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MILTON FIRE STATIONS

Fire Station Sustainability Charette, MEETING NOTES, 25 July 2019

Present:		
	Webster Collins	Fire Station Building Committee (FSBC
	Phillippe Genereux	Fire Station Building Committee (FSBC)
	Alicia Monks	Daedalus Projects, Inc (DPI)
	Jeff Shaw	Context Architecture (CTX)
	Angela Campbell	Context Architecture (CTX)
Distribution:	Brian Walsh	Chair, Fire Station Building Committee (FSBC)
	Dan Clark	V. Chair, Fire Station Building Committee (FSBC)
	Megan McCallon	Daedalus Projects, Inc (DPI)
	Alicia Monks	Daedalus Projects, Inc (DPI)
	Shane Nolan	Daedalus Projects, Inc (DPI)
	Jeff Shaw	Context Architecture (CTX)
	Chris Logan	Context Architecture (CTX)
	Elizabeth Apeldoorn	Context Architecture (CTX)
	Angela Campbell	Context Architecture (CTX)
	Frayan Gonzalez	Context Architecture (CTX)
	Miry Lopez	Context Architecture (CTX)
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The Committee discussed possible options for pursuing sustainable building techniques and LEED accreditation:

Sustainability:
Look at cost implications & incentives for Sustainability for following Tuesday Building Committee meeting (August 13)
Table ideas for now but the committee should provide direction to Context once options are vetted.

Publish Sustainability Charrette on FS website (after corrections).

Next meeting: emphasize Life Cycle costs, reducing energy consumption (from baseline 2004 to meet 70% - compare EUI of other FS's) and discuss overall cost savings potential for incentives & utility reduction
Add: premium for LEED certification (is it worth cost of hiring consultant such as Green Engineers - $40,000 +/- fee)
Include: discussion on strategies used by "Passive House" specifically for Residential portion of building
Add cost premium: LEED Certified vs. LEED certifiable, note the building cannot retroactively be submitted for LEED once that path is chosen
Possibilities: could FS be used for education, placards', displays encouraging fire fighter to give tours to students (safety issue) "Learning Building"
Design for future technology: provide conduits for technology 5-10 years, PV ready, etc.
Comprehensive Energy for town: DPW providing PV solar which can serve fire station; renewable energy purchase in lieu of building renewable energy sources into project
Geothermal: citizen suggested Geothermal could be used for complex of buildings (and allow for future expansion) since Town Hall and ancillary buildings are within tight radius

Technology: charging stations and planning for other future technologies
Technology: storm water runoff, rain garden, storm water retention/swail design to capture and treat water runoff
Rain Water recapture/reclamation: cost to install & maintain, look at optional systems; grey water systems
Discussion: Battery supply for energy storage, not ideal, technology is quickly changing
Building Technology: Mass. Timber design, typically long-span structure would be steel, emerging technology for timber long span to be considered
Studies for building fenestration: .38 u value (& better) .23 high performance window for Net Zero
Understand better: look at life cycle costs over long term & offsets w/PV & other energy alternative costs associated
Town of Milton input: Town Manager, Board of Selectman, Comprehensive Facilities & Sustainable Milton should provide input
Context to provide alternatives and meet with Town to gain input/direction
Consider: DOAS - Chilled Beam energy model by engineers
Energy Modeling can start as early as Schematic Design once concepts are more developed

Town of Milton Fire Station Sustainability Goals

- Introduction: Project Locations & Site Specifics
- Architectural Methods for Sustainability
- MEP Methods for Sustainability
- Cost Analysis for MEP Sustainable Practices
- Specific Project Alternatives
- Project Goals Summary

Sustainable Design

High Performance Building: A building that integrates and optimizes on a life cycle basis all major high-performance attributes

