Discounted Payback (Years)**** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 1. VRF System w/ Air-Source Heat Pump (ASHP) Heat Recovery Condensing Units<br>2. ASHP VAV Dedicated Outdoor Air Systems (DOAS) w/ ERV & DCV with Terminal VAV Boxes<br>3. Supplemental Electric Heating | $2,629,533 | 312,826 | $77,658 | $77,658 | $2.52 | 34.6 | $23,383 | $326,000 | $249,675 | $484,000 | $101,041 | $8,547 | $1,104,173 | Instant ***** |
| 3 | 1. VRF System w/ Water-Source Heat Pump (WSHP) Heat Recovery Condensing Units<br>2. WSHP VAV Dedicated Outdoor Air Systems (DOAS) w/ ERV & DCV with Terminal VAV Boxes<br>3. Supplemental Hot Water Heating from GSHP Hot Water Heater<br>4. Geothermal Well Field and Distribution Plant | $4,234,257 | 293,717 | $72,992 | $72,992 | $2.37 | 32.5 | $25,968 | $0 | $693,925 | $0 | $98,960 | $10,628 | $72,028 | 45 |

* Capital Investment Costs based upon in-house cost estimate utilizing cost data from similar past projects and industry standard estimating references. Costs have been estimated for system comparison purposes only and do not incorporate all supplemental/independent HVAC system costs which would be required for all systems studied (i.e. specialty exhaust, overhead and profit).
** Combined expense savings is the difference between the combined annual expense of the baseline and system in comparison.
*** Total life-cycle savings is based on a 50 year study period.
**** Discounted payback years is based upon BLCC5 Life Cycle Analysis.
***** Discounted payback never reached because system is more efficient and/or less expensive than baseline system.

Note 1: Values based on energy model performed for HVAC System Life Cycle Cost Analysis purposes. A 30% safety factor should be applied for budgeting purposes to account for potential variances to the actual operation of the building. Per ASHRAE Standard 90.1:

*Neither the proposed building performance nor the baseline building performance are predictions of actual energy consumption or costs for the proposed design after construction. Actual experience will differ from these calculations due to variations such as occupancy, building operation and maintenance, weather, energy use not covered by this procedure, changes in energy rates between design of the building and occupancy, and the precision of the calculation tool.*

HKT architects inc.

## Northborough Central Fire Station - Mechanical System Payback Summary
### Including Mass Save Incentives

| Baseline | System | Gross Capital Investment* | Mass Save Heat Pump Adder Incentive** | Net Investment | Annual Elec. Cons. (kWh) | Annual Electric Cost | Combined Utility Cost | Annual Utility $/s.f. | Annual kBTU/s.f. (EUI) | Annual Maint. Cost | 20 Year Equipment Replacement Cost | 30 Year Equipment Replacement Cost | 40 Year Equipment Replacement Cost | Combined Annual Expense | Combined Expense Savings*** | Total Life-Cycle Savings*** | Discounted Payback (Years)**** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1. Chilled/Hot Water Fan Coil Units<br>2. Chilled/Hot Water VAV Dedicated Outdoor Air Systems (DOAS) w/ ERV & Terminal VAV Boxes with DCV<br>3. Supplemental Hot Water Heating<br>4. Air-to-Water Packaged Heat Pump Chiller/Heater Plant | $2,859,734 | $192,000 | **$2,667,734** | 349,496 | $86,205 | $86,205 | $2.79 | **38.7** | $23,383 | $432,000 | $516,675 | $432,000 | $109,588 | - | - | - |

| Option | System | Gross Capital Investment* | Mass Save Heat Pump Adder Incentive** | Net Investment | Annual Elec. Cons. (kWh) | Annual Electric Cost | Combined Utility Cost | Annual Utility $/s.f. | Annual kBTU/s.f. (EUI) | Annual Maint. Cost | 20 Year Equipment Replacement Cost | 30 Year Equipment Replacement Cost | 40 Year Equipment Replacement Cost | Combined Annual Expense | Combined Expense Savings** | Total Life-Cycle Savings*** | Discounted Payback (Years)**** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 1. VRF System w/ Air-Source Heat Pump (ASHP) Heat Recovery Condensing Units<br>2. ASHP VAV Dedicated Outdoor Air Systems (DOAS) w/ ERV & DCV with Terminal VAV Boxes<br>3. Supplemental Electric Heating | $2,629,533 | $200,000 | **$2,429,533** | 312,826 | $77,658 | $77,658 | $2.52 | **34.6** | $23,383 | $326,000 | $249,675 | $484,000 | $101,041 | **$8,547** | **$1,112,173** | Instant ***** |
| 3 | 1. VRF System w/ Water-Source Heat Pump (WSHP) Heat Recovery Condensing Units<br>2. WSHP VAV Dedicated Outdoor Air Systems (DOAS) w/ ERV & DCV with Terminal VAV Boxes<br>3. Supplemental Hot Water Heating from GSHP Hot Water Heater<br>4. Geothermal Well Field and Distribution Plant | $4,234,257 | $900,000 | **$3,334,257** | 293,717 | $72,992 | $72,992 | $2.37 | **32.5** | $25,968 | $0 | $693,925 | $0 | $98,960 | **$10,628** | **$780,028** | **33** |

* Capital Investment Costs based upon in-house cost estimate utilizing cost data from similar past projects and industry standard estimating references. Costs have been estimated for system comparison purposes only and do not incorporate all supplemental/independent HVAC system costs which would be required for all systems studied (i.e. specialty exhaust, overhead and profit).

** Total payment costs indicated for these incentives need to be confirmed by the appropriate providers. Preliminary incentive estimate based on current program offerings and preliminary load estimates, both of which are subject to change.

*** Combined expense savings is the difference between the combined annual expense of the baseline and system in comparison.

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***** Discounted payback years is based upon BLCCS Life Cycle Analysis.

