# MIT
# Design Standards

## Sustainability

## T19 Thematic Folder

Issued 2022

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# 1. INTRODUCTION

MIT is committed to the stewardship of natural systems and the holistic integration of sustainable design in its built environment. The Institute supports the development of high performance projects that include metrics for greenhouse gas emissions, analyzing life cycle costs, minimizing resource consumption and emphasizing human well-being and ecological health. It supports planning and design of campus buildings and sites that measure and promote ecosystem services such as carbon sequestration, protection of air and water quality, and mitigation of heat island effect. In addition, MIT's Plan for Action on Climate Change, released on October 21, 2015, sets forth various Institute-wide goals, including a greenhouse gas reduction goal of 32% below 2014 levels by 2030, inclusive of growth.

MIT's most recent plan, Fast Forward: MIT's Climate Action Plan for the Decade, released in May 2021, commits to net zero carbon emissions by 2026 and a goal of eliminating direct emissions by 2050.

The MIT Sustainability Design Standards, which include MIT specific LEED and Sustainable Sites minimum requirements, establish practices that are to be integrated in all projects. These standards clarify the sustainability scope for consultants to be integrated in their proposals for each phase of the project. Planning level phase requirements are addressed separately and will help establish initial goals for projects to ensure that MIT can meet its sustainability goals.

The architectural design team will be expected to engage sustainability, energy and LEED consultants (referred to in this document as SC). Additional information, such as detailed deliverables and project specific requirements, will be outlined in the Request for Proposals for a project. The standards outlined below are in addition to Commonwealth of Massachusetts and City of Cambridge requirements, such as the Stretch Energy Code, low-emitting materials and construction waste management.

# 2. NC/MR - PRE-DESIGN/CONCEPT DESIGN PHASE

## 2.1 New Construction and Major Renovation (NC/MR) - Integrative Design Charrette

Assume at least one interactive design charrette prior to commencing design. The purpose of the charrette is to identify solutions to meet sustainability goals, including MIT specific LEED and Sustainable Sites Checklists. Areas of focus include site, energy, water, indoor environmental quality, human health and materials. The charrette should include representatives from all impacted parties. Representatives will be proposed by the project sustainability POC and could include:

1. MIT internal team including:

a. Client Group Representatives and Occupant Representatives.
b. Office of Campus Planning (OCP)
c. Campus Construction Project Manager (PM).
d. Facilities Engineering (FE).
e. Systems Performance and Turnover (SP&T).
f. Information Systems and Technology (IS&T).
g. Custodial.
h. Grounds Maintenance.
i. Repair and Maintenance (R&M and CSG).
j. Recycling and Materials Management.
k. Utilities.
l. Environment, Health and Safety (EHS).
m. Office of Sustainability (MITOS)

2. Consultant team (CT) including:

a. Architect.
b. Landscape Architect.
c. Mechanical, Electrical, and Plumbing (MEP) Engineers.
d. Energy Consultant.
e. Lighting Designer.
f. Cost Consultant.
g. Sustainability, Energy and LEED Consultants (SC)
h. Other relevant consultants.

3. Construction team (CM) including:

a. Construction Manager.
b. General Contractor.
c. Relevant subcontractors/suppliers.

## 2.2 Resiliency and Sustainable Sites Review Meeting

The CT will hold a resiliency and sustainable sites focused meeting with MIT to identify and document project and district man-made and climate risks, agree on performance objectives and identify site and infrastructure mitigation strategies. Identify site and infrastructure strategies using an integrated approach to grey and green infrastructure strategies that address multiple performance criteria. Site strategies should align with MIT's Sustainable Sites checklist and Resiliency Standards (See Section 12 and 13 below) and Cambridge initiatives, such as the Cambridge Climate Vulnerability Assessment (CCVA) and the Urban Forest Master Plan.

## 2.3 Energy Modeling

The CT will provide "simple box" energy models to study design alternatives identified in an integrated design charrette and explore relationships between options and integrative system performance. The CT will provide required building data for the energy model as applicable. Incorporate sensitivity analysis. Integrate resilience scenarios based on Cambridge Climate Vulnerability Assessment and MIT-specific climate planning efforts.

## 2.4 Life Cycle Cost Analysis (LCCA)

The CT will coordinate with MIT to identify and develop options for an initial life cycle cost analysis. Cost bundling strategies should be used to ensure adequate evaluation of integrative options. CT to provide model results from the "simple box" energy models for the agreed upon design alternatives for use in the LCCA. CM/Cost estimator to provide pricing for alternates for use in the LCCA.

## 2.5 Commissioning (Cx)

MIT SPT will lead the development of the Owners Project Requirements (OPR) for commissioning. Refer to Division 01 Section "019113 - General Commissioning Requirements" for specifications.

## 2.6 Documentation

The CT will submit an initial sustainability narrative. Sustainability narratives include analysis performed by the consultant team to identify holistic design strategies to meet sustainability goals to reduce energy use and conserve water, enhance human health, support ecosystem services provided by water, soil, and vegetation systems, and address climate change projections. Categories will include as applicable:

1. Passive and active design strategies, including lighting, daylighting and shading, siting and orientation, natural and mechanical ventilation and heating, cooling and envelope systems.
2. Sustainable site strategies, including landscape and stormwater strategies and urban forestry management and their associated environmental and human health impacts.
    a. Basis of Design Site Performance Narrative
    b. Stormwater Design Matrix (excel version to be provided by MIT)
    c. MIT Sustainable Sites Checklist (see section 13)
3. Control strategies and renewable energy potential.
4. Active spaces and healthy spaces.
5. Acoustic, air quality and thermal comfort.
6. Building material choice impacts.
7. Integrated water reduction strategies.
8. Climate resilience narrative (see Section 12). Include:
    a. Flood and heat stress mitigation strategies that enable life safety and business continuity
    b. Description of strategies that enable flexibility for incremental adaptations over time for future climate risks

    c. Description of how the design is meeting MIT and City of Cambridge Climate Adaption and Resiliency Standards
9. Life cycle cost analysis (provided by MIT).
10. GHG calculations.
11. Energy model documentation. Include:
    a. Methodology
    b. Table of inputs
    c. Description of systems modeled
    d. Energy efficiency measures evaluated
    e. Schedules
    f. Energy use by end use and fuel type
    g. GHG emissions
12. LEED Checklist
13. LEED responsibility matrix

# 3. NC/MR - SCHEMATIC DESIGN PHASE

## 3.1 Integrative Design Charrette

Assume a minimum of two interactive design charrettes during schematic design. Charrettes should include representatives from all impacted parties. See Par. 2.1 for potential participants.

