

# **Sustainable Design Guidelines**

World Trade Center Memorial Project  
Lower Manhattan Development Corporation

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**SUSTAINABILITY POTENTIALS: An Introduction to the Guidelines**

**Context**

The nature and scope of the Memorial Project and the surrounding World Trade Center Redevelopment reaches beyond the traditional boundaries of “building and site” and poses significant challenges and opportunities when framing sustainable potentials. The Memorial Project in many ways already incorporates some essential tenets of sustainable design in its simplicity, directness and incorporation of natural elements, water and green open space. The distillation of project elements to essential components and their clear organization to facilitate use, function and readability contributes to sustainable design, as well as, a powerful Memorial. The central role of water and a uniquely large and open planted plaza, not only reminds us of our relationship to natural systems, but also provides opportunities to utilize these systems in a sustaining and productive role.

As part of the World Trade Center Redevelopment, the Memorial Project lies beside a “movement infrastructure” of mass transit, roadways, rail, footpaths, escalators and elevators transporting tens of thousands of people and an urban center supporting very high levels of development density and supporting services. By breaking out of the traditional individual building model, the overall development creates a wide range of opportunities for shared resources, capitalizing on the opportunities inherent in urban density and adjacency.

The realization of key potentials, fundamental “whole system” strategies such as district heating/cooling, river water cooling and shared service facilities creates an infrastructure and “connective tissue” that points in the direction of a true leadership project. The purpose of the Guidelines is both to establish a new level of environmental/sustainable quality for an urban center model and to identify the “pathways” to higher performance over time.

**Framework**

Capturing the urban scale, mixed use and whole-system attributes of the redevelopment has led to an expansion of the traditional model for green guidelines. Notably, as an interrelated list of standards, the guidelines overall exceed the objectives of NY State Executive Order 111 (EO-111), which includes meeting the US Green Building Council’s (USGBC) Leadership in Energy Efficiency (LEED™) Green Building Rating System’s certified level and have been reviewed by the LMDC.

The challenge then from an environmental sustainable perspective, is to describe a framework of guidelines/metrics, which capture the urban scale/mixed use development, can be applied to purely infrastructure and partial projects over time and can address traditional projects. This objective, which creates a level playing field for assessment and “sustainable” quality has the added advantage of meeting the need for annual reporting and/or audit under the requirements of EO-111. The scope of this effort has allowed the development of a basic framework consisting of a stated “Purpose” and “Action” for each guideline, which will be fully supported by Reference Documentation. Several qualities are unique to these guidelines;

**1) Urban Environmental Quality (UEQ)**

A unique set of large-scale sustainable qualities that the projects bring to the surrounding community and urban context. There are a number of “Green Guidelines” around the United States, including the New York State Green Building Tax Credit (NYSGBTC) and the USGBC’s LEED™ Green Building Rating System, which are excellent references and have been selectively incorporated herein. However, these are inherently focused on a specific building type or project. At the project site, there are issues of regional and neighborhood scale – regional transportation systems, relationships to surrounding neighborhoods, as examples – that have informed the development of these strategies and guidelines that go beyond individual buildings.

**2) “Whole system” compliance**

This organizing principle of the guidelines assures that integrated and overlapping qualities of adjoining projects (and the spaces in between) are accounted for by having a coordinated set of guidelines and site resource management plans. The unusual, large-scale, concurrent development of the WTC site offers unique opportunities for coordinated system approaches and resource management. These opportunities are captured in the guidelines and provide overall project economies and flexibilities which would not normally be possible.

**3) Individual projects can draw from a basket of measures with flexible range of scale.**

As an interrelated list of standards, in addition to 1 and 2 above, the guidelines overall exceed the objectives of EO-111, have been reviewed by the LMDC and offer flexibility to design teams. Guidelines indicated as “**Required**” are mandatory and flow directly from the objectives of EO-111, LEED™ certified level requirements and the larger requirements of the LMDC. Required items are to be implemented. The LEED™ “Roadmap for Silver” creates a pathway for moving toward even higher performance. Flexibility is provided through an “**Equivalency Option**” which allows designers to propose an “equivalent option” for a guideline which is part of the LEED™ Calculation, as long as the number of LEED™ points remains the same or better. Guidelines indicated as “**Recommended**” are provided to support efforts by teams seeking additional opportunities to improve environmental performance. Some of the guidelines include extended considerations and larger scale impacts, important to the realization of the guideline. These “**Universal**” impacts, for instance the requirement for water management plans, which also benefit the municipal water infrastructure, are indicated. The Implementation Matrix indicates “**Required**”, “**Equivalency Option**”, “**Recommended**”, “**Exemplar**” and “**Universal**” designations with a distinct set of symbols.

## Management Plans

A specific way in which these guidelines are unique is in the requirement for development and implementation of Resource Management Plans. The Resource Management Plans listed below and incorporated into these guidelines go beyond the framework of existing Green Building Rating Systems (LEED™ for instance, only requires 3 of the 10 plans) and clearly demonstrate the broader consideration of sustainability potentials inherent to this project.