****** Discounted payback never reached because system is more efficient and/or less expensive than baseline system.

Note 1: Values based on energy model performed for HVAC System Life Cycle Cost Analysis purposes. A 30% safety factor should be applied for budgeting purposes to account for potential variances to the actual operation of the building. Per ASHRAE Standard 90.1:

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## Northborough Central Fire Station - Mechanical System Payback Summary
## Including Mass Save Incentives & Federal Tax Credit

| Baseline | System | Gross Capital Investment* | Mass Save Heat Pump Adder Incentive** | 25% IRA Geothermal Federal Tax Credit** | Net Investment | Annual Elec. Cons. (kWh) | Annual Electric Cost | Combined Utility Cost | Annual Utility $/s.f. | Annual kBTU/s.f. (EUI) | Annual Maint. Cost | 20 Year Equipment Replacement Cost | 30 Year Equipment Replacement Cost | 40 Year Equipment Replacement Cost | Combined Annual Expense | Combined Expense Savings*** | Total Life-Cycle Savings*** | Discounted Payback (Years)**** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1. Chilled/Hot Water Fan Coil Units<br>2. Chilled/Hot Water VAV Dedicated Outdoor Air Systems (DOAS) w/ ERV & Terminal VAV Boxes with DCV<br>3. Supplemental Hot Water Heating<br>4. Air-to-Water Packaged Heat Pump Chiller/Heater Plant | $2,859,734 | $192,000 | $0 | **$2,667,734** | 349,496 | $86,205 | $86,205 | $2.79 | **38.7** | $23,383 | $432,000 | $516,675 | $432,000 | $109,588 | - | - | - |

| Option | System | Gross Capital Investment* | Mass Save Heat Pump Adder Incentive** | 25% IRA Geothermal Federal Tax Credit** | Net Investment | Annual Elec. Cons. (kWh) | Annual Electric Cost | Combined Utility Cost | Annual Utility $/s.f. | Annual kBTU/s.f. (EUI) | Annual Maint. Cost | 20 Year Equipment Replacement Cost | 30 Year Equipment Replacement Cost | 40 Year Equipment Replacement Cost | Combined Annual Expense | Combined Expense Savings*** | Total Life-Cycle Savings*** | Discounted Payback (Years)**** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 1. VRF System w/ Air-Source Heat Pump (ASHP) Heat Recovery Condensing Units<br>2. ASHP VAV Dedicated Outdoor Air Systems (DOAS) w/ ERV & DCV with Terminal VAV Boxes<br>3. Supplemental Electric Heating | $2,629,533 | $200,000 | $0 | **$2,429,533** | 312,826 | $77,658 | $77,658 | $2.52 | **34.6** | $23,383 | $326,000 | $249,675 | $484,000 | $101,041 | **$8,547** | **$1,112,173** | Instant ***** |
| 3 | 1. VRF System w/ Water-Source Heat Pump (WSHP) Heat Recovery Condensing Units<br>2. WSHP VAV Dedicated Outdoor Air Systems (DOAS) w/ ERV & DCV with Terminal VAV Boxes<br>3. Supplemental Hot Water Heating from GSHP Hot Water Heater<br>4. Geothermal Well Field and Distribution Plant | $4,234,257 | $900,000 | $1,058,564 | **$2,275,693** | 293,717 | $72,992 | $72,992 | $2.37 | **32.5** | $25,968 | $0 | $693,925 | $0 | $98,960 | **$10,628** | **$1,838,592** | Instant ***** |

* Capital Investment Costs based upon in-house cost estimate utilizing cost data from similar past projects and industry standard estimating references. Costs have been estimated for system comparison purposes only and do not incorporate all supplemental/independent HVAC system costs which would be required for all systems studied (i.e. specialty exhaust, overhead and profit).

** Total payment costs indicated for these incentives need to be confirmed by the appropriate providers. Preliminary incentive estimate based on current program offerings and preliminary load estimates, both of which are subject to change.

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**** Total life-cycle savings is based on a 50 year study period.

***** Discounted payback years is based upon BLCC5 Life Cycle Analysis.

****** Discounted payback never reached because system is more efficient and/or less expensive than baseline system.

Note 1: Values based on energy model performed for HVAC System Life Cycle Cost Analysis purposes. A 30% safety factor should be applied for budgeting purposes to account for potential variances to the actual operation of the building. Per ASHRAE Standard 90.1:

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## Northborough Central Fire Station - LEED v4.0 Energy Savings Summary

| Baseline | Description | Annual Elec. Cons. (kWh) | Annual Electric Cost | Combined Utility Cost | Annual Utility $/s.f. | Annual kBTU/s.f. (EUI) | Combined Expense Savings** | Energy Cost Savings Percentage** | LEED EAc2 Points |
|---|---|---|---|---|---|---|---|---|---|
| LEED Baseline | 1. ASHRAE 90.1-2010 Envelope<br>2. ASHRAE 90.1-2010 Mechanical Systems (System 6 - Packaged DX VAV AHU's w/ Fan-Powered VAV Boxes w/ Electric Reheat)<br>3. ASHRAE 90.1-2010 Lighting System (0.71 w/s.f.)<br>4. ASHRAE 90.1-2010 Electric Domestic Hot Water Systems | 569,723 | $140,196 | $140,196 | $4.54 | 63.0 | - | - | - |

| Option | Description | Annual Elec. Cons. (kWh) | Annual Electric Cost | Combined Utility Cost | Annual Utility $/s.f. | Annual kBTU/s.f. (EUI) | Combined Expense Savings** | Energy Cost Savings Percentage** | LEED EAc2 Points |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1. Design Envelope<br>2. Design Mechanical Systems (Option 1 - Fan Coil System w/ Air-Source Heat Pump Plant)<br>3. Design High-Efficiency Lighting System (0.50 w/s.f.)<br>4. Electric Domestic Hot Water Systems | 373,676 | $92,066 | $92,066 | $2.98 | 41.3 | $48,130 | 34.3% | 13 |
| 2 | 1. Design Envelope<br>2. Design Mechanical Systems (Option 2 - Air-Source VRF Heat Pump System)<br>3. Design High-Efficiency Lighting System (0.50 w/s.f.)<br>4. Electric Domestic Hot Water Systems | 312,826 | $77,658 | $77,658 | $2.52 | 34.6 | $62,538 | 44.6% | 16 |
| 3 | 1. Design Envelope<br>2. Design Mechanical Systems (Option 3 - Geothermal Water-Source VRF Heat Pump System)<br>3. Design High-Efficiency Lighting System (0.50 w/s.f.)<br>4. Electric Domestic Hot Water Systems | 293,717 | $72,992 | $72,992 | $2.37 | 32.5 | $67,204 | 47.9% | 17 |

*Combined expense savings is the difference between the combined annual expense of the baseline and building in comparison.
**Energy cost savings percentage is the difference between the annual energy costs of the baseline and building in comparison.

Note 1: Values based on energy model performed for HVAC System Life Cycle Cost Analysis purposes. A 30% safety factor should be applied for budgeting purposes to account for potential variances to the actual operation of the building. Per ASHRAE Standard 90.1:

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# HVAC LCCA Conclusions:

- Without Incentives or Tax Credits…
  - Option 2, Air-Source VRF Heat Pump System, represents the lowest life cycle cost (L.C.C.)of the system options studied by yielding an approximate **$1,104,173** savings over the 50-year study period with an instant payback compared to the baseline system.
- With Utility incentives…
  - Option 2, Air-Source VRF Heat Pump System, represents the lowest L.C.C. of the system options studied by yielding an approximate **$1,112,173** savings over the 50-year study period with an instant payback compared to the baseline system
- With Utility Incentives & Federal Tax Credits…
  - Option 3, Geothermal VRF Unit System, represents the lowest L.C.C. of option studied by yielding an approximate $1,838,592 savings over the 50-year study period with an instant payback.