## 3.2 Resiliency and Sustainable Sites Review Meeting

The CT will hold a resiliency and sustainable sites focused meeting with MIT to address site and infrastructure mitigation strategies based on goals identified during Concept Design. Site strategies should align with MIT's Sustainable Sites checklist and Resiliency Standards (See Section 12 and 13 below) and Cambridge initiatives, such as the Cambridge Climate Vulnerability Assessment (CCVA) and the Urban Forest Master Plan.

## 3.3 Energy Modeling

The CT will provide energy model studies to test different options to meet project sustainability goals.

## 3.4 Life Cycle Cost Analysis (LCCA)

The CT will coordinate with MIT regarding LCCA of major options including energy, water, and stormwater, as required. Integrate LCCA in Value Engineering (VE) process. Changes in the project design due to Value Engineering should be approved by the entire team. MIT will use energy model results provided by the CT and CM/Cost estimator pricing for use in the LCCA.

### 3.5 Measurement and Verification

The CT will develop a Measurement and Verification strategy with consideration for the following:

1. Building level metering for all major energy and water streams, including electricity, natural gas, chilled water, steam, hot water, domestic water and irrigation
2. Define other metering strategies relevant to the project. Potential strategies include:
    a. Submeter by end use all systems that consume more than 10% of building energy.
    b. Submeter significant uses such as large kitchens, data centers, labs, innovative technology strategies, or as directed by MIT.
    c. Identify additional requirements and monitoring goals for operational management, programmatic needs, and user engagements.
3. Integrate metering strategies with building fault detection systems.

### 3.6 Commissioning (Cx)

The CT will develop a Basis of Design (BOD) for commissioning in accordance with the OPR. Refer to Division 01 Section "019113-General Commissioning Requirements" for specifications. The MIT OPR will be a living document and will be updated at each phase of the project.

### 3.7 Documentation

The CT shall submit an updated SD sustainability narrative.

## 4. NC/MR - DESIGN DEVELOPMENT PHASE

### 4.1 Integrative Design Reviews

Begin integrative design review at Design Development (DD) kick-off meeting.

### 4.2 Resiliency and Sustainable Sites Review Meeting

The CT will hold a resiliency and sustainable sites focused meeting with MIT to evaluate identified site and infrastructure mitigation strategies based on goals identified during Concept Design. Site strategies should align with MIT's Sustainable Sites checklist and Resiliency Standards (See Section 12 and 13 below) and Cambridge initiatives, such as the Cambridge Climate Vulnerability Assessment (CCVA) and the Urban Forest Master Plan.

### 4.3 Energy Modeling

The CT will develop parametric studies of specific areas of study as required for project and provide the following:

1. LEED model at 50% and 100% Design Development.

### 4.4 Life Cycle Cost Analysis (LCCA)

The CT will coordinate with MIT regarding LCCA if required. Integrate LCCA in Value Engineering (VE) process. Changes in the project design due to Value Engineering should be approved by the entire team. MIT will use energy model results provided by the CT and CM/Cost estimator pricing for use in the LCCA

### 4.5 Materials Selection

The CT will hold a materials focused meeting to review materials selection criteria for all areas based on reducing environmental and human health impacts. The CT will identify metrics for tracking materials selection through optimizing LEED v4 IEQ and MR requirements. The CT will also identify red list free materials for division 9 products utilizing the ILFI Living Building Challenge Material Petal framework.

### 4.6 Measurement and Verification

The CT will identify methods based on Measurement and Verification strategies identified in SD.

### 4.7 Commissioning (Cx)

Refer to Division 01 Section "019113 - General Commissioning Requirements" for specifications.

### 4.8 Documentation

The CT will submit an updated DD sustainability narrative.

## 5. NC/MR - CONSTRUCTION DOCUMENTS PHASE

### 5.1 Integrative Design Reviews

Begin integrative design review at Construction Documents (CD) kick-off meeting.

### 5.2 Resiliency and Sustainable Sites Review Meeting

The CT will hold a resiliency and sustainable sites focused meeting with MIT to evaluate identified site and infrastructure mitigation strategies based on goals identified during Concept Design. Site strategies should align with MIT's Sustainable Sites checklist and Resiliency Standards (See Section 12 and 13 below) and Cambridge initiatives, such as the Cambridge Climate Vulnerability Assessment (CCVA) and the Urban Forest Master Plan.

### 5.3 Energy Modeling

The CT will provide energy model updates for LEED and code compliance at 50% and 100% Construction Documents.

### 5.4 Life Cycle Cost Analysis (LCCA)

The CT will coordinate with MIT regarding LCCA as required and for Value Engineering alternatives. Changes in the project design due to Value Engineering should be approved by the entire team. MIT will use energy model results provided by the CT and CM/Cost estimator pricing for use in the LCCA

### 5.5 Materials Selection

The CT will hold a materials focused meeting to review material selections and the applicable sustainability metrics.

### 5.6 Measurement and Verification

Changes in the Measurement and Verification strategies due to Value Engineering shall be approved by the entire team.

### 5.7 Commissioning (Cx)

Refer to Division 01 Section "019113-General Commissioning Requirements" for specifications.

### 5.8 Documentation

The CT will submit the final sustainability narrative.

## 6. NC/MR - CONSTRUCTION AND TURNOVER PHASE

### 6.1 Energy Modeling

The CT will provide energy modeling documents including the following:

1. Final energy model and digital files.
2. Final energy model results for LEED and code compliance.

### 6.2 Commissioning (Cx)

The CM and the CT will support commissioning activities. Refer to Division 01 Section "019113 - General Commissioning Requirements" for specifications.