The following Plans and Studies are required as part of these guidelines. Each plan will require the submission of letter templates, calculations and documentation in the sequence of “Implementation Reviews” running from Conceptual/Schematic to Construction Administration/Signoff (see Implementation Authority). Reference documentation currently under development will clearly illustrate plan components, requirements and reporting documentation.

SEQ-1	Comprehensive Resource Management Plan
SEQ-5	Construction Environment Plan
SEQ-6	Construction Storm Water Pollution Prevention Plan
WEQ-1	Water Management Plan
EEQ-1	Energy Management Plan
EEQ-3	Building Energy Model
EEQ-5	Renewable Energy Transition Plan
MEQ-1	Materials Management Plan
MEQ-2	Construction Waste Management Plan
IEQ-1	Indoor Air Quality Management Plan
IEQ-5	Construction IAQ Management Plan
IEQ-9	Integrated Pest Management Plan

### **Structure of Guidelines**

The Guidelines include two component parts:

- I. Sustainable Design Guidelines:** A specific listing of Purpose and Action for each guideline organized by subject to facilitate exceeding EO-111 and its related cross-reference to LEED™ Certified level. (Note: Currently being completed are the supporting reference documents, standards and case studies for all non-LEED requirements.
- II. Guideline Implementation Matrix:** A matrix is provided to summarize guideline requirements, illustrate the Equivalency Option and provide a roadmap to a LEED™ Silver certification.

The Memorial Sustainable Design Guidelines have been coordinated with the Commercial Sustainable Design Guidelines for WTC Redevelopment Projects as well as guidelines drafted for the WTC Cultural Buildings and WTC Transportation Hub. These guidelines will share reference materials currently in development. A number of guidelines reference the current LEED™ 2.1 Green Building Rating System for New Construction. As new versions of LEED™ are adopted by the USGBC in the future, these guidelines will be updated to maintain conformance with EO-111. Design teams will consider the Guidelines as they relate to unique features of the cultural projects.

The Reference Manual and accompanying materials currently in development will provide essential additional guidance for design teams working with the Guidelines. Design teams will have the Reference Manual as a 'source book' for relevant codes and standards, case studies, definitions, bibliography, explanatory text, description of economic and community issues, synergies and trade-offs, etc. The Reference Manual will assist LMDC in the development of a clear basis for assessment, evaluation and approval. Guidelines cross-referenced to LEED™ criteria will meet USGBC's requirements and have the opportunity and flexibility to draw upon additional USGBC reference materials made available for these LEED™ Guidelines. LMDC will work with the design teams throughout the design process to review the specific attainment levels of overall sustainability.

## **URBAN ENVIRONMENTAL QUALITIES**

### **UEQ-1: Support Urban Development**

**Purpose:** Support development in existing urban areas and fully utilize and support existing infrastructure.

**Action:** Channel development to urban areas. Provide development that supports and maximizes the use of existing infrastructure and exceeds a minimum development density of 60,000SF/acre.

### **UEQ-2: Expanded Public Transit and Bicycle Access**

**Purpose:** Encourage the development of public transportation, address opportunities to connect/cross-connect systems and support and increase bicycle access.

**Action:** Integrate and encourage utilization of public transportation. Provide bicycle racks and follow the recommendations of the NYC Department of City Planning (DCP) 1999 Bicycle Parking Needs Study and the 1997 NYC Bicycle Master Plan.

### **UEQ-4: Pedestrian Movement**

**Purpose:** Support neighborhood, community, visitor and commuter pedestrian pathways and facilitate pedestrian access to and through the site.

**Action:** Diagram anticipated pedestrian pathways that are coordinated with plans for WTC Redevelopment Projects. Enhance pedestrian pathways, both above and below ground, to facilitate and support pedestrian traffic. Describe enhancements including and illustrating connections to buildings, additional pathways and transportation nodes, path size, adjacent area uses, public art, vegetation, access to daylight and direct sun, furnishings, wayfinding, paving materials and patterns and view corridors.

### **UEQ-5: Green Infrastructure**

**Purpose:** Support the development of green infrastructure by developing and linking vegetated site areas with existing neighborhood green spaces.

**Action:** Diagram "green" infrastructure within 1000' of site boundary. Create site vegetated areas to enhance site contributions to natural ecological processes, sustain air and water resources, promote biodiversity and reduce heat island effects. Facilitate creation of green infrastructure linkages in conjunction with adjacent neighborhood green spaces.

Document unique ecological contribution of large green areas and plantings to neighborhood green infrastructure. Consider opportunities to diversify plantings per SEQ-8 toward the support of enlarged wildlife populations.

**UEQ-6: Outdoor Environmental Comfort**

**Purpose:** To facilitate site development that supports outdoor environmental comfort.

**Action:** Design site structures, materials and landscape to enhance comfort and functionality of outdoor spaces and mitigate the effects of heat islands. Extend outdoor comfort levels further into the Spring and Fall seasons with passive strategies that maximize natural assets. Design structures with consideration for site environmental wind conditions where pedestrians would be affected and seek to moderate any such effects.