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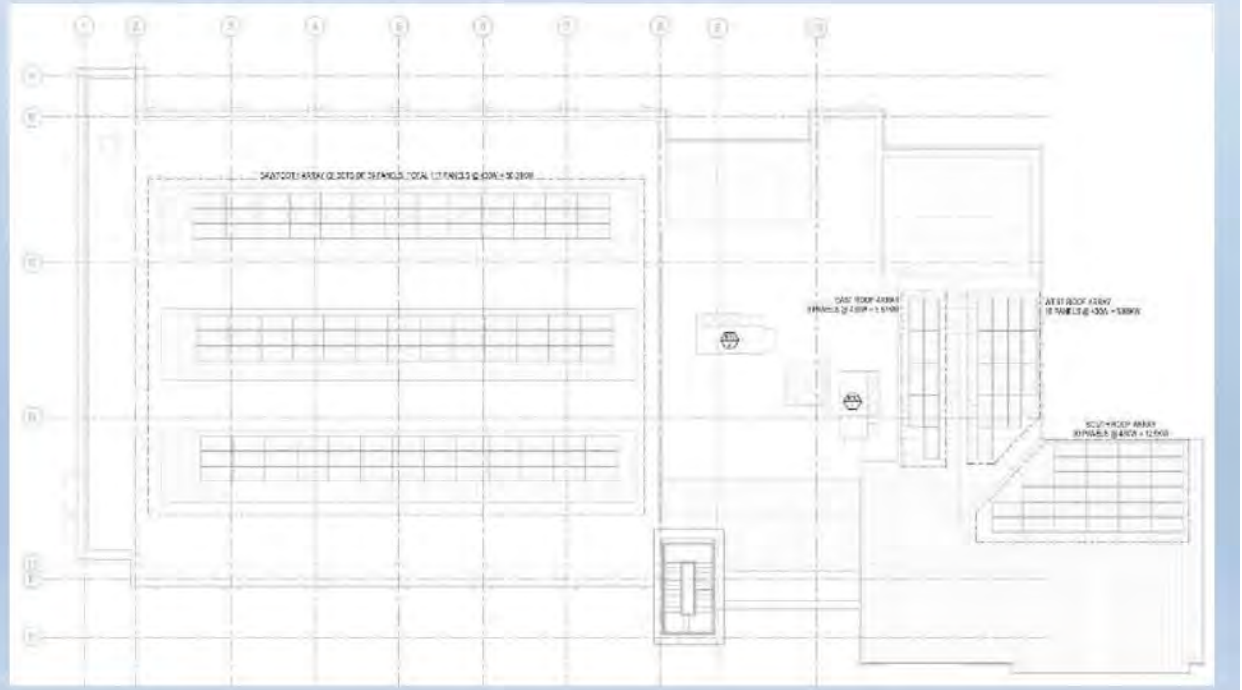
## Photovoltaic (PV) System (Roof Mounted):

- Estimated System Size: 73.95KWdc
- Estimated generation: 89,534kWh/yr (28.62% building consumption)
- Estimated Construction Cost
  - Base System 3.5$/W = $258,860
  - On SMART (Solar Massachusetts Renewable Target) $268,860
  - Inflation Reduction Act (IRA) 30% tax credit;
    - Many stipulations and will require a tax attorney / consultant
- Estimated SMART Compensation: $3,695/yr
- Estimated Discounted Paybacks:
  - Base System, 15 yrs.
    - With IRA 10 yrs.
  - Base System on SMART 11 yrs.
    - With IRA 9 yrs.
- Estimated HVAC System Option EUI's:
  - HVAC Option 1 – 38.7 kBTU/s.f.
    - w/ PV – 31.4 kBTU/s.f.
  - HVAC Option 2 – 34.6 kBTU/s.f.
    - w/ PV – 24.7 kBTU/s.f.
  - HVAC Option 3 – 32.5 kBTU/s.f.
    - w/ PV – 22.6 kBTU/s.f.



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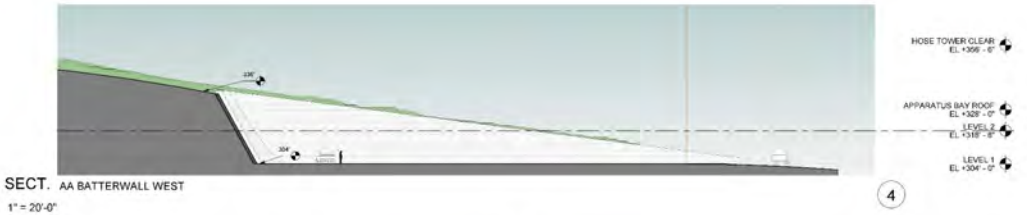
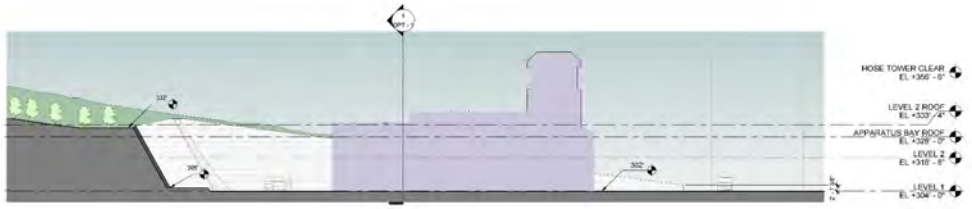
# RETAINING WALL – STRAIGHT + BATTER WALL OPTION

- Geogrid not anticipated for batter
- Straight wall with geogrid on east + west sides
- 30’ high - 17’-2/1/2” deep batter wall on south side