# 7. NC/MR - LEED NC v.4 REQUIREMENTS

## 7.1 LEED BD+C v.4 - General

MIT requires **LEED BD+C** v.4/4.1 Gold Certification for all new construction and major renovation projects including the following credits, categories, and options:

| Credit Category | Credits | Options |
|---|---|---|
| *Integrative Process* | Integrative Process | |
| *Sustainable Sites (See MIT Sustainable Sites Standard at the end of this section)* | Rainwater Management<br><br>Heat Island Reduction<br>Light Pollution Reduction | |
| *Water Efficiency* | Outdoor water use reduction<br>Indoor water use reduction<br>Water metering | TBD by MIT and CT<br>TBD by MIT and CT |
| *Energy and Atmosphere* | Optimize Energy Performance<br><br>Enhanced Commissioning | TBD by MIT and CT<br><br>Option 1, path 2<br>Option 2 |
| *Materials and Resources* | Building Life-Cycle Impact Reduction<br>Building Product Disclosure and Optimization - EPD's<br>Building Product Disclosure and Optimization - Sourcing of Raw Materials<br>Building Product Disclosure and Optimization - Material Ingredients<br>Construction and Demolition Waste Management | Option 4<br>Option 1, Explore Option 2<br>Explore Option 1 and Option 2<br>Option 1, Explore Option 2<br>90% |
| *Indoor Environmental Quality* | Low-Emitting Materials<br><br>Thermal Comfort<br>Interior Lighting<br>Daylight<br>Quality Views | 2 points minimum<br><br><br>1 point minimum<br>1 point minimum, 55% sDA<br>Evaluate if can meet credit |

# 8. PR/LS - CONCEPT DESIGN / SCHEMATIC DESIGN PHASE

## 8.1 Partial Renovation / Limited Scope Projects (PR/LS) – General

The MIT project team and the consultant team shall determine which components indicated below are required based on the scale and scope of the project prior to commencement of the project. For partial renovations and limited scope projects that have greenhouse gas (GHG) emissions or have impacts on multiple systems, a charrette is recommended and sustainability goals and requirements for energy calculations /modeling and LCCA should be determined.

## 8.2 Integrative Design Charrette

If required, hold one interactive design charrette at project kick-off. Additional charrettes may be required depending on the scale and scope of the project. The charrette should include representatives from all impacted parties. Representatives will be proposed by the project sustainability POC and could include:

1. MIT internal team including:

    a. Client Group Representatives and Occupant Representatives.
    b. Office of Campus Planning (OCP)
    c. Campus Construction Project Manager (PM).
    d. Facilities Engineering (FE).
    e. Systems Performance and Turnover (SP&T).
    f. Information Systems and Technology (IS&T).
    g. Custodial.
    h. Grounds Maintenance.
    i. Repair and Maintenance (R&M and CSG).
    j. Recycling and Materials Management.
    k. Utilities.
    l. Environment, Health and Safety (EHS).
    m. Office of Sustainability (MITOS).

2. Consultant team (CT) including:

    a. Architect.
    b. Landscape Architect.
    c. Mechanical, Electrical, and Plumbing (MEP) Engineers.
    d. Energy Consultant.
    e. Lighting Designer.
    f. Cost Consultant.

g. Sustainability, Energy and LEED Consultants.
h. Other relevant consultants.

3. Construction team (CM) including:

   a. Construction Manager.
   b. General Contractor.
   c. Relevant subcontractors/suppliers.

### 8.3 Resiliency Review Meeting

The CT will hold a resiliency focused meeting with MIT to identify and document project man-made and climate risks, agree on performance objectives and identify mitigation strategies.

### 8.4 Energy Modeling and GHG Calculations

If required, the CT will test different design options to meet project sustainability goals. If energy modeling is required, see energy modeling requirements for more information. If energy modeling is not required, MIT will provide the Energy and Emissions Impact Calculator (EEIC) for use with projects.

### 8.5 Life Cycle Cost Analysis (LCCA)

The CT will coordinate with MIT to identify and develop options for an initial life cycle cost analysis. If possible, cost bundling strategies should be used to ensure adequate evaluation of integrative options. CT to provide energy calculations for the agreed upon design alternatives for use in the LCCA. CM/Cost estimator to provide pricing for alternates for use in the LCCA.

### 8.6 Materials Selection

The CT will hold a materials focused meeting to review materials selection criteria for all areas based on reducing environmental and human health impacts. This can be part of the integrated design charrette. The CT to identify metrics for tracking the materials selection through LEED requirements and/or ILFI red list free framework.

### 8.7 Measurement and Verification

The CT will develop a Measurement and Verification strategy with consideration for the following:

1. Building level metering for all major energy and water streams, including electricity, natural gas, chilled water, steam, hot water, domestic water and irrigation
2. Define other metering strategies relevant to the project. Potential strategies include:
   a. Submeter by end use all systems that consume more than 10% of building energy.
   b. Submeter significant uses such as large kitchens, data centers, labs, innovative

technology strategies, or as directed by MIT.

   c. Identify additional requirements and monitoring goals for operational management, programmatic needs, and user engagements.

3. Integrate metering strategies with building fault detection systems.

## 8.8 Commissioning (Cx)

Refer to Division 01 Section “019113 - General Commissioning Requirements” for specifications.

## 8.9 Documentation

The CT will submit an initial sustainability narrative. Sustainability narratives include analyses to identify holistic design strategies to meet sustainability goals to reduce energy use and conserve water, enhance human health, support ecosystem services provided by water, soil, and vegetation systems, and address climate change projections. The analysis will include one or more of the categories noted below based on project scope:

1. Passive and active design strategies, including lighting, daylighting and shading, siting and orientation, natural and mechanical ventilation and heating, cooling and envelope systems.
2. Site strategies, including landscape and stormwater strategies and urban forestry management and their associated environmental and human health impacts.
3. Active spaces and healthy spaces.
4. Acoustic, air quality and thermal comfort.
5. Building material choice impacts.
6. Integrated water reduction strategies.
7. Life cycle cost analysis.
8. Climate resilience narrative. Include:
   a. Flood and heat stress mitigation strategies that enable life safety and business community
   b. Description of strategies that enable flexibility for incremental adaptations over time for future climate risks
   c. Description of how the design is meeting MIT and City of Cambridge Resiliency Standards
9. Energy documentation. See Section 2.4 if energy modeling is included. Include:
   a. Energy use by end use and fuel type
   b. GHG calculations/emissions
   c. Energy efficiency measures evaluated
10. LEED checklist
11. LEED responsibility matrix.

# 9. PR/LS – DESIGN DEVELOPMENT / CONSTRUCTION DOCUMENTS PHASE

## 9.1 Resiliency Review Meeting

The CT will hold a resiliency focused meeting with MIT to evaluate identified system and infrastructure mitigation strategies.

## 9.2 Energy Modeling and GHG Calculations

If included in the project scope, the CT will provide updated GHG calculations using the EEIC calculator or energy model results for LEED and code compliance.

## 9.3 Life Cycle Cost Analysis (LCCA)

Engineering (VE) process. Changes in the project design due to Value Engineering should be approved by the entire team. MIT will use energy calculation results provided by the CT and CM/Cost estimator pricing for use in the LCCA

## 9.4 Commissioning (Cx)

Refer to Division 01 Section "019113 - General Commissioning Requirements" for specifications.