Provide outdoor environmental comfort model to evaluate ability of outdoor rooms to provide extended periods of environmental comfort. This model should minimally include information from the wind modeling, a shadow study, site materials and structures, landscape features and local climatological data.

**UEQ-7: Wayfinding**

**Purpose:** To facilitate both neighborhood and site-user orientation and site readability.

**Action:** Integrate wayfinding as an integral design quality when developing green corridors, visual corridors and memorable place markers in conjunction with surrounding neighborhoods.

**UEQ-8: Vehicular Emissions**

**Purpose:** Reduce back-up of traffic into neighboring streets in order to minimize vehicle emissions and improve neighborhood air quality from pre 9/11 base. Minimize potential idling time for all vehicles.

**Action:** Optimize traffic flow of all vehicles coming to site to reduce the amount of time that vehicles must idle. Seek to reduce traffic backups through scheduling and onsite accommodation. Design bus stops to minimize traffic backups and potential vehicle idling times.

## **SITE / PARCEL ENVIRONMENTAL QUALITIES**

### **SEQ-1: Comprehensive Resource Management Plan**

**Purpose:** Draft and implement the requirements of the Comprehensive Resource Management Plan.

**Action:** The Comprehensive Resource Management Plan provides a tool for an integrated consideration of water, material and energy resources with the goal of identifying, evaluating and optimizing utilization of all resources on the site. The plan overlays information from the individual water, material and energy management plans and identifies integrated opportunities for resource conservation (i.e. storage of captured stormwater in cisterns provides both water for landscape irrigation and potential of cistern to act as thermal bank to reduce peak energy demands).

### **SEQ-2: Storm Water Use**

**Purpose:** To capture and utilize site storm water flows, thereby reducing storm water volume and surges through the system.

**Action:** Implement a plan for stormwater management as part of the Water Management Plan that reduces the post-development flow of stormwater from the site (9/11 base). Construct treatment systems to remove 80% of total suspended solids (TSS) and 40% of total phosphorous (TP) per EPA Document (840-B-93-001c) Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (based on the average annual loadings from all storms less than or equal to the 2 year/24 hour storm). Design plaza to move a calculated amount of surface stormwater flows through planted areas to capture bioremediation potentials of plantings. Consider treatment potential of bioremediation system to treat stormwater from other selected adjacent open areas.

Design site surfaces to allow collection of site storm water flows from other than street surfaces. Provide storage and filtration infrastructure. Fully use captured water as appropriate and in conjunction with Water Management Plan. Integrate large public plazas with permeable paving and appropriate subsurface drainage to ensure appropriate moisture levels for plantings while maximizing rainwater use potentials.

### **SEQ-3: Heat Island Effect Mitigation**

**Purpose:** Reduce site development contributions to “heat island” effects in Lower Manhattan. Seek to maximize areas of landscape planting (green infrastructure) coupled with high albedo surfaces at other areas to mitigate thermal loading of site surfaces and building roofs.

**Action:** Provide green infrastructure coupled with high albedo surfaces to mitigate thermal loading of site surfaces and building roofs. Provide shade and/or use light-colored/high-albedo materials (reflectance of at least .3) or open reinforced grid pavement for at least 30% of the site’s walkways, plazas and open spaces. Use ENERGY STAR® compliant AND high emissivity roofing (emissivity of at least 0.9 when tested in accordance with ASTM 408) for a minimum of 75% of the roof surface; OR install a “green” (vegetated) roof for at least 50% of the roof area. Combinations of high albedo and vegetated roof can be used providing they collectively cover 75% of the roof area. Include fountain contributions through evaporative cooling to heat island effect mitigation.

**SEQ-4: Light Pollution Reduction**

**Purpose:** To reduce light pollution and glare to surrounding sites and night sky.

**Action:** Satisfy Illuminating Engineering Society of North America (IESNA) recommended practice per manual (RP-33-99) for exterior illumination. Design exterior lighting such that all exterior luminaires with more than 1000 initial lamp lumens are shielded and all luminaires with more than 3500 initial lamp lumens meet the Full Cutoff IESNA Classification. The maximum candela value of all interior lighting shall fall within the building (not out through windows) and the maximum candela value of all exterior lighting shall fall within the property.

**SEQ-5: Construction Environment**

**Purpose:** To reduce pollution, noise and vibration from construction activities and vehicles.

**Action:** Implement a Construction Environment Plan, which reduces pollution, noise and vibration from construction activities and vehicles to adjoining neighborhoods.

Develop a materials staging and construction access plan prior to start of construction. Truck staging zones are to be placed for minimum disruption and impact. Limit unnecessary idling times on diesel powered engines to 3 minutes. Consider bio-diesel fuel as an alternative to pure diesel.

Non-road construction equipment of 50hp or greater to include diesel emissions control technology according to EPA diesel retrofit recommendations, unless not technically feasible. All non-road diesel equipment to utilize ultra low sulfur diesel fuel (limit sulfur levels to 15ppm). Explore accelerated implementation of proposed EPA emission standards for non-road diesel equipment. Locate fixed diesel powered exhausts away from fresh air intakes.