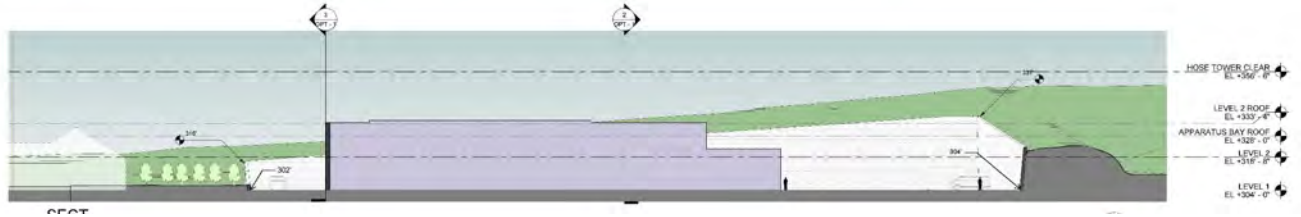


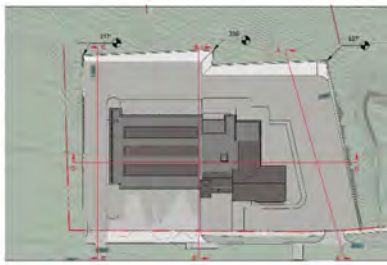

SECT. AA BATTERWALL WEST
1" = 20'-0"
4


SECT. CC BATERWALL EAST
1" = 20'-0"
3

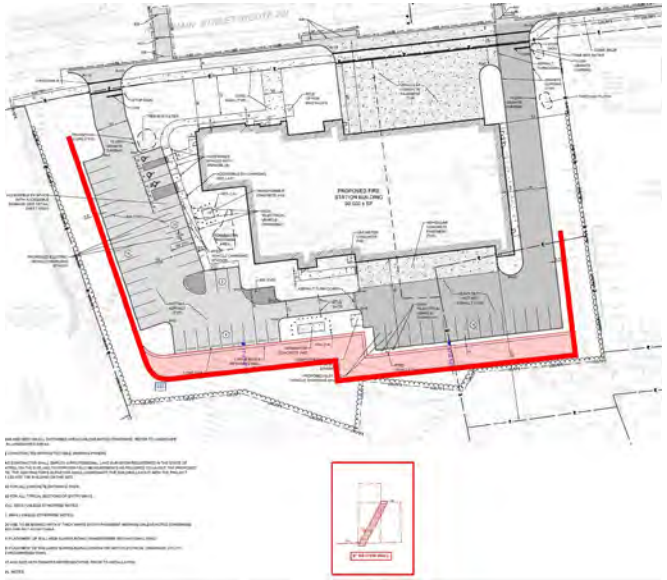



SECT. BB BATTERWALL MID
1" = 20'-0"
2



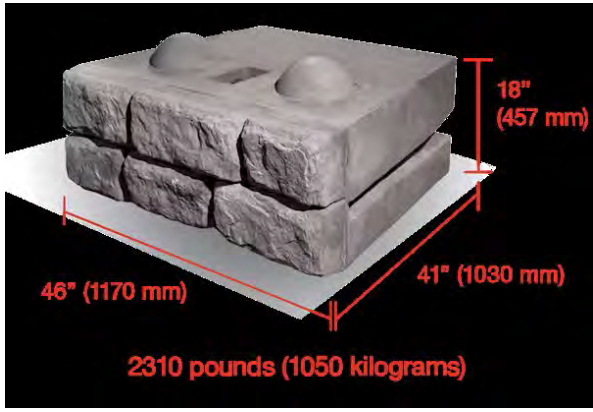
SITE PLAN OPTION 2 BATTERWALL
1" = 60'-0"
5



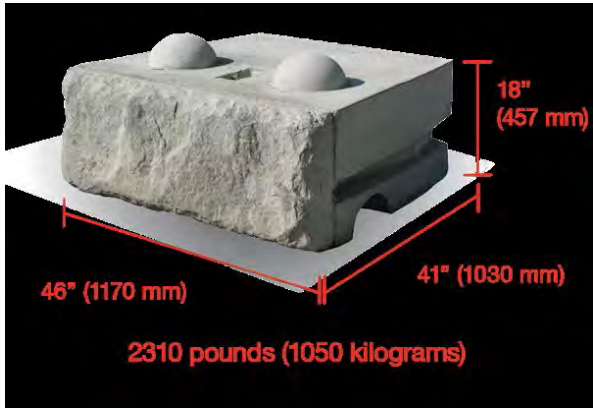
## RETAINING WALL – TEXTURE + COLOR

- Three textures commonly available locally
  - Cobblestone + Limestone – same cost
  - Ledgestone – more costly
- Color options:
  - Gray color standard
  - Custom color available
    - Field applied stain – surface applied color only – less durable
    - Admix + hardener – added to formwork during manufacturing – most costly – ties up manufacturer's equipment + slows their production