# 10. PR/LS – CONSTRUCTION AND TURNOVER PHASE

## 10.1 Energy Modeling and GHG Calculations

If energy modeling or GHG calculations are required, the CT will submit documentation including:

1. Energy model and digital files.
2. Energy model for code compliance
3. EEIC results.

## 10.2 Commissioning (Cx)

The CM and the CT will support commissioning activities. Refer to Division 01 Section "019113 - General Commissioning Requirements" for specifications.

# 11. PR/LS – LEED ID+C v.4 REQUIREMENTS

### 11.1 LEED ID+C v.4 - General

LEED ID+C V4 certification is preferred but not required. Meet the following credits, if within the project scope:

| Credit Category | Credits | Options |
|---|---|---|
| *Integrative Process* | Integrative Process | |
| *Sustainable Sites (LEED NC v.4, see also MIT Sustainable Sites Standards)* | Rainwater Management | Evaluate if can meet credit |
| | Heat Island Reduction | Evaluate if can meet credit |
| | Light Pollution Reduction | Evaluate if can meet credit |
| *Water Efficiency* | Outdoor water use reduction | Submeter irrigation |
| | Indoor water use reduction | TBD by MIT and CT |
| *Energy and Atmosphere* | Optimize Energy Performance | TBD by MIT and CT |
| | Enhanced Commissioning | Option 1 |
| *Materials and Resources* | Building Product Disclosure and Optimization - EPD's | Option 1, Explore Option 2 |
| | Building Product Disclosure and Optimization - Sourcing of Raw Materials | Explore Option 1 and explore Option 2 |
| | Building Product Disclosure and Optimization - Material Ingredients | Option 1, Explore Option 2 |
| | Construction and Demolition Waste Management | 90% |
| *Indoor Environmental Quality* | Low-Emitting Materials | |
| | Thermal Comfort | |
| | Interior Lighting | |
| | Daylight | Evaluate if can meet credit |
| | Quality Views | Evaluate if can meet credit |

## 12. RESILIENCY CRITERIA

### 12.1 Climate Resiliency

As the MIT campus undergoes a major renewal for the next 50-100 years and beyond, we grapple with new and emerging data about climate risks that are projected to be more extreme and more frequent than conditions our campus experienced during its first century. The MIT Plan for Action on Climate Change commits MIT to take steps to reduce and manage these risks of a changing climate. A climate resilient MIT is defined as *the capacity of the MIT community and its physical campus to continue to fulfill its mission in the face of disruptions from intensifying climate risks. Key risks that MIT is currently planning for including the following:*

1. Flooding from more frequent and extreme rains
2. Flooding from storm surges and rising sea-levels
3. Extreme and prolonged heat

The MIT Climate Resiliency Committee has been conducting campus-based flood risk modeling and vulnerability assessments and has developed a framework called the Four MIT Systems of Resilience. These systems are mutually inter-dependent and will be addressed as part of the process (https://sustainability.mit.edu/sites/default/files/resources/2020-03/climate_resiliency_brochure_web.pdf):

1. People & Departments
2. Buildings, Equipment and Building Systems
3. Utility Infrastructure Systems
4. Site Infrastructure Systems

Process:

1. Concept Design: Resiliency focused meeting with MIT to identify and document project man-made and climate risks, agree on performance objectives and identify mitigation strategies (Refer to Section 2-11 above).
2. Schematic Design, Design Development and Construction Documents: Resiliency meetings to review flood modeling results and define and refine design strategies to address climate risks (Refer to Section 2-11 above).
3. Flood modeling:
    a. In coordination with the CT, MIT flood risk modeling will be implemented iteratively at each phase of design for initial high level planning, more detailed design evaluation and final coordination and integration of as-built conditions into the MIT flood model.
    b. The current model is based on LIDAR data. An initial site specific field survey will be developed and integrated into the flood model to determine existing project site elevations.

Overall Resilience Goals:

1. Incorporate flexible and adaptable design strategies that will provide a basic level of redundancy and ability to respond to and recover from a variety of climate events over time
2. Design to accommodate 2070 100 year storm (24 hour design rain) event.

3. Address urban heat island effect as provided by the City of Cambridge Vulnerability Assessment as the baseline design assumptions for informing current and future heat risks.

Order of Priorities:

The project will develop design strategies to address emergencies based on the following criteria:

1. Enable life-safety of the occupants
2. Enable business continuity
    - Enable use of spaces after flood or heat event; or, enable rapid recovery and restoration of programs
    - Enable temporary continuity of activities remote from building if building systems are not operable for supporting building program

Resilient Design Strategies:

The design team will evaluate and incorporate appropriate resilient design strategies to mitigate and protect impacts from identified risks and meet stated goals:

- Sustainable stormwater management and grey and green infrastructure strategies to mitigate flooding potential and mimic and restore the natural water cycle to the extent feasible
- Urban heat island reduction strategies such as cool roofs and pavements and increase of vegetative cover and tree cover
- Building level flood protection measures:
    - Raising ground floor and critical infrastructure above Defined Flood Event (DFE)
    - Providing accessible entrances above DFE
    - Limiting glass to above the DFE
    - Interior pumps and drainage systems
    - Waterproofing/sealing of critical building and utility system lines and conduits
    - Elevators with pit flood sensors and auto return to lowest floor above the DFE
    - Active and passive barrier systems
    - Durable, cleanable and moisture resistant interior and waterproof exterior materials on levels below the DFE
    - Building control strategies to enable ease of flexibility of operations under different crises
- Back-up power and redundancy in critical building systems to provide basic utilities and services to occupants and for critical building functions during an emergency. Criticality of building and/or building systems to be determined by MIT in collaboration with the CT.