Reduce noise and vibration impacts through scheduling and coordination with adjacent construction activities. Consider noise barriers where practicable.

Consider condition of surrounding buildings, structures, infrastructure and utilities where appropriate. Coordinate construction activities in adjacent and nearby locations to avoid or minimize impacts and communicate plans with the public.

Prepare contingency measures in the event established limits are exceeded.

**SEQ-6: Construction Storm Water Runoff and Pollution Prevention**

**Purpose:** Control site erosion and reduce negative impacts on hydrological and atmospheric systems produced by construction activities.

**Action:** Provide Construction Storm Water Pollution Prevention Plan conforming to US EPA document 832/R-92-005. Prevent air pollution from dust and particulate matter during the course of construction. Utilize sprayed suppressing agents (nonhazardous, biodegradable) for containment of fugitive dust and adjust strategies per meteorological conditions. Coordinate with SEQ-5 Construction Environment Plan.

**SEQ-7: Use Existing Site Structures**

**Purpose:** Encourage the re-use of existing site structures to conserve resources.

**Action:** Incorporate existing slurry wall, bathtub excavation, elements of Temporary PATH Station and utilities (such as the River Water Pump Station) for re-use in new site development to the extent possible.

**SEQ-8: Plant/Vegetation Selection**

**Purpose:** Use indigenous or acclimatized plants to reduce irrigation and maintenance requirements.

**Action:** Specify naturalized or indigenous plant materials, which will promote biodiversity and support site ecological systems, as well as, reduce maintenance requirements. Use plantings that can be sustained by natural rainfall levels to reduce irrigation requirements.

Consider plant selections, which will optimize environmental comfort through shoulder seasons, as well as, realize memorial design intentions.

**SEQ-9: Daylight/Exterior Public Spaces**

**Purpose:** Design buildings and site structures to consider available daylight for public open spaces and green areas (within the context of the established massing guidelines).

**Action:** Determine critical open spaces and green areas. Utilize shadow studies to determine available sunlight. Consider available sunlight in planning outdoor public spaces and site plantings.

Include plaza plantings and reflective potentials from water features at Memorial in daylight analysis.

**SEQ-10: Solar Access/Harvesting**

**Purpose:** To optimize solar access for utilization of solar energy.

**Action:** Determine maximum available photovoltaic potentials for all building surfaces. Develop strategy for possible future transition to capture this potential. Quantify and document this strategy and any other “near threshold” renewable technologies in the Renewable Energy Transition Plan.

Consider integration of photovoltaic cells into site lighting fixtures and wayfinding elements to enhance site security, reduce dependence on emergency systems and provide visible demonstration of solar potentials.

**SEQ-11: Recovery of Resources**

**Purpose:** To optimize utilization of site material resources and to facilitate the reduction of waste generated by building occupants that would otherwise be hauled to and disposed of in landfills and/or incinerators.

**Action:** Study large-scale and small-scale opportunities for on-site recovery of waste. Consider opportunities to recover food, paper, plastic, metal and construction waste. Consider composting, biomethanization and other viable “waste to reuse” strategies. Consider in conjunction with Renewable Energy Transition Plan and Co-generation study.

**SEQ-13: Natural History**

**Purpose:** Make tangible elements of site natural history to educate and inform site users.

**Action:** Integrate and exhibit site natural features and history to educate site users in interrelationships between built and natural environments and history. A unique opportunity exists through the Memorial to connect visitors with this underlying bedrock, Manhattan Schist, formed 500 million years ago and once supporting the World Trade Center Towers.

**WATER ENVIRONMENTAL QUALITIES**

**WEQ-1: Comprehensive Water Management Plan**

**Purpose:** To optimize utilization of site water resources.

**Action:** Implement a Water Management Plan to evaluate use of storm water, waste water and potable water resources, study potentials for onsite stormwater cisterns and reclamation of wastewater and provide a coordinated management plan for full site water resources.

Use EPA recommendations per EO 12123 (June 1999) and Federal Energy Management Program (FEMP) Best Management Practices to develop Plan. The Plan must include, at a minimum, information on operation & maintenance, utility information, facility information, emergency response information and planning considerations.

**WEQ-2: Wastewater Reuse**

**Purpose:** To minimize site wastewater outflows.

**Action:** Implement wastewater strategies as required by Water Management Plan. Use reclaimed storm water and/or site water for toilet flushing, cooling tower makeup, vehicle maintenance and irrigation needs. Study additional opportunities to reduce the amount of potable water used in the building for conveying sewage.

**WEQ-3: Water Use Efficiency**

**Purpose:** To maximize water efficiency within buildings and reduce the burden on municipal water systems.

**Action:** Reduce consumption of potable water as required by Water Management Plan. Use 30% less potable water than a baseline building (utilize 1992 Energy Policy Act fixture requirements to determine baseline) would by utilizing efficient water fixtures, automatic controls and/or waterless urinals.

**WEQ-4: Landscape Hydrology**

**Purpose:** To maximize utilization of site water for landscape requirements.

**Action:** Use storm water for landscape irrigation requirements in conjunction with Water Management Plan. Specify plantings requiring low amounts of watering. Use indigenous or acclimatized plants suitable for the current nature of the site. Employ high-efficiency irrigation systems with slow-drip, sub-soil irrigation and computer operation with linkages to meteorological data to optimize water resources.