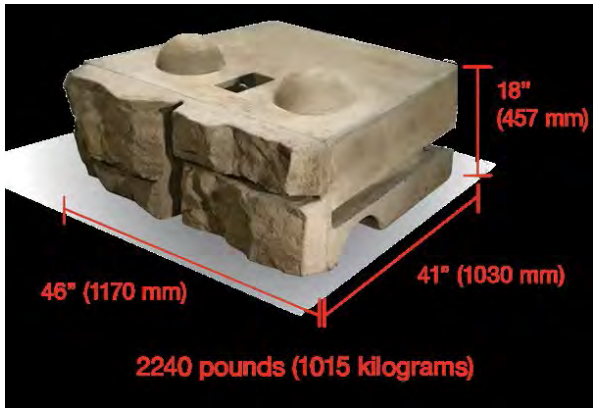
COBBLESTONE




LIMESTONE

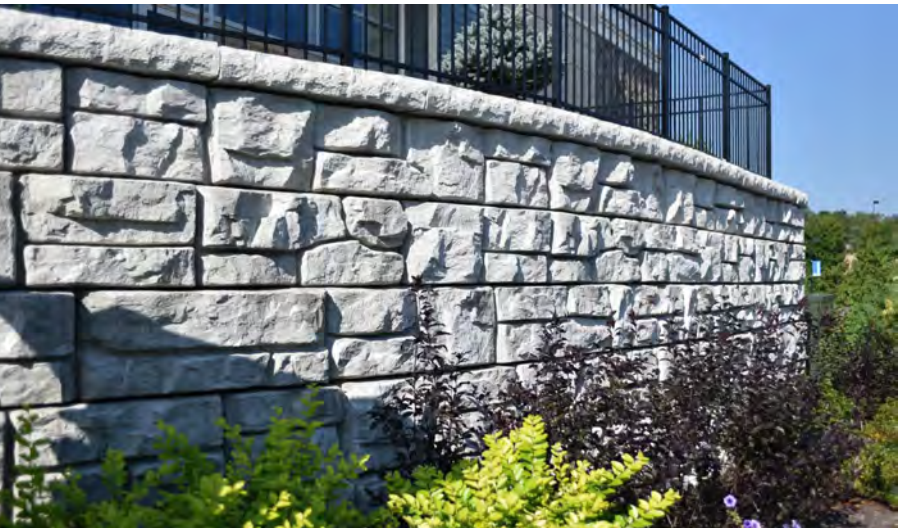



LEDGESTONE



## RETAINING WALLS

LIMESTONE



LEDGESTONE

COBBLESTONE

## MATERIALS + COLORS


NORTH ELEVATION - COLOR OPTION 1


NORTH ELEVATION - COLOR OPTION 2

## MATERIALS + COLORS

VIEW FROM NORTHEAST - COLOR OPTION 1

VIEW FROM NORTHEAST - COLOR OPTION 2

VIEW FROM NORTHWEST - COLOR OPTION 1

VIEW FROM NORTHWEST - COLOR OPTION 2

## MATERIALS + COLORS

MAIN ENTRY VIEW - COLOR OPTION 1

MAIN ENTRY VIEW - COLOR OPTION 2

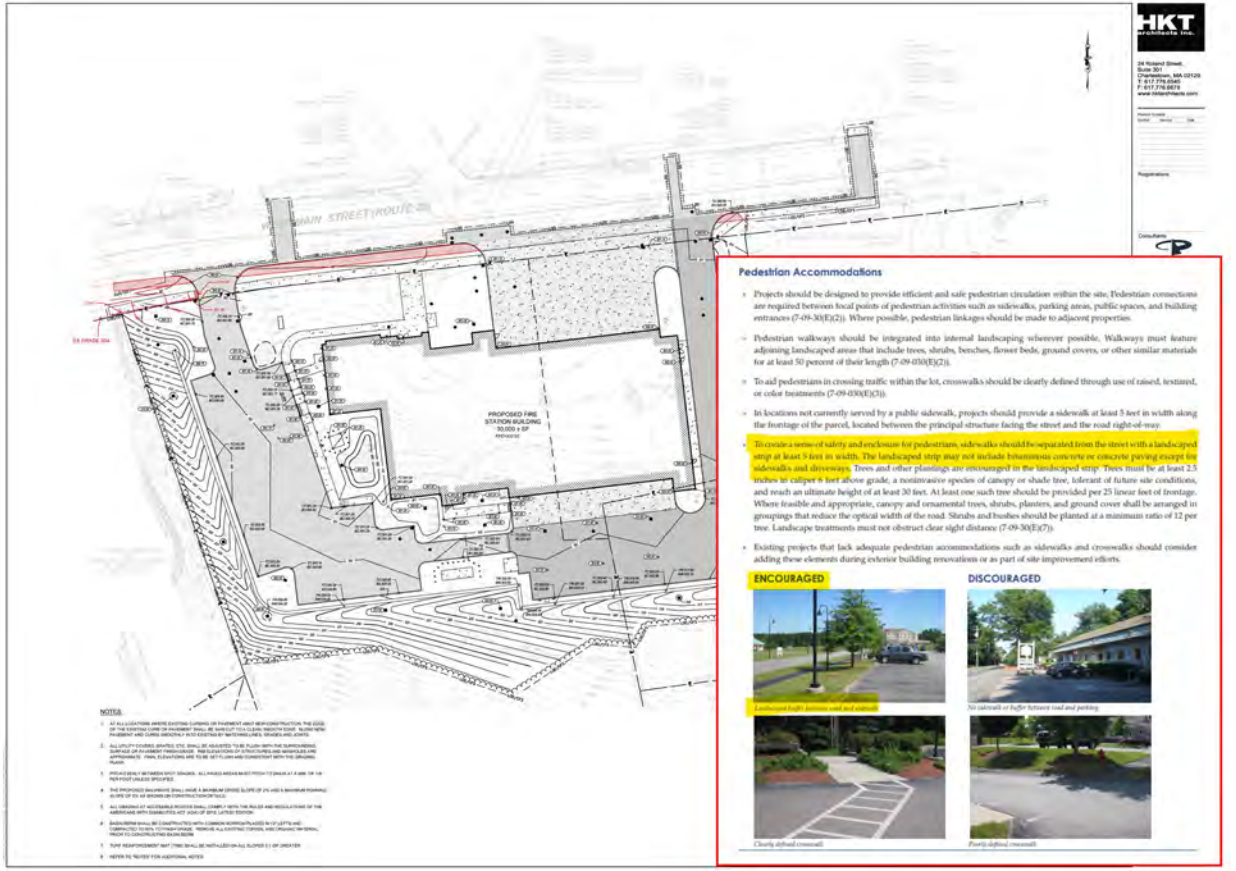
## MATERIALS + COLORS

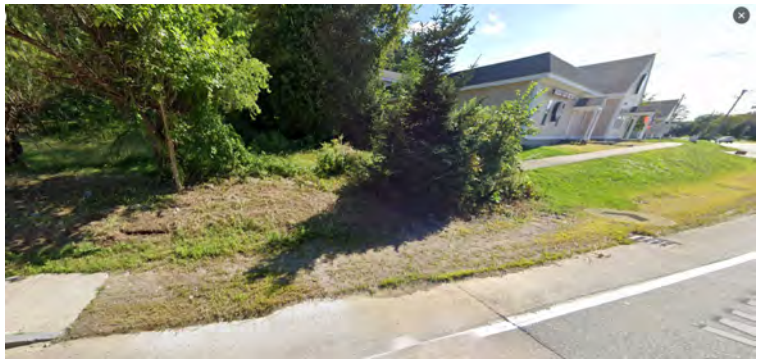

APPARATUS BAY VIEW - COLOR OPTION 1


APPARATUS BAY VIEW - COLOR OPTION 2

## OTHER ITEMS OF NOTE

- ZBA Results
  - Setback variance approved
  - Building Sign size variance approved
  - LED portion of site sign not approved
- Design Review Committee comments on Sidewalk
  - Waive green space requirement to continue walkway as it currently exists
  - Sidewalk won't connect at adjacent property



## DEVELOPMENT OF TOTAL PROJECT COSTS

- Hard Construction Costs – Building + Site
  - Estimating Package consisted of limited drawings + outline specifications + engineering narratives
  - Statement of Probable Costs included design + pricing contingencies of 10% to allow for the unknowns
  - Included 14 Alternate Options + 1 Allowance Order of Magnitude Alternate
- Soft Costs – Other Project Costs outside the Scope of the Builder
  - Furnishings, Fixtures + Equipment: Loose Furnishings, Program Related Equipment, Date/Telecom Equipment, AV Equipment Security, Other Specialty Items
  - Fees + Expenses: Designer + OPM Fees, Commissioning, Legal, Utility Assessment, Materials Testing Fees During Construction
  - Contingency: Construction + Owner's Project
- Next estimate is scheduled at the end of Design Development + will be based on a more advanced design with more detailing + definition of the scope of work
  - Reconciliation Process will occur at the DD level estimate

## TOTAL PROJECT COSTS – PROCESS

- Initial conversation determined that this project should be designed to meet the current + future operational needs of the Fire Department rather than to meet a predetermined budget
    - Programming focused on current + future needs
    - Site planning was based on the approved program + expected operations
        - Site layout first + foremost is based on the movement of fire apparatus onto + from the site
    - Building planning was based on the approved program + expected operations
        - The layout of the apparatus + support spaces is planned for ease + quick movement of vehicles with support spaces that respond to health concerns for firefighters
        - Administration spaces were designed to provide oversight + suitable interaction with the community
        - Living quarters provide appropriate space for 24/7 occupancy
        - MEPFP space requirements support modern systems
    - Fire station was to be a gateway to a revitalized Downtown District with a traditional aesthetic
- If a predetermined budget is now the direction, how do we proceed? Will FD operations be affected?