# 13. SITES PERFORMANCE STANDARDS FOR MIT PROJECTS

MIT has developed multiple tools to support our goals to ensure a holistic approach to the development of MIT's urban landscape. See Appendix – attached following:

1. MIT specific Sustainable Sites Checklist
2. Stormwater Design Matrix (MIT will provide an editable version)

In addition, the CT will develop a Basis of Design Site Performance Narrative, generated by the site consultants including the landscape architect and civil engineer. The BOD will document the following:

- Existing Site Conditions
- Resiliency
- Stormwater Management
- Vegetation
- Pedestrian Circulation
- Traffic, Loading and Parking (including bicycle parking)
- Sun/Shade analysis
- Site Lighting
- Maintenance (including snow removal)

The BOD will include:

- Sustainable site plan documenting and quantifying performance characteristics
- MIT Stormwater Management Matrix

The design team will quantify the following existing and proposed conditions as part of the BOD:

- Summary of storm events outlining existing peak runoff rates, proposed peak runoff rates and % reduction
- Summary of storm events outlining existing peak runoff volume, proposed peak runoff volume and % reduction
- Reduction in phosphorus in lbs/yr and percentage reduction
- Stormwater storage
- Breakdown by percentage and quantity of treatment for stormwater events by landscape filters and stormwater infrastructure
- % increase in permeable pavement and light colored pavement
- Area of site under management
- Vegetation: tree quantity, dhb and % canopy coverage added

**Refer to the SITES Performance Standards for MIT Projects Goals following this page**.

END OF DOCUMENT

# *SITES* PERFORMANCE STANDARDS FOR MIT PROJECTS

*SITES* Performance Standards for MIT Projects will help ensure that individual projects support the larger campus sustainability goals identified by the Sustainable Stormwater and Landscape Ecology Plan (currently under development). The key goals established by the Plan are intended to address the following campus and regional issues:


The SITES Performance Standards for MIT Projects build on several credits established under the American Society of Landscape Architect's (ASLA's) SITES v2 Rating System in the Water, Soil + Vegetation, and Human Health + Well-Being categories. The SITES credit rating system supplements the USGBC LEED® Rating System credit rating system, which is heavily weighted on the building sustainability performance and not site and campus issues, which are currently reviewed as part of most design projects on campus.

Consistent with the Sustainable Stormwater and Landscape Ecology Plan, the selected SITES credits were identified as having relevance for addressing campus-wide resiliency, stormwater, and landscape ecology priorities.  The selected SITES credits were further adapted to suit the urban campus. Expanding on the SITES criteria of "ensuring site precipitation is treated as an amenity in the ways it's received, conveyed, and managed", the Performance Standards promote treatment of site runoff through "multi-benefit" solutions to stormwater management that provide other benefits such as resiliency, habitat creation, urban heat island mitigation, and potable water conservation.

The recommended Performance Standards shall be reviewed and considered by individual projects on MIT's campus as part of the planning and design process, as directed by MIT.  Priority credits have been identified with the priority icon ❗.

## *SITES* PERFORMANCE STANDARDS FOR MIT PROJECTS Scorecard

| GUIDELINES + DESCRIPTIONS | | PROJECT COMPLIANCE | | | | |
|---|---|---|---|---|---|---|
| STANDARD | REFERENCE SITES CREDIT | SITES CREDIT MODIFIED? | YES | NO | MAYBE | COMMENTS |
| MANAGE PRECIPITATION ON SITE<br><br>**INTENT**<br>Maintain site water balance, protect water quality, and reduce negative impacts to aquatic ecosystems, channel morphology, and dry weather base flow by replicating natural hydrologic conditions and providing retention and treatment for precipitation on site.<br><br>**ALIGNMENT WITH SUSTAINABLE STORMWATER LANDSCAPE ECOLOGY GOALS:** | WATER P3.1<br>WATER C3.3 | Y | | | | |
| REDUCE OUTDOOR WATER USE<br><br>**INTENT**<br>Conserve water resources and minimize energy use by encouraging water conservation strategies that limit the use of potable water, natural surface water, and groundwater withdrawals for landscape irrigation and other outdoor use.<br><br>**ALIGNMENT WITH SUSTAINABLE STORMWATER LANDSCAPE ECOLOGY GOALS:** | WATER P3.2<br>WATER C3.4 | Y | | | | |
| DESIGN MULTI-BENEFIT STORMWATER FEATURES<br><br>**INTENT**<br>Provide a connection to the local climate and hydrology by integrating aesthetically pleasing stormwater features that are visually and physically accessible and manage on-site stormwater.<br><br>**ALIGNMENT WITH SUSTAINABLE STORMWATER LANDSCAPE ECOLOGY GOALS:** | WATER C3.5 | Y | | | | |
| USE APPROPRIATE PLANTS<br><br>**INTENT**<br>Improve landscape performance and reduce resource use by installing only plants that are appropriate for site conditions, climate, and design intent.<br><br>**ALIGNMENT WITH SUSTAINABLE STORMWATER LANDSCAPE ECOLOGY GOALS:** | SOIL + VEG P4.3 | Y | | | | |
| CONSERVE HEALTHY SOILS AND APPROPRIATE VEGETATION<br><br>**INTENT**<br>Protect existing ecosystem services and landscape performance and protect soil heath by limiting the disturbance of existing appropriate plants and healthy soils.<br><br>Support healthy plants, biological communities, and water storage and infiltration by planning for soil restoration in the design stage and limiting soil disturbance during construction.<br><br>**ALIGNMENT WITH SUSTAINABLE STORMWATER LANDSCAPE ECOLOGY GOALS:** | SOIL + VEG C4.4 | Y | | | | |

## *SITES* PERFORMANCE STANDARDS FOR MIT PROJECTS Scorecard (Continued)

| | | | | | | |
|---|---|---|---|---|---|---|
| CONSERVE SPECIAL STATUS VEGETATION<br><br>**INTENT**<br>Protect existing ecosystem services by identifying and conserving all vegetation on site designated as special status.<br><br>**ALIGNMENT WITH SUSTAINABLE STORMWATER LANDSCAPE ECOLOGY GOALS:** | SOIL+VEG C4.5 | Y | | | | |
| MINIMIZE EFFECTS ON MICROCLIMATE<br><br>**INTENT**<br>Minimize effects on microclimate and human and wildlife habitat by using vegetation in strategic locations to reduce energy consumption and heat island effects.<br><br>**ALIGNMENT WITH SUSTAINABLE STORMWATER LANDSCAPE ECOLOGY GOALS:** | SOI +VEG C4.9<br>SOIL +VEG C4.10 | Y | | | | |
| PROVIDE OPTIMUM SITE ACCESSIBILITY, SAFETY, AND WAYFINDING<br><br>**INTENT**<br>Increase sites users' ability to understand and access outdoor spaces by incorporating elements of accessibility and publicly available on-site evens, facilities, amenities, or programming.<br><br>**ALIGNMENT WITH SUSTAINABLE STORMWATER LANDSCAPE ECOLOGY GOALS:** | HHWB C6.2 | N | | | | |
| SUPPORT HUMAN WELL-BEING<br><br>**INTENT**<br>Improve human health and well-being by providing visual and physical connections to restorative outdoor spaces, encourage outdoor physical activity and support people gathering, eating, working and playing together.<br><br>**ALIGNMENT WITH SUSTAINABLE STORMWATER LANDSCAPE ECOLOGY GOALS:** | HHWB C6.4<br>HHWB C6.5<br>HHWB C6.6 | Y | | | | |

# MANAGE PRECIPITATION ON SITE

## REFERENCE SITES V2 CREDITS: WATER P3.1, WATER C3.3

**Intent**

Maintain site water balance, protect water quality, and reduce negative impacts to aquatic ecosystems, channel morphology, and dry weather base flow by replicating natural hydrologic conditions and providing retention and treatment for precipitation on site.

