Reference Information, MS4 Individual Permit Discussions, Buckley AFB
OLDWEILER, CORWIN E GS-12 USAF 460 CES 460 CES/CEAN
02/12/2013 08:07 AM
To: Amy Clark
Cc: "FISHER, LAURIE B GS-13 USAF 460 CES 460 CES/CEA", "BROGAN, ELIZABETH A CTR USAF 460 CES 460 CES/CEAN"
This message is digitally signed.

2 attachments

2011-06-02_HQ-USAF-A7C_SDD-ImplementingGuidance_Portfolio.pdf ufc_3_210_10_LID-Manual_Nov2010.pdf

Amy,
As follow-up to our 23 Jan 13 meeting and prep for the site tour next week and 27 Feb 13 meeting, I'm providing three references for your review.
The Air Force Sustainable Design and Development (SDD) Implementing Guidance, HQ-USAF/A7C, 2 Jun 11;, is significant in its scope, which specifically calls out and requires EISA Section 438 compliance (see memo text and Attachment 7) ; also of note is that it was issued in June 2011, well after our draft individual permit; having this requirement in place on Buckley AFB now reinforces the conflict, on a technical basis, of referencing EISA Section 438-like requirements in the individual MS4 permit.
Please note the memo is strongly worded, such as:
o begins with FYI2,
o is applicable regardless of funding source,
o is applicable to all permanent construction activity on Air Force installations (i.e., applicable to tenants facilities)
o the requirements of this memorandum are not optional,
o sustainable elements necessary to comply with this memorandum cannot be eliminated to save scope or cut cost.

And further, in Attachment 7 - Implementing Guidance to Meet EISA 2007 Section 438 Requirements:
o If any DoD or other federal agency has an applicable construction project on Air Force installations, they will comply with this guidance.

This 'new' document, along with the DoD EISA Section 438 Policy Memo 19 Jan 10 (previously provided) both post-date EPA's time

frame of individual
federal facility permit planning including Buckley AFB's audit, SOB, and
initial draft permit. Both documents clearly layout our post-construction
MEP.

UFC 3-210-10, Low Impact Development, 15 Nov 2010 is significant in its
scope and its release date, which is contemporaneous with our public notice
draft individual permit. This document provides a ready resource for LID
design, but in addition it is readily referenced in basis of design scopes
of work.

Another activity that post-dates the audit and basis of permit timeframe is
the Major Drainageway Planning and Flood Hazard Area Delineation (FHAD)
study, Toll Gate Creek and East Toll Gate Creek (Downstream of Hampden)
Project being conducted by Urban Drainage and Flood Control District.
Buckley AFB, along with the City of Aurora, are sponsors on this project.
A link to the project webpage is provided at:
http://www.udfcd.org/projects/proj_msplan.htm, click: East Toll Gate Creek
(Downstream of Hampden) MDP and FHAD.
This project is underway. Objectives include updating the hydrology under
both existing and future conditions, identifying flood hazards and map
floodplain / floodway hydrology, planning for future basinwide improvements,
and developing design alternatives for channel stabilization as necessary.
Results from this project will provide meaningful data on which to base a
monitoring program.

We are looking forward to the site visit next week and continuing
discussions.
Please let me know if you have any questions.
Thanks, Cory

//signed//
Corwin Oldweiler, PE, DAF
WQP Mngr
460 CES/CEAN
Direct: 720-847-4655; DSN: 847-4655
Cell: 720-413-3739

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON, DC

2 JUN 2011

MEMORANDUM FOR SEE DISTRIBUTION

FROM: HQ USAF/A7C
1260 Air Force Pentagon
Washington, DC 20330-1260

SUBJECT: Air Force Sustainable Design and Development (SDD) Implementing Guidance

This memorandum reinforces the Air Force commitment to incorporate sustainable concepts in the planning, programming, design, construction, and operation of facilities and infrastructure. Beginning with FY12 and *regardless of funding source*, all permanent construction activity on Air Force installations in the United States (including Alaska and Hawaii) and its territories on permanent Active Air Force installations, resulting in Air Force Real Property Assets, shall comply with the requirements of this memorandum. This policy shall apply to overseas construction activities to the extent practical, considering mission objectives, and Host Nation agreements. The requirements of the following directives are incorporated into this memorandum:

- Executive Order (EO) 13327, Federal Real Property Asset Management, 6 Feb 04
- Public Law 109-58, Energy Policy Act (EPAct) 2005, 8 Aug 05
- Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding and Guiding Principles, 24 Jan 06
- EO 13423, Strengthening Federal Environmental, Energy, and Transportation Management, 26 Jan 07
- Public Law 110-140, Energy Independence and Security Act (EISA) of 2007, 19 Dec 07
- EO 13514, Federal Leadership in Environmental, Energy, and Economic Performance, 8 Oct 09
- Deputy Under Secretary of Defense (Installations and Environment) Memorandum, 19 Jan 10, Subject: DoD Implementation of Storm Water Requirements under Section 438 of the Energy Independence and Security Act (EISA)
- Deputy Under Secretary of Defense (Installations and Environment) Memorandum, 25 Oct 10, Subject: Department of Defense Sustainable Buildings Policy
- 10 CFR Part 433, Energy Efficiency Standard for the Design and Construction of New Federal Commercial and Multi-Family High Rise Residential Buildings
- 10 CFR Part 436, Subpart A – Methodology and Procedures for Life Cycle Cost Analyses
- FY12 Defense Planning and Programming Guidance

The following sustainability requirements apply to the Air Force Construction program:

a. All new vertical construction, and major renovations[1] (Restoration & Modernization), **meeting the USGBC LEED 2009 Minimum Program Requirements (MPRs)** (see attachments 1 and 2) – All facilities in this category shall fully incorporate Federal

[1] For the purposes of this memorandum, a major renovation project is defined as changes to a building that provide significant opportunity for substantial improvement in the sustainable design elements of the building, including energy efficiency, as determined by the signatory of the DD Form 1391. For major renovation projects seeking formal LEED certification, criteria established in the MPRs and the LEED Reference Guide must also be met.

requirements for High Performance and Sustainable Buildings (HPSB) (see attachment 3); shall be registered in USGBC LEED-Online; *shall be formally certified and achieve at a minimum LEED Silver certification* (or meet a comparable level of achievement with an overseas third-party green building rating system); and shall achieve not less than 20 points (40 percent of the Silver point threshold) dedicated toward energy efficiency and water conservation.

b. All new vertical construction, and major renovations (R&M), **not meeting the USGBC LEED 2009 MPRs**, shall fully incorporate the Federal requirements for HPSBs and shall pursue LEED credits (or credits in an equivalent overseas third-party green building rating system), relevant to the scope of the project, to the maximum extent practicable (see attachment 3). For horizontal, utility, and industrial projects, attachments 4, 5, and 6 have been provided as guidance to indicate appropriate thresholds of compliance with this memorandum. The project types are defined in ETL 08-13, *Incorporating Sustainable Design and Development (SDD) and Facility Energy Attributes in the Air Force Construction Program* as:

- Vertical – Includes typical building construction for which LEED-NC was developed as a metric
- Horizontal – Includes site development, heavy earthwork, construct and repair roads, runways, taxiways, aircraft aprons, containment, sidewalks, parking lots, revetments, curbs, and gutters
- Utility - Includes electric, gas, water, steam, and wastewater, including substations, lift stations, oil/water separators, storage tanks, petroleum, oil, lubricants (POL) lines, and transformers
- Industrial – Includes all enclosed facilities for which mechanical cooling/heating is provided for less than 50 percent of the building square footage

The following paragraphs apply to all projects subject to the requirements of paragraphs a and b above, and other construction activities noted herein.

Apply life cycle cost criteria as specified in 10 CFR 436 Subpart A - Methodology and Procedures for Life Cycle Cost Analyses; EO 13327, Federal Real Property Asset Management; AFI 32-1021, Planning and Programming Military Construction (MILCON) Projects; and AFI 32-1032, Planning and Programming Appropriated Funded Maintenance Repair and Construction Projects, as appropriate.

As a continuation of the Air Force commitment to low impact development, implement the DUSD (I&E), DoD Implementation of Storm Water Requirements under Section 438 of Energy Independence and Security Act (EISA) policy for FY11 O&M and MILCON projects (see attachment 7 for implementing guidance). In exceptional circumstances where project considerations may affect the practicability of implementing the DoD guidance in FY11 O&M projects and FY11 or FY12 MILCON projects, low impact development design strategies will continue to be consistent with existing applicable Air Force design guidance.

The requirements of this memorandum are not optional. Sustainable elements necessary to comply with this memorandum cannot be eliminated to save scope or cut cost. The DD Form 1391 shall include the scope and the cost estimate to achieve the requirements of this memorandum. A separate line item entitled "SDD, EPAct05, EO 13423, EISA 438, and EO 13514" shall list the scope and estimated cost. In lieu of a cost estimate, an allowance, not exceeding 2 percent of the total construction cost, may be identified on the DD Form in the "SDD, EPAct05, EO 13423, EISA 438, and EO 13514" line item.

For MILCON projects, a Federal government employee of the design/construction agent (as the Owner's Agent) and the BCE, or his/her designee (as the Owner) shall sign the LEED Project Registration Agreement and the LEED Certification Agreement as appropriate.

The Air Force MILCON Sustainability Requirements Reporting Scoresheet (attachment 3) shall be used for reporting Air Force compliance with the Federal HPSB requirements and LEED status, of all MILCON project types listed in paragraphs a and b of this memorandum. AFCEE MILCON Project Managers shall send the Air Force MILCON Sustainability Requirements Reporting Scoresheet to AFCEE.TDB.MILCONrptg@us.af.mil, at: 1) the initial design charrette; 2) the RFP/35 percent design; 3) design complete; and 4) construction complete phases of all MILCON projects addressed by this memorandum. Any decisions based on cost constraints leading to deletion of sustainable concepts, or certification of the project, shall be included in the documentation. At the completion of the project provide HPSB status information to the installation Civil Engineering office for the purpose of updating the ACES-RP, RPA Sustainability Code field.

Specific roles and responsibilities in support of this memorandum are:

ORGANIZATION	ROLES AND RESPONSIBILITIES
HQ USAF/A7C	Development and dissemination of sustainable development policy. POC: Gene Gallogly, AF/A7CA, thomas.gallogly@us.af.mil Development and dissemination of MILCON program policy. POC: Robert Gill, AF/A7CP, robert.gill@us.af.mil
AFCEE	Provide guidance documents and technical support, to include planning, design criteria, the delivery process, and general guidance on sustainability and LEED certification. POC: Paula Shaw, AFCEE/TDBS, paula.shaw@us.af.mil
AFCESA	Provide guidance documents and technical support to include engineering criteria, construction standards, life cycle and sustainable costs, and operations and maintenance issues. POC: Clifford Fetter, AFCESA/CEOA,
	clifford.fetter@us.af.mil Provide guidance documents and technical support to include energy and water conservation, and renewable energy technologies. POC: Ken Walters, AFCESA/CEN, kenneth.walters.1@us.af.mil

As new LEED rating systems are introduced by USGBC, AFCEE and AFCESA will evaluate the potential for incorporation into the Air Force Construction Program and will forward recommendations to HQ USAF/A7C for guidance update consideration.

Timothy A. Byers

TIMOTHY A. BYERS, Maj Gen, USAF
The Civil Engineer
DCS/Logistics, Installations & Mission Support

7 Attachments:
1. LEED 2009 Minimum Program Requirements (MPR)
2. LEED 2009 MPR Supplemental Guidance
3. Air Force MILCON Sustainability Requirements Reporting Scoresheet, LEED 2009
4. Guidance on Applying LEED Principles to Air Force Horizontal Construction Projects
5. Guidance on Applying LEED Principles to Air Force Utility Construction Projects
6. Guidance on Applying LEED Principles to Air Force Industrial Construction Projects
7. Implementing Guidance to Meet EISA 2007 Section 438 Requirements

DISTRIBUTION:
SAF/IEE/IEI/IEN/AQC/FMBI
AF/A7CA/A7CI/A7CP/A7CR/A7CX
AF/A1S
AFCEE/CL/CM/EX/TD
AFCESA/CC/CEN/CEO
AFRPA/DR/RPM
HQ AFSVA/CC
ALMAJCOM/A7
11 WG/CE
USAFA/CE
AFIT/CE
HQ AAFES-CF
HQ DECA-CIF
HQ USACE/CEMP-ZA
HQ NAVFAC/(00)

USGBC
2101 L STREET, NW
SUITE 500
WASHINGTON DC 20037
202 828-7422
WWW.USGBC.ORG

LEED 2009
Minimum Program Requirements

Apply to
LEED 2009 for New Construction and Major Renovations, LEED 2009 for Core & Shell development, LEED 2009 for Schools, LEED 2009 for Commercial Interiors, and LEED 2009 for Existing Buildings: Operations & Maintenance

Do not apply to LEED for Homes, LEED for Neighborhood Development, or any LEED rating system adopted prior to 2009

Version November 2009
This version adds to the April 2009 version clarifying language, but not new requirements, that was approved by the LEED Steering Committee and the USGBC Executive Committee in November 2009

INTRODUCTION

This document identifies the MPRs, or minimum characteristics that a project must possess in order to be eligible for LEED Certification. These requirements define the types of buildings that the LEED Green Building Rating Systems were designed to evaluate, and taken together serve three goals: to give clear guidance to customers, to protect the integrity of the LEED program, and to reduce complications that occur during the LEED certification process. The requirements in this document will apply to all those, and only those projects seeking to demonstrate conformance with the rating systems listed above.

Definitions, exceptions, and more extensive guidance relating to these MPRs are available in a separate document titled: *LEED 2009 MPR Supplemental Guidance*. Terms that are *italicized and underlined* here are defined in the Supplemental Guidance document (they are marked as such only the first time that they appear).

At this time U.S. Green Building Council, Inc. has authorized the Green Building Certification Institute (GBCI) to confer LEED Certification. GBCI has agreed to consider requests for exceptions to MPRs that are not already defined in the LEED 2009 MPR Supplemental Guidance document on a case-by-case basis for special circumstances.

In addition to complying with the MPRs, a project must also demonstrate compliance with all rating system requirements in order to achieve LEED Certification.

1. MUST COMPLY WITH ENVIRONMENTAL LAWS

New Construction, Core & Shell, Schools, Commercial Interiors

The *LEED project building or space*, all other *real property* within the *LEED project boundary*, and all *project work* must comply with applicable federal, state, and local building-related environmental laws and regulations in place where the project is located. This condition must be satisfied from the date of *LEED project registration* or the commencement of *schematic design*, whichever comes first, up and until the date that the building receives a *certificate of occupancy* or similar official indication that it is fit and ready for use.

Existing Buildings: O&M

The LEED project building, all other real property within the LEED project boundary, any project work, and all *normal building operations* occurring within the LEED project building and the LEED project boundary must comply with applicable federal, state, and local building-related environmental laws and regulations in place where the project is located. This condition must be satisfied from the commencement of the LEED project's initial LEED-EB: O&M *performance period* through the expiration date of the LEED Certification.

All Rating Systems

A lapse in a project's compliance with a building-related environmental law or regulation that results from an unforeseen and unavoidable circumstance shall not necessarily result in non-compliance with this MPR. Such lapses shall be excused so long as they are remediated as soon as feasibly possible.

2. MUST BE A COMPLETE, PERMANENT BUILDING OR SPACE

All Rating Systems

All LEED projects must be designed for, constructed on, and operated on a permanent location on already existing *land*. LEED projects shall not consist of mobile structures, equipment, or vehicles. No building or space that is designed to move at any point in its lifetime may pursue LEED Certification.

New Construction, Core & Shell, Schools

LEED projects must include the new, ground-up design and construction, or *major renovation*, of at least one commercial, institutional, or high-rise residential building in its *entirety*.

Commercial Interiors

The LEED project scope must include a *complete interior space* distinct from other spaces within the same building with regards to at least one of the following characteristics: ownership, management, lease, or party wall separation.

Existing Buildings: O&M

LEED projects must include at least one existing commercial, institutional, or high-rise residential building in its entirety.

3. MUST USE A REASONABLE SITE BOUNDARY

New Construction, Core and Shell, Schools, Existing Buildings: O&M

1. The LEED project boundary must include all contiguous land that is associated with and supports normal building operations for the LEED project building, including all land that was or will be disturbed for the purpose of *undertaking the LEED project*.
2. The LEED project boundary may not include land that is owned by a party other than that which owns the LEED project unless that land is associated with and supports normal building operations for the LEED project building.
3. LEED projects located on a campus must have project boundaries such that if all the buildings on campus become LEED certified, then 100% of the gross land area on the campus would be included within a LEED boundary. If this requirement is in conflict with MPR #7, Must Comply with Minimum Building Area to Site Area Ratio, then MPR #7 will take precedence.
4. Any given parcel of real property may only be attributed to a single LEED project building.
5. *Gerrymandering* of a LEED project boundary is prohibited: the boundary may not unreasonably exclude sections of land to create boundaries in unreasonable shapes for the sole purpose of complying with prerequisites or credits.

Commercial Interiors

If any land was or will be disturbed for the purpose of undertaking the LEED project, then that land must be included within the LEED project boundary.

4. MUST COMPLY WITH MINIMUM FLOOR AREA REQUIREMENTS

New Construction, Core and Shell, Schools, Existing Buildings: O&M

The LEED project must include a minimum of 1,000 square feet (93 square meters) of gross floor area.

Commercial Interiors

The LEED project must include a minimum of 250 square feet (22 square meters) of gross floor area.

5. MUST COMPLY WITH MINIMUM OCCUPANCY RATES

New Construction, Core & Shell, Schools, and Commercial Interiors

Full Time Equivalent Occupancy

The LEED project must serve 1 or more *Full Time Equivalent* (FTE) occupant(s), calculated as an annual average in order to use LEED in its entirety. If the project serves less than 1 annualized FTE, optional credits from the Indoor Environmental Quality category may not be earned (the prerequisites must still be earned).

Existing Buildings: O&M

Full Time Equivalent Occupancy

The LEED project must serve 1 or more Full Time Equivalent (FTE) occupant(s), calculated as an annual average in order to use LEED in its entirety. If the project serves less than 1 annualized FTE, optional credits from the Indoor Environmental Quality category may not be earned (the prerequisites must still be earned).

Minimum Occupancy Rate

The LEED project must be in a state of *typical physical occupancy*, and all building systems must be operating at a capacity necessary to serve the current occupants, for a period that includes all performance periods as well as at least the 12 continuous months immediately preceding the first submission for a review.

6. MUST COMMIT TO SHARING WHOLE-BUILDING ENERGY AND WATER USAGE DATA

All Rating Systems

All certified projects must commit to sharing with USGBC and/or GBCI all available actual whole-project energy and water usage data for a period of at least 5 years. This period starts on the date that the LEED project begins typical physical occupancy if certifying under New Construction, Core & Shell, Schools, or Commercial Interiors, or the date that the building is awarded certification if certifying under Existing Buildings: Operations & Maintenance. Sharing this data includes supplying information on a regular basis in a free, accessible, and secure online tool or, if necessary, taking any action to authorize the collection of information directly from service or utility providers. This commitment must carry forward if the building or space changes ownership or lessee.

7. MUST COMPLY WITH A MINIMUM BUILDING AREA TO SITE AREA RATIO

All Rating Systems

The gross floor area of the LEED project building must be no less than 2% of the gross land area within the LEED project boundary.

LEED 2009 MPR

SUPPLEMENTAL GUIDANCE

Version 1.0 **November 2009**

Contents

INTRODUCTION

The LEED 2009 MPR Supplemental Guidance was written to help project teams understand how their buildings and their spaces can meet the Minimum Program Requirements (MPRs). This document builds on the MPRs by establishing exceptions, providing direction for specific situation, defining key terms, and describing the intent behind each MPR. This Supplemental Guidance is the dynamic partner of the MPRs: it will evolve over time to respond to a changing and complex industry while the requirements themselves will remain the same.

ABOUT THE MPRS

The MPRs list the basic characteristics that a project must possess to be eligible for certification under the LEED 2009 rating systems, therefore defining a broad category of buildings that the LEED 2009 rating systems were designed to evaluate. They were developed over a period of nine months by USGBC staff and committee members, and were officially approved in April, 2009 by the LEED Steering Committee (LSC). In November 2009, the LSC and the USGBC Executive Committee approved of additional MPR language that clarified, but did not add to, the existing requirements. When new rating system versions become available, the MPRs will be completely revised and re-approved. Please find the MPRs at the following locations:

- stated throughout this document
- condensed for all rating systems here: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=2014

APPLICABLE RATING SYSTEMS

Projects registering under the following rating systems, including those that upgrade from past versions, are subject to the MPRs: New Construction and Major Renovations 2009 (NC), Core & Shell 2009 (CS), Schools 2009, Commercial Interiors 2009 (CI), and Existing Buildings: Operations 2009 (EB: O&M). *The MPRs do NOT apply to LEED for Homes, LEED for Neighborhood Development, rating systems that have not yet launched, and pre-2009 rating systems.*

VERSIONS OF THIS DOCUMENT

This document will be regularly updated as necessary to provide additional clarification on the intent and application of the MPRs. All changes and additions will be clearly communicated as highlighted text within each new version. Retired versions will be archived and permanently accessible.

Projects must comply with the version of this document that is current at the time of the project's registration. It is the responsibility of the project team to be familiar with the current version when registering a project. Versions published after a LEED project's registration may be referenced by project teams for additional clarifications, if desired.

SUBMITTING QUESTIONS ABOUT THE MPRS

The process for submitting alternative compliance or interpretation requests regarding MPRs is still under development. This process and fees related thereto will be described in a later version of this document. All general inquires relative to the MPRs should be sent to GBCI from this website: http://www.gbci.org/customerserv.aspx.

IF MPR COMPLIANCE IS IN QUESTION

If it becomes known that a LEED project is or was in violation of an MPR, certification may be revoked, or the certification process may be halted. These situations will be handled on a case by case basis according to GBCI's challenge policy.

UNUSUAL BUILDING TYPES

Some buildings have characteristics that are not specifically prohibited by the MPRs, but nonetheless make them unsuitable for evaluation under the LEED rating systems. If a project team recognizes that their building has such a characteristic, they are encouraged to implement green building strategies but refrain from attempting LEED certification. The decision not to attempt certification is at the discretion of the project team only. In general, GBCI will not prevent a building or space from attempting LEED certification as a result of an unusual characteristic that is not addressed by the MPRs.

PRECERTIFICATION AND RECERTIFICATION

Projects pre-certifying under LEED CS must meet the MPRs applicable to all LEED CS projects. Projects re-certifying under LEED EB: O&M must meet the MPRs applicable to all LEED EB: O&M projects.

RATING SYSTEM SELECTION

The MPRs, and this document, do not deal with rating system selection, i.e., choosing the proper LEED rating system for a given project. Please find guidance on this topic in the introductions to each rating system and in the rating system selection wizard tool found in the registration process in LEED Online.

DOCUMENTING COMPLIANCE WITH THE MPRS

The LEED project owner must confirm that the project complies with each of the MPRs by completing checkboxes and an initial box in the Project Information form #1 in LEED Online v3. Unless there is a special circumstance, project teams are not required to submit additional documentation to prove compliance.

MULTIPLE BUILDINGS

With a few exceptions, this document excludes guidance specific to multiple building projects. Such guidance is under development and will be included in a later version of this document.

Please find underlined terms in the definitions section at the end of this document.

1. MUST COMPLY WITH ENVIRONMENTAL LAWS.

MPR Language

All Rating Systems:

A lapse in a project's compliance with a building-related environmental law or regulation that results from an unforeseen and unavoidable circumstance shall not necessarily result in non-compliance with this MPR. Such lapses shall be excused so long as they are remediated as soon as feasibly possible.

New Construction, Core & Shell, Schools, Commercial Interiors:

The *LEED project building or space*, all other *real property* within the *LEED project boundary*, and all *project work* must comply with applicable federal, state, and local building-related environmental laws and regulations in place where the project is located. This condition must be satisfied from the date of *LEED project registration* or the commencement of *schematic design*, whichever comes first, up to and until the date that the building receives a *certificate of occupancy* or similar official indication that it is fit and ready for use.