ENERGY CONSERVATION	ENVIRONMENT	SAFETY	DURABILITY	COST-BENEFIT	FUNCTIONALITY & OPERATIONS BENEFIT
Building Shape	Site improvement Least impact	Red List Building Materials	Long Life Cycle Building	HPE Commissioning	Building Commissioning
Building Floor to Enclosure Ratio	Limiting Light Pollution	Health Benefits of Low VOC Building Materials Low-emitting chemical materials	Impact	Using Living Building Challenge 2030 Protocol for monitoring, one-year meter data	Energy Alternatives: Geothermal, Solar PV, Solar hot water cost savings
Window to Wall Ratio	Limiting Heat Island Effect	Indoor Air Quality benefits	Water infiltration prevention		
Window Performance: U-Value & SHGC Fixed Fenestration: 0.38 U - 0.30 U-Value	On-site water treatment	Limit indoor pollutant sources	Air Leakage Barrier		
Air Leakage	On-site water capture systems		Vapor Diffusion Barrier		
Thermal Bridging	Renewable Materials		Condensation Barrier		
Thermal Mass/Insulation R-30, 40, 45	Exterior Surface color		Heat/Thermal Barrier		
Shading & Overhangs	Cradle to Grave		Ultraviolet Light (UV) Barrier		
Entrance design			Fire		

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Sustainable Design: Commissioning

High Performance Envelope commissioning can be separate or part of the MEP Commissioning contract

DESIGN CONSIDERATIONS (early design)	DURABILITY & PERFORMANCE (pre-construction)	AIR LEAKAGE TESTING (post construction)	MONITORING & OPERATIONS (life cycle of building)
Design for efficient floor-to-enclosure ratio	Vapor Barrier performance	Meet/Exceed Mass. State Energy Code 0.40 cfm/ft^2 ASTM E779	Determine energy savings goals; HPE Design can yield energy savings as high as 46%
Optimize Window to Wall ratio to balance Solar Heat Gain & Daylight	Air Leakage vs. Water Diffusion	Air Barrier testing	Periodic testing/functional testing
Meet Window and Door U-value and SHGC performance	*Improving the thermal barrier is a waste of resources If the water, air and vapor barriers are not properly Designed and constructed	Thermal modeling	
Limit thermal bridging, provide Continuous insulation			
PV ready/Photovoltaics analysis	Thermal Insulation R-value performance		
3d Thermal Modeling			
Hygrothermal modeling			
Orientation of Building and develop massing to respond to solar position			

Sustainable Design: Standards & Incentives

FEDERAL/NATIONAL	STATE/LOCAL	LEED
Energy Star Program: Commercial Building Standard by DOE – Median EUI=171 per Fire Station standards	IECC & State Energy Compliance standards	Low Flow Fixtures
US Department of Homeland Security Owner Project Requirements Tool	Massachusetts Clean Energy Program	Water Limiting
ASHRAE: Building Energy Quotient (hiring an outside energy rating consultant)	Small Building Program, Department of Energy	Rain Water Reclaim
The 2030 Challenge: Architecture 2030 Meeting the Carbon Neutral Goal for 2030		High-Efficiency Condensing Gas Water Heater
Living Building Challenge (exceeds LEED requirements)		Heat Island Effect
Passive House, Passive House Institute US		
Reflective Surfaces		

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Building Performance Analysis

- Programming
- Conceptual
- Schematic
- Design Development
- Construction Documentation

the building. Translucent glazing materials can be used to provide filtered, uniform, and glare-free daylight. By combining transparent vision glass at eye level with translucent glass above and below, designers can enhance the daylighting while giving occupants views to the outside.

3. BUILDING PERFORMANCE ANALYSIS PROCEDURES

Building performance simulations are an integral part of the design process for energy efficient and high-performance buildings, since they help in investigating design options and assess the environmental and energy impacts of design decisions (Aksamija, 2009a; Aksamija, 2010; Augenbroe et al., 2004). They are an essential part of the design process for sustainable, high-performance building facades. Quantifiable predictions during the different stages of the design process help establish metrics that can be used to measure improvements by using different design strategies. In order to evaluate and optimize the building performance, different analysis cycles should be part of an integrated design process (Punjabi & Miranda, 2005).