**Alignment with Campus Goals**


**Project Performance**

Credit 3.3: Manage precipitation beyond baseline by retaining or treating the precipitation volume from the $90^{th}$ percentile precipitation event through on-site infiltration, evapotranspiration, and reuse.

Any precipitation volume for the $90^{th}$ percentile storm event that is <u>not retained</u> through on-site infiltration, evapotranspiration, and reuse (due to site constraints) <u>shall be treated</u> for total suspended solids (TSS), phosphorus, and bacteria through landscape-based treatment systems. Perform load-based water quality calculations to confirm 80% TSS removal and 65% phosphorus removal.

**Clarifications**

The calculated $90^{th}$ percentile precipitation event as defined by the US EPA in the Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act is approximately 1.2-inches. The calculated $95^{th}$ percentile precipitation event is 1.6".

These strategies to retain and treat the $90^{th}$ percentile storm event (1.2 inches) slightly exceeds the City of Cambridge requirement to provide TSS and phosphorus removal for the 1-inch storm. The City also requires peak runoff rate mitigation so that the proposed 25-year storm peak rate is consistent with the existing 2-year peak rate. The strategies used to meet Credit 3.3 will contribute to meeting the peak rate reduction requirement, however additional detention strategies and calculations may be required to confirm that the project also meets the City's requirement.

**Strategies and Toolkit**

MIT's Stormwater Toolkit includes several strategies for managing stormwater in a manner that is integrated with the landscape, including:

- Green Roofs
- Porous Pavement
- Bioretention Practices
- Infiltration Practices
- Filtration Practices
- Rainwater Harvesting

# REDUCE OUTDOOR WATER USE

## REFERENCE SITES V2 CREDITS: WATER P3.2, WATER C3.4

**Intent**

Conserve water resources and minimize energy use by encouraging water conservation strategies that limit the use of potable water, natural surface water, and groundwater withdrawals for landscape irrigation and other outdoor use.

**Alignment with Campus Goals**


**Project Performance**

Prerequisite: Reduce the use of potable water, natural surface water, and groundwater withdrawals for landscape irrigation (beyond plant establishment) by reducing water usage by at least 50 percent from the baseline case as required in SITES v2 Prerequisite 3.2 (Reduce water use for landscape irrigation) Option 1.

Credit: Reduce the use of potable water, natural surface water, and groundwater withdrawals for landscape irrigation by aligning with SITES v2 Credit 3.4 (Reduce outdoor water use) Option 1 by reducing water use by at least 75 percent from a baseline case.

**Clarifications**

Projects should align with this credit by using conservation and reuse strategies to reduce the use of potable water for landscape irrigation in alignment with the Prerequisite and Option 1.

Note, Water P3.2 is more stringent than the LEEDv4 Prerequisite for outdoor water use (option 2) which requires a 30 percent reduction from the baseline irrigation case for the site's peak irrigation month.

Note, Water C3.4 is more stringent than the LEEDv4 Credit for outdoor water use reduction (Option 2), which requires a 50 percent reduction from the baseline irrigation case for the site's peak irrigation month.

In the case where created water features are proposed on a given project, Water C3.4 guidance under Options 1, 2, and/or 3 should be considered.

**Strategies and Toolkit**

Water-efficient Irrigation Systems

Rainwater and Graywater Harvesting

Adaptive and Appropriate Vegetation

# DESIGN MULTI-BENEFIT STORMWATER FEATURES

## REFERENCE SITES V2 WATER C3.5

**Intent**

Provide a connection to the local climate and hydrology by integrating aesthetically pleasing stormwater features that are visually and physically accessible and manage on-site stormwater.

**Alignment with Campus Goals**


**Project Performance**

Align with SITES v2 Credit 3.5 (Design functional stormwater features as amenities) by ensuring site precipitation is treated as an amenity in the way it's received, conveyed, and managed (Option 1).

**Clarifications**

For the purposes of this credit, projects should use landscape-based, multi-benefit stormwater strategies wherever space allows, as well as collecting and repurposing stormwater

**Strategies and Toolkit**

Green Roofs

Passive Water features

Artistic Expression of Water

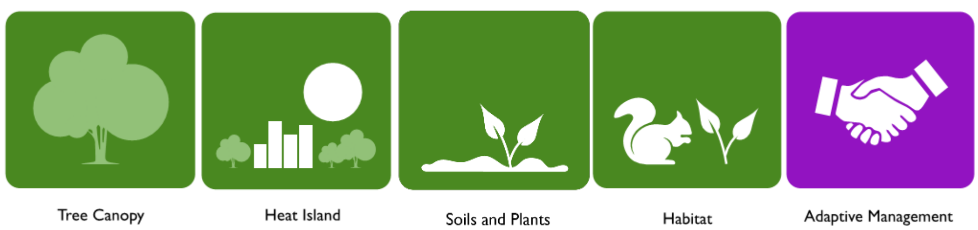
# USE APPROPRIATE PLANTS

REFERENCE SITES V2 SOIL VEG P4.3

**Intent**

Improve landscape performance and reduce resource use by installing only plants that are appropriate for site conditions, climate, and design intent.

**Alignment with Campus Goals**




**Project Performance**

Minimum Requirement: Select plants species that are suitable for site conditions, climate, and design intent as required by SITES v2 Prerequisite 4.3 (Use appropriate plants) by using only appropriate plant species that are suitable for the site conditions, climate, and design intent for both native and non-native plants.  Use plants that are nursery-grown or salvaged for reuse from on or off site. All nursery-grown plants must use standards set by the ANSI Z60.1-2004 American Standard for Nursery Stock.

**Clarifications**

Specific to MIT's urban campus, plant selections must be species that have proven to be resilient and tolerant of urban planting conditions including criteria such as reduced planting soil volumes, pollution, paved rooting zones, root structure, reduced watering, heat reflectance from pavements and buildings, temperature extremes, wind, and pollution. (See "Strategies and Toolkit", below.)