Existing Buildings: O&M:

The LEED project building, all other real property within the LEED project boundary, any project work, and all *normal building operations* occurring within the LEED project building and the LEED project boundary must comply with applicable federal, state, and local building-related environmental laws and regulations in place where the project is located. This condition must be satisfied from the commencement of the LEED project's initial LEED-EB: O&M *performance period* through the expiration date of the LEED Certification.

Intent:

The purpose of this MPR is to highlight the importance of environmental laws and regulations that apply to LEED projects. While all building projects ought to comply with all legal requirements, as the LEED rating systems are standards for excellence in green building, it is appropriate and logical to specifically require LEED certified buildings to comply with applicable environmental laws and regulations. Such legislation establishes a baseline standard for sustainability.

THIS MPR DOES NOT INTEND TO:

- align LEED, USGBC, or GBCI with any form of government
- give USGBC/GBCI the opportunity to penalize project teams or building owners for unintended, short term, minor offenses

- extend to environmental laws that are not related to the design, construction, and operation of a LEED project building
- force project teams to make extensive and unnecessary effort to verify compliance with environmental building laws

Specific Allowed Exceptions:

- *Short- term lapse*
  As stated in the MPR, a lapse in a building's compliance with an environmental law that results from unforeseen and unavoidable circumstances will not be considered as a basis for revocation of LEED certification. However, the LEED project team must demonstrate a dedicated effort to return the building to compliance as soon as feasibly possible. As a precaution and at the project team's discretion, the building owner may notify GBCI of any lapse in compliance and efforts to bring the building back into compliance. The MPR form under 'Project Information Forms' in LEED Online should be used for this purpose. If the lapse occurs after certification (applicable only to EB: O&M certified projects), the project team may contact GBCI through regular customer service at http://www.gbci.org/customerserv.aspx.

- *Exemption granted by authorities*
  If the project is granted an exemption from a building-related environmental law from governmental authorities for any reason, then that project is exempt from this MPR in regards to that particular law. In the event that this occurs, a description of the situation leading to the exemption and proof of the exemption (such as an official letter from the granting authority) must be provided in the MPR form under 'Project Information Forms' in LEED Online.

- *Special consideration for LEED for Commercial Interiors projects*
  Only the gross floor area within the LEED project boundary of a LEED CI project must comply with this MPR, NOT the building that the project is located in.

- *Special consideration for LEED for Core and Shell projects*
  For LEED-CS projects, interior fit-out work conducted by a tenant is NOT subject to this MPR unless strategies implemented in the fit-out space contribute to earned credits for that project via the tenant sales and lease agreement path. For the purposes of this exception, a tenant is considered an entity which is leasing space from the owner.

Additional Information and Clarification

- *Applicable building-related environmental laws*

  DEFINITION

  For the purposes of this MPR, an 'environmental law' is considered to be a statute, rule, treaty, convention, executive order, regulation, or ordinance that seeks to protect the natural environment and/or human health which may be negatively impacted by activities surrounding the design, construction, development, and (for those using EB: O&M), operation of a building.

  LOCATION

  This MPR applies to ALL LEED projects, regardless of location, and includes all existing building-related environmental laws in the jurisdiction where the LEED project is located. For US projects, this includes laws at the federal, state, and local level.

  CATEGORIES

  Categories containing laws that fall under the purview of this MPR include, but are not limited to the following: wetlands, noise, runoff, asbestos, air quality, pollution, sewage, pesticides, safety, and forestry.

  EXAMPLES

  The following are examples of US federal building-related environmental laws and regulations that USGBC generally expects will fall under the purview of this MPR for most LEED projects. This list is not intended to be exhaustive, only illustrative: its purpose is to further orient project teams as to the meaning of this MPR and to assist project teams in determining which laws fall under the purview of this MPR. **It is the project team's responsibility to know which laws apply to the building and to verify that the project is in compliance.**

  - Clean Water Act
  - OSHA Safety and Health Regulations for Construction
  - Endangered Species Act
  - OSHA Recording and Reporting Occupational Injuries and Illness

- *New laws and regulations*

  This MPR includes new laws, regulations, and ordinances as they are enacted.

- *Conflicts between LEED 2009 requirements and laws*

  In the rare case that an applicable building-related environmental law covered by this MPR conflicts with an MPR, or a LEED prerequisite or credit, the law will take precedence. Project teams may still comply with the MPR and achieve the prerequisite or credit by submitting a Project CIR requesting approval of an alternative compliance path that satisfies both the law and the intent of the LEED requirement.

- *Law enforcement*
  By verifying that a LEED project complies with this MPR, it is assumed that project owners are accurately and willingly attesting that the LEED project complies with applicable building-related environmental laws. LEED is a voluntary program that rewards exemplary building performance. In no way will USGBC or GBCI act as law enforcement. With this MPR, USGBC and GBCI are using established laws only to ascertain that the LEED project is meeting a minimum environmental standard.

- *MPR #1 and Sustainable Sites Credit 1 (SSc1) Site Selection in LEED NC, LEED CS, and LEED for Schools*
  The intent and requirements of SSc1 differs from that of this MPR. This MPR requires compliance with the law, and SSc1 rewards voluntary land use choices. A point may be earned under SSc1 if the LEED project complies with a series of criteria. Projects that do not meet these criteria demonstrate unsustainable, but not illegal development practices. SSc1 essentially builds on the requirements of MPR #1.

- *Settlements*
  It is recognized that, in the case of an alleged environmental law violation, building owners sometimes agree on a settlement with EPA or other governmental agency to make reparations for their actions. Guidance on how this MPR will be applied in such a situation is forthcoming. If you are in this situation and need to know if you are in compliance with this MPR, please contact GBCI through this website http://www.gbci.org/customerserv.aspx.

2. MUST BE A COMPLETE, PERMANENT BUILDING OR SPACE

MPR Language

All Rating Systems:

All LEED projects must be designed for, constructed on, and operated on a permanent location on already existing *land*. LEED projects shall not consist of mobile structures, equipment, or vehicles. No building or space that is designed to move at any point in its lifetime may pursue LEED Certification.

New Construction, Core & Shell, Schools:

LEED projects must include the new, ground-up design and construction, or *major renovation*, of at least one commercial, institutional, or high-rise residential building in its *entirety*.

Commercial Interiors:

The LEED project scope must include a *complete interior space* distinct from other spaces within the same building with regards to at least one of the following characteristics: ownership, management, lease, or *party wall separation*.

Existing Buildings: O&M:

LEED projects must include at least one existing commercial, institutional, or high-rise residential building in its entirety.

Intent:

The LEED rating systems were designed to evaluate complete buildings and spaces in fixed locations. Partial buildings or spaces are unsuitable for LEED certification because, when analyzed under the requirements of LEED prerequisites and credits, they create results inconsistent with those of whole buildings or spaces. Also, partial certification can easily appear to encompass an entire building or space, sending a false message to users.

Permanency is an important requirement because a significant percentage of LEED prerequisites and credits are dependent on location, making a mobile building or space unacceptable. The stipulation for already existing land responds to the fact that artificial land masses displace and disrupt marine ecosystems. Buildings that generate the need to develop such land do not meet the overall intent of the LEED rating system. Anything less than a distinct, complete, and permanent project on existing land will not be able to accurately demonstrate compliance with LEED.

THIS MPR DOES NOT INTEND TO:

- exclude a building or space that could be fairly evaluated through the LEED certification process if the exclusion is based on a technicality
- exclude buildings with an unusual design or built through non-traditional means that could be fairly evaluated through the LEED certification process

Specific Allowed Exceptions:

- *Movable buildings and parts of buildings*
  Prefabricated or modular structures and moveable building elements of any variation may be certified once permanently installed and/or established as part of the LEED project building in the location that they are intended to stay for the life of the complete structure.

- *Horizontally attached buildings (including additions)*
  Horizontally attached buildings may be certified independently, provided that the following two conditions are met:
  a) they are physically distinct (see definition in Glossary)
  b) they have unique addresses or names.
  If these conditions are not met, the structure is considered a single building and must be certified as such.

- *Vertically Attached Buildings*
  Currently, structures that are vertically stacked are not recognized as distinct buildings that may apply separately to LEED. Buildings may only be distinguished if they are horizontally attached. However, an alteration to this rule that would allow some vertically stacked structures to certify separately is under consideration. There is no timeline for the release of this alteration. If you would like to certify a building that is built on top of or below another building please contact GBCI through this website http://www.gbci.org/customerserv.aspx.

- *Buildings constructed on top of or below underground public infrastructure*
  Buildings vertically connected to, but physically distinct from public infrastructure such as a transportation hub, may be considered a building in its entirety and certified independently of the infrastructure.

- *Special consideration for LEED for Commercial Interiors projects*
  MOBILITY
  Buildings in which CI projects are located must be immobile, and are subject to the same guidance on the subject of permanency as projects that are certifying under whole building rating systems.
  ALREADY EXISTING LAND
  Buildings in which CI projects are located are NOT required to be built on already existing land.

- *Special Consideration for LEED for Core & Shell projects*
  For a project certifying under CS, the project is considered a 'building in its entirety' without interior fit-outs complete

- *Artificial land mass or support structures*
  - Buildings located on previously constructed docks, piers, jetties, infill, and other manufactured structures in or above water or other bodies are permissible, provided that artificial land is previously developed, i.e., once supported hardscape or another building before the development of the LEED project.
  - Buildings cantilevered over water, highways, or other bodies are acceptable.
  - Existing land to which soil or other material has been added is acceptable.

- *Multi-tenant buildings certifying under LEED EB: O&M*
  Multi-tenant buildings certifying under LEED EB: O&M may exclude up to 10% of the gross floor area from some prerequisites and credits as outlined in the LEED EB: O&M reference guide and the submittal forms in LEED Online.

- *Floor separation may be used to define a complete interior space*
  Ownership, management, lease, and party walls are listed in the MPR as acceptable methods for defining complete interior spaces for LEED-CI. Floors and ceilings, i.e. the structural component separating two floors, may also define two complete interior spaces if one floor is unaffected by construction work, even if both floors serve the same occupant.

- *Owner-occupied buildings and CI: Certifying space not separate by ownership, management, lease, party wall, or floor*
  There are many situations in which a single entity owns, manages, and occupies an entire building, and wishes to certify a renovated portion of the building which is not separate from other portions by a party wall or floor. For example, a single floor in an academic building might be divided into labs and offices, and only the labs undergo a renovation. Such a space is not automatically disqualified from attempting to certify under LEED CI. Project teams with this situation must submit a narrative in Project Information Form #1 in LEED Online v3 confirming that the conditions below are met.
  a) It is unreasonable or impossible to draw a project boundary where there is separation by ownership, management, lease, or party wall separation.
  b) The LEED project boundary is not drawn in such a way as to specifically avoid floor area that would not comply with other MPRs, prerequisites, or attempted credits.
  c) The LEED project boundary is drawn at a clear functional and physical barrier such that the LEED certification, if awarded, could not easily be perceived to extend to uncertified floor area.
  d) The LEED project boundary is not drawn in such a way as to create an unreasonably difficult review process that results from the reviewer's inability to distinguish between strategies, services, or materials in the LEED certifying space and the non-LEED certifying space. For example, it would be best if the LEED project boundary coincided with an HVAC zone boundary.

e) If the project is on multiple floors, the renovation or fit-out work is conducted under a single construction contract and signage will be used to clearly indicate which floors/space is LEED certified. The floors need not be adjacent.

Additional Information and Clarification

- *Movable buildings*
  - Structures not compliant with this MPR include cars, motor homes, trains, boats, ships, planes, and transient exhibits of any kind.
  - If, for any reason, a LEED 2009 certified building is moved from the location cited at the time of LEED certification, it will no longer be in compliance with this MPR.

- *Certifying buildings with movable parts*
  Buildings with large movable parts, such as a retracting ceiling in a stadium, are acceptable.

- *Certifying temporary buildings*
  The amount of time that a building or space is intended to remain standing does not affect compliance with this MPR.

- *Multi-party ownership*
  Multiple-party ownership of a certifying building or space is acceptable. Proper accountability for MPR and rating system conformance must be in place.

- *Building types*
  The categories of buildings suitable for LEED - commercial, institutional, and high rise residential are intentionally inclusive, and are in no way exclusive. They cover a wide range of building types, including industrial. GBCI will not prevent a building from attempting certification due to its use. However, building use may restrict project teams to one rating system or another. For example, single family homes are restricted to LEED for Homes. Information on rating system selection can be found in the introduction to each rating system and the wizard tool found in the registration process in LEED Online v3.

- *No exceptions for projects with EQp2 conflicts*
  Some project buildings, such as casinos, typically have difficulty achieving LEED certification due to a smoking policy that conflicts with Indoor Environmental Quality prerequisite 2, Environmental Tobacco Smoke Control (EQp2). There will be no exceptions to this MPR to allow for partial building certification of such buildings. Project teams are encouraged to carefully review option 2 in EQp2 to explore opportunities to achieve LEED certification despite a smoking room located within a project.

3. MUST USE A REASONABLE SITE BOUNDARY

MPR Language

New Construction, Core and Shell, Schools, Existing Buildings: Operations and Maintenance

1. The *LEED project boundary* must include all contiguous land that is associated with and supports normal building operations for the LEED project building, including all land that was or will be disturbed for the purpose of *undertaking the LEED project*.

2. The LEED project boundary may not include land that is owned by a party other than that which owns the LEED project unless that land is associated with and supports normal building operations for the LEED project building.

3. LEED projects located on a campus must have project boundaries such that if all the buildings on campus become LEED certified, then 100% of the gross land area on the campus would be included within a LEED boundary. If this requirement is in conflict with MPR #7, Must Comply with Minimum Building Area to Site Area Ratio, then MPR #7 will take precedence.

4. Any given parcel of real property may only be attributed to a single LEED project building.

5. *Gerrymandering* of a LEED project boundary is prohibited: the boundary may not unreasonably exclude sections of land to create boundaries in unreasonable shapes for the sole purpose of complying with prerequisites or credits.

Commercial Interiors

If any land was or will be disturbed for the purpose of undertaking the LEED project, then that land must be included within the LEED project boundary.

Intent:

In order to ensure fair and consistent evaluation for all projects under the Sustainable Sites credit category, it is necessary to have guidelines for an acceptable LEED project boundary. All site conditions and impacts related to a building must be considered and addressed in the certification process to ensure a complete and thorough examination of the environmental impact of a building.

THIS MPR DOES NOT INTEND TO:

- force project teams to create an awkward or misrepresentative LEED project boundary that does not reflect actual land use
- prevent project teams from making appropriate use of land to earn prerequisites and credits
- imply that land left outside of the LEED project boundary should not also benefit from environmentally sensitive land use practices.

Specific Allowed Exceptions:

- *Assigning real property for subsequent certification under EB: O&M*
  SINGLE BUILDING
    LEED projects certifying under EB: O&M may use some or all of the same real property that was used in the previous Design and Construction OR EB: O&M certification. The boundary does not need to be drawn in the same location – as long as the requirements of this MPR are met, the project team may re-draw the project line at their discretion.
  MULTIPLE BUILDINGS
    A single building previously certified as part of a multiple building LEED project may wish to pursue subsequent LEED certification under EB: O&M independently. Real property within the original collective boundary can be re-attributed to that single building for the EB: O&M certification.

- *Including non-contiguous parcels in the LEED project boundary*
  Non-contiguous parcels of land may be included within the LEED project boundary if the conditions below are met.
    a) Non-contiguous parcels must be separated by land that is owned and operated by an entity different than the owner of the land that the LEED project building sits on.
    b) All parcels separate from the parcel that the LEED building sits on must directly support or be associated with normal building operations.
    c) Non-contiguous parcels are no more than ¼ mile (0.40 kilometer) walking distance apart.
    d) There is a clear walking path between the parcels
    e) All real property within the LEED project boundary, including the non-contiguous parcel(s), is subject to the requirements of all MPRs, prerequisites, and attempted credits. For example, two sets of storm water calculations would need to be provided for two separate parcels to demonstrate compliance with Sustainable Sites credit 6.
    f) All land within the LEED project boundary must be governed by a common regulatory jurisdiction and is owned, leased, or managed by the same organizational entity.
    g) A description of the non-contiguous parcels of land within the LEED project boundary, the land between them, and compliance with items (a) through (f)

above must be provided in the Additional Details section of Project Information form #1 in LEED Online v3.

- *Land outside the LEED project boundary used for compliance with specific credits*
  LEED -EB: O&M, SUSTAINABLE SITES CREDIT 5
  Any off-site land used to earn this credit is not required to be included in the LEED project boundary, and therefore is not subject to consideration for prerequisite, other credit, or other MPR compliance EXCEPT MPR#7.
  ALL RATING SYSTEMS: STORM WATER DESIGN CREDITS
  The nature of storm water calculations often necessitates that land outside the LEED project boundary be considered when determining compliance for these credits. Also, it may be necessary to discharge site runoff to a regional or master stormwater management system, such as a retention pond. This additional real property does not need to be included in the LEED project boundary or be considered for prerequisite, other credit, or other MPR compliance.

- *Facilities (including parking) outside the LEED project boundary used for compliance with specific credits*
  Facilities (including parking) that are not within the LEED project boundary but are used to demonstrate compliance with a credit or prerequisite, as allowed per the rating system and reference guide, need not be considered for other prerequisite, credit, or MPR compliance. However, those facilities cannot be used to show compliance for other LEED projects, unless the sufficient capacity is present.
  EXAMPLE
  Off-site showers used to show compliance with Sustainable Sites credit 4.2, Alternative Transportation, Bicycle Storage and Changing Rooms in LEED NC need not be included in the calculations for Water Efficiency prerequisite 1, and cannot be used to earn this credit for an additional LEED project unless the required shower-to-FTE ratio is met for both projects.

- *Real property no longer attributed to a certified building*
  If a certified building is demolished, all real property attributed to that LEED project may be assigned to another LEED project.

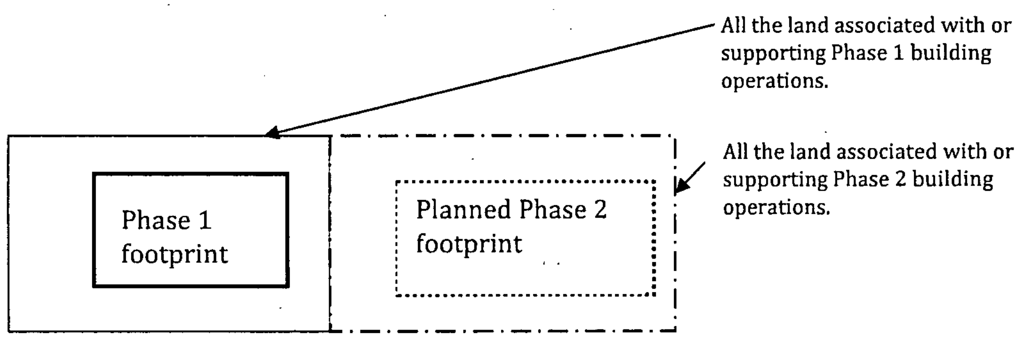
- *Easements and leases*
  Land that the LEED project owner leases or has an easement on may be included within the LEED project boundary.

- *Shared construction sites*
  A LEED project boundary must include all land disturbed for that project's construction, regardless of overlapping construction activity for other projects. For information on overlapping LEED project boundaries, please see the bullet below entitled 'Site boundary guidance for phased building projects, or building on land that was designated for a previously certified LEED project'.

- *Site boundary guidance for phased building projects, or building on land that was designated for a previously certified LEED project*
  Project teams with phased building projects often wish to certify each phase as it is completed.

  Phased building projects are either 1) buildings with planned future additions or 2) sites with a master plan for multiple buildings. If a phased project falls into the first category, the bullet entitled 'Horizontally Attached Buildings', in the MPR #2 section, must be consulted for information on whether or not the different phases are permitted to certify separately.

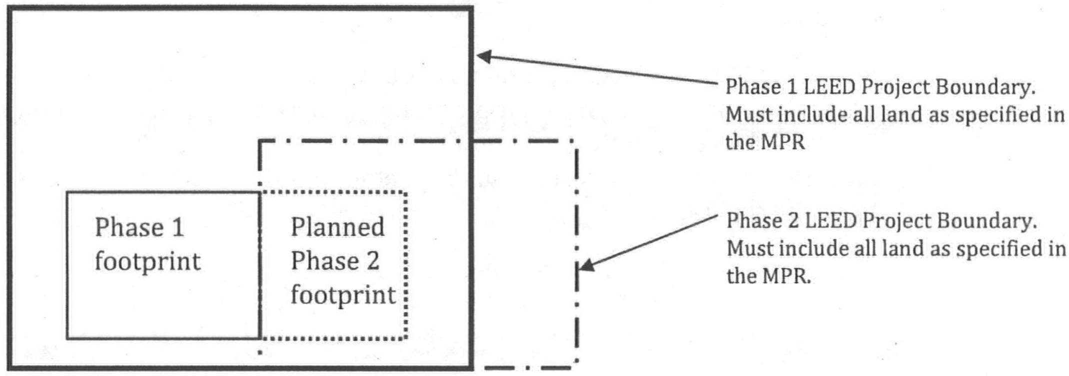
  Phased projects with multiple buildings will often be able to easily designate a LEED project boundary (LPB) for each building, such as in this example:



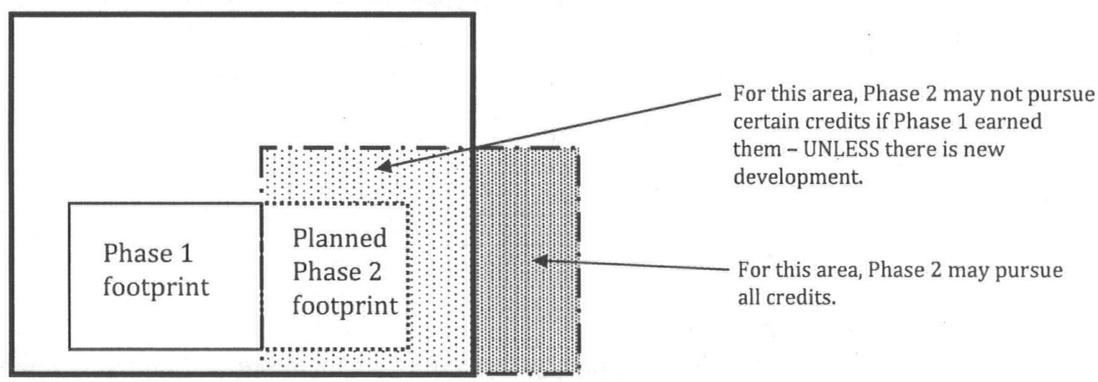
For projects with multiple phases of the same building, or a building located on land that is a part of an already certified LEED project, overlapping LEED project boundaries is inevitable. An exception to the fourth stipulation in this MPR - "Any given parcel of real property may only be attributed to a single LEED project building" – may be made in this situation if certain criteria are met. **Note that the purpose of this exception is to protect the integrity of certified LEED projects while allowing the future projects to successfully pursue LEED certification.** Please see below an illustration of what is required and allowable in this situation, with corresponding written guidance on the next page.

EXAMPLE: JONES ELEMENTARY SCHOOL, USING THE LEED FOR SCHOOLS 2009 RATING SYSTEM

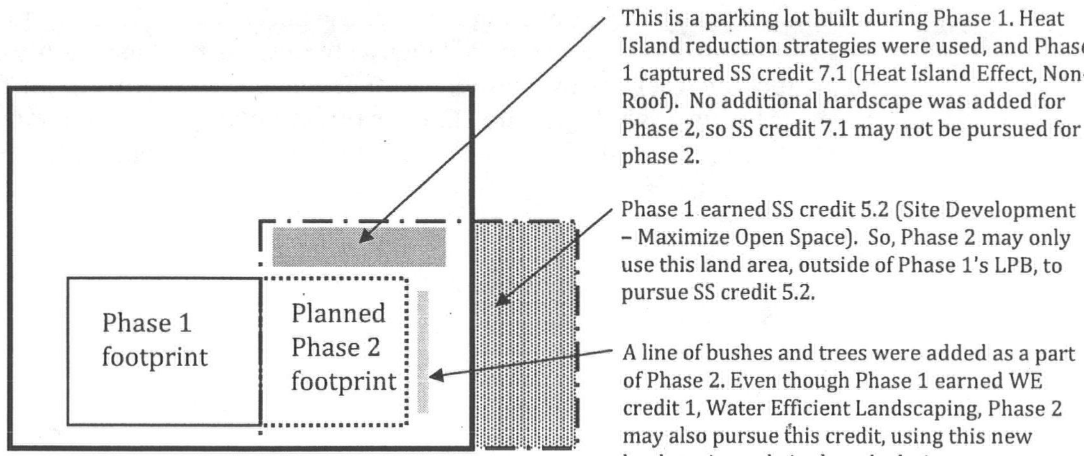
Description of phases



Description of overlapping areas



Example results of overlapping areas



EPA-BAFB-0000918

LEED PROJECT BOUNDARY GUIDELINES FOR THE FIRST PHASE

The first building in a phased building project must include all land as required by this MPR. Land designated for a future building may not be excluded.