## TOTAL PROJECT COSTS – DECISIONS PROCESS

- Time is of the essence as costs continue to climb. However, this is the time to halt the design development effort if significant changes are expected. Architectural + engineering work would need to pause + then the team would remobilize based on the revised scope.
    - Site costs are high but include retaining walls, related earthwork, stormwater management + export of surplus materials. What if anything can bring those costs down?
    - Exterior wall materials, decorative elements + trim, roof shape + materials, door + window openings will need to be considered. What happens to the process if the building looks different?
    - Mechanical/electrical/plumbing/fire protection systems inside + outside building – simplest systems available that meet the code?
- First costs + long term costs will need to be considered as well as impact on end users. Will maintenance costs + replacement cost be higher than hoped for?
- How sustainable does the Town wish to be? Will the Town invest now in significant systems to meet sustainable expectations with the hope of saving over the years of service? Or is first-cost the driving factor? There may be reimbursable funding available, but the Town will need to be able to build it now with the hope that the program will be there to reimburse in the future.

# PROJECT BUDGET – MARCH 27. 2024

## PROJECT BUDGET

Colliers Project Leaders

### Town of Northborough
New Fire Station

**Project Budget Development - High / Low Cost Range**

Date: March 27, 2024

| $(000) except $/GSF | PROPOSED BUDGET (HIGH RANGE) 2/28/2024 | PROPOSED BUDGET (LOW RANGE) 2/28/2024 | PROPOSED BUDGET (HIGH RANGE) 3/27/2024 | PROPOSED BUDGET (LOW RANGE) 3/27/2024 | |
|---|---|---|---|---|---|
| New Construction GSF | 30,850 | 30,850 | 30,850 | 30,850 | |
| Renovation GSF | | | | | |
| **Total GSF** | 30,850 | 30,850 | 30,850 | 30,850 | |
| New Construction $/GSF - Current | $ 1,001.63 | $ 1,001.63 | $ 1,001.63 | $ 1,001.63 | |
| Total Project $/GSF | $ 1,617.70 | $ 1,392.86 | $ 1,466.11 | $ 1,288.47 | |
| I. **Building Construction** | | | | | |
| A New Building Construction | $ 30,900.3 | $ 30,900.3 | $ 30,900.3 | $ 30,900.3 | |
| B Energy Enhancements: Triple glz, added insul | $ 944.6 | $ 750.0 | $ 944.6 | $ 750.0 | |
| C Other Construction - PV on roof, 63.7KW | $ 576.6 | $ - | $ 576.6 | $ - | |
| **Total Building Construction** | 32,421.5 | 31,650.3 | 32,421.5 | 31,650.3 | |
| II. **Related Construction** | | | | | |
| A Sitework | | | | | |
| 1 Earthwork / Site Prep | - | - | - | - | |
| 2 Exterior Improvements | | | | | |
| a EV - ready Charging stations | 128.4 | 60.0 | 128.4 | - | Required by code |
| b Sidewalks / Paths | - | - | - | - | |
| c Wetlands Mitigation | - | - | - | - | |
| d Landscape & Planting | - | - | - | - | |
| e Athletic / Recreational Surfaces | - | - | - | - | |
| f Fencing / Gates | - | - | - | - | |
| g Retaining Walls:Terrace/ Batter | 750.0 | 300.0 | 296.0 | 296.0 | Voted to accept batter wall 2/26/2024 |
| h Misc Site Improvements | 150.0 | 50.0 | w/ construction | w/ construction | |
| B Site Utility Systems | | | | | |
| 1 Water & Wells | - | - | - | - | |
| a Fire Protection | - | - | - | - | |
| 2 Sanitary Sewage | - | - | - | - | |
| 3 Storm Drainage | - | - | - | - | |
| 4 Gas | - | - | - | - | |
| 5 Steam | - | - | - | - | |
| 6 Chilled Water | - | - | - | - | |
| 7 Electric | - | - | - | - | |
| 8 Data & Communications on Water Tower | 900.0 | 400.0 | - | - | Voted to Eliminate 2/26/24 |
| 9 Site Lighting | - | - | - | - | |
| **Total Site Construction** | 1,928.4 | 810.0 | 424.4 | 296.0 | |
| C Building Demolition | - | - | - | - | |
| D Hazardous Materials Removal | - | - | - | - | |
| E Sustainable Elements | | | | | |
| 1 Solar Panels / PV Array | - | - | - | - | |
| 2 Wind Power Generation | - | - | - | - | |
| 3 Geothermal Wells/ VRFw heat pumps | 2,255.6 | (292.8) | 2,255.6 | (292.8) | |
| 4 Rain Garden | 32.0 | - | 32.0 | - | |
| 5 Waste Water Treatment Plants | - | - | - | - | |
| F GC / CM Mark-ups | w/ construction | w/ construction | w/ construction | w/ construction | |
| **Total Related Construction** | 4,216.0 | 517.3 | 2,712.0 | 3.3 | |
| **Subtotal Construction - Current $** | 36,637.5 | 32,167.6 | 35,133.5 | 31,653.6 | |
| III. **Escalation (2025 Construction)** | 960.8 | 843.5 | w/ construction | w/ construction | |
| **Total Construction - Escalated** | $ 37,598.3 | $ 33,011.1 | $ 35,133.5 | $ 31,653.6 | |
| IV. **Furniture, Fixtures & Equipment (FF&E)** | | | | | |
| A Loose Furnishings | 450.0 | 300.0 | 450.0 | 300.0 | |
| B Program Related Equipment | 400.0 | 200.0 | 400.0 | 200.0 | |
| C Data / Telecomm Equipment | 350.0 | 150.0 | 350.0 | 150.0 | |
| 1 Cabling / Wall Jack / Devices | w/ construction | w/ construction | w/ construction | w/ construction | |
| D Audio/Visual Equipment | 50.0 | 30.0 | 50.0 | 30.0 | |
| E Security Equipment | 50.0 | 30.0 | 50.0 | 30.0 | |
| 1 Cabling / Wall Jack / Devices | w/ construction | w/ construction | w/ construction | w/ construction | |
| F Specialty Signage | 45.0 | 15.0 | 45.0 | 15.0 | |
| **Total FF & E** | $ 1,345.0 | $ 725.0 | $ 1,345.0 | $ 725.0 | |