While use of urban-tolerant native plants is encouraged, plant selection should also consider native adapted plants, particularly those shown to be resilient in MIT's urban campus.  Adapted plants are those that were not originally part of the natural ecosystem but have evolved to a point where the physical conditions such as soil, climate, and water needs are conducive for healthy growth. https://www.forestadaptation.org/ne-species

Do not use plants that are listed on the "Massachusetts Prohibited Plant List", current edition, as published by the MA Executive Office of Energy and Environmental Affairs.(See "Strategies and Toolkit", below.)

Plants that are susceptible to being infected by known invasive alien species of pests should not be planted. Refer to "Massachusetts Introduced Pests Outreach Project". Infected plants should be evaluated by a certified arborist for treatment and, if untreatable, should be removed. (See "Strategies and Toolkit", below.)

Plants infected by the diseases should be evaluated by a certified arborist for their potential to spread to other trees. Evaluate infected trees for efficacy of treatment and determine if trees should be removed. (See "Strategies and Toolkit", below.)

Soil volumes are critical for long-term health and resiliency for urban trees due to the prevalence of pavement. Achieving recommended soil volumes (See "Strategies and Toolkit", below) is likely to require that roots occupy soil below pavement.

**Strategies and Toolkit**

Structural Soil, or another proven material or system, proven to maximize soil volume for trees in pavement.

Resilient Urban Plants: MIT to develop urban plant palette acceptable for their campus. https://forestadaptation.org/framework-components/forest-adaptation-resources and https://species.itreetools.org/selector/

Plant Soil Volumes: Calculate soil volumes based on anticipated mature caliper size. For trees: http://www.greenblue.com/na/resources/soil-calculator/

Invasive Plants: "Massachusetts Prohibited Plant List", current edition, as published by the MA Executive Office of Energy and Environmental Affairs: http://www.mass.gov/eea/agencies/agr/farm-products/plants/massachusetts-prohibited-plant-list.html

Insect Pests: "Massachusetts Introduced Pests Outreach Project" https://www.massnrc.org/pests

Plant Diseases: https://extension.umass.edu/landscape/sites/landscape/files/pdf-doc-ppt/disease_guide/disease_guide_x_disease_pathogen.pdf

# CONSERVE HEALTHY SOILS AND APPROPRIATE VEGETATION

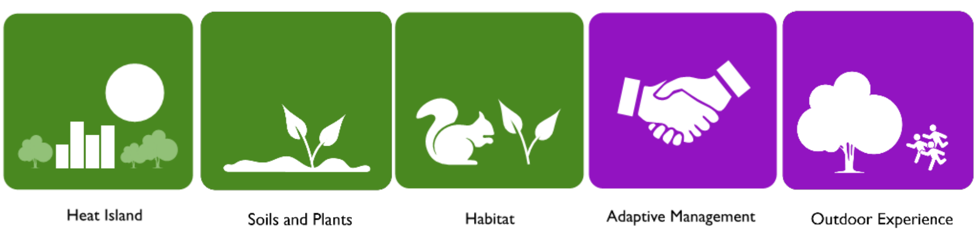
REFERENCE SITES V2 SOIL + VEG C4.4

**Intent**

Protect existing ecosystem services and landscape performance and protect soil heath by limiting the disturbance of existing appropriate plants and healthy soils.

Support healthy plants, biological communities, and water storage and infiltration by planning for soil restoration in the design stage and limiting soil disturbance during construction.

**Alignment with Campus Goals**




**Project Performance**

Align with SITES v2 Credit 4.4 (Conserve healthy soils and appropriate vegetation) (Option 1) by conserving existing healthy soils and plants that are appropriate for site conditions, climate, and design intent in Vegetation and Soil Protection Zones (VSPZs). This will be different for every MIT site and should be determined on a case-by-case basis taking into consideration plant health, soil condition, amendment program, constructability, and construction sequencing. The primary aims are to prevent damage to soil structure that can result in the inability to amend and re-use soil resources and to eliminate construction practices that threatens tree health.

**Clarifications**

Disregard the percentage requirements for vegetated soil protection zones (VSPZ). Instead, use MIT's Specification Section 015640 "Temporary Tree and Soil Protection" for percentage requirements for VSPZs.

The density of MIT's urban campus makes it likely that VSPZs will be limited in size, making protection impracticable for project logistics and of limited long-term value. To determine the efficacy of establishing VSPZs, a preliminary soil management plan (SMP) should be prepared during the analysis phase of the project to identify locations of existing healthy soils and vegetation on site. At minimum, identify soil zones where the topsoil could be removed, amended, and reused on the project or elsewhere on campus. When soil must be removed from MIT's campus, all jobs must contact MIT Environment, Health & Safety for disposal protocol.

The preliminary soil management plan (SMP) should also identify special status trees and other plants and specifically identify these zones as part of the VSPZ. Emphasis for soil management should be placed on preserving and creating contiguous soil zones for plant roots, regardless of final surface condition. For plants in impervious surfaces, extend root zones below pavement by using sand-based structural soil, or another proven material or system that is beneficial for urban tree growth. Consider the viability of using and connecting to root zones on adjacent sites to improve the overall campus connectivity for plant roots. To the extent possible, use permeable pavements over root zones to allow great water infiltration and air exchange.

Trees adjacent to a development site, including street trees, could also be impacted by construction activity. During the analysis phase, examine site context and identify trees at risk. Recommend extent of tree protection.

Protection of trees should be aligned with BMP for urban trees, see Strategies and Toolkit, below:

**Strategies and Toolkit**

VSPZ Protection: MIT's Specification Section 015640, Temporary Tree and Soil Protection" and https://www.nycgovparks.org/pagefiles/84/standard-tree-protection-notes-for-permits-and-plan-review-spring-2015.pdf

# CONSERVE SPECIAL STATUS VEGETATION

## REFERENCE SITES V2 SOIL + VEG C4.5

**Intent**

Protect existing ecosystem services by identifying and conserving all vegetation on site designated as special status.

**Alignment with Campus Goals**


**Project Performance**

Align with SITES v2 Credit 4.5 (Conserve Special Status Vegetation) by protecting special status vegetation such as heritage or legacy trees, specimen trees, rare and endangered species, rare vegetation in a unique habitat, and unusual genetic variants of a particular species.