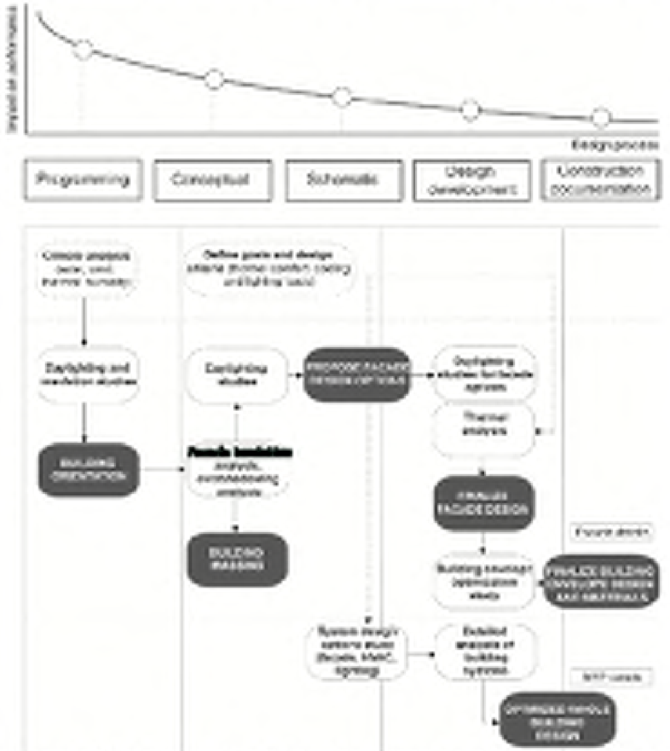

FIGURE 1. Framework for incorporating building performance analysis procedures with design of high-performance building envelopes.

Code (IECC 2015) Minimum Requirements

ELECTRICAL	WATER	HVAC
Daylight sensors in code required spaces.	Low Flow Fixtures	80% Efficient Boilers
Occupancy sensors in code required spaces.		Code-Efficient Air-Cooled Chillers and/or Condensing Units
Basic code required local lighting control		Variable Frequency Drives
0.67 watts/sf		Code-Efficient Packaged Air-Cooled DX Rooftop Units
		Variable Frequency Drives
		Energy Recovery (50% efficiency where required)
		Variable Air Volume Boxes

Code (IECC 2015) Minimum Requirements

BUILDING	ELECTRICAL	WATER	HVAC
Roof Insulation: R-30 c.i. ✓	Daylight sensors in code required spaces. ✓	Low Flow Fixtures ✓	80% Efficient Boilers ✓
Wall Insulation: R-13 + 7.5 c.i. ✓	Occupancy sensors in code required spaces. ✓		Code-Efficient Air-Cooled Chillers and/or Condensing Units ✓
Fixed Fenestration: 0.38 U-Value ✓	Basic code required local lighting control ✓		Variable Frequency Drives ✓
Operable Fenestration: 0.45 U-Value ✓	0.67 watts/sf ✓		Code-Efficient Packaged Air-Cooled DX Rooftop Units ✓
			Variable Frequency Drives ✓
			Energy Recovery (50% efficiency where required) ✓
			Variable Air Volume Boxes ✓

High-Performance (HPE) Building Design Measures

ENVELOPE	ELECTRICAL	WATER	HVAC
High-Performance Roof Insulation: R-40 c.i. (min.)	Daylight sensors in all spaces where daylight is available.	Low Flow Fixtures	High-Efficiency Condensing Boilers (92% efficient min.)
High-Performance Wall Insulation: R-15 – R-20 c.i. (min.)	Occupancy sensors located in all regularly occupied spaces.	Water Limiting	High-efficiency Chillers and/or Condensing Units
High-Performance Fixed Fenestration: 0.33 U-Value (max.)	Automated lighting control system	High-Efficiency Condensing Gas Water Heater	Variable Frequency Drives
High-Performance Operable Fenestration: 0.38 U-Value (max.)	Local lighting controls with multi-level switching in all spaces.	Recirculated Hot Water System	High-efficiency Packaged DX Rooftop Units
Shading Elements	0.5 watts/sf	Heavy Density Snap-On Insulation on all water piping	Demand Control Ventilation
Optimal Building Orientation	PV ready/Photovoltaics		Energy Recovery (60-70% efficient)
Reflective Surfaces			Variable Air Volume Boxes
			Chilled/Hot Water Coil Terminal Induction Units (served by Air-Cooled Chiller Plant)
			Variable Refrigerant Flow (VRF) Terminal Units (served by Air-Cooled Condensing Units)