Page 1

## PROJECT BUDGET

Colliers Project Leaders

### Town of Northborough
New Fire Station

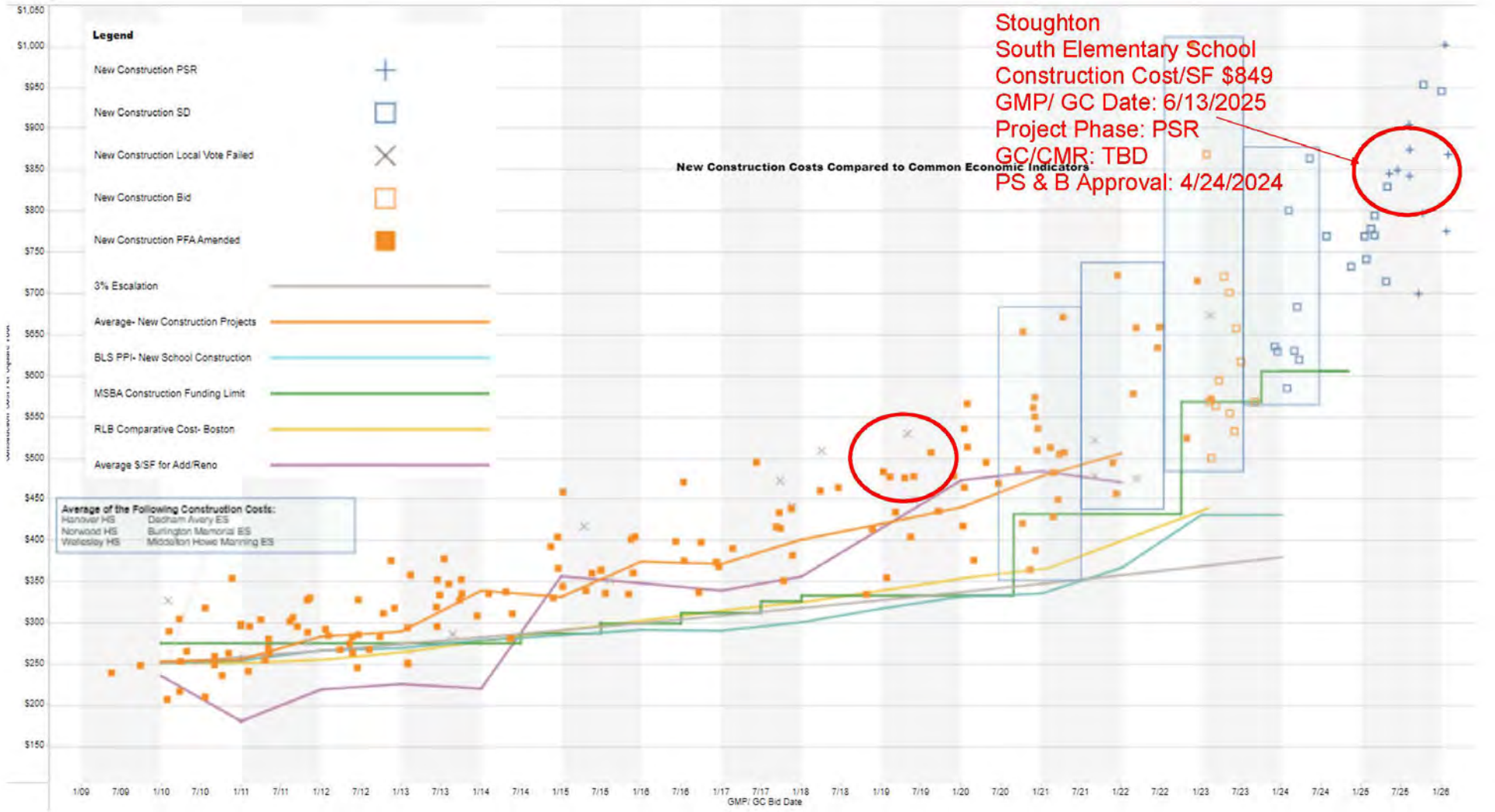
**Project Budget Development - High / Low Cost Range**