**Clarifications**

For MIT, the following areas have Special Status Vegetation and require a protection plant and soil protection plan (VSPZ, reference Project Performance Standard section entitled "Conserve Healthy Soils and Appropriate Vegetation"):

Killian Court Allees.

Chapel Grove.

Massachusetts Avenue Oaks.

Eastman-McDermott Court Planetrees.

Walker Memorial / Hayden Memorial Allee Honey Locusts and mixed planting.

All trees identified as "healthy" on MIT's" 2017 Tree Inventory" shall be evaluated for retention. https://mit.treekeepersoftware.com/.

Regardless of their physical condition, special status shall not be given to plants that are listed on the "Massachusetts Prohibited Plant List", current edition, as published by the MA Executive Office of Energy and Environmental Affairs: http://www.mass.gov/eea/agencies/agr/farm-products/plants/massachusetts-prohibited-plant-list.html

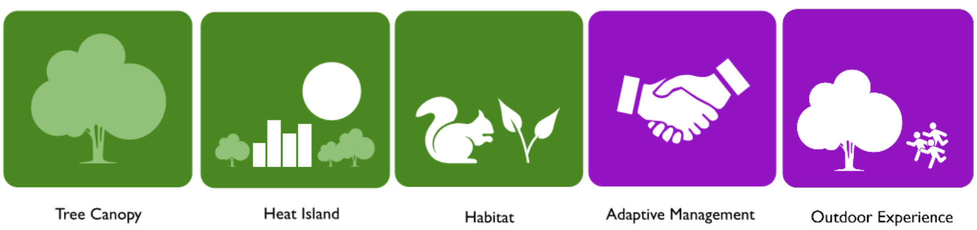
# MINIMIZE EFFECTS ON MICROCLIMATE

## REFERENCE SITES V2 SOIL + VEG C4.9, SOIL + VEG C4.10

**Intent**

Minimize effects on microclimate and human and wildlife habitat by using vegetation in strategic locations to reduce energy consumption and heat island effects.

**Alignment with Campus Goals**




**Project Performance**

Align with SITES v2 Credit 4.9 (Reduce urban heat island effects) by using existing plant material and installing plants that provide shade over paving areas. Use formula provided by SITES to measure reduction of urban heat island effect for site paving and structures or alternative approach using solar reflectance index (SRI) and solar reflectance (SR) as provided by SITES.

Align with SITES v2 Credit 4.10 - Study the options for vegetation: reduce energy use, provide shade, provide windbreak.

**Clarifications**

Note Credit 4.9 is the same as the LEED v 4 Credit for Heat Island Reduction. The LEED credit also allows for an optional compliance path to provide covered parking.

Note, although LEED suggests that landscape can be used as a strategy to reduce building energy use, SITES v.2 Credit 4.10 establishes criteria for using landscape to reduce energy use.

**Strategies and Toolkit**

Placement of trees for creating windbreaks: [http://nfs.unl.edu/documents/windbreakdesign.pdf](http://nfs.unl.edu/documents/windbreakdesign.pdf)

Placement of tree for maximizing shade benefits: https://www.epa.gov/sites/production/files/2014-06/documents/treesandvegcompendium.pdf

# PROVIDE OPTIMUM SITE ACCESSIBILITY, SAFETY, AND WAYFINDING

## REFERENCE SITES V2 HHWB C6.2

**Intent**

Increase sites users' ability to understand and access outdoor spaces by incorporating elements of accessibility and publicly available on-site events, facilities, amenities, or programming.

**Alignment with Campus Goals**

Network Connectivity Adaptive Management Outdoor Experience

**Project Performance**

Align with SITES v2 C6.2 (Provide optimum site accessibility, safety, and wayfinding) by providing site access and usability, improving safety, and creating an environment that makes it easy and intuitive for users to orient themselves and navigate from place to place.

**Clarifications**

Wherever possible, design the accessible route so that it is also the main route to the building for everyone. This can be done by using pavement slopes equal to 5% or less (NOTE: using a maximum 4.5% slope is recommended to allow for construction tolerances. Review MIT Site Standards "Landscape and Site Thematic Folder" section 1.3 ADA and MAAB Compliance for MIT recommended slopes.)

**Strategies and Toolkit**

Discuss ongoing efforts with MIT Office of Campus Planning.

# SUPPORT HUMAN WELL-BEING

## REFERENCE SITES V2 HHWB C6.4, HHWB C6.5, HHWB C6.6

**Intent**

Improve human health and well-being by providing visual and physical connections to restorative outdoor spaces, encourage outdoor physical activity and support people gathering, eating, working and playing together.

**Alignment with Campus Goals**

Network Connectivity | Adaptive Management | Outdoor Experience

**Project Performance**

Align with SITES v2 C6.4 (Support mental restoration) by providing accessible, quiet outdoor spaces that include seating for five percent of total site users, visual and physical access to vegetation, elements that reduce noise and mitigate negative distractions, and elements that address microclimate and other site-specific conditions (e.g. sun, shade, wind). For sites with regularly occupied buildings, provide unobstructed views of vegetation, from 50 percent of common spaces (e.g., office spaces, classrooms, waiting rooms, living areas, dining rooms).

Align with SITES v2 C6.5 (Support physical activity) by developing and implementing a functional plan that encourages outdoor physical activity, provide services to support site users during physical activity, and considers outdoor physical activity features.

Align with SITES v2 C6.6 (Support social connection) by providing outdoor spaces to encourage social connections that include seating for a minimum of 10 percent of the total site users that accommodate a variety of group sizes and is appropriate to the site; elements that address microclimate and other site-specific conditions (e.g. sun, shade, wind); and amenities, services, or activity spaces (e.g. games, wireless access, food concessions, picnic or dining areas, outdoor auditoriums, playground's, farmers' markets)

**Clarifications**

For Credit C6.5 (Support physical activity), disregard the requirement to provide at least two of the following five outdoor physical activity features.  The number of outdoor physical activities does not need to be quantified unless required by MIT planning/facilities staff.

Work with MIT Planning to determine the best and highest use of outdoor spaces for each development area.

Consider the scale of MIT's urban campus and evaluate adjacencies to existing physical outdoor activities and social spaces, relative to what would be appropriate and desirable on the proposed development site.

**Strategies and Toolkit**

Discuss ongoing efforts with MIT Office of Campus Planning.

Human well-being: Restorative Benefits of Nature: Toward an Integrated Framework, by Stephen Kaplan http://www.wienerzeitung.at/_em_daten/_wzo/2015/08/07/150807_1710_kaplan_s._19951.pdf