High-Performance (HPE) Building Design Measures

BUILDING	ELECTRICAL	WATER	HVAC
High-Performance Roof Insulation: R-40 c.i. (min.) $	Daylight sensors in all spaces where daylight is available. ✓	Low Flow Fixtures ✓	High-Efficiency Condensing Boilers (92% efficient min.) $
High-Performance Wall Insulation: R-15 – R-20 c.i. (min.) $	Occupancy sensors located in all regularly occupied spaces. ✓	Water Limiting $	High-efficiency Chillers and/or Condensing Units $
High-Performance Fixed Fenestration: 0.33 U-Value (max.) ✓	Automated lighting control system ✓	High-Efficiency Condensing Gas Water Heater ✓	Variable Frequency Drives ✓
High-Performance Operable Fenestration: 0.38 U-Value (max.) $	Local lighting controls with multi-level switching in all spaces. $	Recirculated Hot Water System $	High-efficiency Packaged DX Rooftop Units $
Shading Elements $	0.5 watts/sf ✓	Heavy Density Snap-On Insulation on all water piping $	Demand Control Ventilation $
Optimal Building Orientation ✓	PV ready/Photovoltaics ✓		Energy Recovery (60-70% efficient) $
Reflective Surfaces ✓			Variable Air Volume Boxes ✓
			Chilled/Hot Water Coil Terminal Induction Units (served by Air-Cooled Chiller Plant) $
			Variable Refrigerant Flow (VRF) Terminal Units (served by Air-Cooled Condensing Units) $

Net Zero Building Additional Design Measures

ENVELOPE	ELECTRICAL	WATER	HVAC
High-Performance Roof Insulation: R-45 c.i. (min.)	Daylight sensors in all spaces where daylight is available.	Low Flow Fixtures	High-Efficiency Geothermal Heat Pump Chiller Plant w/ Closed Loop Geothermal Wells (sized for building cooling load)
High-Performance Wall Insulation: R-20 – R-25 c.i. (min.)	Occupancy sensors located throughout the building.	Water Limiting	Supplemental High-Efficiency Condensing Boilers (92% efficient min.)
High-Performance Fixed Fenestration: 0.30 U-Value (max.)	Automated lighting control system	Rain Water Reclaim	Variable Frequency Drives
High-Performance Operable Fenestration: 0.30 U-Value (max.)	Local lighting controls with multi-level switching in all spaces.	High-Efficiency Electric Water Heater	High-Efficiency Heat Pump Rooftop Units
Shading Elements	0.4 watts/sf	Heavy Density Snap-On Insulation on all water piping	Demand Control Ventilation
Optimal Building Orientation	Maximize photovoltaic opportunity		Energy Recovery (70-80% efficient)
Reflective Surfaces	Wind Energy		Variable Air Volume Boxes
			Chilled/Hot Water Coil Terminal Induction Units (served by Heat Pump Chiller Plant)
			Variable Refrigerant Flow (VRF) Terminal Units (served by Heat Pump Water-Cooled Condensing Units)