Design system in concert with stormwater bioremediation system from SEQ-2.

**ENERGY ENVIRONMENTAL QUALITIES**

**EEQ-1: Comprehensive Energy Management Plan**

**Purpose:** To conserve and optimize building energy use and minimize air emissions, including greenhouse gases, associated with energy consumption at the site.

**Action:** Prepare an Energy Management Plan to conserve and optimize building energy use, minimize air emissions and coordinate and maximize the utilization of any site generated energy resources. The Plan shall include an energy use budget for the project for the first year of operation (building shall be a minimum of 50% occupied with unoccupied areas and building systems normalized for full occupancy) and broken down by major energy consumption category (i.e., heating, cooling, lighting, fan energy, pump energy, etc.). Consider base building systems apart from occupancy with allowances for interconnections. After each year of operation, the actual utilization of energy shall be recorded and compared to this baseline energy use budget with appropriate adjustments for deviations in occupancy, base building conditions and climate norms. Significant deviations shall be evaluated and a detailed explanation for the probable cause of the deviation recorded in the updated plan. Strategies for reducing energy consumption below the first year of operation, as defined above, shall be identified and described.

The Energy Management Plan shall include a similar itemization of any site generated energy resources, including a budget for each component, and annual updates of actual performance. The Plan shall identify measures and strategies for increasing utilization of clean on-site energy above the first year of operation, as defined above.

Review opportunities for coordinated site strategies to conserve energy. Provide matrix outlining additional costs and savings, available incentives, benefits and impacts from, for instance, a co-generation plant, river water cooling, building integrated PV, fuel cells and other strategies.

Consider linkages with site master plan's potential utilization of river water for cooling. This plant would be close to the memorial and create opportunities for exchanges between the river water and the plant to include thermal exchanges to the fountain water. In winter months the water might be heated, providing additional heat exchange opportunities for the plant, protecting the water from freezing and adding potentials for radiative warming of memorial areas. In summer months this same system could be used to reject heat from the Memorial's HVAC system.

**EEQ-2: Building Systems Commissioning**

**Purpose:** To implement a Building Commissioning Plan.

**Action:** Engage an independent commissioning authority to prepare and execute a commissioning plan. Implement fundamental, best practice building commissioning procedures. Include design phase reviews, contractor submittal reviews, pre-functional and functional testing (including seasonal testing), training, Operations & Maintenance manuals and post occupancy review (within the first year of occupancy). Provide Building Commissioning Plan consistent with the requirements of NY State Green Building Tax Credit (NYSGBTC) 638.8.

**EEQ-3: Optimize Energy Performance**

**Purpose:** To optimize the performance of building energy systems.

**Action:** Optimize the performance of building energy systems through the utilization of a full DOE-2.1E or Energy Plus building energy model to compare alternative strategies for energy efficiency (kwh) peak load reduction (kW) and reduced use of fossil fuels. Integrate with Energy Management Plan. This is to include the full analysis of architectural and mechanical decisions in relationship to building energy expenditures. Achieve a minimum of 20% decrease in energy cost above ASHRAE 90.1-1999. Provide daylight dimming and occupancy sensors on light fixtures where appropriate. All light fixtures to use high efficiency ballasts and low mercury/low lead, long life lamps. Specify recyclable lamps. Utilize energy efficient equipment, which meets or exceeds the following; NEMA premium efficiency motors, variable speed systems for all fans, pumps and motors and ENERGY STAR® products. Comply with FEMP levels for commercial products not rated by ENERGY STAR®. Provide a high performance building envelope, including minimized thermal bridging, superior insulation, air infiltration barrier and insulated wavelength selective glazing (to improve daylight transmission). Provide envelope construction details consistent with NYSGBTC 638.7(d)(2). Use air-side and water-side economizers, as appropriate.

**EEQ-4: Ozone Layer Protection**

**Purpose:** To reduce emission of ozone depleting chemicals.

**Action:** Specify building HVAC systems with zero levels of CFC refrigerants, and provide plan for future elimination of HCFC's and halon in HVAC and refrigeration equipment and fire suppression systems. Avoid insulation materials that utilize chlorine based gases

**EEQ-5: Renewable Energy Plan**

**Purpose:** To meet a portion of site energy requirements with on site and/or purchased renewable energy sources and institute a plan for transition as renewables become more cost-effective.

**Action:** Utilize site generated and/or purchased renewable energy for a percentage of total building energy use. Provide transition plan for future conversion to renewables. Purchase or generate on-site a minimum of 20% of overall annual electric energy requirements with renewables by 2010 consistent with NY State EO-111's evolving requirements and capabilities. Provide infrastructure to integrate technology into building systems, when possible.