LEED PROJECT BOUNDARY GUIDELINES FOR SUBSEQUENT PHASES

A subsequent building in a phased building project must include/exclude land as required by this MPR with the exception of the fourth stipulation: 'Any given parcel of real property may only be attributed to a single LEED project building.' This exception may be made if the following conditions are met.

a) Information on previous project must be disclosed. The project team must inform the LEED reviewer when they are developing on land belonging to a previously certified LEED project. The name, LEED project number, LEED project boundary, and list of credits earned must be disclosed. This information may be disclosed in Project Information Form #1 in LEED Online v3.
b) Land necessary to earned SS credit 5.1 or 5.2 for a previous project must not be displaced. A subsequent building phase located on land that is part of a certified LEED project MAY NOT displace land that is critical to a previous phase's compliance with SS credit 5.1 or 5.2. The Phase 1 project team must take into consideration future phases when applying for SS credit 5.1 and 5.2. If unforeseen circumstances result in an infringement on this policy, the project team must submit a Project CIR to request consideration for an alternative solution that satisfies the intent of SS credit 5.1 and 5.2.
c) Credits are not double counted. Overlapped LEED project boundaries restrict project teams' ability to pursue certain credits, as detailed below.

SS credit 3, Brownfield Redevelopment: The same brownfield redevelopment effort can contribute to capturing this credit for only one LEED project.

SS credit 5.1, Site Development - Protect or Restore Habitat: Land area that contributed to an earlier LEED project's capture of this credit via Case 2 (Previously Developed Areas or Graded Sites), may not be used by a later project to capture the credit.

SS credit 5.2, Site Development - Maximize Open Space: Land area that contributed to an earlier LEED project's capture of this credit may not be used by a later project to capture the credit.

SS credit 7.1, Heat Island Effect, Non-Roof: Strategies that contributed to an earlier LEED project's capture of this credit may not be used by a later project. If there is new development during a later phase on the same land (such as new sidewalk), then strategies associated with that new feature may contribute to the capture of the credit for that phase.

WE credit 1, Water Efficient Landscaping: Strategies that contributed to an earlier LEED project's capture of this credit may not be used by a later project. If there is new development during a later phase on the same land (such as new shrubbery plantings), then strategies associated with that new feature may contribute to the capture of the credit for that phase.

NOTE on SS prerequisite 2, Environmental Site Assessment: The same documentation may be used to show compliance for multiple LEED projects.

Additional Information and Clarifications

- *Defining land that is associated with and directly supports a building*
  This MPR requires that 'The LEED project boundary must include all contiguous land that is associated with and supports normal building operations for the LEED project building....'. This includes land which is altered in any way as a result of the LEED project construction, and features enjoyed by building users, such as:
  - hardscape, such as parking and sidewalks
  - septic treatment equipment
  - stormwater treatment equipment
  - landscaping

  Often, these features are shared with other nearby buildings. In this case, the project team must make a judgment and divide the land reasonably among the buildings. See guidance for shared hardscape and construction site situations below.

- *Shared hardscape and on-site parking facilities*
  If a LEED project building shares use of a parking lot, parking garage, or other amenity with another building, then those amenities must be allocated according to the percentage of use for each building. A brief description of the situation and any related calculations should be provided in Project Information form #1 in LEED Online v3. The project team must only show that the appropriate percentage of amenities is included within the boundary for their own project. It is also their responsibility to ascertain that they do not inappropriately cross boundaries with another LEED project.
  EXAMPLE
  Two neighboring stores are being constructed, and one is pursuing LEED certification. A new parking lot with fifty spaces will be shared by the two stores. The certifying store estimates that it will use twenty parking spaces on a regular basis to serve its employees and customers. Therefore, the project team must draw its LEED project boundary to include twenty spaces and forty percent of the supporting hardscape (driveways, sidewalks, etc).

- *Supporting infrastructure not owned by building owner*
  Infrastructure supporting the LEED project building may be omitted from the LEED project boundary if it is not owned by the LEED project owner AND if it is not included in the scope of construction work for the LEED project. This omittance must be done consistently throughout the submission.

- *Small buildings within the LEED project boundary*
  Occasionally, there are small buildings physically close to the LEED project building, and associated with its normal building operations. Such a building may be included within the LEED project boundary and excluded from required compliance with MPRs, prerequisites, and credits (unless specifically addressed below) if the conditions listed below are met. Temporary structures erected for the purposes of supporting construction administration work and that will be removed at construction completion are not subject to this MPR and will not be required to certify.
  a) The building must be ineligible to apply for LEED certification because it does not meet MPR #2, Must Be A Complete, Permanent Building or Space, MPR#4, Must Comply with Minimum Floor Area Requirements, or MPR #5 Must Comply with Minimum Occupancy Rates.
  b) The building must comply with MPR #1, Must Comply with Environmental Laws
  c) The building must comply with all Sustainable Sites prerequisites.
  d) No credit may be claimed for strategies implemented in the building.
  e) Only two such buildings may be included within the LEED project boundary.

4. MUST COMPLY WITH MINIMUM FLOOR AREA REQUIREMENTS.

MPR Language

New Construction, Core and Shell, Schools, Existing Buildings: Operations and Maintenance

The LEED project must include a minimum of 1,000 square feet (93 square meters) of gross floor area.

Commercial Interiors

The LEED project must include a minimum of 250 square feet (22 square meters) of gross floor area.

Intent:

The thresholds and calculations that make up the system of evaluation in LEED begin to break down and lose meaning once the building or space being evaluated reaches relatively diminutive proportions. A building or space that is too small would compromise the integrity of the LEED certification system.

THIS MPR DOES NOT INTEND TO:

- exclude small buildings and spaces for any reason other than that stated in the intent: simply that they cannot be fairly analyzed by the LEED rating system
- imply that small buildings and spaces do not also have an impact on the environment and their occupants, and therefore also have the opportunity to achieve green building excellence in their design and construction

Specific Allowed Exceptions

None

Additional Information and Clarifications

- Open air stadiums, kiosks, and similar building types satisfy this MPR if the minimum required amount of gross floor area is met for some part of the structure. The definition of gross floor area must be carefully reviewed when considering such a building for compliance with this MPR. For example, many parking garage structures will not meet this definition if they are essentially large roofed-over areas, because such areas are not counted within the total gross floor area.

5. MUST COMPLY WITH MINIMUM OCCUPANCY RATES

MPR Language

New Construction, Core & Shell, Schools, and Commercial Interiors:

Full Time Equivalent Occupancy

The LEED project must serve 1 or more *Full Time Equivalent* (FTE) occupant(s), calculated as an annual average in order to use LEED in its entirety. If the project serves less than 1 annualized FTE, optional credits from the Indoor Environmental Quality category may not be earned (the prerequisites must still be earned).

Existing Buildings: O&M:

Full Time Equivalent Occupancy

The LEED project must serve 1 or more Full Time Equivalent (FTE) occupant(s), calculated as an annual average in order to use LEED in its entirety. If the project serves less than 1 annualized FTE, optional credits from the Indoor Environmental Quality category may not be earned (the prerequisites must still be earned).

Minimum Occupancy Rate

The LEED project must be in a state of *typical physical occupancy*, and all building systems must be operating at a capacity necessary to serve the current occupants, for a period that includes all performance periods as well as at least the 12 continuous months immediately preceding the first submission for a review.

Intent:

Many credits and prerequisites throughout the LEED rating systems evaluate the impact of the LEED project building on the building users, particularly those in the Indoor Environmental Quality credit category. USGBC believes it is appropriate and necessary to require that a minimum number of people benefit from the strategies implemented in order to earn the credits.

In EB: O&M, compliance with many prerequisites and credits is evaluated based on actual usage patterns. Therefore, it is necessary to require that typical usage of the LEED project building is underway during the performance periods, so that accurate measurements can be taken.

THIS MPR DOES NOT INTEND TO:

- imply that buildings and spaces with a small amount of human traffic do not also have an impact the few occupants they do have, and therefore also have the opportunity to achieve green building excellence in their design and construction
- exclude buildings that experience fluctuations in occupancy

Specific Allowed Exceptions

MINIMUM OCCUPANCY RATE *APPLICABLE TO EBOM ONLY*

- *Unexpected and temporary decline in occupancy (applicable to EBOM only)*
  If occupancy unexpectedly and temporarily falls below the required threshold within the period of time subject to this MPR*, but still meets the requirement using a weighted average (as described below), the project team must submit a description of the situation as well as the measures they have taken to keep the reduced occupancy numbers from affecting the results for each prerequisite and credit that deals with occupancy. Explanations specific to a prerequisite or credit should be given in the optional section for that prerequisite or credit, and general descriptions should be given in the MPR form under 'Project Information Forms' in LEED Online.

*As stated in the MPR language, the period of time subject to this MPR includes at least the 12 continuous months immediately preceding the first submission for a review and all performance periods.

Additional Information and Clarifications

FULL TIME EQUIVALENT OCCUPANCY *APPLICABLE TO ALL RATING SYSTEMS*

- *Calculation method for determining annual FTE (the calculation for determining weighted occupancy for EB: O&M is below)*
  Although each building varies in regular occupancy, the purpose of setting the baseline annual FTE is to ensure sufficient occupancy to warrant awarding points in the EQ credit category.
  Annual FTE is based on the average 40 hour work week, assuming 48 total work weeks in the year. Based on this assumption, one annual FTE is defined as one person spending eight hours a day for 240 days in the building, or 1920 hours annually. The calculation can be done by average FTE occupants per day, week, or month:
  By day, must be greater than or equal to 240: (total occupant hours in an average day/8) x number of occupied days
  By week, must be greater than or equal to 48: (total occupant hours in an average week/40) x number of occupied weeks
  By month, must be greater than or equal to 12: (total occupant hours in an average month/160) x number of occupied months

EXAMPLE

A religious worship facility has an hour-long service once a week for a year, and an average of thirty people attends each service. The building stands empty the remainder of the time. The annual FTE calculation for this building is:

(30 total occupant hours in an average day / 8) x 52 occupied days = 195

So, the combined occupant hours result in the equivalent of one person spending 195 eight hour days in the facility. EQ credits may not be pursued. However, if it gains 10 new members, this MPR would be satisfied:

40 total occupant hours in an average day / 8) x 52 occupied days = 260

- Only occupant hours that the building intends and expects to accommodate under normal building operations shall be included in annual FTE calculations.

MINIMUM OCCUPANCY RATE ***APPLICABLE TO EBOM ONLY***

- *Space types subject to this MPR*
  Gross floor area that is designed to be regularly occupied should be the focus when determining compliance with this MPR.
  Any common space such as a lobby or bathroom that receives any use as well as any space that does not typically have occupants (such as closets or mechanical rooms) counts toward compliance with this MPR. Common space that is not receiving any use – for example, a bathroom on a floor completely devoid of occupants – does not count toward compliance.

- *Determining typical physical occupancy*
  The definition of typical physical occupancy is 'The state in which normal building operations are underway and the building is in use by the average number of full time equivalent occupants for which it was designed.'
  To determine the average number of full time equivalent occupants the building was designed for, project teams must assess buildings on a case by case basis, using reasonable judgment. Design intentions, floor area capacity, and building system capacity must all be considered. Atypical or indeterminate cases must be described in the Project Information forms #1 in LEED Online v3.
  All buildings except for hotels are considered to be in compliance with this MPR if more than 50% of its floor area is fully occupied (i.e., in a state of typical physical occupancy), as time-averaged over the performance period for all prerequisites and attempted credits, including the 12 months leading up to the initial submittal of application for review. The threshold for hotels is 55%.
  Any building that experiences occupancy of less than 100% during a performance period should refer to the LEED EB: O&M Reduced Occupancy Guidance when completing submittal requirements. This document can be found here: http://www.gbci.org/customerserv.aspx.

EXAMPLE

A hotel has 100 equally sized rooms, and no common space aside from a small lobby. Since the hotel was built, sixty of the rooms have been full as an annual average, taking into account all seasons. Therefore, it is considered to be in compliance with this MPR because sixty exceeds the minimum threshold of 55%.

EXAMPLE

There is a school with nine equally sized classrooms, and circulation space equal to the square footage of one classroom. Four of the classrooms are not being used, but the other five are being fully used. Therefore, occupancy for the entire building is at 60%. If attendance in the three of the classrooms drops to 50% each, then occupancy for the entire building drops to 45%, and compliance with this MPR is in question.

- *Minimum Occupancy Rate Threshold Change*
  In fall 2009, the minimum occupancy rate threshold for EB: O&M changed from the historic number 75% to the 55% and 50%, as detailed above. This change was as a result of a scrutiny of marketplace conditions, and was approved by the LEED Steering Committee (LSC). This threshold is not expected to change again in the foreseeable future. If and when it does change to become more stringent, the change will only apply to projects registered after the date the change is announced.

- *Calculation method for determining weighted occupancy (the calculation for determining annual FTE is in a separate section)*
  A LEED project building experiencing fluctuating occupancy rates during the period of time subject to this MPR* may utilize the following formula in determining compliance:

[(number of days at x% capacity * x%) + (number of days at y% capacity * y%) + (...)] / total days in operation

EXAMPLE

An office building with ten equally sized floors submits for preliminary review on January 1, exactly a year after its earliest performance period began. It is open 260 days a year. The building operated at full capacity for the first 150 work days of that year. Unexpectedly, six floors become vacant (occupancy drops to 40%) for 50 days. Then, those six floors become occupied again, each operating at half its capacity for the last 60 days (occupancy for the entire building rises to 60%).

[(150*1) + (50*.4) + (60*.6)] / 260 = 79%

Because offices are required to be at 50% capacity at a minimum, this building is in compliance with this MPR.

* As stated in the MPR language, the period of time subject to this MPR includes at least the 12 continuous months immediately preceding the first submission for a review and all performance periods.

- *Project area is leased but not occupied*
  Leased but unoccupied space does not comply with this MPR because it is not considered physically occupied.

6. MUST ALLOW USGBC ACCESS TO WHOLE-BUILDING ENERGY AND WATER USAGE DATA

MPR Language

All certified projects must commit to sharing with USGBC and/or GBCI all available actual whole-project energy and water usage data for a period of at least 5 years. This period starts on the date that the LEED project begins typical physical occupancy if certifying under New Construction, Core & Shell, Schools, or Commercial Interiors, or the date that the building is awarded certification if certifying under Existing Buildings: Operations & Maintenance. Sharing this data includes supplying information on a regular basis in a free, accessible, and secure online tool or, if necessary, taking any action to authorize the collection of information directly from service or utility providers. This commitment must carry forward if the building or space changes ownership or lessee.

Intent:

The goal of decreased energy and water use consumption is a major component of LEED certification. Tracking actual building consumption and comparing it to the usage proposed in design cases, or tracked during a performance period, is essential to the individual success of each LEED certified building and the ongoing evaluation and development of the LEED program.

By providing usage data, LEED project owners will not only be taking a very active part in advancing the green building movement, but they will also be provided feedback about the performance of their building in the context of comparable buildings. As well, buildings that achieve LEED certification in a Design and Construction rating system will be able to more easily pursue certification under LEED for Existing Buildings, Operations and Maintenance with readily available performance data.

Access to complete and accurate information on every LEED building project's performance allows the USGBC to aggregate individual building information and perform program evaluations on its efficacy such as average LEED energy and water savings relative to national and regional averages. Aggregate figures on carbon emissions, costs, and other environmental impacts associated with building energy usage are of significant interest to USGBC and GBCI as well as green building advocates, builders, owners, and operators. USGBC will use all building data to inform the continuous improvement of the LEED rating systems, develop related educational programming, identify key areas of needed research and present clear, unbiased results to the building community. Building performance feedback will be provided to LEED project owners based on the information by making comparisons to national or known comparable datasets.

THIS MPR DOES NOT INTEND TO:

- penalize project teams with buildings that do not perform as well as intended
- create insurmountable technical or legal barriers to registering a LEED project

Specific Allowed Exceptions:

- *Where whole project meters are cost-prohibitive or physically impractical to install*
  Owners of LEED project buildings or spaces that do not have meters in place that measure energy and/or water usage for the entire LEED certified gross floor area will not be expected to supply energy and/or water usage data unless and until such meters are installed. Many Commercial Interiors projects, higher education campuses, and military bases will fall into this category.

- *Sale, Assignment or other Transfer of Ownership*
  To own a LEED certified project is to participate in the ongoing evolution of the green building movement. In that spirit, and in keeping with the intent of this MPR, the owner's commitment to provide whole-building energy and usage data is expected to carry forward to the next owner if all or part of a LEED certified project is sold, re-assigned or otherwise transferred. However, it is recognized that this may not always be possible, and GBCI will respect the realities of situations in which reasonable efforts to maintain the commitment are not successful. In this situation, the initial building owner will no longer be required to provide the data or access to the data.

Additional Information and Clarifications

- *Correlation of actual performance to design performance*
  Data collection is for research purposes only, and project teams are required simply to share data, NOT to show that design cases submitted during certification were accurate. For projects in NC, CI, CS, and Schools, actual performance will usually vary from projected performance. This MPR addresses the act of data sharing, not the content of the data. (Note that projects certifying under LEED EB: O&M are required to submit performance data *during* the certification process, and this *does* affect if, and what level of certification will be achieved.)

- *Determining typical physical occupancy*

  The definition of Typical Physical Occupancy', as given in the definitions section below, is: 'The state in which normal building operations are underway and the building is in use by the average number of people that it was designed for.'
  To determine the average number of full time equivalent occupants that the building was designed for, project teams must assess buildings on a case by case basis, using reasonable judgment. Design intentions, floor area capacity, and building system capacity must all be considered.

Projects certifying under LEED for New Construction, Commercial Interiors, Core & Shell, and Schools must begin sharing data once 50% of the gross floor area meets the definition of typical physical occupancy.

- *Process of data collection*
  The process of data collection as well as the specific data that will be collected is currently under development, and a more detailed description will be released as soon as it is available.

- *Reporting Results*
  Analysis of the data will be made publicly available on a regular basis (schedule to be determined).

- *Facilitating certification under LEED for Existing Buildings: Operations & Maintenance*
  All building performance data collected may be used to meet the submittal requirements of the EB: O&M application.

- *Core & Shell projects do not require special treatment*
  Metering and data collection for Core & Shell projects does not differ from other projects. Data may be collected from spaces that the LEED project team did not fit out as part of their core and shell design and construction – this is normal and acceptable.

7. MUST COMPLY WITH A MINIMUM BUILDING AREA TO SITE AREA RATIO

MPR Language

The *gross floor area* of the LEED project building must be no less than 2% of the gross land area within the LEED project boundary.

Intent:

Because LEED is a rating system for buildings, it is appropriate to restrict the amount of land associated with a LEED certified project. While it is recognized that large sections of real estate may be affected by human activity generated by a building as well as an owner's general land use decisions, this stipulation has been put into place to ensure that an overabundance of land associated with a LEED certification does not occur and certain Sustainable Sites credits are awarded fairly.

THIS MPR DOES NOT INTEND TO:

- imply that land left outside of the LEED project boundary should not also benefit from the environmentally sensitive land use practices

Specific Allowed Exceptions

None

Additional Information and Clarifications

- *Calculation method for determining gross floor area to site area ratio*

  [Gross Floor Area (sf) / Site Area (sf)] x 100

  EXAMPLE

  A 4000 square foot building is located on a five acre (217,800 sq ft) site:

  [4000/ 217,800] x 100 = 1.8%

  This building must claim only 4.6 acres (200,000 sq ft) within its LEED project boundary to meet the 2% building area to site area minimum.

- There is no maximum building area to site area ratio.

- Site area (or, gross land area) includes all land within the LEED project boundary, including the footprint of the LEED project building.
- If a LEED project boundary must be adjusted in order to meet this MPR, the adjustment must be done such that the new boundary also complies with MPR #3, Must Use a Reasonable Site Boundary. If there is a conflict, this MPR takes precedence. In other words, the project team may eliminate land that is usually required by MPR #3 to be within the project boundary, in order to comply with this MPR. However, the elimination must be done in a reasonable fashion: the project team cannot remove land specifically because it would not comply with another MPR, prerequisite, or credit requirements.
- If there is not any land included within the LEED project boundary (as will typically be the case with LEED CI projects), the project will be in compliance with this MPR by default.
- Off-site land used to earn Sustainable Sites credit 5 in EB: O&M must be included in the calculations for this MPR.

GLOSSARY

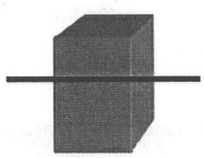
Certificate of Occupancy: A document issued by a local authority indicating that premises comply with provisions of zoning, building ordinances, building code, and/or approved plans and specifications. This is often required before premises can be occupied and title transferred.

Complete Interior Space: At a minimum, all the gross floor area within the exterior walls of a building that is within a single occupant's control and contains all building components altered as part of the LEED-certifying construction scope. Ownership, management, lease, and party walls are acceptable methods for defining two complete interior spaces. Floors/ceilings, i.e. the structural component separating two floors, may also define two complete spaces if one floor is unaffected by construction work, even if both floors serve the same occupant.

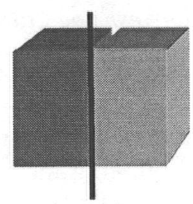
Design and Construction Rating Systems: Any LEED rating system that addresses both the design and construction of a building or interior space. Includes LEED for New Construction and Major Renovation, LEED for Core & Shell, LEED for Schools, LEED for Commercial Interiors, LEED for Retail, and LEED for Healthcare.

Entirety: The sum of the constructed components that make up a building which is physically distinct from another building. Must include all vertically attached components of the building.

This horizontal dividing line CANNOT distinguish the top half of this structure from the bottom half as a building in its entirety:



This vertical dividing line CAN distinguish the building on the right from the building on the left, if they are physically distinct and separate addresses or names:



Full Time Equivalent (FTE): A regular building occupant who spends 40 hours per week in the building or space, or the equivalent. Part-time or overtime occupants have FTE values based on their hours per day.

Gerrymander: To divide and assign land in such a way as to give unfair, inconsistent representation to one parcel over another.

Gross Floor Area: *(based on ASHRAE definition)* Sum of the floor areas of the spaces within the building, including basements, mezzanine and intermediate-floored tiers, and penthouses with headroom height of 7.5 ft (2.2 meters) or greater. Measurements must be taken from the exterior faces of exterior walls OR from the centerline of walls separating buildings, OR (for LEED CI certifying spaces) from the centerline of walls separating spaces. Excludes non-enclosed (or non-enclosable) roofed-over areas such as exterior covered walkways, porches, terraces or steps, roof overhangs, and similar features. Excludes air shafts, pipe trenches, and chimneys.

Gross Square Feet/Square Meters: see 'Gross floor area'.

Normal Building Operations: The complete activities and functions intended to take place within the building and on associated property.

Land: Any part of the earth's surface not covered by a body of water.

LEED Project: All real property within the LEED project boundary, including the building(s) or space(s), all structures, land, etc. which collectively is attempting or has earned certification.

LEED Project Boundary: The line drawn on a site plan submitted to GBCI indicating the limits of the real property for which the project team is attempting or has earned certification.

LEED Project Building: The structure which is attempting or has earned certification.

LEED Project Space: The gross floor area which is attempting or has earned certification.

LEED Project Registration: The process through which the project team establishes a LEED project in LEED Online. This process is considered complete once payment is received by USGBC and/or GBCI.

Major Renovation: Construction work that is extensive enough such that normal building operations cannot be performed while the work is in progress, and/or a new certificate of occupancy is required.

Operational Activities: See 'Normal Building Operations'.

Party Wall: A wall without openings erected as a common support to structures on both sides.