Net Zero Building Additional Design Measures

BUILDING	ELECTRICAL	WATER	HVAC
High-Performance Roof Insulation: R-40 c.i. (min.) $	Daylight sensors in all spaces where daylight is available. ✓	Low Flow Fixtures ✓	High-Efficiency Condensing Boilers (92% efficient min.) $
High-Performance Wall Insulation: R-15 – R-20 c.i. (min.) $	Occupancy sensors located in all regularly occupied spaces. ✓	Water Limiting $	High-efficiency Chillers and/or Condensing Units $
High-Performance Fixed Fenestration: 0.33 U-Value (max.) ✓	Automated lighting control system ✓	High-Efficiency Electric Water Heater ✓	Variable Frequency Drives ✓
High-Performance Operable Fenestration: 0.38 U-Value (max.) $	Local lighting controls with multi-level switching in all spaces. $	Recirculated Hot Water System $	High-efficiency Packaged DX Rooftop Units $
Shading Elements $	0.5 watts/sf ✓	Heavy Density Snap-On Insulation on all water piping $	Demand Control Ventilation $
Optimal Building Orientation ✓	PV ready/Photovoltaics ✓		Energy Recovery (60-70% efficient) $
Reflective Surfaces ✓			Variable Air Volume Boxes ✓
			Chilled/Hot Water Coil Terminal Induction Units (served by Air-Cooled Chiller Plant) $
			Variable Refrigerant Flow (VRF) Terminal Units (served by Air-Cooled Condensing Units) $

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Zero Combustion Net Zero Building Additional Design Measures

ENVELOPE	ELECTRICAL	WATER	HVAC
High-Performance Roof Insulation: R-45 c.i. (min.)	Daylight sensors in all spaces where daylight is available.	Low Flow Fixtures	High-Efficiency Geothermal Heat Pump Chiller Plant w/ Additional Closed Loop Geothermal Wells (sized for building heating load)
High-Performance Wall Insulation: R-20 – R-25 c.i. (min.)	Occupancy sensors located throughout the building.	Water Limiting	Variable Frequency Drives
High-Performance Fixed Fenestration: 0.30 U-Value (max.)	Automated lighting control system	Rain Water Reclaim	High-Efficiency Heat Pump Rooftop Units
High-Performance Operable Fenestration: 0.30 U-Value (max.)	Local lighting controls with multi-level switching in all spaces.	High-Efficiency Condensing Gas Water Heater	Demand Control Ventilation
Shading Elements	0.4 watts/sf	Heavy Density Snap-On Insulation on all water piping	Energy Recovery (70-80% efficient)
Optimal Building Orientation	Maximize photovoltaic opportunity		Variable Air Volume Boxes
Reflective Surfaces	Wind Energy		Chilled/Hot Water Coil Terminal Induction Units (served by Heat Pump Chiller Plant)
			Variable Refrigerant Flow (VRF) Terminal Units (served by Heat Pump Water-Cooled Condensing Units)