**EEQ-6: Energy Systems Control and Maintenance**

**Purpose:** To provide for ongoing verification of initial operation and energy utilization of building energy systems.

**Action:** Provide a computerized, fully-integrated Building Management System (BMS) with energy and fluid flow measurement capabilities for all major energy consuming systems. Institute a maintenance plan for ongoing measurement, verification and maintenance of equipment efficiencies and resource utilization. Provide programmable controls. Install permanent monitoring systems to track energy performance. Provide for maintenance and operational continuity through manuals and education. Install continuous metering equipment for a representative sample of lighting systems, motors, drives, chiller efficiencies, and trending of economizer and heat recovery equipment cycles, air distribution pressures and volumes and boiler efficiencies. Integrate the above systems into the Building Commissioning Plan.

**EEQ-8: Thermal Energy Storage**

**Purpose:** To maximize opportunities for storage of thermal energy to balance large shifts in demand.

**Action:** Consider thermal banking potentials of bedrock at the lower levels of the Memorial and the use of water cisterns to store stormwater and fountain make-up. Bedrock maintains a constant temperature in this latitude of 55 degrees, which can be used to our advantage as we seek to mitigate external temperature extremes. Earth-coupled systems exist in many forms across the world and across climates. The potential in this project appears to be significant and certainly merits further study and analysis.

**MATERIAL ENVIRONMENTAL QUALITIES**

**MEQ-1: Comprehensive Material Management Plan**

**Purpose:** To optimize utilization of site material resources and to facilitate the reduction of waste generated by building occupants that would otherwise be hauled to and disposed of in landfills and/or incinerators.

**Action:** Implement a Materials Management Plan, which coordinates and implements material guideline requirements within the Sustainable Design Guidelines. Describe materials utilized, recycled content, location of manufacture/harvest, agricultural content, sustainable harvest certification, expected lifetime, maintenance requirements and recyclable/reuse potential at end of useful life. Minimize travel distance for building products and systems and locate sinks for highest recycled use for 'waste' materials in conjunction with MEQ-2 and MEQ-5. Provide infrastructure necessary to implement the recycling requirements of the plan. A central location for appropriately-sized recycling facilities must be provided for all buildings. Facilities must include, at a minimum, space for the separation, collection and storage for recycling of paper, corrugated cardboard, glass, plastics and metals, and each of these areas should be clearly identified. Provide easy truck access for the pick-up and removal of recyclables.

**MEQ-2: Construction Waste Management**

**Purpose:** To reduce the amount of construction and demolition (C&D) waste going to landfills and/or incinerators and to conserve resources through reuse and recycling.

**Action:** Implement a Construction Waste Management Plan to divert construction, demolition and land clearing debris from landfill disposal to redirect recyclable and/or recovered resources back to the manufacturing process and to redirect salvageable materials to appropriate sites. Recycle and/or salvage a minimum of 50% of construction, demolition and land clearing waste, calculated by weight. Divert a minimum of 50% of construction waste by weight from landfill.

**MEQ-3: Resource Reuse**

**Purpose:** To incorporate previously used building materials and products into new construction.

**Action:** In coordination with the Materials Management Plan consider the use of salvaged, refurbished or reused materials and products in the building. Materials for reuse typically include reclaimed lumber and wood such as salvaged wood flooring and wood doors and cabinets, structural metal work such as beams, and miscellaneous metal such as doors, door hardware, etc. Decorative and specialized items such as salvaged wood and glass panels, banquettes, front and back bars and decorative or period lighting fixtures may be used in special public locations such as cafeterias or restaurants, and can contribute to this credit.

**MEQ-4: Materials with Recycled Content**

**Purpose:** To incorporate materials with recycled content and increase market demand for building materials and products that incorporate recycled content.

**Action:** Specify materials with recycled-content in conjunction with the Materials Management Plan. The value of the recycled content portion of materials is to be at least 10% of the total project materials value (mechanical and electrical components are not to be included in these calculations).

Determine recycled content value according to the following formula. For post-consumer recycled content determine percentage of recycled content in the material and multiply by value of material. For post-industrial recycled content determine percentage of recycled content in the material, multiply by  $\frac{1}{2}$  and multiply by value of the material.

**MEQ-5: Material Proximity**

**Purpose:** To reduce environmental degradation resulting from transportation impacts by increasing the demand for building materials and products that are extracted and/or manufactured in close proximity to the building site.

**Action:** Utilize local/regional materials in conjunction with the Materials Management Plan. Use a minimum of 20% of all building materials (based on cost) that are manufactured within a 500 mile radius of the site. Manufactured in this context means the location where 'final assembly' takes place.

Seek to utilize materials "extracted" within a 500 mile radius of the site where possible.

**MEQ-6: Wood Certification**

**Purpose:** To specify wood which has been harvested according to sustainable forest management principles.

**Action:** Utilize wood materials certified under the Forest Stewardship Council's Principles and Criteria (FSC) in conjunction with the Materials Management Plan. These materials may include dimensional framing components, flooring, doors, paneling, millwork and furnishings, handrails and trim, etc., as well as, temporary lumber and wood construction materials. Request vendor's chain-of-custody certificate number to verify certification.

**MEQ-7: Agricultural Materials**

**Purpose:** To encourage the specification of materials which are renewable and that grow in such a way as to support biological diversity and the health of the ecosystem.