Performance Period: The continuous, unbroken time during which sustainable operations performance for a building and/or site is being measured.

Physically Distinct: The condition in which a building has both of the following:

a) exterior walls that are party walls or are separate from adjoining buildings by air space
b) lighting, HVAC, plumbing, and other mechanical systems that are separate from the systems of adjoining buildings.

LEED project boundary lines that "slice" through party walls must not pass through any mechanical, electrical and plumbing (MEP) service infrastructure. Exceptions include buildings served by a common or shared chiller plant or heating water, or steam supply pipes (i.e., not air ducts), and only if the thermal energy serving the structure to be separated is sub-metered.
Note that the definition of 'physically distinct' has special implications for complicated retail and mixed use situations, and specific guidance on this issue will be provided upon the release of LEED for Retail. In the meantime, if this definition proves insufficient for a potential LEED project, GBCI should be contacted: http://www.gbci.org/customerserv.aspx.

Project Work: See 'Undertaking the LEED Project'.

Regularly occupied spaces: Areas where workers are seated or standing as they work inside a building. In residential applications, these areas are all spaces except bathrooms, utility areas, and closets or other storage rooms. In schools, they are areas where students, teachers, or administrators are seated or standing as they work or study inside a building.

Real Property: Land and land alterations that are a direct result of human activities that subsequently support an active land use, including structures of any kind.

Schematic Design: The initial phase of architectural work that establishes the scope and physical outline of the project.

Substantial Completion of Construction: The point at which work on the building project is sufficiently complete in accordance with all construction contract documents, and any strategies that the project is receiving recognition for under LEED are fully implemented, except for operations-related strategies (such as a thermal comfort survey).

Typical Physical Occupancy: The state in which normal building operations are underway and the building is being used by the average number of full time equivalent occupants for which it was designed.

Undertaking the LEED Project: All design, construction, and development work that contribute to the creation of the LEED project building.

Air Force MILCON Sustainability Requirements Scoresheet

version LEED® 2009

General Information

		Project ID (e.g. ABCD12345)
		Building Name
		Project Type
		Installation
		City
		State
		MAJCOM
		PM Name
		PA ($k)
		Building Size (SF)
		Program Year (FY####)
		Project Phase
		Design Started (FY####)
		BOD (MM/DD/YY)
		Pursuing formal LEED® Certification
		Date Project Registered with USGBC (MM/DD/YY)
	LEED® 2009	LEED® Rating System
	0	LEED® Credits Achievable
	Prerequisites Not Achieved	LEED® Certification Level Achievable (per AF SDD Policy (July 2007))
		LEED® Credits Awarded by GBCI (e.g. 42)
		LEED® Certification Level Awarded by GBCI
		LEED® Energy and Water Credits Achievable
		Date Project Certified by GBCI (MM/DD/YY)
		Registration Fees ($)
		Certification Fees ($)
	0%	HPSB Compliant
	0%	Water Conservation Achieved (% below EPAct 1992)
	0%	Energy Efficiency Achieved (% below ANSI/ASHRAE/IESNA Standard 90.1-2007)
		Cost to Implement EISA 438 (Pre-Development Hydrology)
		Comments

Color Coding: See Instructions Tab for more detail

Drop-Down Box	Drop-Down Box Stoplight	Custom Subquestions
No Entry	Yes - Credit Achieved	Not Required
Custom General Information	Maybe - Credit Maybe	
LEED Prerequisite	No - Credit not Achieved	

EPA-BAFB-0000936

Air Force MILCON Sustainability Requirements Scoresheet

version LEED® 2009

Federal Requirements for High Performance Sustainable Buildings (HPSB)				
HPSB I: Employ Integrated Design Principles				
Achievable Points 0			Possible Points	2
	HPSB I.1	**Integrated Design**		1
	HPSB I.2	**Commissioning**		1
HPSB II: Optimize Energy Performance				
Achievable Points 0			Possible Points	5
	HPSB II.1	**Energy Efficiency, Achieve Option 1 or 2 and insert design per centage**		1
	1		Reduce energy use 30% Below AN SI/ASHRAE/IESNA Standard 90.1 - 2007, OR	
	2		If not at least 30% below ANSI/ASHRAE/IESNA Standard 90.1- 2007, will the design achieve the maximum level of energy efficiency that is life-cycle cost-effective?	
			Insert percentage bel ow ANSI/ASHRAE/IESNA Standard 90.1-200 7 in terms of energy use (e.g. 32)	
			Insert building energy intensity (Btu/SF) calculated with the energy model per 10 CFR 433	
			Roof Attributes (Recommended)	
			Cool roof (LEED SS cr 7.2 or Energy Star)	
			Green roof	
			Solar electric	
			Solar thermal	
			Solar passive	
			Achieve "Designed to Earn the Energy Star" rating - Benchmark from first year of operation (Recommended)	
	HPSB II.2	**Preferential use of EN ERGY STAR or FEMP-designated equipment, when lifecy cle cost effectiv e**		1
	HPSB II.3	**On-site Renewable Energy - Solar Hot Water Heater System**		1
			Lifecycle cost assessment found solar hot water heater s ystem not effective	
			When lifecycle cost effective, solar hot water system installed - min 30% dem and	
			Insert percentage achieved	
	HPSB II.4	**On-site Renewable Energ y**		1
			Lifecycle cost assessment found renewable energy generation projects not effective	
			When lifecycle cost effective, renewable energy generation p rojects installed	
			Renewable energy type	
			Insert first renewable energy type, if applicable	
			Insert second renewable energy type, if applicable	
			Insert generation capacity (kW)	
			Insert percentage of total building	
	HPSB II.5	**Measurement and Ver ification - Advanced Metering**		1
			Water Metering: Select N/A if not used	
			Electric Metering: Select N/A if not used	
			Natural Gas Metering: Sel ect N/A if not used	
			Steam Metering: Select N/A if not us ed	
	HPSB II.6	Project Case Study Entered in High Performance Federal Buildings Database (Recommended)		
	EISA 2007 II.7	Reduction in fossil fuel-generated energy consumption (Recommended)		
	EISA 2007 II.8	Data Center Energy Consumption (Recommended)		
HPSB III: Protect and Conserve Water				
Achievable Points 0			Possible Points	7
	HPSB III.1	**Indoor Water - 20% Reduction**		1
			Insert percentage achieved	
	HPSB III.2	**Outdoor Water - Reduce P otable Water Use by 50%**		1
	HPSB III.3	**Outdoor Water - Stormwater runoff**		1
	HPSB III.4	**Outdoor Water - Achieve Pre-Development Hydrology when technically feasible, when disturbance > 5,000 GSF**		1
			Insert cost to implement	
	HPSB III.5	**Process water pot able water use**		1
			Energy efficiency measures using water were cons idered and the cost was included in lifecycle cost assessment	
			Energy efficiency measures using water were not considered for the design	
	HPSB III.6	**Water-Efficient Products**		1
	HPSB III.7	**Water Efficient Products - Irrigatio n Contractors**		1

Air Force MILCON Sustainability Requirements Scoresheet
version LEED® 2009

HPSB IV: Enhance Indoor Environmental Quality			
Achievable Points	0	Possible Points	9
	HPSB IV.1	**Thermal Comfort, ASHRAE 55-2004**	1
	HPSB IV.2	**Ventilation: ASHRAE 62.1-2007**	1
	HPSB IV.3	**Moisture Control**	1
	HPSB IV.4	**Daylighting - 75% of Spaces**	1
	HPSB IV.5	**Daylighting - Controllability of Systems**	1
	HPSB IV.6	**Low Emitting Materials**	1
	HPSB IV.7	**Protect Indoor Air Quality during Construction**	1
	HPSB IV.8	**Protect Indoor Air Quality after Construction**	1
	HPSB IV.9	**Environmental Tobacco Smoke (ETS) Control**	1
HPSB V: Reduce Environmental Impact of Materials			
Achievable Points	0	Possible Points	6
	HPSB V.1	**Recycled Content**	1
	HPSB V.2	**Biobased Content**	1
	HPSB V.3	**Environmentally Preferable Products**	1
	HPSB V.4	**Waste and Materials Management - Recycling**	1
	HPSB V.5	**Waste and Materials Management - Divert 50% from Disposal**	1
	HPSB V.6	**Ozone Depleting Compounds**	1
HPSB Totals		Possible Points	29
0	**Federal Requirements Achieved (29 line items)**		
0	**Federal Requirements Maybe Achieved**		
0	**Federal Requirements Not Achieved**		
0%	**Percentage of Federal Requirements Achieved**		

Air Force MILCON Sustainability Requirements Scoresheet

version LEED® 2009

LEED® 2009 Checklist

LEED® Credits and/or Prerequisites that meet HPSB Requirements
LEED® Credits and/or Prerequisites that align closely with HPSB Requirements
LEED® Credits that meet USAF Energy & Water Criteria (may depend on technologies & strategies)

Sustainable Sites			
Achievable Points	0	Sustainable Sites	Possible Points 26
	Prereq 1	Construction Activity Pollution Prevention (HPSB GP3)	Required
	Credit 1	**Site Selection**	1
	Credit 2	**Development Density & Community Connectivity**	5
	Credit 3	**Brownfield Redevelopment**	1
	Credit 4.1	**Alternative Transportation** - Public Transportation Access	6
	Credit 4.2	**Alternative Transportation** - Bicycle Storage & Changing Rooms	1
	Credit 4.3	**Alternative Transportation** - Low-Emitting & Fuel Efficient Vehicles	3
	Credit 4.4	**Alternative Transportation** - Parking Capacity	2
	Credit 5.1	**Site Development,** Protect or Restore Habitat	1
	Credit 5.2	**Site Development,** Maximize Open Space	1
	Credit 6.1	Stormwater Design, Quantity Control (HPSB GP3)	1
	Credit 6.2	Stormwater Design, Quality Control (HPSB GP3)	1
	Credit 7.1	**Heat Island Effect** - Non-Roof	1
	Credit 7.2	**Heat Island Effect** - Roof	1
	Credit 8	**Light Pollution Reduction**	1
		Select which LEED® Interior Lighting Option was used	
Water Efficiency			
Achievable Points	0		Possible Points 10
	Prereq 1	Water Use Reduction - 20% Reduction (HPSB GP3)	Required
	Credit 1	Water Efficient Landscaping (HPSB GP3)	2 to 4
		2 Reduce Potable Water Use by 50% (HPSB GP3)	2
		4 No Potable Use or Irrigation (HPSB GP3)	2
	Credit 2	**Innovative Wastewater Technologies**	2
	Credit 3	Water Use Reduction (HPSB GP3)	2 to 4
		2 30% Reduction (HPSB GP3)	2
		3 35% Reduction (HPSB GP3)	1
		4 40% Reduction (HPSB GP3)	1
Energy & Atmosphere			
Achievable Points	0		Possible Points 35
	Prereq 1	Fundamental Commissioning of the Building Energy Systems (HPSB GP1)	Required
	Prereq 2	Minimum Energy Performance (HPSB GP2)	Required
	Prereq 3	Fundamental Refrigerant Management (HPSB GP5)	Required
	Credit 1	Optimize Energy Performance (HPSB GP2)	1 to 19
		1 12% for New Buildings/8% for Existing Building Renovations	1
		2 14% for New Buildings/10% for Existing Building Renovations	1
		3 16% for New Buildings/12% for Existing Building Renovations	1
		4 18% for New Buildings/14% for Existing Building Renovations	1
		5 20% for New Buildings/16% for Existing Building Renovations	1
		6 22% for New Buildings/18% for Existing Building Renovations	1
		7 24% for New Buildings/20% for Existing Building Renovations	1
		8 26% for New Buildings/22% for Existing Building Renovations	1
		9 28% for New Buildings/24% for Existing Building Renovations	1
		10 30% for New Buildings/26% for Existing Building Renovations	1
		11 32% for New Buildings/28% for Existing Building Renovations	1
		12 34% for New Buildings/30% for Existing Building Renovations	1
		13 36% for New Buildings/32% for Existing Building Renovations	1
		14 38% for New Buildings/34% for Existing Building Renovations	1
		15 40% for New Buildings/36% for Existing Building Renovations	1
		16 42% for New Buildings/38% for Existing Building Renovations	1
		17 44% for New Buildings/40% for Existing Building Renovations	1
		18 46% for New Buildings/42% for Existing Building Renovations	1
		19 48%+ for New Buildings/44%+ for Existing Building Renovations	1
	Credit 2	On-Site Renewable Energy (HPSB GP2)	1 to 7
		1 On-site 1%	1
		2 On-site 3%	1
		3 On-site 5%	1
		4 On-site 7%	1
		5 On-site 9%	1
		6 On-site 11%	1
		7 On-site 13%	1
	Credit 3	Enhanced Commissioning (HPSB GP1)	2
	Credit 4	Enhanced Refrigerant Management (HPSB GP5)	2
	Credit 5	Measurement & Verification (HPSB GP2)	3
	Credit 6	**Green Power**	2

Air Force MILCON Sustainability Requirements Scoresheet

version LEED® 2009

Materials & Resources

Achievable Points 0 — Possible Points 14

Prereq 1	Storage & Collection of Recyclables (HPSB GP5)		Required
Credit 1.1	**Building Reuse,** Maintain Existing Walls, Floors & Roof		1 to 3
	1	Maintain 55% of Existing Walls, Floors & Roof	1
	2	Maintain 75% of Existing Walls, Floors & Roof	1
	3	Maintain 95% of Existing Walls, Floors & Roof	1
Credit 1.2	**Building Reuse,** Maintain 50% of Interior Non-Structural Elements		1
Credit 2	Construction Waste Management (HPSB GP5)		1 to 2
	1	50% Recycled or Salvaged	1
	2	75% Recycled or Salvaged	1
Credit 3	**Materials Reuse**		1 to 2
	1	5%	1
	2	10%	1
Credit 4	Recycled Content (HPSB GP5)		1 to 2
	1	10%	1
	2	20%	1
Credit 5	**Regional Materials**		1 to 2
	1	10% Extracted, Processed & Manufactured	1
	2	20% Extracted, Processed & Manufactured	1
Credit 6	Rapidly Renewable Materials (HPSB GP5)		1
Credit 7	Certified Wood (HPSB GP5)		1

Indoor Environmental Quality

Achievable Points 0 — Possible Points 15

Prereq 1	Minimum IAQ Performance (HPSB GP4)	Required
Prereq 2	Environmental Tobacco Smoke (ETS) Control (HPSB GP4)	Required
Credit 1	**Outside Air Delivery Monitoring**	1
Credit 2	**Increased Ventilation**	1
Credit 3.1	Construction IAQ Management Plan, During Construction (HPSB GP4)	1
Credit 3.2	Construction IAQ Management Plan, Before Occupancy (HPSB GP4)	1
Credit 4.1	Low Emitting Materials, Adhesives & Sealants (HPSB GP4)	1
Credit 4.2	Low Emitting Materials, Paints & Coatings (HPSB GP4)	1
Credit 4.3	Low Emitting Materials, Flooring Systems (HPSB GP4)	1
Credit 4.4	Low Emitting Materials, Composite Wood & Agrifiber Products (HPSB GP4)	1
Credit 5	**Indoor Chemical & Pollutant Source Control**	1
Credit 6.1	Controllability of Systems, Lighting (HPSB GP4)	1
Credit 6.2	**Controllability of Systems,** Thermal Comfort	1
Credit 7.1	Thermal Comfort, Design (HPSB GP4)	1
Credit 7.2	**Thermal Comfort,** Verification	1
Credit 8.1	Daylight & Views - Daylight 75% of Spaces (HPSB GP4)	1
Credit 8.2	**Daylight & Views** - Views for 90% of Spaces	1

Innovation & Design Process

Achievable Points 0 — Possible Points 6

Credit 1.1	**Innovation in Design 1.1**	1
	Select if ID 1.1 was for energy and/or water	
Credit 1.2	**Innovation in Design 1.2**	1
	Select if ID 1.2 was for energy and/or water	
Credit 1.3	**Innovation in Design 1.3**	1
	Select if ID 1.3 was for energy and/or water	
Credit 1.4	**Innovation in Design 1.4**	1
	Select if ID 1.4 was for energy and/or water	
Credit 1.5	**Innovation in Design 1.5**	1
	Select if ID 1.5 was for energy and/or water	
Credit 2	**LEED® Accredited Professional**	1

Regional Priority Credits

Achievable Points 0 — Possible Points 4

Credit 1.1	**Regional Priority 1.1**	1
	Select if RP 1.1 was for energy and/or water	
Credit 1.2	**Regional Priority 1.2**	1
	Select if RP 1.2 was for energy and/or water	
Credit 1.3	**Regional Priority 1.3**	1
	Select if RP 1.3 was for energy and/or water	
Credit 1.4	**Regional Priority 1.4**	1
	Select if RP 1.4 was for energy and/or water	

LEED Project Totals (pre-certification estimates) — Possible Points 110

0	LEED® Credits Achievable
0	LEED® Credits Maybe Achievable
0	LEED® Credits Not Achievable
	LEED® Energy and Water Credits Achievable (when pursuing LEED® Certification)
Prerequisites Not Achieved	**LEED® Certification Level Achievable**
N/A	**LEED® Horizontal Benchmark Level**
N/A	**LEED® Utility Benchmark Level**
N/A	**LEED® Industrial Benchmark Level**

MILCON Sustainable Building Requirements Scoresheet Instructions	
Color Coding	
Green text	**LEED® Credits and/or Prerequisites that align closely with Federal High Performance Sustainable Buildings (HPSB) Requirements** These credits and/or prerequisites align closely with the associated HPSB Guiding Principle. They could be either more or less stringent or have different measurement metrics. In the case where one is more stringent than the other, achieving the more stringent one does not imply the less stringent is achieved.
Blue Text	**LEED® Credits and/or Prerequisites that meet Federal High Performance Sustainable Buildings (HPSB) Requirements** These credits and/or prerequisites have the same requirements as the associated HPSB Guiding Principle. This does not guarantee achieving the LEED Credit, as some documentation methods may vary.
Gray Text	**Recommended (Federal Requirement not fully defined at this time)**
Purple Text	**Summary Calculations fo LEED and HPSB Scores**
Light Orange Cell	Cell uses a drop down box for set values. User should select using the drop-down box.
Light Gray Cell	Cell is populated by other cells. User is not required to enter values.
White Cell	Cell is for custom entry of General Building Information. Boxes that appear when cell is selected give further instruction on entering data. Some cells restrict values that can be entered - which is explained if incorrectly entered
Light Blue Cell (When used, conditional formatting changes text to Green, Yellow, or Red depending on entry)	Cell uses a drop down box for LEED Prerequisites and allows for "Yes", "Maybe" and "No"
	Cell uses a drop down box and user is designating "Yes"
	Cell uses a drop down box and user is designating "Maybe"
	Cell uses a drop down box and user is designating "No"
Light Green Cell (When used, conditional formatting changes cell to Green, Yellow, or Red depending on entry)	Cell provides a drop-down box for the user to select which LEED Credits and HPSB Requirements that the project is attempting. When a "Yes", "Maybe", or "No" is selected the cell follows the stoplight convention to visually represent progress. The stoplight convention is also used for "Yes", "Maybe" or "No" totals. Some light green boxes also have an option for "N/A" when used for subquestions
	Cell uses a drop down box and user is designating "Yes" or "N/A" when applicable
	Cell uses a drop down box and user is designating "Maybe"
	Cell uses a drop down box and user is designating "No"
Dark Blue Cell, White Text	**LEED® Credits that meet USAF Energy & Water Criteria (may depend on technologies & strategies). The DoD Sustainable Buildings Policy and AF Sustainable Design and Development Memorandum require a minimum of 20 energy and water credits for all projects seeking LEED certification. SS Credits 7.1-7.2, WE Credits 1.1 - 3, EA Credits 1-3 and Credits 5-6, IEQ Credit 1 and Credit 8.1 are always energy and water projects according to AF policy. SS Credit 8 is an energy and water credit if the project uses Option 1 for Indoor Lighting. Innovation and Design and Regional Priority Credits must be specified as energy and water projects for inclusion.**
Light Yellow Cell	Cell is for custom entry on how the project is pursuing LEED Credits and HPSB requirements. These are subquestions.
Dark Gray Cell	Cell is for selections that does not count towards achieving HPSB status

High Performance Sustainable Building Requirements and LEED® 2009 References		Links
	The High Performance Sustainable Building Requirements (Dec 08) described below are also found on the FedCenter website:	High Performance Sustainable Building Guidance (Dec 08)
	For more information on LEED® Credits that meet or align closely with federal requirements as well as other credits a building can pursue towards the Silver certification level, review the LEED® New Construction and Major Renovations 2009 Rating System:	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
Color Code	**LEED® Credits and/or Prerequisites that align closely with Federal High Performance Sustainable Buildings (HPSB) Requirements** These credits and/or prerequisites align closely with the associated HPSB Guiding Principle. They could be either more or less stringent or have different measurement metrics. In the case where one is more stringent than the other, achieving the more stringent one does not imply the less stringent is achieved.	Air Force Sustainable Design and Development Policy Memorandum (July 2007)
	LEED® Credits and/or Prerequisites that meet Federal High Performance Sustainable Buildings (HPSB) Requirements These credits and/or prerequisites have the same requirements as the associated HPSB Guiding Principle. This does not guarantee achieving the LEED Credit, as some documentation methods may vary.	
	Recommended (Federal Requirement not fully defined at this time)	
	LEED® Credits that meet USAF Energy & Water Criteria (may depend on technologies & strategies). The DoD Sustainable Buildings Policy and AF Sustainable Design and Development Memorandum require a minimum of 20 energy and water credits for all projects seeking LEED certification. SS Credits 7.1-7.2, WE Credits 1.1 - 3, EA Credits 1-3 and Credits 5-6, IEQ Credit 1 and Credit 8.1 are always energy and water projects according to AF policy. SS Credit 8 is an energy and water credit if the project uses Option 1 for Indoor Lighting. Innovation and Design and Regional Priority Credits must be specified as energy and water projects for inclusion.	
	HPSB I: Employ Integrated Design Principles	
HPSB I.1: Integrated Design	Use a collaborative, integrated planning and design process that • Initiates and maintains an integrated project team as described on the Whole Building Design Guide in all stages of a project's planning and delivery, http://www.wbdg.org/design/engage_process.php • Integrates the use of OMB's A-11, Section 7, Exhibit 300: Capital Asset Plan and Business Case Summary • Establishes performance goals for siting, energy, water, materials, and indoor environmental quality along with other comprehensive design goals and ensures incorporation of these goals throughout the design and lifecycle of the building • Considers all stages of the building's lifecycle, including deconstruction.	HPSB Guidance
Requirement Source Document(s)	Federal Leadership in High Performance and Sustainable Buildings MOU	
LEED Credit(s) aligns closely with HPSB:	None	
LEED Credit(s) meet HPSB:	None	
HPSB I.2: Commissioning	Employ commissioning practices tailored to the size and complexity of the building and its system components in order to verify performance of building components and systems and help ensure that design requirements are met. This should include an experienced commissioning provider, inclusion of commissioning requirements in construction documents, a commissioning plan, verification of the installation and performance of systems to be commissioned, and a commissioning report.	HPSB Guidance
Requirement Source Document(s)	Federal Leadership in High Performance and Sustainable Buildings MOU	
LEED Credit(s) aligns closely with HPSB:	LEED EA Prerequisite 1: Fundamental Commissioning of Building Energy Systems LEED EA Credit 3: Enhanced Commissioning	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
LEED Credit(s) meet HPSB:	None	