Date: March 27, 2024

| $(000) except $/GSF | PROPOSED BUDGET (HIGH RANGE) 2/28/2024 | PROPOSED BUDGET (LOW RANGE) 2/28/2024 | PROPOSED BUDGET (HIGH RANGE) 3/27/2024 | PROPOSED BUDGET (LOW RANGE) 3/27/2024 | |
|---|---|---|---|---|---|
| V. **Fees and Expenses** | | | | | |
| A Fees | | | | | |
| 1 Existing Conditions & Space Program | - | - | - | - | |
| 2 Architect | 3,894.3 | 3,373.6 | 2,918.3 | 2,590.3 | |
| Civil Engineering | w/ architect | w/ architect | w/ architect | w/ architect | |
| Landscape Architect | w/ architect | w/ architect | w/ architect | w/ architect | |
| Structural Engineering | w/ architect | w/ architect | w/ architect | w/ architect | |
| MEP/FP Engineering | w/ architect | w/ architect | w/ architect | w/ architect | |
| Interior / Furniture Designer | w/ architect | w/ architect | w/ architect | w/ architect | |
| Lighting Consultant | w/ architect | w/ architect | w/ architect | w/ architect | |
| Acoustical Consultant | w/ architect | w/ architect | w/ architect | w/ architect | |
| Signage Consultant | w/ architect | w/ architect | w/ architect | w/ architect | |
| LEED Designer | w/ architect | w/ architect | w/ architect | w/ architect | |
| Referendum Services | w/ architect | w/ architect | w/ architect | w/ architect | |
| Code Consultant | w/ architect | w/ architect | w/ architect | w/ architect | |
| Designer's Cost Estimator | w/ architect | w/ architect | w/ architect | w/ architect | |
| 3 Special Consultants | | | | | |
| Haz. Mat. Consultant | - | - | - | - | |
| Audio / Visual | w/ architect | w/ architect | w/ architect | w/ architect | |
| Technology / Security Systems Design | w/ architect | w/ architect | w/ architect | w/ architect | |
| Geo-Tech Engineering | 200.0 | 80.0 | 200.0 | 80.0 | |
| Traffic Engineer | 50.0 | 30.0 | 50.0 | 30.0 | |
| Ecologist / Soil Sample | - | - | - | - | |
| Peer Reviews | 25.0 | 7.5 | 25.0 | 7.5 | |
| Green Building Consultant | w/ architect | w/ architect | w/ architect | w/ architect | |
| Storm Water Monitoring | 25.0 | 10.0 | 25.0 | 10.0 | |
| 4 Project Management | 1,000.0 | 1,000.0 | 740.3 | 740.3 | |
| 5 Building Commissioning | 175.0 | 156.3 | 120.0 | 60.0 | |
| 6 Owner's Cost Estimator | 80.0 | 60.0 | 40.0 | 30.0 | |
| 7 CM Preconstruction Fee | - | - | - | - | |
| 8 Owner's Legal Fees | 30.0 | 15.0 | 30.0 | 15.0 | |
| 9 Site Survey | 30.0 | 15.0 | 30.0 | 15.0 | |
| 10 Utility Assessment | 125.0 | 50.0 | 125.0 | 50.0 | |
| Sub-total Fees | 5,634.3 | 4,799.4 | 4,303.6 | 3,628.1 | |
| B Expenses | | | | | |
| 1 Owner's Insurance | 56.4 | 49.5 | 52.7 | 47.5 | 0.15% of Construction |
| 2 Permits | | | | | |
| a Building | w/ Construction | w/ Construction | w/ Construction | w/ Construction | |
| b Town / Site | - | - | - | - | |
| 3 Printing | 20.0 | 10.0 | 20.0 | 10.0 | |
| 4 Construction Utilities Use | w/ Construction | w/ Construction | w/ Construction | w/ Construction | |
| 5 Site Borings | 50.0 | 30.0 | 50.0 | 30.0 | |
| 6 Materials Testing | 150.0 | 100.0 | 150.0 | 100.0 | |
| 7 Special Inspections | 50.0 | 10.0 | 50.0 | 10.0 | |
| 8 Consultant Reimbursables | 30.0 | 10.0 | 30.0 | 10.0 | |
| 9 Moving / Relocation | 100.0 | 25.0 | 100.0 | 25.0 | |
| 10 Temporary Space / Operations | - | - | - | - | |
| 11 Advertising | 10.0 | 10.0 | 10.0 | 10.0 | |
| 12 Physical Plant Expenses | - | - | - | - | |
| 13 Misc. Expenses | 150.0 | 100.0 | 150.0 | 100.0 | |
| 14 Financing Costs / Bond Origination | - | - | - | - | |
| 15 Site Acquisition | - | - | - | - | |
| a Real Estate Fees | - | - | - | - | |
| b Closing Costs | - | - | - | - | |
| Sub-total Expenses | 624.4 | 344.5 | 620.7 | 342.5 | |
| **Total Fees and Expenses** | 6,258.7 | 5,143.9 | 4,924.3 | 3,970.6 | |
| V. **Contingency** | | | | | |
| A Construction | 2,443.9 | 2,145.7 | 1,756.7 | 1,582.7 | Reduced from 6.5% to 5% of Construction |
| B Owner's Project | 2,260.1 | 1,944.0 | 2,070.1 | 1,817.5 | 5% of Project |
| **Total Contingency** | 4,704.0 | 4,089.7 | 3,826.8 | 3,400.2 | |
| **Total Project** | $ 49,986.0 | $ 42,969.7 | $ 45,229.6 | $ 39,749.4 | |
| Construction Cost vs. Total Project Cost | 75% | 77% | 78% | 80% | |
| Soft Cost vs. Total Project Cost | 25% | 23% | 22% | 20% | |

Page 2

# PROJECT BUDGET – MSBA CAPITAL PLANNING DATA – TRACKING COST INCREASES



## SCHEDULE – DESIGN DEVELOPMENT THRU BIDDING

- Design Development: Complete end of May/early June 2024
  - 5-6 Committee Meetings
  - 2 Design Review Meetings
  - 1 Zoning Board Meeting
  - 2 Planning Board Meetings
  - 1 Community Information Session
  - 1 Land Disturbance Meeting
- Construction Documents: Sept. 2024
- Bidding: Complete end of Oct. 2024

| II. | Design Development Phase 2/29/24 - 5/29/24 | | | | |
|---|---|---|---|---|---|
| 1 | Update Work plan - finalize schedule | | | | |
| 2 | *Committee meeting #7 - pre submission to DR #3 and ZBA* | ○ | *February 14, 2024* | | |
| 3 | *Design Review meeting #3: Documents to Planner 2/22/24* | ◊ | *February 29, 2024* | | |
| | *Note Committee meeting #8 SD- Sign off on February 28, 2024* | ○ | *February 28, 2024* | | |
| 4 | *Committee meeting #9: Exterior materials meeting* | ○ | *March 20, 2024* | | |
| 5 | *Zoning Board Meeting #1: Documents to Planner by 3/4/24* | ✉ | *March 26, 2024* | | |
| 6 | Committee meeting #10 - DD progress + LCCA Review | ○ | **March 27, 2024** | | |
| 7 | Planning Board Meeting #1: Documents to Planner by 3/18/24 | ● | **April 16, 2024** | | |
| 8 | Committee meeting #11 - DD progress | ○ | **April 17, 2024** | | |
| 9 | Committee meeting #12 - DD design sign off for estimate | ○ | **May 1, 2024** | | |
| 10 | Community Information Session #3 - DD progress | ★ | **May 8, 2024** | | |
| 11 | Design Review meeting #4: Documents to Planner 5/2/24 | ◊ | **May 9, 2024** | | |
| 12 | ConCom Land Disturbance Meeting: Documents to Planner 4/25/24 | ◀ | **May 13, 2024** | | |
| 13 | Planning Board Meeting #2: Documents to Planner by 4/15/24 | ● | **May 21, 2024** | | |
| 14 | Design Development cost estimate | | May 3, 2024 | to | May 24, 2024 |
| 15 | Committee meeting #13 - Cost estimate presented - DD sign off to CD | ○ | **May 29, 2024** | | |

- Item #8: Agenda to be determined
- Item #12: Meeting Dependent on PB Meeting #1
- Item #13: Meeting Dependent on PB Meeting #1

## NEXT STEPS

- Presentations to Committees and Boards
    - Planning Board
    - Community Information Meeting #3
    - Land Disturbance: Date Pending
    - Design Review Meeting
- FSBC meetings






# THANK YOU