**Action:** In coordination with the Materials Management Plan use renewable and rapidly renewable building materials and products.. Materials with annual growing cycles or which regenerate naturally within a 10-year-cycle are considered to be rapidly renewable materials. These materials include bamboo, poplar, cork, wool, cotton, jute, sisal, and soy-based products. Agricultural 'waste' materials such as wheatgrass, sunflower seed husks, and straw also qualify under this category. Release agents for concrete forms, which are made from plant oils such as corn oil are included. Use agricultural compost for site applications, including, but not limited to, turf, plantings and erosion control.

Provide capability for site composting and reuse of site plant trimmings.

**INDOOR ENVIRONMENTAL QUALITIES**

**IEQ-1: IAQ Performance**

**Purpose:** Establish high indoor air quality (IAQ) for the comfort and well-being of the building's occupants by minimizing the potential for poor air quality, and by establishing minimum IAQ performance and standards.

**Action:** Provide an Indoor Air Quality Management Plan which employs architectural and HVAC design strategies to establish minimum outdoor air quantities, chemical, biological and particulate source control and on-going air quality monitoring to achieve a positive impact on the overall indoor environment and well being of the occupants. Meet the requirements of ASHRAE Standard 62-2001: "Ventilation for Acceptable Indoor Air Quality", utilizing the Ventilation Rate Procedure.

Prepare plan in accordance with the requirements of NYSGBTC 638.7(d)(1,2 and 3). Draft the plan in accordance with the EPA "Building Air Quality: A Guide for Building Owners and Facility Managers", 1991 and EPA and National Institute for Occupational Safety and Health, Building Air Quality Action Plan, 1998.

Prohibit smoking in the building.

**IEQ-2: Daylight & Views**

**Purpose:** Provide building occupants with connections to the outdoors through the introduction of daylight into habitually occupied areas of the building. Provide building occupants with views via direct line of sight to the outdoors from regularly occupied spaces when possible.

**Action:** Incorporate skylights or translucent paving materials to facilitate the transfer of daylight into below grade areas. Design daylight openings away from densely planted areas to mitigate interference with soil layer requirements.

**IEQ-3: Air Quality Monitoring**

**Purpose:** To retain high indoor air quality standards by establishing monitoring protocols to assist in maintaining appropriate ventilation rates for the comfort and well-being of building occupants.

**Action:** Indoor air quality must be tested annually and must meet minimum criteria for five years in accordance with minimum requirements of NY State EO-111 reference to NYSGBTC 638.7(d)(1). Once radon measurements are found to be satisfactory, subsequent testing for this contaminant is not required. Where concentration levels of noted contaminants exceed the established parameters in any specific area during this 5 year period, seek to locate and remediate/eliminate contaminants, then flush out area with 100% outside air for a minimum of one week and retest until a satisfactory result is achieved.

Consideration should be given to a permanent indoor air quality monitoring system with centralized controls that provides feedback on ventilation performance and contaminant concentrations based on a combined carbon monoxide, carbon dioxide and volatile organic compound monitor.

**IEQ-4: Ventilation Air Quality**

**Purpose:** To provide outside air to all occupied spaces in the building to support the comfort and well-being of building occupants and as an energy conservation measure.

**Action:** Demonstrate that the requirements of Section 5, 'Best Practices for Maintaining IEQ' of the International Performance Measurement & Verification Protocol, Volume II 'Concepts and Practices for Improved Indoor Environmental Quality', March 2002 have been met. Provide capability for system default to 100% outside air at all times where practicable and in balance with energy conservation.

**IEQ-5: Construction IAQ Management Plan**

**Purpose:** To provide minimum standards for the air quality of building areas upon occupancy.

**Action:** Implement a Construction Indoor Air Quality Management Plan in conformance with NY State EO-111 reference to NYSGBTC 638.7(d)(2) and the USGBC LEED 2.1 Rating System. During construction, meet or exceed the recommended Design Approach of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guideline for Occupied Buildings under Construction, Chapter 3. Use high efficiency filtration media at all HVAC return air grilles during construction and replace all base building mechanical system filtration media with Minimum Efficiency Reporting Value of 13 (MERV 13) filters in accordance with ASHRAE 52.2 – 1999 immediately prior to occupancy.

On completion of construction and prior to occupancy, conduct a two-week flush out with new filtration media using 100% outside air, in accordance with NYSGBTC 638.7(d)2. Replace all filtration media used with new MERV 13 filters. Alternatively, test indoor air quality at random sampling points for every 20,000 sf, or by each floor if smaller, in accordance with recognized national standards, to achieve an air quality profile at time of occupancy which satisfies the specific minimums for carbon dioxide, carbon monoxide, formaldehyde, volatile organic compounds, particulates and radon as per NY State EO-111 reference to NYSGBTC 638.7(d)2 and include one additional testing procedure for 4-PCh to satisfy all of the Alternate Procedure Requirements for LEED 2.1. Where concentration levels of contaminants exceed the established parameters in any specific area, flush out area with 100% outside air for a minimum of two weeks and retest until a satisfactory result is achieved.