EPA-BAFB-0000943

High Performance Sustainable Building Requirements and LEED® 2009 References		Links
	HPSB II: Optimize Energy Performance	
HPSB II.1: Energy Efficiency.	For new construction, reduce the energy use by 30 percent compared to the baseline building performance rating per the American National Standards Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., (ASHRAE)/Illuminating Engineering Society of North America (IESNA) Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential, except for the performance rating formula in G1.2, which should be used as follows (from 10 CFR 433.5): Percentage improvement = 100 x (Baseline building consumption—Proposed building consumption) ÷(Baseline building consumption—Receptacle and process loads). This differs from the LEED calculation. For major renovations, reduce the energy use by 20 percent below pre-renovations 2003 baseline. Laboratory spaces may use the Labs21 Laboratory Modeling Guidelines. ENERGY STAR qualified low-slope roofs (2:12 inches or less) have an intial solar reflectance greater than or equal to 0.65 and is greater than or equal to 0.50 three years after installation. Steep slope roofs (greater than 2:12 inches) have an intial solar reflectance greater than or equal to 0.25 and is greater than or equal to 0.15 three years after installation	HPSB Guidance
Requirement Source Document(s)	10 CFR 433.5, Federal Leadership in High Performance and Sustainable Buildings MOU	GPO Access: 10 CFR 433.5
LEED Credit(s) aligns closely with HPSB:	LEED EA Prerequisite 2: Minimum Energy Performance LEED EA Credit 1: Optimize Energy Performance	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
LEED Credit(s) meet HPSB:	None	
HPSB II.2: Preferential use of ENERGY STAR or FEMP-designated equipment, when lifecycle cost effective	Use ENERGY STAR® and FEMP-designated Energy Efficient Products, where available.	HPSB Guidance
Requirement Source Document(s):	Federal Leadership in High Performance and Sustainable Buildings MOU	
LEED Credit(s) aligns closely with HPSB:	None	
LEED Credit(s) meet HPSB:	None	
HPSB II.3: On-site Renewable Energy - Solar Hot Water Heater System	Per the Energy Independence and Security Act (EISA) Section 523, meet at least 30% of the hot water demand through the installation of solar hot water heaters, when lifecycle cost effective.	HPSB Guidance
Requirement Source Document(s):	EISA Sec. 523, Federal Leadership in High Performance and Sustainable Buildings MOU	Energy Independence and Security Act of 2007
LEED Credit(s) aligns closely with HPSB:	LEED EA Credit 2: On-Site Renewable Energy	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
LEED Credit(s) meet HPSB:	None	
HPSB II.4: On-site Renewable Energy	Per Executive Order 13423, implement renewable energy generation projects on agency property for agency use, when lifecycle cost effective. Renewable energy types include: Geothermal, GSHP, Solar PV, Solar CP, Solar Thermal, Wind, Hydro, Daylighting, Waste to Energy.	HPSB Guidance
Requirement Source Document(s):	Federal Leadership in High Performance and Sustainable Buildings MOU	
LEED Credit(s) aligns closely with HPSB:	LEED EA Credit 2: On-Site Renewable Energy	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
LEED Credit(s) meet HPSB:	None	
HPSB II.5: Measurement and Verification - Advanced Metering	Per the Energy Policy Act of 2005 (EPAct) Section 103, install building level electricity meters in new major construction and renovation projects to track and continuously optimize performance. Per EISA Section 434, include equivalent meters for natural gas and steam, where natural gas and steam are used. Per A7C Memorandum, *DoD Facilities Metering Installation Initiative* (27 April 2006), all new construction should install potable water meters.	HPSB Guidance
Requirement Source Document(s):	EPAct 2005 Section 103, EISA 2007 Section 434, Federal Leadership in High Performance and Sustainable Buildings MOU	Energy Policy Act of 2005
LEED Credit(s) aligns closely with HPSB:	LEED EA Credit 5: Measurement and Verification	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
LEED Credit(s) meet HPSB:	None	

High Performance Sustainable	Building Requirements and LEED® 2009 References	Links
HPSB II.6: Project Case Study Entered in High Performance Federal Buildings Database	As a recommendation, enter data and lessons learned from sustainable buildings into the High Performance Buildings Database.	HPSB MOU
Requirement Source Document(s):	Federal Leadership in High Performance and Sustainable Buildings MOU	http://femp.buildinggreen.com/
LEED Credit(s) aligns closely with HPSB:	None	
LEED Credit(s) meet HPSB:	None	
EISA 2007 II.7: Reduction in fossil fuel-generated energy consumption	For new Federal buildings and Federal buildings undergoing major renovations…(I) The buildings shall be designed so that the fossil fuel generated energy consumption of the buildings is reduced, as compared with such energy consumption by a similar building in fiscal year 2003 (CBECS or RECS data from EIA), by the percentage specified...FY2010 (55%), 2015 (65%), 2020 (80%), 2025 (90%), and 2030 (100%). *The DOE Rulemaking is not yet complete*	Energy Independence and Security Act of 2007
Requirement Source Document(s):	EISA 2007, Sec. 433, (a)(D)(i)	
LEED Credit(s) aligns closely with HPSB:	None	
LEED Credit(s) meet HPSB:	None	
EISA 2007 II.8: Data Center Energy Consumption	EISA 2007 Section 453 directs DOE and EPA to initiate a voluntary national information program for widely used data centers and data center equipment for which there is significant potential for energy savings. *The DOE/EPA guidance is not yet issued.*	Energy Independence and Security Act of 2007
Requirement Source Document(s):	EISA 2007, Sec. 453	
LEED Credit(s) aligns closely with HPSB:	None	
LEED Credit(s) meet HPSB:	None	
	HPSB III: Protect and Conserve Water	
HPSB III.1: Indoor Water - 20% Reduction	Employ strategies that in aggregate use a minimum of 20 percent less potable water than the indoor water use baseline calculated for the building, after meeting the EPAct 1992, Uniform Plumbing Codes 2006, and the International Plumbing Codes 2006 fixture performance requirements. The installation of water meters is encouraged to allow for the management of water use during occupancy. The use of harvested rainwater, treated wastewater, and air conditioner condensate should also be considered and used where feasible for nonpotable use and potable use where allowed.	HPSB Guidance
Requirement Source Document(s):	EPAct 1992, Federal Leadership in High Performance and Sustainable Buildings MOU	THOMAS EPAct 1992
LEED Credit(s) aligns closely with HPSB:	LEED WE Credit 3: Water Use Reduction - Reduce by 30% (3.1), 35% (3.2), 40% (3.3)	
LEED Credit(s) meet HPSB:	LEED WE Prerequisite 1: Water Use Reduction - 20% Reduction	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
HPSB III.2: Outdoor Water - Reduce Potable Water Use by 50%	Use water efficient landscape and irrigation strategies, such as water reuse, recycling, and the use of harvested rainwater, to reduce outdoor potable water consumption by a minimum of 50 percent over that consumed by conventional means (plant species and plant densities). The installation of water meters for locations with significant outdoor water use is encouraged.	HPSB Guidance
Requirement Source Document(s):	Federal Leadership in High Performance and Sustainable Buildings MOU	
LEED Credit(s) aligns closely with HPSB:	LEED WE Credit 1.2: Water Efficient Landscaping - No Potable Water Use or Irrigation	
LEED Credit(s) meet HPSB:	LEED WE Credit 1.1: Water Efficient Landscaping - Reduce by 50%	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
HPSB III.3: Outdoor Water - Stormwater runoff	Employ design and construction strategies that reduce storm water runoff and discharges of polluted water offsite.	HPSB Guidance
Requirement Source Document(s):	AF ETL 03-1, Federal Leadership in High Performance and Sustainable Buildings MOU	Engineering Technical Letter (ETL) 03-1 - Stormwater Construction Standards
LEED Credit(s) aligns closely with HPSB:	None	
LEED Credit(s) meet HPSB:	LEED SS Prerequisite 1: Construction Activity Pollution Prevention	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008

High Performance Sustainable Building Requirements and LEED® 2009 References		Links
HPSB III.4: Outdoor Water - Achieve Pre-Development Hydrology when technically feasible, when disturbance > 5,000 GSF	Per EISA Section 438, to the maximum extent technically feasible, maintain or restore the predevelopment hydrology of the site with regard to temperature, rate, volume, and duration of flow using site planning, design, construction, and maintenance strategies.	HPSB Guidance
Requirement Source Document(s):	OUSD Memo 19 Jan 2010, EISA 2007 Sec 438, Federal Leadership in High Performance and Sustainable Buildings MOU	OUSD Memo EISA Section 438
LEED Credit(s) aligns closely with HPSB:	LEED SS Credit 6.1: Stormwater Design - Quantity Control LEED SS Credit 6.2: Stormwater Design - Quality Control	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
LEED Credit(s) meet HPSB:		
HPSB III.5: Process water - potable water use	Per the Energy Policy Act of 2005 Section 109, when potable water is used to improve a building's energy efficiency, deploy lifecycle cost effective water conservation measures.	HPSB Guidance
Requirement Source Document(s):	EPAct 2005, Sec. 109, Federal Leadership in High Performance and Sustainable Buildings MOU	Energy Policy Act of 2005
LEED Credit(s) aligns closely with HPSB:	None	
LEED Credit(s) meet HPSB:	None	
HPSB III.6: Water-Efficient Products	Specify EPA's WaterSense-labeled products or other water conserving products, where available.	HPSB Guidance
Requirement Source Document(s):	Federal Leadership in High Performance and Sustainable Buildings MOU	
LEED Credit(s) aligns closely with HPSB:	None	
LEED Credit(s) meet HPSB:	None	
HPSB III.7: Water Efficient Products - Irrigation Contractors	Choose irrigation contractors who are certified through a WaterSense labeled program.	HPSB Guidance
Requirement Source Document(s):	Federal Leadership in High Performance and Sustainable Buildings MOU	
LEED Credit(s) aligns closely with HPSB:	None	
LEED Credit(s) meet HPSB:	None	
	HPSB IV: Enhance Indoor Environmental Quality	
HPSB IV.1: Thermal Comfort, ASHRAE 55-2004	Meet ASHRAE Standard 55-2004, Thermal Environmental Conditions for Human Occupancy, including continuous humidity control within established ranges per climate zone.	HPSB Guidance
Requirement Source Document(s):	Federal Leadership in High Performance and Sustainable Buildings MOU	
LEED Credit(s) aligns closely with HPSB:	None	
LEED Credit(s) meet HPSB:	LEED EQ Credit 7: Thermal Comfort - Design	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
HPSB IV.2: Ventilation: ASHRAE 62.1-2007	Meet ASHRAE Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality.	HPSB Guidance
Requirement Source Document(s):	Federal Leadership in High Performance and Sustainable Buildings MOU	
LEED Credit(s) aligns closely with HPSB:	None	
LEED Credit(s) meet HPSB:	LEED EQ Prerequisite 1: Minimum Indoor Air Quality Performance	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
HPSB IV.3: Moisture Control	Establish and implement a moisture control strategy for controlling moisture flows and condensation to prevent building damage, minimize mold contamination, and reduce health risks related to moisture.	HPSB Guidance
Requirement Source Document(s):	ETL 04-3: Design Criteria for Prevention of Mold in Air Force Facilities (Achieves HPSB GP4, Moisture Control), Federal Leadership in High Performance and Sustainable Buildings MOU	AF ETL 04-3
LEED Credit(s) aligns closely with HPSB:	None	
LEED Credit(s) meet HPSB:	None	
HPSB IV.4: Daylighting - 75% of Spaces	Achieve a minimum daylight factor of 2 percent (excluding all direct sunlight penetration) in 75 percent of all space occupied for critical visual tasks.	HPSB Guidance
Requirement Source Document(s):	Federal Leadership in High Performance and Sustainable Buildings MOU	
LEED Credit(s) aligns closely with HPSB:	LEED EQ Credit 8.1: Daylight and Views - Daylight	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
LEED Credit(s) meet HPSB:	None	

High Performance Sustainable Building Requirements and LEED® 2009 References		Links
HPSB IV.5: Daylighting - Controllability of Systems	Provide automatic dimming controls or accessible manual lighting controls, and appropriate glare control.	HPSB Guidance
Requirement Source Document(s):	Federal Leadership in High Performance and Sustainable Buildings MOU	
LEED Credit(s) aligns closely with HPSB:	LEED EQ Credit 6.1: Controllability of Systems - Lighting	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
LEED Credit(s) meet HPSB:	None	
HPSB IV.6: Low Emitting Materials	Specify materials and products with low pollutant emissions, including composite wood products, adhesives, sealants, interior paints and finishes, carpet systems, and furnishings.	HPSB Guidance
Requirement Source Document(s):	Federal Leadership in High Performance and Sustainable Buildings MOU	
LEED Credit(s) aligns closely with HPSB:	LEED EQ Credits 4.1-4.4: Low-Emitting Materials - Adhesives and Sealants (4.1), Paints and Coatings (4.2), Flooring Systems (4.3), and Composite Wood and Agrifiber Products (4.4)	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
LEED Credit(s) meet HPSB:	None	
HPSB IV.7: Protect Indoor Air Quality during Construction	Follow the recommended approach of the Sheet Metal and Air Conditioning Contractor's National Association Indoor Air Quality Guidelines for Occupied Buildings under Construction, 2007.	HPSB Guidance
Requirement Source Document(s):	Federal Leadership in High Performance and Sustainable Buildings MOU	
LEED Credit(s) aligns closely with HPSB:	LEED EQ Credit 3.1: Construction Indoor Air Quality Management Plan - During Occupancy	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
LEED Credit(s) meet HPSB:	None	
HPSB IV.8: Protect Indoor Air Quality after Construction	After construction and prior to occupancy, conduct a minimum 72-hour flush-out with maximum outdoor air consistent with achieving relative humidity no greater than 60 percent. After occupancy, continue flush-out as necessary to minimize exposure to contaminants from new building materials.	HPSB Guidance
Requirement Source Document(s):	Federal Leadership in High Performance and Sustainable Buildings MOU	
LEED Credit(s) aligns closely with HPSB:	LEED EQ Credit 3.2: Construction Indoor Air Quality Management Plan - Before Occupancy	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
LEED Credit(s) meet HPSB:	None	
HPSB IV.9: Environmental Tobacco Smoke (ETS) Control	Implement a policy and post signage indicating that smoking is prohibited within the building and within 25 feet of all building entrances, operable windows, and building ventilation intakes during building occupancy.	HPSB Guidance
Requirement Source Document(s):	GSA Federal Register: December 22, 2008 (Volume 73, Number 246), Federal Leadership in High Performance and Sustainable Buildings MOU	Federal Register - Protecting Federal Employees from Environmental Tobacco Smoke
LEED Credit(s) aligns closely with HPSB:	None	
LEED Credit(s) meet HPSB:	LEED EQ Prerequisite 2: Environmental Tobacco Smoke (ETS) Control	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
	HPSB V: Reduce Environmental Impact of Materials	
HPSB V.1: Recycled Content	Per Section 6002 of the Resource Conservation and Recovery Act (RCRA), for EPA-designated products, specify products meeting or exceeding EPA's recycled content recommendations. For other products, specify materials with recycled content when practicable. If EPA-designated products meet performance requirements and are available at a reasonable cost, a preference for purchasing them shall be included in all solicitations relevant to construction, operation, maintenance of or use in the building.	EPA's Comprehensive Procurement Guideline Website
Requirement Source Document(s):	RCRA 2002, Sec 6002, Federal Leadership in High Performance and Sustainable Buildings MOU	RCRA 2002
LEED Credit(s) aligns closely with HPSB:	LEED MR Credit 4.1-4.2: Recycled Content - 10% of Content (4.1), 20% of Content (4.2)	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
LEED Credit(s) meet HPSB:	None	

High Performance Sustainable Building Requirements and LEED® 2009 References		Links
HPSB V.2: Biobased Content	Per Section 9002 of the Farm Security and Rural Investment Act (FSRIA), for USDA-designated products, specify products with the highest content level per USDA's biobased content recommendations. For other products, specify biobased products made from rapidly renewable resources and certified sustainable wood products. If these designated products meet performance requirements and are available at a reasonable cost, a preference for purchasing them shall be included in all solicitations relevant to construction, operation, maintenance of or use in the building.	USDA's Biopreferred Website
Requirement Source Document(s):	FSRIA 2002 Section 9002, Federal Leadership in High Performance and Sustainable Buildings MOU	FSRIA 2002
LEED Credit(s) aligns closely with HPSB:	LEED MR Credit 6: Rapidly Renewable Materials LEED MR Credit 7: Certified Wood	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
LEED Credit(s) meet HPSB:	None	
HPSB V.3: Environmentally Preferable Products	Use products that have a lesser or reduced effect on human health and the environment over their lifecycle when compared with competing products or services that serve the same purpose. A number of standards and ecolabels are available in the marketplace to assist specifiers in making environmentally preferable decisions.	WBDG Federal Green Construction Guide
Requirement Source Document(s):	Federal Leadership in High Performance and Sustainable Buildings MOU	
LEED Credit(s) aligns closely with HPSB:	None	
LEED Credit(s) meet HPSB:	None	
HPSB V.4: Waste and Materials Management - Recycling	Incorporate adequate space, equipment, and transport accommodations for recycling in the building design.	HPSB Guidance
Requirement Source Document(s):	EO 13423, Sec 2(e), Federal Leadership in High Performance and Sustainable Buildings MOU	Executive Order 13423
LEED Credit(s) aligns closely with HPSB:	None	
LEED Credit(s) meet HPSB:	LEED MR Prerequisite 1: Storage and Collection of Recyclables	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
HPSB V.5: Waste and Materials Management, Divert 50% from Disposal	During a project's planning stage, identify local recycling and salvage operations that could process site-related construction and demolition materials. Provide salvage, reuse and recycling services for waste generated from major renovations, where markets or onsite recycling opportunities exist. During construction, recycle or salvage at least 50 percent of the non-hazardous construction, demolition and land clearing materials, excluding soil, where markets or onsite recycling opportunities exist.	HPSB Guidance
Requirement Source Document(s):	Federal Leadership in High Performance and Sustainable Buildings MOU	
LEED Credit(s) aligns closely with HPSB:	None	
LEED Credit(s) meet HPSB:	LEED MR Credit 2.1: Construction Waste Management	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
HPSB V.6: Ozone Depleting Compounds	Eliminate the use of ozone depleting compounds during and after construction where alternative environmentally preferable products are available, consistent with either the Montreal Protocol and Title VI of the Clean Air Act Amendments of 1990, or equivalent overall air quality benefits that take into account lifecycle impacts.	HPSB Guidance
Requirement Source Document(s):	Federal Leadership in High Performance and Sustainable Buildings MOU	
LEED Credit(s) aligns closely with HPSB:	LEED EA Credit 4: Enhanced Refrigerant Management	LEED(R) for New Construction & Major Renovations 2009 - Nov 2008
LEED Credit(s) meet HPSB:	LEED EA Prerequisite 3: Fundamental Refrigerant Management	

ATTACHMENT 4

APPLYING LEED™ 2009, NC PRINCIPLES TO AIR FORCE HORIZONTAL CONSTRUCTION*

Project Checklist

Sustainable Sites			6 Possible Points
	Prereq 1	Construction Activity Pollution Prevention	Required
	Credit 1	Site Selection	1
	Credit 3	Brownfield Redevelopment	1
	Credit 5.1	Site Development - Protect or Restore Habitat	1
	Credit 6.1	Stormwater Design - Quantity Control	1
	Credit 6.2	Stormwater Design - Quality Control	1
	Credit 8	Light Pollution Reduction	1
Water Efficiency			4 Possible Points
	Credit 1	Water Efficient Landscaping	2-4
Materials & Resources			8 Possible Points
	Credit 2	Construction Waste Management	1-2
	Credit 3	Materials Reuse	1-2
	Credit 4	Recycled Content	1-2
	Credit 5	Regional Materials	1-2
Innovation & Design Process			6 Possible Points
	Credit 1.1	Innovation in Design	1
	Credit 1.2	Innovation in Design	1
	Credit 1.3	Innovation in Design	1
	Credit 1.4	Innovation in Design	1
	Credit 1.5	Innovation in Design	1
	Credit 2	LEED Accredited Professional	1
Regional Priority			4 Possible Points
	Credit 1.1	Regional Priority	1
	Credit 1.2	Regional Priority	1
	Credit 1.3	Regional Priority	1
	Credit 1.4	Regional Priority	1
Project Totals			28 Possible Points

* Projects may pursue other LEED 2009, NC credits, not listed, towards meeting benchmark.

APPLYING LEED™ 2009, NC PRINCIPLES TO AIR FORCE HORIZONTAL CONSTRUCTION

MET BENCHMARK LEVELS

Certified	7 - 8 points
Silver	9 - 10 points
Gold	11 - 13 points
Platinum	14 - 28 points

ATTACHMENT 5

APPLYING LEED™ 2009, NC PRINCIPLES TO AIR FORCE UTILITY CONSTRUCTION*

Project Checklist

Sustainable Sites		7 Possible Points
Prereq 1	Construction Activity Pollution Prevention	Required
Credit 1	Site Selection	1
Credit 3	Brownfield Redevelopment	1
Credit 5.1	Site Development - Protect or Restore Habitat	1
Credit 5.2	Site Development - Maximize Open Space	1
Credit 6.1	Stormwater Design - Quantity Control	1
Credit 6.2	Stormwater Design - Quality Control	1
Credit 8	Light Pollution Reduction	1
Water Efficiency		4 Possible Points
Credit 1	Water Efficient Landscaping	2-4
Materials & Resources		2 Possible Points
Credit 2	Construction Waste Management	1-2
Innovation & Design Process		6 Possible Points
Credit 1.1	Innovation in Design	1
Credit 1.2	Innovation in Design	1
Credit 1.3	Innovation in Design	1
Credit 1.4	Innovation in Design	1
Credit 1.5	Innovation in Design	1
Credit 2	LEED Accredited Professional	1
Regional Priority		4 Possible Points
Credit 1.1	Regional Priority	1
Credit 1.2	Regional Priority	1
Credit 1.3	Regional Priority	1
Credit 1.4	Regional Priority	1
Project Totals		23 Possible Points

* Projects may pursue other LEED 2009, NC credits, not listed, towards meeting benchmark.

APPLYING LEED^{TM} 2009, NC PRINCIPLES TO AIR FORCE UTILITY CONSTRUCTION

MET BENCHMARK LEVELS

Certified	5 – 6 points
Silver	7 – 8 points
Gold	9 – 10 points
Platinum	11 – 23 points

ATTACHMENT 6

APPLYING LEED^{TM} 2009, NC PRINCIPLES TO AIR FORCE INDUSTRIAL FACILITIES*

Project Checklist

Sustainable Sites		15 Possible Points
Prereq 1	Construction Activity Pollution Prevention	Required
Credit 1	Site Selection	1
Credit 3	Brownfield Redevelopment	1
Credit 4.2	Alternative Transportation - Bicycle Storage & Changing Rm	1
Credit 4.3	Alternative Transportation - Low Emitting & Fuel Efficient Vehicles	3
Credit 4.4	Alternative Transportation - Parking Capacity	2
Credit 5.1	Site Development - Protect or Restore Habitat	1
Credit 5.2	Site Development: Maximize Open Space	1
Credit 6.1	Stormwater Design - Quantity Control	1
Credit 6.2	Stormwater Design - Quality Control	1
Credit 7.1	Heat Island Effect - Non-Roof	1
Credit 7.2	Heat Island Effect - Roof	1
Credit 8	Light Pollution Reduction	1
Water Efficiency		10 Possible Points
Prereq	Water Use Reduction – 20% Reduction	Required
Credit 1	Water Efficient Landscaping	2-4
Credit 2	Innovative Wastewater Technologies	2
Credit 3	Water Use Reduction	2-4
Energy and Atmosphere		26 Possible Points
Prereq 1	Fundamental Commissioning of Building Energy Systems	Required
Prereq 2	Minimum Energy Performance	Required
Prereq 3	Fundamental Refrigerant Management	Required
Credit 1	Optimize Energy Performance	1-10
Credit 2	On-Site Renewable Energy	1-7
Credit 3	Enhanced Commissioning	2
Credit 4	Enhanced Refrigerant Management	2
Credit 5	Measurement & Verification	3
Credit 6	Green power	2
Materials & Resources		14 Possible Points
Prereq 1	Storage & Collection of Recyclables	Required
Credit 1.1	Building Reuse - Maintain Existing Walls, Floor & Roof	1-3
Credit 1.2	Building Reuse - Maintain 50% Interior Non-Structural	

	Elements	1
Credit 2	Construction Waste Management	1-2
Credit 3	Materials Reuse	1-2
Credit 4	Recycled Content	1-2
Credit 5	Regional Materials	1-2
Credit 6	Rapidly Renewable Materials	1
Credit 7	Certified Wood	1
Indoor Environmental Quality		10 Possible Points
Prereq 1	Minimum IAQ Performance	Required
Prereq 2	Environmental Tobacco Smoke (ETS) Control	Required
Credit 1	Outdoor Air Delivery Monitoring	1
Credit 2	Increased Ventilation	1
Credit 3.1	Construction IAQ Management Plan - During Occupancy	1
Credit 3.2	Construction IAQ Management Plan - Before Occupancy	1
Credit 4.1	Low-Emitting Materials - Adhesives & Sealants	1
Credit 4.2	Low-Emitting Materials - Paints & Coatings	1
Credit 4.3	Low-Emitting Materials - Carpet Systems	1
Credit 4.4	Low-Emitting Materials - Composite Wood & Agrifiber Products	1
Credit 5	Indoor Chemical & Pollutant Source Control	1
Credit 8.1	Daylight & Views – Daylight	1
Innovation & Design Process		6 Possible Points
Credit 1.1	Innovation in Design	1
Credit 1.2	Innovation in Design	1
Credit 1.3	Innovation in Design	1
Credit 1.4	Innovation in Design	1
Credit 1.5	Innovation in Design	1
Credit 2	LEED Accredited Professional	1
Regional Priority		4 Possible Points
Credit 1.1	Regional Priority	1
Credit 1.2	Regional Priority	1
Credit 1.3	Regional Priority	1
Credit 1.4	Regional Priority	1
Project Totals		85 Possible Points

* Projects may pursue other LEED2009, NC credits, not listed, towards meeting benchmark.