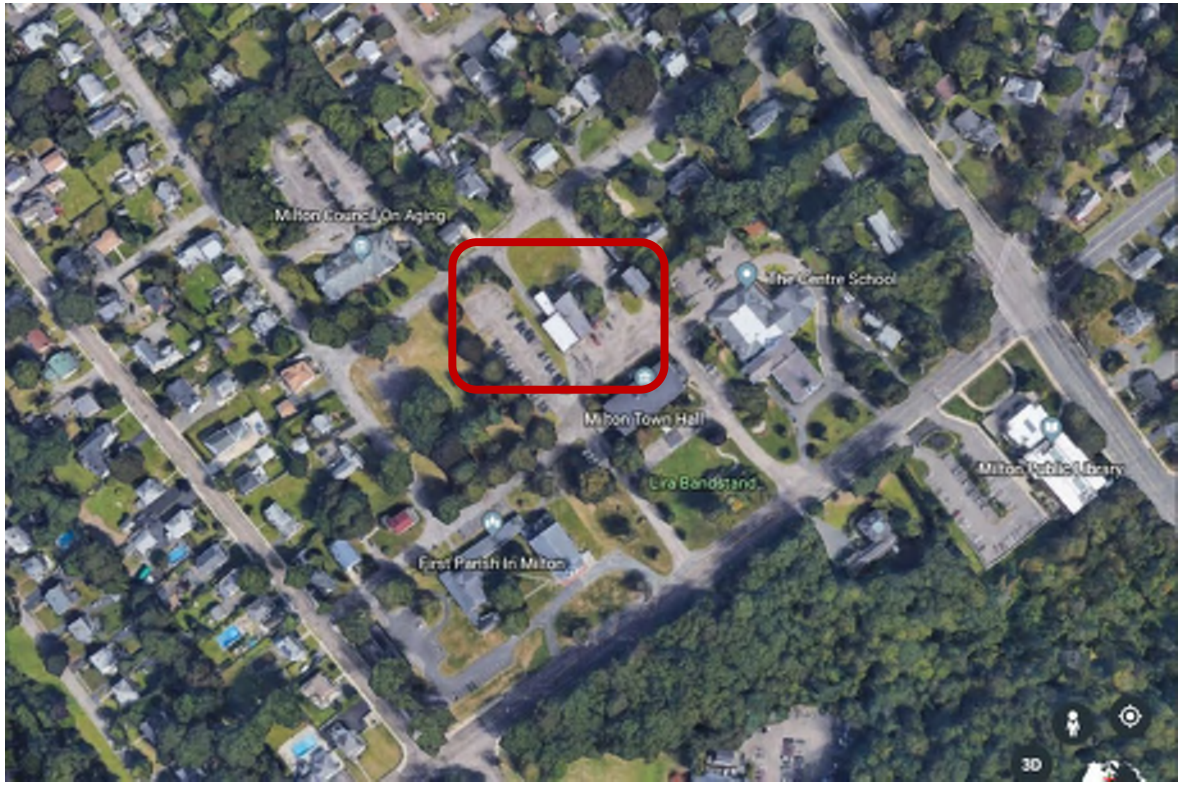
Zero Combustion Net Zero Building Additional Design Measures

BUILDING	ELECTRICAL	WATER	HVAC
High-Performance Roof Insulation: R-45 c.i. (min.) ✓	Daylight sensors in all spaces where daylight is available. ✓	Low Flow Fixtures ☐	High-Efficiency Geothermal Heat Pump Chiller Plant w/ Additional Closed Loop Geothermal Wells (sized for building heating load) $$$$
High-Performance Wall Insulation: R-20 – R-25 c.i. (min.) $$	Occupancy sensors located throughout the building. ✓	Water Limiting $	Variable Frequency Drives ✓
High-Performance Fixed Fenestration: 0.30 U-Value (max.) $$	Automated lighting control system ✓	Rain Water Reclaim $	High-Efficiency Heat Pump Rooftop Units $
High-Performance Operable Fenestration: 0.30 U-Value (max.) $$	Local lighting controls with multi-level switching in all spaces. $	High-Efficiency Condensing Gas Water Heater $$	Demand Control Ventilation $
Shading Elements $	0.4 watts/sf $	Heavy Density Snap-On Insulation on all water piping $	Energy Recovery (70-80% efficient) $
Optimal Building Orientation ✓	Maximize photovoltaic opportunity $$$$$$		Variable Air Volume Boxes ✓
Reflective Surfaces ✓	Wind Energy $$$$$$		Chilled/Hot Water Coil Terminal Induction Units (served by Heat Pump Chiller Plant) $
			Variable Refrigerant Flow (VRF) Terminal Units (served by Heat Pump Water-Cooled Condensing Units) $