**IEQ-6: Reduce Contaminants from Materials**

**Purpose:** To reduce the density of contaminants that are emitted by common building materials and which affect the comfort and well-being of building occupants.

**Action:** Develop and implement a Materials Management Plan to minimize utilization of materials with high levels of volatile organic compounds (VOC's) and other toxic characteristics which adversely affect Indoor Air Quality (IAQ). VOC's must meet or be lower than those in the following standards:

- Adhesives and sealants: South Coast Air Quality Management District Rule #1168
- Paints and coatings: Green Seal Standard GS-11
- Carpet and carpet adhesives: Carpet and Rug Institute Green Label Indoor Air Quality Test Program

Where possible use non-urea-formaldehyde-based bonding agents in composite wood and typical millwork applications such as veneer and plastic laminate applications, etc.

Minimize unprotected insulation in ducts, supply plenums and return plenums per NYSGBTC 638.7(j).

**IEQ-7: Chemical & Particulate Control**

**Purpose:** To minimize sources of chemical and particulate air contamination.

**Action:** Design all major entrances with permanent walk-off grilles to minimize particulate transfer. Provide MERV 13 air filters for removal of 90% of particulates at air supply systems and provide building owner with a maintenance schedule for filter replacement. Build slab-to-slab partitions and provide negative air pressure of at least 7PA with isolated exhaust systems of at least .5cfm/sf at work rooms with printing and copying equipment, janitorial closets and all chemical use areas. Locate exhausts to ensure that there is no potential for re-entrainment of exhaust air to other supply in-takes. Provide drains for appropriate disposal of liquid waste in spaces where water and chemical concentrate mixing occurs.

**IEQ-8: Thermal Comfort**

**Purpose:** To provide building users with a high level of thermal comfort to promote comfort, well-being and enhanced productivity.

**Action:** Design the building envelope in accordance with ASHRAE Standard 55-2004 to manage the flow of air, moisture and thermal energy in the building. Include capability for adjustments to thermal conditions to address seasonal changes and associated modifications in typical levels of clothing. Design an integrated system (thermal shell and HVAC) that allows building operators to monitor and control air temperature in each zone. To avoid condensation problems, mechanical systems must be designed to deal with part-load cooling conditions so that they are able to maintain appropriate dehumidification levels.

Radiative heating and cooling systems should be designed for easy maintenance and should consider linkages to river water-cooling potentials and thermal banking potentials of earth/water cisterns.

**IEQ-9: Pest Control**

**Purpose:** To mitigate health concerns caused by any unwanted pests, their excrement and the chemicals used to control them.

**Action:** Develop an Integrated Pest Management Plan based on USEPA Best Management Practices, which promotes physical controls and non-pesticide measures over pesticide application. Physical controls include building sealing strategies, improved sanitation, pest-resistant plantings and improved maintenance of wet areas. When necessary, use boric acid or other nontoxic alternatives in lieu of more toxic chemicals to control and eliminate rodent populations from building.

**IEQ-10: Personal Control**

**Purpose:** To provide building occupants with a high level of thermal, ventilation and lighting system control to promote productivity, comfort and well-being.

**Action:** Provide building occupants with individual controls over airflow, temperature and lighting systems. Provide operable windows where practicable and feasible.

**IEQ-11: Acoustics**

**Purpose:** Minimize vibration and noise levels in indoor spaces and at exterior environments to achieve appropriate physical comfort and sound isolation for tasks and speech intelligibility, while contributing to human well-being and productivity.

**Action:** Where practical program locations of mechanical equipment and other sources of noise away from areas of building and exterior spaces designed for use by building tenants and the public. Design separations to minimize transfer of noise. Consider strategies to reduce the transmission of exterior ambient noise. Comply with the recommendations of ASHRAE Applications Chapter 46 Design Guidelines to reduce potential noise and vibration from mechanical equipment, and the Architectural Graphic Standards 8th Edition: Sound Isolation Criteria Table, page 44 to address acoustic criteria for enclosed office space such as offices, meeting rooms and other occupied areas.

Ensure fountain and site developments consider appropriate responses to mitigation of noise from West, Greenwich, Liberty and Fulton Street traffic and falling water of fountain.

**IEQ-12: Lighting Quality**

**Purpose:** Employ advanced lighting design to maximize comfort and productivity of building occupants and enhance the quality and efficiency of electric lighting. Fully coordinate ambient electrical lighting design with daylighting strategies.

**Action:** Design an ambient electrical lighting system that is coordinated with daylighting strategies to provide flexible illumination. Endeavor to meet the recommendations of the Illuminating Engineering Society of North America's (IESNA) 9th Edition Handbook, Chapter 10 Quality of the Visual Environment, and the Lighting Design Guide. Provide high frequency electronic ballasts, recyclable lamps and low mercury/low lead lamps as defined by the US Environmental Protection Agency's Toxicity Characteristic Leaching Procedure (TCLP) testing procedure. Supplement ambient lighting system with multi-level task lighting to maintain a minimum of 35 footcandles (in typical office area) at desk level throughout hours of occupancy.