APPLYING LEED^{TM} 2009, NC PRINCIPLES TO AIR FORCE INDUSTRIAL FACILITIES

MET BENCHMARK LEVELS

Certified	30 - 37 points
Silver	38 - 44 points
Gold	45 - 59 points
Platinum	60 - 85 points

ATTACHMENT 6

APPLYING LEED™ 2009, NC PRINCIPLES TO AIR FORCE INDUSTRIAL FACILITIES*

Project Checklist

Sustainable Sites			15 Possible Points
	Prereq 1	Construction Activity Pollution Prevention	Required
	Credit 1	Site Selection	1
	Credit 3	Brownfield Redevelopment	1
	Credit 4.2	Alternative Transportation - Bicycle Storage & Changing Rm	1
	Credit 4.3	Alternative Transportation - Low Emitting & Fuel Efficient Vehicles	3
	Credit 4.4	Alternative Transportation - Parking Capacity	2
	Credit 5.1	Site Development - Protect or Restore Habitat	1
	Credit 5.2	Site Development: Maximize Open Space	1
	Credit 6.1	Stormwater Design - Quantity Control	1
	Credit 6.2	Stormwater Design - Quality Control	1
	Credit 7.1	Heat Island Effect - Non-Roof	1
	Credit 7.2	Heat Island Effect - Roof	1
	Credit 8	Light Pollution Reduction	1
Water Efficiency			10 Possible Points
	Prereq	Water Use Reduction – 20% Reduction	Required
	Credit 1	Water Efficient Landscaping	2-4
	Credit 2	Innovative Wastewater Technologies	2
	Credit 3	Water Use Reduction	2-4
Energy and Atmosphere			26 Possible Points
	Prereq 1	Fundamental Commissioning of Building Energy Systems	Required
	Prereq 2	Minimum Energy Performance	Required
	Prereq 3	Fundamental Refrigerant Management	Required
	Credit 1	Optimize Energy Performance	1-10
	Credit 2	On-Site Renewable Energy	1-7
	Credit 3	Enhanced Commissioning	2
	Credit 4	Enhanced Refrigerant Management	2
	Credit 5	Measurement & Verification	3
	Credit 6	Green power	2
Materials & Resources			14 Possible Points
	Prereq 1	Storage & Collection of Recyclables	Required
	Credit 1.1	Building Reuse - Maintain Existing Walls, Floor & Roof	1-3
	Credit 1.2	Building Reuse - Maintain 50% Interior Non-Structural	

		Elements	1
	Credit 2	Construction Waste Management	1-2
	Credit 3	Materials Reuse	1-2
	Credit 4	Recycled Content	1-2
	Credit 5	Regional Materials	1-2
	Credit 6	Rapidly Renewable Materials	1
	Credit 7	Certified Wood	1
Indoor Environmental Quality			10 Possible Points
	Prereq 1	Minimum IAQ Performance	Required
	Prereq 2	Environmental Tobacco Smoke (ETS) Control	Required
	Credit 1	Outdoor Air Delivery Monitoring	1
	Credit 2	Increased Ventilation	1
	Credit 3.1	Construction IAQ Management Plan - During Occupancy	1
	Credit 3.2	Construction IAQ Management Plan - Before Occupancy	1
	Credit 4.1	Low-Emitting Materials - Adhesives & Sealants	1
	Credit 4.2	Low-Emitting Materials - Paints & Coatings	1
	Credit 4.3	Low-Emitting Materials - Carpet Systems	1
	Credit 4.4	Low-Emitting Materials - Composite Wood & Agrifiber Products	1
	Credit 5	Indoor Chemical & Pollutant Source Control	1
	Credit 8.1	Daylight & Views – Daylight	1
Innovation & Design Process			6 Possible Points
	Credit 1.1	Innovation in Design	1
	Credit 1.2	Innovation in Design	1
	Credit 1.3	Innovation in Design	1
	Credit 1.4	Innovation in Design	1
	Credit 1.5	Innovation in Design	1
	Credit 2	LEED Accredited Professional	1
Regional Priority			4 Possible Points
	Credit 1.1	Regional Priority	1
	Credit 1.2	Regional Priority	1
	Credit 1.3	Regional Priority	1
	Credit 1.4	Regional Priority	1
Project Totals			85 Possible Points

* Projects may pursue other LEED2009, NC credits, not listed, towards meeting benchmark.

APPLYING LEED™ 2009, NC PRINCIPLES TO AIR FORCE INDUSTRIAL FACILITIES

MET BENCHMARK LEVELS

Certified	30 - 37 points
Silver	38 - 44 points
Gold	45 - 59 points
Platinum	60 - 85 points

Attachment 7 - Implementing Guidance to Meet EISA 2007 Section 438 Requirements

Applicability. This guidance applies to projects that construct facilities with a footprint greater than 5,000 gross square feet, or expand the footprint of existing facilities by more than 5,000 gross square feet (See DoD policy memorandum, 19 Jan 2010, Subject: DoD Implementation of Storm Water requirements under Section 438 of the Energy Independence and Security Act (EISA) for details). If any DoD or other federal agency has an applicable construction project on Air Force installations, they will comply with this guidance. Air Force overseas installations and activities will strive to achieve Low Impact Development (LID) approaches consistent with applicable host nation requirements and in accordance with the host nation Final Governing Standards (FGS), Overseas Environmental Baseline Guidance Document (OEBGD) or applicable international agreements, e.g., Staus of Force Agreements.

Estimating pre- and post-development hydrologic parameters. Air Force planners and designers and Construction Agents use standard engineering practices to estimate development hydrologic parameters. Unified Facilities Criteria 3-230-01 1 Aug 2006, Surface Drainage Design reviews three methods appropriate to the scope of EISA 2007 Section 438 compliance. These are: 1) the rational method, 2) National Resource Conservation Service (formerly Soil Conservation Service) technical release 55 (TR-55) method, and 3) the U.S. Geological Survey (USGS) regression equations. Planners and designers should choose a method that is practical and appropriate to the scope of the project. For example, watershed continuous models like EPA's BASINS and HSPF would not typically be appropriate.

Maximum Extent Technically Feasible (METF). Restoring predevelopment hydrology can be difficult to achieve and Congress recognized this potential difficulty by including the METF language in the statute. For projects where technical infeasibility exists, document and quantify that storm water strategies, such as infiltration, evapotranspiration, and harvesting were employed to the METF. If the design objective cannot be met within in the project footprint, LID measures may be applied at nearby locations on DoD property (e.g., downstream from the project) within available resources. The land surrounding the project site is available to implement the appropriate Green Infrastructure (GI)/LID practices where optimal. Although the performance requirements of EISA Section 438 apply only to the project footprint, the flexibility exists to utilize the entire federal property in implementing the storm water strategies for the project.

Documentation: All site-specific technical constraints that limit the full attainment of the design objective shall be documented and retained in the project record. Documentation of technical infeasibility should include, but may not be limited to, engineering calculations, geologic reports, hydrologic analyses, and site maps. The installation construction project engineer validates the designer has met METF.

Retention / Detention Ponds. Any construction of permanent retention or detention ponds is strongly discouraged. If retention/ detention option is selected, written documentation for options considered and justification for the choice should be included in the design analysis, Additionally Bird Aircraft Strike Hazard (BASH) as well as other storm water management, maintenance and real property issues should be addressed. Where cost effective and allowed, LID measures should consider on site reuse of storm water for landscape/irrigation purpose to meet the water conservation requirements of EO 13514.

Post-construction analysis: Installations verify the effectiveness of as-built storm water features by periodic site visits to document the storm water LID systems and practices are functioning as intended.

INSTRUCTIONS FOR ACES-PM INPUTS FOR EISA 2007 SECTION 438

In the unique field of an applicable project input the words "EISA 438." In the Value field input one of the following:

Unique Field Value Input	Definition
YES	This project is a federal project with a footprint greater than 5,000 SF and **can** demonstrate with documentation the project maintains or restores, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow. Alternatively the installation may report project compliance with this metric by reporting completion of an installation-wide stormwater management hydrology evaluation that defines the installation pre-development condition and demonstrates through established hydrology methods and tools the post-development parameters of temperature, rate, volume and duration of storm water flow do not exceed pre-development parameters at the federal property boundary to the maximum extent technically feasible.
NO	This project is a federal project with a footprint greater than 5,000 SF and **cannot** demonstrate with documentation that storm water design objectives were met through practices that infiltrate, evapotranspire and/or harvest and use the rainfall to the maximum extent technically feasible.

If a project is not applicable to EISA 2007 Section 438 no Unique Field data inputs are required.

UFC 3-210-10
15 NOVEMBER 2010

UNIFIED FACILITIES CRITERIA (UFC)

LOW IMPACT DEVELOPMENT

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by \1\ ... /1/)

Change No.	Date	Location

This UFC supersedes UFC 3-210-10, dated 25 October 2004, UFC 3-210-10N (DRAFT) and ITG FY10-2, both dated 6 April 2010.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD(AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the more stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Center for Engineering and the Environment (AFCEE) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request (CCR). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.

JAMES C. DALTON, P.E. Chief, Engineering and Construction U.S. Army Corps of Engineers	JOSEPH E. GOTT, P.E. Chief Engineer Naval Facilities Engineering Command
TERRY G. EDWARDS, P.E. Director, Air Force Center for Engineering and the Environment Department of the Air Force	MICHAEL McANDREW Director, Facility Investment and Management Office of the Deputy Under Secretary of Defense (Installations and Environment)

UNIFIED FACILITIES CRITERIA (UFC)
REVISION SUMMARY SHEET

Document: **UFC 3-210-10, Low Impact Development**

Superseding: This UFC supersedes UFC 3-210-10, dated 25 October 2004, UFC 3-210-10N and ITG FY1-0-2, both dated 6 April 2010.

Description of Changes: This update to UFC 3-210-10 presents criteria necessary to comply with new policy and legislation regarding implementation of Section 438 of the Energy Independence and Security Act 2007. These changes are required to handle stormwater runoff from development or redevelopment projects involving a Federal facility with a footprint that exceeds 5,000 square feet.

Reasons for Changes:

- In December 2007, Congress enacted the Energy Independence and Security Act (EISA). Section 438 of that legislation establishes stormwater runoff requirements for Federal development and redevelopment projects.

- A January 2010 Deputy Under Secretary of Defense, Installation and Environment (DUSD(IE)) memorandum directs DoD components to implement EISA Section 438 using LID techniques. The memorandum directs the policy be incorporated into applicable DoD Unified Facilities Criteria.

Impacts: Sites with available land and good vegetative cover and soil conditions may see a net reduction in site civil construction costs. Highly developed sites with fair to poor soils may see increased costs for LID implementation. However, the following benefits should be realized.

- Standardized criteria will provide a simple, uniform approach to assist the Services in complying with the Energy Independence and Security Act (EISA) Section 438 requirements.
- While care must be taken to ensure a shift in design paradigms, LID techniques can be used to manage site civil costs.
- Newer site design philosophies will provide additional treatment and control at a localized level. Low Impact Development techniques work alongside the current stormwater management approach to provide a micro-view of handling runoff at its source or point of origination, to mitigate adverse impacts from stormwater runoff and hold the net increase in stormwater runoff in the LID facilities provided on-site.
- Low Impact Development (LID) will help to protect natural resources from continuing degradation.

TABLE OF CONTENTS

LIST OF FIGURES

APPENDIX B

LIST OF TABLES

CHAPTER 1- INTRODUCTION

1-1 PURPOSE AND SCOPE

This UFC provides technical criteria, technical requirements, and references for the planning and design of applicable projects to comply with stormwater requirements under Section 438 of the Energy Independence and Security Act (EISA) enacted in December 2007 (hereafter referred to as EISA Section 438).

1-2 DEFINITION OF LOW IMPACT DEVELOPMENT

Low Impact Development (LID) is a stormwater management strategy designed to maintain site hydrology and mitigate the adverse impacts of stormwater runoff and nonpoint source pollution.

LID actively manages stormwater runoff by mimicking a project site's pre-development hydrology using design techniques that infiltrate, store, and evaporate runoff close to its source of origin. LID strategies provide decentralized hydrologic source control for stormwater runoff. In short, LID seeks to manage the rain, beginning at the point where it falls. This is done through a series of techniques that are referred to as LID Integrated Management Practices (LID-IMPs). The LID-IMPs are distributed small scale controls that closely mimic hydrological behavior of the pre-project sites for a design storm event.

1-3 APPLICABILITY

The criteria and design standards in this UFC are required for all Department of Defense construction in the United States and United States Territories.

EISA Section 438 requirements apply to projects that construct facilities with a "footprint" greater than 5,000 gross square feet, or expand the footprint of existing facilities by more than 5,000 gross square feet. The project "footprint" consists of all horizontal hard surfaces and disturbed areas associated with the project development, including both building area and pavements (such as roads, parking, and sidewalks). These requirements do not apply to internal renovations, maintenance, or resurfacing of existing pavements.

Where EISA Section 438 is not applicable (e.g., projects under 5,000 square feet), LID techniques apply to the extent practical.

1-4 REFERENCES

Appendix A contains the list of references used in this document.

CHAPTER 2 - POLICY AND GENERAL REQUIREMENTS

2-1 STATUTORY REQUIREMENT

EISA Section 438 established into law new stormwater design requirements for Federal development and redevelopment projects. Under these requirements, Federal projects with a footprint over 5,000 square feet must "maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow".

2-2 DOD POLICY

The Deputy Under Secretary of Defense (Installations and Environment) memorandum of 19 January 2010 (Appendix C) directs DoD components to implement EISA Section 438 using LID techniques in accordance with the methodology illustrated in Figure 1 and further described below. In addition, this policy memo references U.S. Environmental Protection Agency (EPA) *Technical Guidance on Implementing the Stormwater Runoff requirements for Federal Projects under Section 438 of the Energy Independence and Security Act.* Individual Services may have more stringent implementation and applicability requirements relating to Low Impact Development.

2-2.1 Establishing Design Objective and Pre-Development Condition

The overall design objective for each applicable project is to maintain predevelopment hydrology and prevent any net increase in stormwater runoff. DoD defines "predevelopment hydrology" as the pre-project hydrologic conditions of temperature, rate, volume, and duration of stormwater flow from the project site. The analysis of the predevelopment hydrology must include site-specific factors (such as soil type, ground cover, and ground slope) and use modeling or other recognized tools to establish the design objective for the water volume to be managed from the project site.

The increase in runoff between pre- and post-development conditions is to be managed on the project site, to the maximum extent technically feasible, through interception, infiltration, storage, and/or evapotranspiration processes. Other design requirements may need to be considered.

2-2.2 Maximum Extent Technically Feasible

The designer shall evaluate project site options to achieve the design objective to the maximum extent technically feasible. The "maximum extent technically feasible" criterion requires full employment of accepted and reasonable stormwater retention and reuse technologies (further described in Chapter 3) subject to site and applicable regulatory constraints (e.g., site size, soil types, vegetation, demand for recycled water, existing structural limitations, state or local prohibitions on water collection). All site-specific technical constraints that limit the full attainment of the design objective shall be documented. If the design objective cannot be met within the project footprint, LID measures may be applied at nearby locations on DoD property (e.g., downstream from the project) within available resources. Examples of technical constraints are as follows:

- Retaining stormwater on-site would adversely impact receiving water flows
- Site has shallow bedrock, contaminated soils, high groundwater table, underground

facilities or utilities
- Soil infiltration capacity is limited
- Site is too small to infiltrate significant volume
- Non-potable water demand (irrigation, toilets, wash-water, etc.) is too small to warrant water harvesting and reuse system
- Structural, plumbing, and other modifications to existing building to manage stormwater are infeasible
- State or local regulations restrict water harvesting
- State or local regulations restrict use of green infrastructure/LID.

2-2.3 Restoration of Natural Hydrological Conditions

The designer shall consult with the government representative to determine whether natural hydrological conditions of the property can be restored, to the extent practical.

2-2.4 Documentation of Project Costs

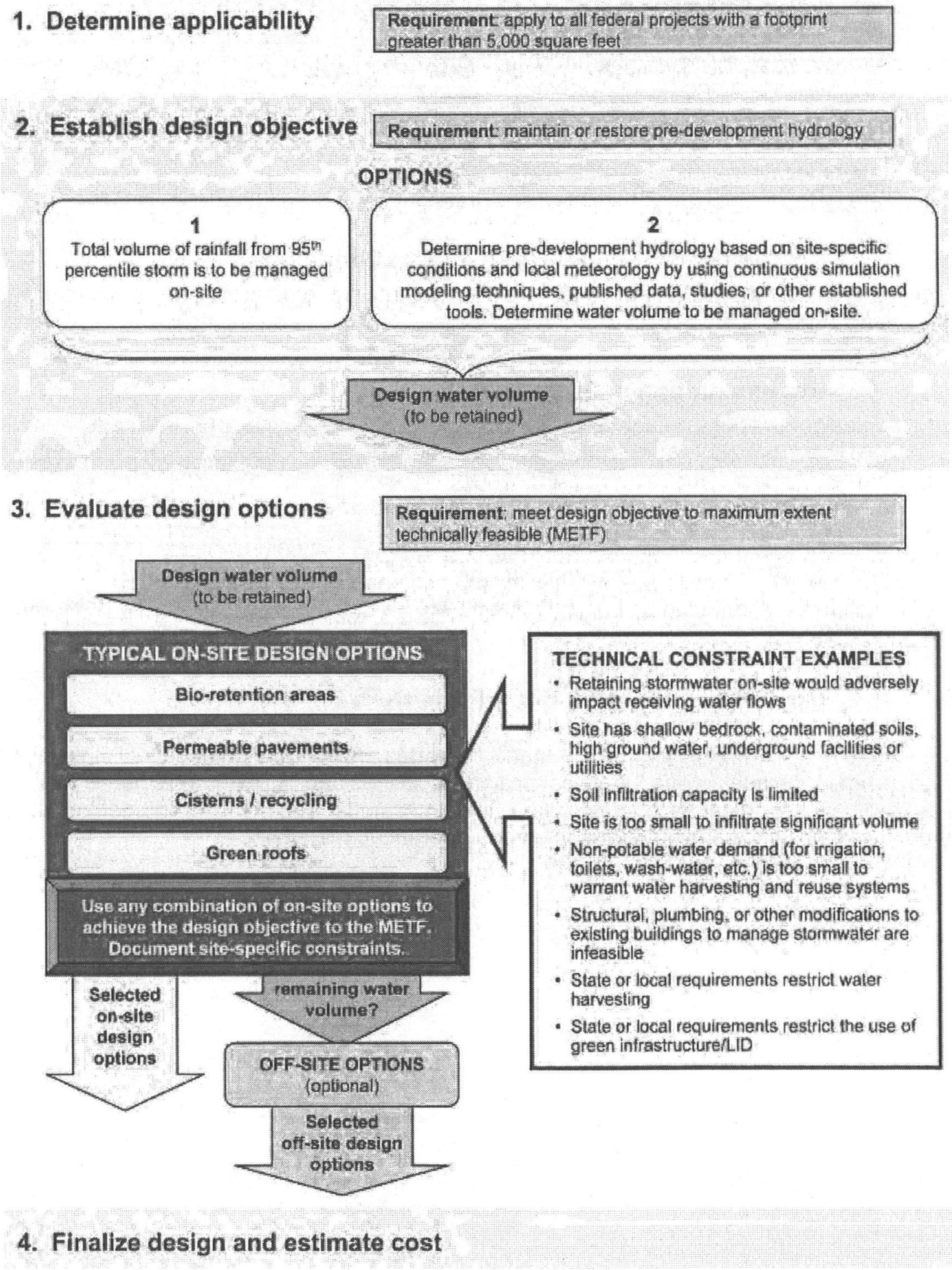
Estimated design and construction costs for implementing EISA Section 438 shall be documented in the project cost estimate as a separate line item. Final implementation costs will be documented as part of the project historical file.

Post-construction analysis shall also be conducted to validate the effectiveness of as-built stormwater features. For compliance the Designer of Record (DOR) shall provide documentation to validate the as-built LID-integrated management practices (IMP) meet the design requirements and analyses.

2-3 GENERAL BUILDING REQUIREMENTS

UFC 1-200-01, General Building Requirements, provides applicability of model building codes and government-unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, sustainability, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

FIGURE 1: IMPLEMENTATION OF EISA SECTION 438



EPA-BAFB-0000970

CHAPTER 3 – PLANNING AND DESIGN

3-1 HYDROLOGIC ANALYSIS & RECOMMENDED TR-55 METHODOLOGY

DoD policy specifies that the designer is to determine pre-development hydrology based on site-specific conditions and local meteorology by using continuous simulation modeling techniques, published data, studies, or other established tools. The designer would then identify the pre-development condition of the site and quantify the post-development runoff volume and peak flow discharges that are equivalent to pre-development conditions. The post-construction rate, volume, duration and temperature of runoff should not exceed the pre-development rates and the redevelopment hydrology should be replicated through site design and other appropriate practices to the maximum extent technically feasible. These goals should be accomplished through the use of infiltration, evapotranspiration, rainwater harvesting and/or other proven LID techniques. Defensible and consistent hydrological assessment tools should be used and documented.

Service components may use a methodology or standard practice for estimating surface hydrology. These methods include, but or not limited to, Soil Conservation Service (SCS) weighted flow, the rational formula, or a dynamic rainfall-runoff simulation model like the EPA's Storm Water Management Model (SWMM). Models developed for watershed nonpoint source analysis like EPA's Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) should not be used for this type of hydrologic analysis.

To control the stormwater volume in accordance with DoD policy, the use of methodology from TR-55 Curve Number Methodology (SCS 1986), Chapter 2: "Estimating Runoff" is recommended. Calculate the runoff depth for both the pre- and post-development conditions, and the difference will be the depth from which the volume to be retained on-site can be determined (see equation 2 below).

This methodology is likely the most efficient and practical for designers to comply with EISA Section 438 requirements. Therefore, details of this methodology have been summarized in the following paragraphs.

During a storm event a portion of the precipitation is caught in the form of interception, depression storage, evaporation, transpiration, and infiltration. These losses are collectively referred to as *abstractions*. Only that part of the rainfall in excess of abstractions is defined as stormwater runoff.

The Soil Conservation Service (SCS 1986), now the Natural Resources Conservation Service (NRCS), presented an empirical method of determining initial abstraction based on the runoff curve number (CN) of the site and is given by:

EQUATION 1: Initial abstraction (inches), $I_a = 0.2*S$

Where S = potential maximum retention after <u>runoff</u> begins (inches) = $\frac{1000}{CN} - 10$

The initial abstraction defined in Eq. 1 also represents the rainfall at which the direct runoff begins. Any rainfall over and above the initial abstraction results in direct surface runoff.