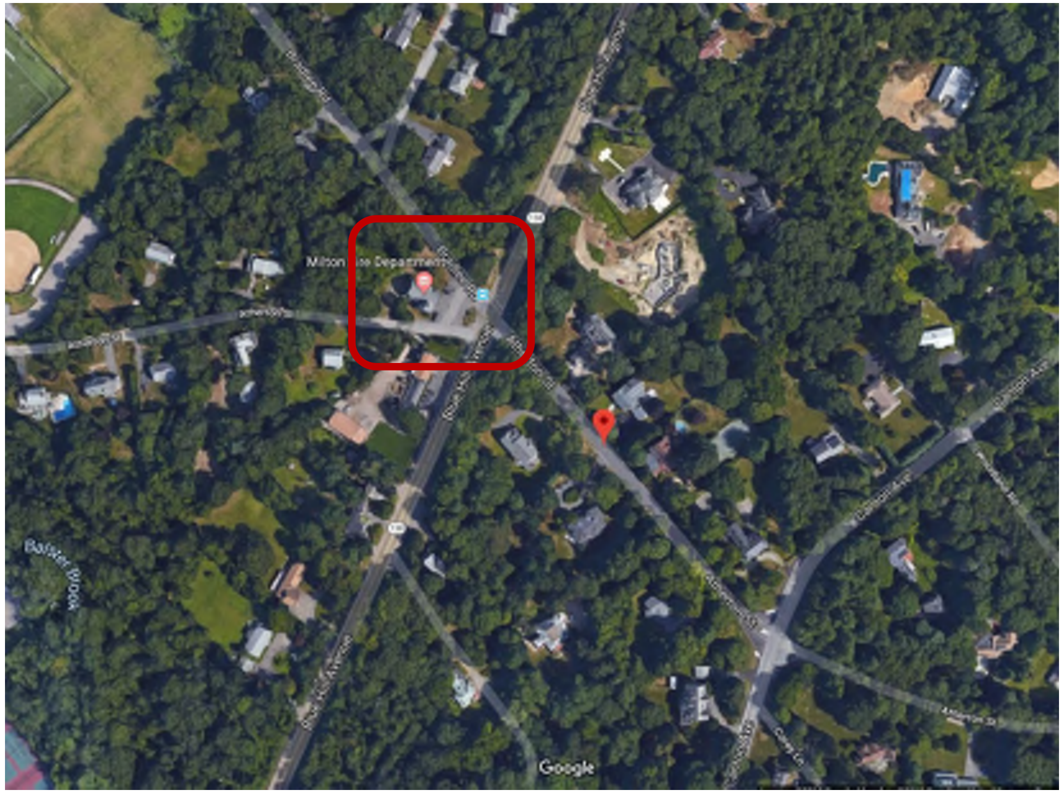
Sustainability Objectives

GOALS	HEADQUARTERS	ATHERTON
Efficiency of Spaces; compensate for volumes	Large volumes of spaces and large openings are programmatically necessary and can limit the efficiency of heating	Large volumes of spaces and large openings are programmatically necessary and can limit the efficiency of heating
Exterior Envelope Studies	Study efficient envelope variations	Study efficient envelope variations
Window-to-wall studies as part of Schematic Design	Provide studies for window-to-wall ratios during design	Provide studies for window-to-wall ratios during design
Commissioning	Provide enhanced commissioning throughout initial schematic design phase through to construction	Provide enhanced commissioning throughout initial schematic design phase through to construction
Energy Modeling	Provide Energy Modeling through consultants at schematic design through to construction	Provide Energy Modeling through consultants at schematic design through to construction
Optimal site and building orientation	Maximize photovoltaic opportunity. Review passive solar, shading design technique	Maximize photovoltaic opportunity. Review passive solar, shading design technique
PV Solar Array	Design for rooftop PV solar array	Design for rooftop PV solar array
Alternative Energy Options: Geothermal, Rain Water Re-capture	Review costs associated; pursue feasible alternative energy solutions	Review costs associated; pursue feasible alternative energy solutions

Headquarters Aerial View



Atherton Aerial View



Summary and Project Goals

- Select key sustainable technologies to be included in cost estimate & apply premium or cost allowance to specific strategies
- Track Building Commissioning closely and target goals early on
- Define targets for energy use intensity & water use
- Study as part of Schematic Design Window to Wall and Floor-to-Enclosure Ratios Carefully
- Target Federal and State Incentives early on
- Define Project Alternatives per site requirements
- Provide Project Goals Summary to the team