EQUATION 2: Total depth of increase in runoff (inches), $D = \frac{(P-0.2*S')^2}{(P+0.8*S')} - \frac{(P-0.2*S)^2}{(P+0.8*S)}$

Where, P = design storm rainfall depth (inches)

S & S' = potential maximum retention after <u>runoff</u> begins (inches) during the pre- and post-development conditions, respectively

Note: Eq. 2 is valid if P > 0.2*S. Otherwise, the term calculating the runoff depth

$$\frac{(P-0.2*S)^2}{(P+0.8*S)} = 0$$

D= the depth of rainfall that becomes runoff

EQUATION 3: The design storage, $V_{LID} = D * A$

D = total depth of increase in stormwater runoff (inches)

A = drainage area or the area of the parcel being developed (square units)

The design storage of LID-IMP features, calculated using Equation 3, ensures no net increase in stormwater runoff volume for the design rainfall event replicating pre-development hydrology.

Additional details on hydrologic analysis are located in Appendix B – Low Impact Development Best Practices, Chapter 4.

3-2 DESIGN OPTIONS FOR LID INTEGRATED MANAGEMENT PRACTICES

The site designer shall give priority to those LID-IMPs that are proven in their regional area to have the greatest cost benefit ratio and lowest lifecycle costs. Highly developed sites, sites with a high ratio of impervious to pervious area, industrial sites, and airfield projects may require more costly, higher maintenance LID-IMPs in order to meet LID goals within the constraint of maximum extent technically feasible (see section 2-2.2).

The designer shall verify with the Installation the capability to maintain LID-IMPs prior to selecting for use on-site. LID-IMPs that cannot be maintained by the Installation with current capability and contract capacity shall require approval prior to construction.

LID-IMPs can be categorized in four main categories:

3-2.1 Bioretention

Natural type depression storage, infiltration, and evapotranspiration. This design option is typically the least costly and easiest to accomplish if site availability, soils, water table, etc. are conducive. Other site treatments such as swales, rain gardens, open space, etc. fall under this general category and are advisable due to lower initial costs.

3-2.2 Permeable Pavements

Provide infiltration and prevent concentrated flow. Permeable pavements (including pavers) are the next most cost effective method of meeting the design goals. Limitations on the use of these design options are wheel loading, traffic, ability to maintain, FOD danger, etc.

3-2.3 Cisterns/Recycling

Re-use systems that store and re-use stormwater. This design option is preferable if adequate demands for reuse water exist. Many facilities do not have the potential for reuse to make this option cost effective.

3-2.4 Green Roofs

Limit peak discharges and seasonal evapotranspiration. Green roofs are a design option where the site is constrained by space limitations and other design options do not meet the design goals. Green roofs should be assessed with consideration of other benefits such as lower energy costs.

3-3 TIME OF CONCENTRATION FOR PRE- AND POST-DEVELOPMENT CONDITIONS

In order to mimic pre-project hydrologic patterns the site designer needs to provide features that limit the rate at which runoff leaves the site. To the maximum extent technically feasible, the post-development time of concentration (T_c) must be equal to or greater than the pre-development T_c.

Maintaining T_c close to pre-development conditions is critical because the peak runoff rate, and thereby the volume of runoff from individual lots, is inversely proportional to the time of concentration. The T_c shall be maintained to the maximum extent technically feasible, by strategies such as reduction of impervious areas, maintaining natural vegetation, siting of impervious areas in poor draining soils, and disconnecting impervious areas.

3-3.1 Stormwater Flow Segments

The Soil Conservation Services TR-55 Curve Number Methodology (SCS, 1986) is well documented and is used widely in engineering practice and may be used to determine the T_c (other computerized methods based on site-specific conditions and acceptable to the local regulating authority may also be used). The method presumes that rainfall-runoff moves through a watershed as sheet flow, shallow concentrated flow, pipe/channel flow, or some combination of these. The time of concentration T_c is the sum of travel flow times calculated separately for the consecutive flow segments along the longest flow path. These three flow segments along with their implications on time of concentration are discussed separately. Typical site design shall use SCS TR-55 Manual: *Urban Hydrology for Small Watersheds* for calculating time of concentration. Other methods may be used for larger more complex sites.

3-4 DESIGN STORM EVENT

The design storm event shall be the 95th percentile rainfall depth or the required water quality depth as defined by State or local requirements, whichever is more stringent. Most Local and State stormwater regulations include a first-flush or water quality depth for 2-, 5-, 10-, 25-, 50-, or 100-year regulated storm events. The LID-IMPs shall be designed to control all regulated storm events, as stipulated by Local and State regulations, to handle the peak rate and/or volume of discharge for flood control purposes.

3-5 OFF-SITE OPTIONS

If the design goals objectives cannot be met within the project footprint, LID measures may be applied at nearby locations on DoD property (e.g.downstream from the project) to manage the remaining design water volume within available resources. Off-site options are generally less desirable than on-site options, as many of the benefits of managing the stormwater close to the source may be lost.

3-6 CLEAN WATER ACT PERMITS

Any applicable State and local requirement for stormwater management shall be met in addition to UFC requirements. State stormwater construction permits required under the Clean Water Act shall be obtained using their approved methodology. Coordination of the design is the responsibility of the site designer to insure that the criteria are met from both the regulatory and LID perspectives.

EISA Section 438 requirements are independent of stormwater requirements under the Clean Water Act. The DUSD (IE) EISA Section 438 policy directive (Appendix C) states, "EISA Section 438 requirements are independent of stormwater requirements under the Clean Water Act and should not be included in permits for stormwater unless a state (or EPA) has promulgated regulations for certain EISA Section 438 requirements (i.e., temperature/heat criteria) that are applicable to all regulated entities under its Clean Water Act authority."

3-7 OTHER DESIGN REQUIREMENTS

3-7.1 Regional Requirements

Regional regulatory requirements may affect the design of specific LID elements and practices as defined herein. LID implementation goals are achieved by selecting a set of LID-IMPs that can closely maintain or replicate hydrological behavior of the pre-project site for the design storm event. Most LID-IMPs are distributed small-scale controls that increase rainfall interception and slow the time of concentration. The design for LID-IMPs to be incorporated shall meet the stated goals (i.e. water volume design objectives) for compliance with EISA Section 438 per the DUSD(IE) memorandum in Appendix C.

For design of LID-IMPs to meet EISA 438 design objectives, the site designer shall refer to State and Local standards where available. In the absence of State and Local standards for design of LID-IMPs, refer to the LID National Manuals guidance prepared by the Prince George's County, Maryland, Department of Environmental Resources Programs and Planning Division (PGDER), and information provided by the US EPA.

3-7.2 Sustainable Design

Site design should incorporate sustainable development concepts to reduce energy consumption, O&M costs, reduce waste, and reduce pollution. Refer to UFC 4-030-01, *Sustainable Development* for specific design guidance.

3-7.3 Architectural Compatibility

LID-IMP facilities shall comply with DoD and Activity requirements and surrounding base architecture. Compliance with this UFC must be in accordance with other directives such as the new DoD Architectural Barriers Act (ABA) Accessibility Standard and Access for People with Disabilities Memorandum dated Oct. 31, 2008. In addition, LID design must follow applicable industry practice standards and locally restrictive building codes (e.g., earthquake zones).

3-7.4 Base Design and Development Documents

The intent of Installation Master Planning shall be incorporated into designs. The site designer shall follow published design guidelines that contain criteria relative to achieving, maintaining, and emphasizing a positive exterior visual environment applicable to military installations. The site designer shall consult the Project Manager for direction in case of conflicts. Direction to deviate from these documents should be given in writing.

3-7.5 Anti-Terrorism (AT)

The design of LID-IMP facilities shall comply with UFC 4-010-01, *DoD Minimum Antiterrorism Standards For Buildings* and UFC 4-010-02, *DoD Minimum Antiterrorism Standoff Distances For Buildings*. When conflicts arise between this document and UFC 4-010-01 or 4-010-02, UFCs 4-010-01 and 4-010-02 take precedence.

3-7.6 Airfield Criteria

The design of LID-IMP facilities shall comply with UFC 3-260-01, *Airfield and Heliport Planning and Design*. When conflicts arise between this document and UFC 3-260-01, UFC 3-260-01 takes precedence.

APPENDIX A – REFERENCES

1. U.S. EPA Technical Guidance on Implementing Section 438 of the Energy Independence and Security Act, December 2009.

2. Unified Facilities Criteria

UFC 3-200-10N	*Civil Engineering,* Final Draft
UFC 3-201-02	*Landscape Architecture*
UFC 4-010-01	*DoD Minimum Antiterrorism Standards For Buildings*
UFC 4-010-02	*DoD Minimum Antiterrorism Standoff Distances For Buildings*
UFC 4-030-01	*Sustainable Development*

3. Department of the Navy Low Impact Development (LID) Policy for Storm Water Management, *Assistant Secretary of the Navy (Installations and Environment) Memorandum,* November 2007

4. NAVFAC INSTRUCTIONS 9830.1: Sustainable Development Policy.

5. Low-Impact Development Design Strategies, An Integrated Design Approach, *Prince George's County, Maryland, Department of Environmental Resources, Programs and Planning Division*, June 1999.

6. Low-Impact Development Hydrologic Analysis, Prince George's County, *Maryland, Department of Environmental Resources, Programs and Planning Division*, July 1999.

7. Low Impact Development Manual for Michigan, *Southeast Michigan Council of Governments*, 2008.

8. Urban Hydrology for Small Watersheds, TR-55, *Natural Resources Conservation Services*, June 1986 (SCS 1986).

9. Sustainable Building Technical Manual: Green Building Design, Construction, and Operations, *Public Technology, Inc., and the U.S. Green Building Council, 1996.*

10. Urban Hydrology, Hydraulics, and Stormwater Quality, *A. Osman Akan and Robert J. Houghtalen*, 2003.

APPENDIX B – LOW IMPACT DEVELOPMENT BEST PRACTICES

This Best Practices appendix provides additional detail and analysis supporting the criteria and builds process action steps in the Planning, Design, and post-construction stages of project development. In addition, the appendix gives a basic level of understanding for the rationale behind the UFC criteria hydrology and methods of calculation.

The UFC criteria are predicated on standard practices in the field of stormwater management. The design storm event is typically defined by the 95th percentile storm (see also section 3-4 of this UFC). By averaging all storm events that occur within 24 hours for several years, the designer can statistically predict the intensity of a storm that is equal to or less than 95 percent of all storms. The method of calculation for this is taken to be the Natural Resource Conservation Service (NRCS), formerly the Soil Conservation Service (SCS) method TR-55. A site designer can easily hand calculate the necessary information for small sites using formulas given in the criteria. For larger sites, computer calculations and simulation modeling are encouraged.

By design, LID methods do not control runoff in excess of the pre-development condition, but are intended to bypass larger storm volumes to flood control measures as defined by the conventional stormwater management techniques. LID is in addition to the requirements of the stormwater permits required. There are other regulatory requirements that also affect the design of stormwater management, quality, and control that are specific to local regions and areas not covered in this document.

ACRONYMS AND ABBREVIATIONS

Item	Definition
ARC	Antecedent Runoff Condition
Bio	Biological
BMP	Best Management Practice
CN	Curve Number
CWA	Clean Water Act
DoD	Department of Defense
e.g.	for example
EISA	Energy Independence and Security Act
EPA	United States Environmental Protection Agency
Eq.	Equation
FEC	Facilities Engineering Command
hr	hour
HSG	Hydrologic Soil Group
I&E	Installations and Environment
I&F	Installations and Facilities
i.e.	as such
I_a	Initial Abstraction
IMP	Integrated Management Practice
in/hr	inches per hour
LEED	Leadership in Energy and Environmental Design
LID	Low Impact Development
DoD	Department of Defense
MWR	Morale, Welfare, and Recreation
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
O&M	Operations and Maintenance
OMSI	Operation and Maintenance Support Information
PGDER	Prince George's County Department of Environmental Resources
pH	Measure of the acidity of a solution
PWD	Public Works Department
SCS	USDA Soil Conservation Service
sec/hr	seconds per hour
sq ft	square feet
SWM	Stormwater Management
Tc	Time of Concentration
TR-55	NRCS Technical Release 55 (formerly SCS)
UFC	Unified Facilities Criteria
USDA	United States Department of Agriculture

APPENDEX B: CHAPTER 1 - BACKGROUND

Since 2004, LID techniques for controlling stormwater runoff have been considered for many projects based on-site requirements and constraints. LID strategies provide a decentralized hydrologic source control for stormwater. LID implementation is based on selecting LID-IMPs that are distributed small-scale controls that can closely maintain or replicate hydrological behavior of the pre-project site for a defined design storm event. The use of LID was pioneered in the 1990s by Prince George's County, Maryland Department of Environmental Resources (PGDER) under a grant from the Environmental Protection Agency (EPA).

LID differs from conventional SWM principles in that it does not store and release stormwater. LID uses infiltration, evaporation, plant transpiration, and reuse of rainwater to keep the additional stormwater generated due to the developed condition contained on-site.

The application of LID to infrastructure development program is practical and achievable, but it will require a change of thinking on the part of the site designer. The LID-IMPs fall into five categories, as follows:

1) Site Utilization: Begin the site process by reducing the impervious footprint if possible. Narrower streets, vertical construction, parking structures, and the removal of curb, gutter, and paved swales are a few of the ways to reduce impervious surfaces. It is crucial to mimic the pre-development hydrologic conditions in order for LID to be effective. Choose rougher surfaces, disconnect impervious areas, and increase the time of concentration (Tc). Retain as much of the natural tree cover as practical, and place the impervious structures in areas of the poorest soil types where possible.
2) Filtration: Include filtration practices in the site design. Vegetative buffers, filter strips, vegetative swales, check dams, sediment traps, and overland flow will provide natural water quality treatment and increase the time of concentration (Tc).
3) Interception/Infiltration: The infiltration techniques of LID are the backbone of the runoff volume reduction. Depression storage, bio-infiltration, pervious pavements, open pavers, rain gardens, infiltration trenches, and tree boxes are gaining wide acceptance as tools in the SWM toolbox. Interception can also play a major role in reducing runoff volumes. Interception techniques include deep mulch beds, tree cover, and soil amendments.
4) Retention of Stormwater Volumes: Retention can play an important part in successful LID implementation. Retention seeks to hold runoff from localized impervious surfaces for subsequent treatment after the rainfall event. Rain barrels, storage and release cisterns, and parking lot storage that slowly drain to infiltration zones are examples of retention techniques. DoD discourages the construction of detention ponds
5) Structural Solutions: Structural solutions represent the last line of defense in the LID-IMPs. Structural solutions will increase the facility construction cost and must be balanced with mission requirements. In urban and industrial areas, sensitive environments, or known contaminated sites, structural solutions are often the only solution. These techniques are engineered solutions for the particular facility and can include green roofs, rainwater reuse systems, parking structures, and irrigation storage systems.

The site designer is encouraged to contact the Project Manager, Environmental Technical point of contact, State and local regulatory officials to verify the requirements of applicable stormwater programs. Table 1 has a link to NPDES specific State program statuses as granted by EPA. Table 1 also has additional useful links on LID topics by EPA.

A list of LID design reference material is included at the end of Chapter 4. Additional information may be found on the following link to the WBDG LID Resource Page: http://www.wbdg.org/resources/lidtech.php

Table 1: U.S. EPA Websites related to LID

U.S. Environmental Protection Agency

Low Impact Development (LID) is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treats stormwater as a resource rather than a waste product. Many practices have been used to adhere to these principles such as bioretention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavements. By implementing LID principles and practices, water can be managed in a way that reduces the impact of built areas and promotes the natural movement of water within an ecosystem or watershed. Applied on a broad scale, LID can maintain or restore a watershed's hydrologic and ecological functions. LID has been characterized as a sustainable stormwater practice by the Water Environment Research Foundation and others.

Low Impact Development (LID)
http://www.epa.gov/nps/lid/

Stormwater Program
http://cfpub.epa.gov/npdes/home.cfm?program_id=6

Authorization Status for EPA's Stormwater Construction and Industrial Programs
http://cfpub.epa.gov/npdes/stormwater/authorizationstatus.cfm

State Program Status
http://cfpub.epa.gov/npdes/statestats.cfm?view=specific

Managing Wet Weather with Green Infrastructure
http://cfpub.epa.gov/npdes/home.cfm?program_id=298

APPENDIX B: CHAPTER 2 - PLANNING

2-1 THE PLANNING COMPONENT

Successful implementation of LID begins during the planning process, which is one of the first steps. During the planning phase, the exact configuration of LID-IMPs and the ways in which LID will shape the site design is not expected to be determined. This section will provides the organizational tools and steps to build upon in considering LID in the final project.

Each step progresses further into the details of the planning process. For example, budget planning at an early stage may only develop Step 1, then move on to Cost Analysis. Master Planning would necessarily move through Step 4, and preliminary design through Step 6.

2-1.1 ORGANIZING THE PLANNING PROCESS AND TIMELINE

Step 1: *Define project objectives and goals at a macro-level*

1) Identify the LID objectives and legal requirements for the project (e.g., stormwater permits, state erosion control and flood requirements, EISA Section 438). Estimate runoff volume, peak runoff rate, duration, frequency, and water quality.
2) Make assumptions on existing stormwater infrastructure in terms of how well it functions with respect to each of these aspects.
3) Evaluate the goals and feasibility for control of runoff volume, duration, and water quality, as well as on-site use of stormwater (e.g. irrigation, flushing toilets).
4) Prioritize and rank basic objectives.
5) Identify applicable local regulations or codes.
6) Determine Typical LID-IMPs required to meet objectives as best as possible (i.e. infiltration, filtration, discharge frequency, volume of discharges, and groundwater recharge) taking into consideration available space, underground utilities, soil infiltration characteristics, slope, drainage patterns, water table protected areas, setbacks, easements, topographic features, and other site features that should be protected such as floodplains, steep slopes, and wetlands.

Consider non-structural site planning techniques:

- Minimize total site impervious area.
- Use alternative roadway layouts that minimize imperviousness.
- Reduce road widths and drive aisles where safety considerations allow.
- Limit sidewalks to one side of roads.
- Reduce on-street parking
- Use permeable paving materials where it does not reduce the functionality and is permitted.
- Minimize directly connected impervious areas.
- Disconnect roof drains and direct drainage to vegetated areas.
- Site layout to direct flows from paved areas to stabilized vegetated areas.
- Site layout to break up flow directions from large paved surfaces.

> **LID Planning Steps:**
> **Define Project Goals**
> **Evaluate Site**
> **Develop LID Strategies**
> **Assume LID Concept Design**
> **Target O&M Strategy**

- Site development to encourage sheet flow through vegetated areas.
- Locate impervious areas so that they drain to permeable areas.
- Maximize overland sheet flow.
- Maximize use of open swale systems.
- Increase (or augment) the amount of vegetation on the site.
- Use site fingerprinting. Restrict ground disturbance to the smallest possible area
- Reduce construction on highly permeable soils.
- Locate impervious areas to avoid removal of existing trees.
- Maintain existing topography and associated drainage divides to encourage dispersed flow paths.
- Locate new buildings, parking, and ponds in areas that have lower hydrologic function, such as clayey or disturbed soils.

2-2 COST ANALYSIS

One of the most difficult challenges is to properly allocate resources for projects so that they are successful and fulfill the mission as programmed. LID requirements can add a new level of complexity to the project that must be addressed during planning. While it may be too early in the process to determine the exact final design configuration of the LID-IMPs, the information to determine a level of effort required to implement LID can be used. (LID-IMP design is discussed in Appendix B, Chapter 4).

The three resources that must be addressed for LID are:
1) Implementation cost (may be less than traditional)
2) Operation & Maintenance costs (lifecycle)
3) Time impacts to design and permitting process

Information on the project mission must be gathered including; geographical location, site requirements, available sites, programmed space requirements related to increased impervious area, and the ability of the installation to maintain the LID-IMP. These set points will also help to determine the proper resource allocations to apply for the implementation of the LID site. LID is a method of SWM that focuses on the macro vision for site development. LID is implemented on every square foot of the site at the point of rainfall onward. LID-IMPs used in conjunction with conventional SWM will create a treatment train to hold, infiltrate, and filter the stormwater runoff. The LID site will contain less channelization of stormwater, less impervious pavement, more trees, more open ditches (less curb and gutter), and more planting buffers (rainwater filters). Many parameters must be weighted in the design of a LID site. Design must match the particular regional conditions.

Many of these site conditions affect the design of LID. Regional differences in weather patterns, soil types, groundwater conditions, existing development status, and current stormwater patterns will greatly influence the actual design and layout of the LID site and the choice of the LID-IMPs. However, one of the most important parameters will be the ratio of increased impervious surface area to the available land area or change in land cover.

Optimal LID implementation on a suitable site may result is a reduction in project cost. Classic LID design should reduce the amount of disturbed land, reduce impervious surface area, eliminate curb and gutter, reduce the size of pipes and holding ponds, increase the area planted in low maintenance tree cover, and reduce high maintenance structural planting beds and grass. Building a large facility on a small site will cost more to implement LID than building a small building on a large site. The small site will require the selection of IMPs that are structural in nature and are more expensive to build and maintain, while the small building on the large site can use the more organic LID-IMPs that are less costly and more easily maintained.

2-3 EPA LID GUIDANCE

The following EPA manuals are referenced as sources: "Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices" and "Low Impact Development (LID) A Literature Review". These manuals were based on the PDGR document "Low-Impact Development Design Strategies; An Integrated Design Approach", and is geared toward general site development. Sites on military bases may have additional constraints that will influence which LID-IMPs may be used.

Other Federal Directives and Executive Orders that affect LID planning and design must be identified and considered.

APPENDIX B: CHAPTER 3 - STORMWATER MANAGEMENT

Human development increases impervious surfaces. Buildings, roads, sidewalks, and parking lots quickly shed rainwater and increase the percentage of rainfall that ends up as runoff. The resulting increase in runoff volume and the peak flows create negative consequences such as stream degradation and flooding risk. The principal objective of LID is to retain this increase in runoff on-site. LID techniques allow the developed site to mimic the pre-development hydrologic conditions.

LID builds on the conventional SWM philosophies and carries them a step further. LID processes begin at the point where the rain falls. Considering incorporating LID concepts, tools, and approaches requires assessment of the following at a minimum:

- Will the concept closely mimic the hydrology of pre-development condition thereby meeting certain regulatory requirement and/or resource protection goals?
- Will the concept mitigate adverse effects from increased stormwater runoff from the project?
- Can the drainage conveyance structures be optimized and reduce the overall cost of the project?
- What might be the hurdles for public acceptance? If required for the project to move forward, can these be reasonably achieved?

Implementing LID alone on the project may not suffice in meeting all regulatory requirements. LID must be used in combination with applicable BMPs in order to continue to produce effective SWM benefits.

3-1 HYDROLOGIC CYCLE

Dr. David Maidment in his *Handbook of Hydrology* states:

> "The hydrologic cycle is the most fundamental principle of hydrology. Water evaporates from the oceans and the land surface, is carried over earth in atmospheric circulation as water vapor, precipitates again as rain or snow, is intercepted by trees and vegetation, provides runoff on the land surface, infiltrates into soils, recharges groundwater, discharges into streams, and ultimately, flows out into the oceans from which it will eventually evaporate once again. This immense water engine, fueled by solar energy, driven by gravity, proceeds endlessly in the presence or absence of human activity."

Of the total precipitation that occurs, a portion of it is lost through the following:
(i) interception due to land cover
(ii) evapotranspiration
(iii) surface depression storage
(iv) infiltration

Only the excess precipitation results in runoff that reaches receiving water bodies, such as streams and lakes. The process of infiltration is responsible for the largest portion of rainfall losses in pervious areas. LID techniques seek to mimic pre-development hydrologic condition in the post-development phase.
An understanding of the dynamics and inter-relationships in the hydrologic cycle is essential in preserving the pre-development hydrology. A comparison of pre-development and post-

development hydrologic conditions is evaluated for four basic measures – runoff volume, peak rate of runoff, flow frequency/duration, and water quality. These four evaluation measures are discussed below:

Runoff Volume: LID techniques, if implemented properly into site design, will result in 'no net increase' in runoff for a specified design storm event.

Peak Rate of Runoff: LID is designed to maintain pre-development hydrologic conditions for all storms smaller than the design storm event. If additional controls are required, either to meet the state or local regulations and/or flooding issues for unusual storm events, conventional SWM facilities may be designed and implemented.

Flow Frequency/Duration: LID techniques mimic pre-development hydrologic conditions if implemented properly. The flow frequency/duration should be almost the same.

Water Quality: Because of the very nature of decentralized hydrologic source control, the nonpoint source pollution is greatly reduced, thereby, increasing the water quality of the receiving water bodies.

Table 2 compares and summarizes concepts of stormwater management and LID techniques. For designs with LID-IMPs, it is appropriate to analyze the site as discrete units and rationalize on a case-by-case basis. When calculating the runoff potential from LID sites one should consider land cover, impervious areas, its connection with centralized collection system, soil type and texture, and antecedent moisture condition. These should all be considered on a site-specific basis.

3-2 STORMWATER DISPOSAL VS. STORMWATER MANAGEMENT

The main principle of incorporating LID elements into site planning design is to ensure that there is no net increase in runoff volume for the design storm. As detailed in Chapter 2 of this manual, there are a number of techniques that can be employed in eliminating the increase.

The main processes or practices that affect elimination of an increase in runoff volume for the design storm include infiltration at decentralized locations, increasing the length and time of flow over pervious areas, and disconnecting impervious areas that drain to stormwater collection systems. These help to retain the increase in runoff from new development on-site.

Conventional SWM facilities are primarily designed to divert unusual storm event runoff volumes and to control flooding and downstream impacts due to this increased runoff, but also provide water quality benefits.

Table 2: Summary of Concepts of SWM and LID Techniques.

Concepts of SWM	Concepts of LID Techniques
End-of-pipe stormwater treatment.	Stormwater is treated at or very close to the source/origination of runoff.
Centralized collection system	Decentralized system
Reroute stormwater away from the site quickly and efficiently	Mimics the pre-development hydrologic condition. The goal of LID is to retain the same amount of rainfall within the development site as that was retained on the site prior to the project
Many of the stormwater management facilities are designed to control or attenuate peak runoff	LID techniques reduce the size of stormwater management facilities.
SWM facilities are designed to treat first-flush i.e. first ½ inch of runoff from impervious areas of development.	LID techniques may suffice to treat the first-flush on-site without a need for separate treatment options.

Table 2 above contrasts conventional SWM methods that use "end-of-pipe" treatment and LID techniques that may reduce land requirements associated with conventional treatment and may make the overall design more aesthetically pleasing if incorporated early on during the planning and design phase. LID may reduce the overall costs of a project and reap benefits in protecting the environment and natural habitats.

Table 3 summarizes how conventional SWM and LID technology alter the hydrologic regime for on-site and off-site conditions.

Table 3: Comparison of Conventional SWM and LID Technologies

Hydrologic Parameter	Conventional SWM	LID
	On-Site	
Impervious Cover	Encouraged to achieve effective drainage	Minimized to reduce impacts
Vegetation/Natural Cover	Reduced to improve efficient site drainage	Maximized to maintain pre-development hydrology
Time of concentration (Tc)	Shortened, reduced as a by-product of drainage efficiency	Maximized and increased to approximate pre-development conditions
Runoff Volume	Large increases in runoff volume not controlled	Controlled to pre-development conditions
Peak Discharge	Controlled to pre-development design storm (2 year & 10 year)	Controlled to pre-development conditions for all storms
Runoff Frequency	Greatly increased, especially for small, frequent storms	Controlled to pre-development conditions for all storms
Runoff Duration	Increased for all storms, because volume is not controlled	Controlled to pre-development conditions
Rainfall Abstractions (interception, infiltration, depression storage)	Large reduction in all elements	Maintained to pre-development conditions
Groundwater Recharge	Reduction in recharge	Maintained to pre-development conditions
	Off-Site	
Water Quality	Reduction in pollutant loadings but limited control for storm events that are less than design discharges	Improved pollutant loading reductions, full control for storm events that are less than design discharges
Receiving Streams	Severe impacts documented – channel erosion and degradation, sediment deposition, reduced base flow, and habitat suitability decreased, or eliminated	Stream ecology maintained to pre-development
Downstream Flooding	Peak discharge control reduces flooding immediately below control structure, but can increase flooding downstream through cumulative impacts & superpositioning of hydrographs	Controlled to pre-development conditions

Source: Low-Impact Development Design Strategies, prepared by Prince George's County, Maryland.

3-3 WATER QUALITY AND POLLUTION PREVENTION

LID or decentralized hydrologic source control, use LID-IMPs that are distributed small-scale controls, closely maintaining or replicating the hydrology of pre-development site conditions. LID-IMPs address additional regulatory requirements or other resource protection goals. Similarly, in meeting the regulatory requirements, BMPs can be designed to act as effective, practicable means of minimizing the impacts of development associated with water quality and quantity control.

Because of the very nature of decentralized hydrologic source control, the nonpoint source pollution is greatly reduced, thereby, increasing the water quality of the receiving water bodies.

3-4 DESIGN INPUTS

If possible, design inputs for successful implementation of LID techniques into a site development project obtain the following:

a. Detailed land cover and land-use information
b. Topographic contours, preferably at an interval that allows the flowpaths to be distinguished (Generally 1' interval contours minimum supplemented by spot elevations).
c. Soil borings, minimum of three borings, 15-foot deep. These borings should reveal nature and condition of the shallow subsurface soils at this location, as well as defining the groundwater table, usability of on-site material for select fill, and through compositional analysis should determine both vertical and horizontal hydraulic conductivities.
d. Existing site drainage outfall conditions and characteristics including water level elevation and water quality
e. Watershed reports and master plans
f. Flooding issues, past or present
g. Installation Appearance Guide

3-5 PRECIPITATION DATA

The intensity-duration-frequency (IDF) curves for the United States were recently revised and published by the National Oceanic and Atmospheric Administration (NOAA), and are called Atlas-14 curves. These curves should be used when determining the precipitation depth/intensity for required duration and/or frequency. Other sources such as State drainage manuals have IDF curve data as well.

Long-term rainfall records for regional weather stations can be obtained from many sources, including the NOAA data center, at http://www.nesdis.noaa.gov. Table 8 provides a summary of rainfall analysis for selected locations.

3-6 LOW-IMPACT DESIGN ELEMENTS FOR STORMWATER MANAGEMENT

The LID concept encourages innovation and creativity in management of site planning impacts. As mentioned earlier, the implementation of LID techniques must be carefully evaluated for opportunities and constraints on a case-by-case basis. Many of the techniques are site-specific. Table 4 summarizes the specific use of LID techniques, requirement, and applicability. Table 5 summarizes hydrologic functions of LID practices.

Table 4: Summary of LID Techniques, Constraints, Requirements and Applicability

	Maintenance	Max. depth	Proximity to building foundations	Water Table/Bedrock	Slopes	Soils	Space required
Bioretention	Low requirement, property owner can include in normal site landscape maintenance	2- to 4-ft depth depending on soil type	Minimum distance of 10 ft down gradient from buildings and foundations recommended	2- to 4-ft clearance above water table/bedrock recommended	Usually not a limitation, but a design consideration.	Permeable soils with infiltration rates > 0.27 inches/hr are recommended. Soil limitations can be overcome with use of underdrains.	Minimum surface area range: 50 to 200 ft². Minimum width 5 to 10 ft. Minimum Length 10 to 20 ft. Minimum depth 2 to 4 ft.
Dry Well	Low requirement	6- to 10-ft depth depending on soil type	Minimum distance of 10 ft down gradient from buildings and foundations recommended	2- to 4-ft clearance above water table/bedrock recommended	Usually not a limitation, but a design consideration. Must locate down gradient of building foundations.	Permeable soils with infiltration rates > 0.27 inches/hr are recommended.	Minimum surface area range: 8 to 20 ft². Minimum width 2 to 4 ft. Minimum Length 4 to 8 ft. Minimum depth 4 to 8 ft.
Filter/Buffer Strip	Low requirement, routine landscape maintenance	Not applicable	Minimum distance of 10 ft down gradient from buildings and foundations recommended	Generally not a constraint.	Usually not a limitation, but a design consideration.	Permeable soils perform better, but soil not a limitation.	Minimum length of 15 to 20 ft.
Swales: Grass, Infiltration, Wet	Low requirement, routine landscape maintenance	Not applicable	Minimum distance of 10 ft down gradient from buildings and foundations recommended	Generally not a constraint.	Swale side slopes: 3:1 or flatter. Longitudinal slope: 1.0% minimum; maximum based on permissible velocities.	Permeable soils provide better hydrologic performance, but soils not a limitation. Selection of type of swale, grassed, infiltration or wet is influenced by soils.	Bottom width: 2 ft minimum, 6 ft maximum
Rain Barrels	Low requirement	Not applicable	Not a factor	Generally not a constraint.	Usually not a limitation, but a design consideration.	Not a factor	Not a factor
Cistern					Not a factor	Not a factor	Not a factor
Infiltration Trench	Moderate to high	6- to 10-ft depth depending on soil type	Minimum distance of 10 ft down gradient from buildings and foundations recommended	2- to 4-ft clearance required	Usually not a limitation, but a design consideration. Must locate down gradient of building foundations.	Permeable soils with infiltration rates > 0.52 inches/hr are recommended.	Minimum surface area range: 8 to 20 ft². Minimum width 2 to 4 ft. Minimum Length 4 to 8 ft.

Source: Low-Impact Development Design Strategies, prepared by Prince George's County, Maryland

Table 5: Summary of Hydrologic Functions of LID Practices

Hydrologic Functions	Bioretention	Dry Well	Filter/Buffer Strip	Swales: Grass, Infiltration, Wet Wells	Rain Barrels	Cistern	Infiltration Trench
Interception	High	None	High	Moderate	None	None	None
Depression Storage	High	None	High	High	None	None	Moderate
Infiltration	High	High	Moderate	Moderate	None	None	High
Ground Water Recharge	High	High	Moderate	Moderate	None	None	High
Runoff Volume	High	High	Moderate	Moderate	Low	Moderate	High
Peak Discharge	Moderate	Low	Low	Moderate	Moderate	Moderate	Moderate
Runoff Frequency	High	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Water Quality	High	High	High	High	Low	Low	High
Base Flow	Moderate	High	High	Moderate	Moderate	None	Low
Stream Quality	High	High	High	Moderate	None	Low	High

Source: Low-Impact Development Design Strategies, prepared by Prince George's County, Maryland.

APPENDIX B: CHAPTER 4 - LID DESIGN

4-1 INTRODUCTION

LID strategies provide decentralized hydrologic source control for stormwater. LID implementation centers around selecting IMPs which are distributed small-scale controls that can closely maintain or replicate hydrological behavior of the natural system for a design storm event.

The principal goal of designing LID-IMPs is to maintain existing pre-development hydrology resulting in no net increase in stormwater runoff from major renovation and construction projects for the design storm under consideration. The designer will be required to design SWM BMPs as mandated by the State regulators, and LID-IMPs to control all regulated storm events. This section of the criteria guidance manual defines a design storm to provide consistent application of the LID criteria. Further, the guidance manual provides a few of the design considerations in designing LID-IMP features that are not discussed elsewhere in this document. LID-IMPs will control runoff volume and time of concentration (Tc) in order to mimic the pre-development hydrologic conditions, while standard BMPs will be used in conjunction with LID-IMPs depending on site conditions to handle the peak rate of discharge for flood control.

The site designer shall follow published design guidelines that contain criteria relative to achieving, maintaining, and emphasizing a positive exterior visual environment applicable to military installations.

HYDROLOGIC ANALYSIS

During a storm event, a portion of the precipitation is lost in the form of interception, depression storage, evaporation, transpiration, and infiltration. These losses are collectively referred to as *abstractions*. Only that part of the rainfall in excess of abstractions is realized as stormwater runoff. [1]

The Soil Conservation Service (SCS 1986) presented an empirical method of determining initial abstraction based on the runoff curve number (CN)[2] of the site and is given by:

EQUATION 1: Initial abstraction (inches), $I_a = 0.2*S$

Where S = potential maximum retention after <u>runoff</u> begins (inches) = $\frac{1000}{CN} - 10$

[1] Holding excess rainwater on-site that would ordinarily end up as runoff can be detrimental in some cases. Rainfall that is retained in excess of the initial abstraction can destabilize certain soils on slopes, impact sensitive coastal tidal zones, increase the need for mosquito control, and in certain riparian or usufructuary rights create an infringement. In many areas where shallow groundwater aquifers are used for supply or irrigation, excess infiltration the designer must consider contamination issues.

[2] The runoff CN method accounts for all types of losses. The value of the curve number depends on the hydrologic soil group, soil cover type, hydrologic condition, the percentage of impervious areas in the watershed, and the antecedent moisture condition of the soil.

The initial abstraction defined in Eq. 1 also represents the rainfall at which the direct runoff begins. Any rainfall over and above the initial abstraction results in direct surface runoff whether it is a virgin forest or a developed piece of land. Table 6 gives representative runoff curve numbers and the calculated initial abstractions for selected soil types. The runoff generated from a project site and the initial abstraction of the site does not have a linear relationship. For this reason, required design storage of LID-IMPs is calculated using Eq. 2 and Eq. 3 discussed later in this document in Section 4-1.4, Design Storage of LID-IMP Features.

Runoff curve numbers are determined by land cover type, hydrologic condition, antecedent runoff condition (ARD), and hydrologic soil group (HSG). Curve numbers for various land covers based on an average ARC for annual floods and Eq. 1 can be found in Urban Hydrology for Small Watersheds (Soil Conservation Service, 1986).

Table 6: Initial Abstraction for Indicated Soil Types

Existing Site Conditions	Curve Number (CN)	Initial Abstraction (inches)
Woods - good condition, HSG B	55	1.64
Woods - poor condition, HSG D	83	0.41
Pasture, grasslands - good condition, HSG B	61	1.28
Pasture, grasslands - fair condition, HSG C	79	0.53
Open space - lawns, park in fair condition, HSG B	69	0.90
Residential districts - 1/3 acre, 30% impervious, HSG B	72	0.78
Residential districts - 1/3 acre, 30% impervious, HSG C	81	0.47
Industrial area - 72% impervious, HSG B	88	0.27

4-1.1 Mimic Existing (Pre-Development) Hydrologic Conditions

From the preceding table, it can be seen that the hydrology of a naturally wooded environment in good condition provides a maximum retention that in turn increases the water quality treatment of stormwater runoff. For redevelopment the site is not set at maximum retention, but to maintain pre-development levels. However, the typical site development project results in the following adverse environmental impacts:

- Changes to existing land-use and land cover
- Changes to natural drainage patterns
- Clear cutting of the native vegetation
- Soil compaction due to the use of heavy construction vehicles on-site
- Increase in impervious area
- Drainage systems that quickly move the water downstream.

As a result, the post-development hydrologic conditions are worsened, and in many cases, the damage becomes irreversible. For this reason, it is important to consider LID and mimic pre-development hydrologic conditions. The 'pre-development' condition shall be taken to mean a typical condition of the project site just prior to project. The site designer should provide a site condition narrative to document the analysis of the pre-development condition. Apart from the potential increase in impervious area, the primary impacts due to human development are soil compaction, and increased efficiency of drainage patterns. The two land development conditions of concern are:

- Pre-Development Condition
- Post-Development Condition

In the development of the site narrative the site designer shall document the existing soil conditions, groundwater table of the project site, description of typical surrounding natural lands, and a brief history of existing development; including impervious area, lawns/meadows, forested area, wetlands, and water bodies, that comprises the existing development condition. It is recognized that there are very many different existing development conditions (including everything from leveling and fill, to existing conditions that bear no resemblance to what came before). The goal, however, is to document a return to a realistic natural pre-development condition for the particular locale and setting.

LID techniques mimic the natural systems by capturing at the minimum, all of the initial abstraction through bio-infiltration practices (such as shown by photo1 below) and/or structural solutions of reuse or footprint reduction for a design storm event.

Photo 1: Typical Bio-infiltration 'Rain Garden'.

Note curb cut inlet. Design should be based on regional plants and growing conditions.

4-1.2 Time of Concentration (Tc) For Pre- and Post-Development Conditions

In order to mimic natural hydrologic patterns the site designer needs to provide features that limit the rate at which runoff leaves the site. The post-development time of concentration (Tc) must be equal to or greater than the pre-development Tc. Maintaining Tc close to pre-development conditions is critical because the peak runoff rate and thereby the volume of runoff from individual lots, is inversely proportional to the time of concentration. The Tc shall be maintained by strategies such as reduction of impervious areas, maintaining natural vegetation, siting of impervious areas in poor draining soils, and disconnecting impervious areas.

Using traditional site planning techniques the post-development time of concentration (Tc) is invariably reduced. This is due to the curbs, channels, and pipes causing quicker drainage, resulting in higher peak flow rates. In order to mimic the natural hydrologic pattern the site designer needs to provide features that slow down the runoff from the site. To maintain the Tc use the following site planning techniques:

- Maintaining or increasing pre-development sheet flow length
- Preserving natural vegetation
- Increasing surface roughness
- Detaining flows
- Disconnecting impervious areas
- Reducing longitudinal slopes of swales and ditches.

Achieving a Tc close to pre-development conditions is often an iterative process and requires analyzing different combinations of the appropriate techniques.

4-1.3 Design Storm Event for LID Design and Implementation

Storm events are a complex natural phenomenon, and methods to predict and control their impacts rely upon empirical and mathematical modeling of the event. It is important to provide criteria to be used by the site designer that is easily understood and is based on recognized industry standards. Three principal approaches in determining the design storm event were analyzed, as follows:

Prince George's County Methodology (Soil Conservation Service, TR-55 Method):
As previously mentioned any rainfall over and above the initial abstraction will result in direct surface runoff. It is prudent to design and implement IMPs for that rainfall event that exceeds initial abstraction (Eq. 1) in the pre-development conditions. The design methodology would apply a modifying factor of 1.5 times the initial abstraction (as suggested in the Prince George's County LID manual) to serve as a practical approach to design LID-IMP features.

EPA Methodology:
See Technical Guidance on Implementing Section 438 of the Energy Independence and Security Act, *Guidance prepared by EPA*, December 2009 for Option 1 methodology.

First-Flush Water Quality Volume:
Many States and localities have adopted the conventional approach of collecting and treating the *first-flush* or *water-quality* depth of rainfall. These terms are defined by the local regulatory agency. In certain areas, this first flush depth is generally taken to be the first one inch of rainfall. In other localities with sensitive coastal or reservoir watersheds, the first-flush depth is

taken to be the first 1.5 inches of rainfall. The water quality volume is equated to the volume of stormwater runoff generated by the first-flush rainfall depth. Therefore, it would be practical to design LID-IMP features to handle the first-flush rainfall depth. The stormwater runoff quality is further improved by the design of conventional SWM practices required to meet the state regulations.

Most Local and State stormwater regulations include a first-flush or water quality depth for 2-, 5-, 10-, 25-, 50-, or 100-year regulated storm events. State and Local requirements for stormwater management shall be met before the LID requirements are satisfied. The SWM BMPs shall be designed to control all regulated storm events, as stipulated by Local and State regulations to handle the peak rate and/or volume of discharge for flood control purposes.

DOD Accepted Methodology:
DoD has chosen to use the 95th percentile design storm event in UFC 3-210-10 criteria for determining the LID design volume. When in conflict with other State or Local requirements the most stringent apply.

To control the stormwater volume in accordance with LID policy, use the methodology from TR-55, Chapter 2: "Estimating Runoff". Calculate the runoff depth for both the pre- and post-development conditions, and the difference will be the depth from which the volume to be retained on-site can be determined.

4-1.4 Design Storage of LID-IMP Features

For the selected design storm event, the LID volume is equal to or greater than the total net increase in runoff from the pre- to post-development states. Physically, the total volume of stormwater runoff generated during the post-development conditions exceeds the total volume of stormwater runoff generated from the site during the pre-development conditions. The design storage of LID-IMP features would be the difference in total volume of stormwater runoff generated between pre- and post-development conditions. The required design storage is calculated using the SCS methodology for compliance with EISA Section 438. Other methods may be specifically required by State SWM guidance to comply with State SWM program requirements. The designer is to balance the various requirements to determine the LID-SWM design that meets all policies and programs.

EQUATION 2: Total depth of increase in runoff (inches), $D = \frac{(P-0.2*S')^2}{(P+0.8*S')} - \frac{(P-0.2*S)^2}{(P+0.8*S)}$

Where, P = design storm rainfall depth (inches)

S & S' = potential maximum retention after runoff begins (inches) during the pre- and post-development conditions, respectively

Note: Eq. 2 is valid if $P > 0.2*S$. Otherwise, the term calculating the runoff depth

$$\frac{(P-0.2*S)^2}{(P+0.8*S)} = 0$$

EQUATION 3: The design storage, $V_{LID} = D * A$

D = total depth of increase in stormwater runoff (inches),
A = drainage area or the area of the parcel being developed (square units).

The design storage of LID-IMP features, calculated using Eq. 3, is compliant with DoD policy for stormwater runoff volume for the design rainfall event by maintaining pre-development hydrology.

Table 7 illustrates the total depth of increase in stormwater runoff for a hypothetical representative site. The depth of increase in stormwater runoff calculated will be used in designing the LID-IMP features to handle all of the net increases in stormwater runoff generated from a parcel being developed (using Eq. 3).

4-2 PREDEVELOPMENT HYDROLOGY AND NO NET INCREASE

The principal goal of designing LID-IMPs is to achieve no net increase in stormwater runoff volume and sediment or nutrient loading from major renovation and construction projects for the design storm under consideration. The design storage volume of LID-IMP features, as calculated using Eq. 3, is a minimum requirement and must be followed to ensure no net increase in stormwater runoff volume for the design storm depth. This will assure the most practical solution and provide the maximum value for achieving an improved water quality discharge downstream. In certain geographical areas on optimal sites, the site designer will be able to improve the efficiency of the LID features to handle a portion of the flood control element of stormwater. For other rainfall events, which exceed normal intensities, the runoff will be collected and conveyed to the conventional SWM facilities. The conventional SWM facilities should be designed to discharge/outfall over a 24-hour period to reduce the peak flow rate below the pre-development outflow rate. Further, outfall water quality is improved through an additional treatment from conventional SWM facilities. To design the LID-IMP features for gross increases in stormwater runoff over a range of storm events, for less frequent or high return period storm events, would be impractical. Depending on site conditions, the use of conventional SWM facilities in conjunction with LID-IMPs may be required to handle unprecedented rainfall events and to avoid any downstream flooding of facilities and roadways that might become a life safety concern.

4-3 DESIGN CONSIDERATIONS

A few of the most relevant design considerations are listed below. For a more detailed list, the reader is referred to published literature given in the References.

Develop LID control strategies:
Use hydrology as a design element. In order to minimize the runoff potential of the development, the hydrologic evaluation should be an ongoing part of the design process. An understanding of site drainage can suggest locations for both green areas and potential building sites. An open drainage system can help integrate the site with its natural features, creating a more aesthetically pleasing landscape.

a) Determine the State regulatory design storms. Regulatory requirements for design storms may also be stipulated in local ordinances, and these may limit or constrain the use of LID techniques or necessitate that structural controls be employed in conjunction with LID techniques.

b) Determine LID volumes using 95th percentile design storm and NRCS TR-55 Curve Number methodologies.
c) Evaluate current conditions. Analyze site with traditional hand methods or computer simulations. Use the results of modeling to estimate baseline values for the four evaluation measures: runoff volume, peak runoff rate, flow frequency and duration, and water quality.
d) Evaluate site planning benefits and compare with baseline values. The modeling analysis is used to evaluate the cumulative hydrologic benefit of the site planning process in terms of the four evaluation measures.
e) Evaluate the need for IMPs. If site planning is not sufficient to meet the site's LID objectives, additional hydrologic control needs may be addressed through the use of LID-IMPs. After LID-IMPs are selected for the site, a second-level hydrologic evaluation can be conducted that combines the IMPs with the controls provided by the planning techniques. Results of this hydrologic evaluation are compared with the baseline conditions to verify that the site LID objectives have been achieved. If not, additional LID-IMPs are located on the site to achieve the optimal condition.
f) Evaluate supplemental needs. If supplemental control for either volume or peak flow is still needed after the use of IMPs, selection and listing of additional management techniques should be considered. For example, where flood control or flooding problems are key design objectives, or where site conditions, such as poor soils or a high water table, limit the use of LID-IMPs, additional conventional end-of-pipe methods, such as large detention ponds or constructed wetlands, should be considered. In some cases their capacity can be reduced significantly by the use of LID upstream. It may be helpful to evaluate several combinations of LID features and conventional stormwater facilities to determine which combination best meets the stated objectives. Use of hydrologic evaluations can assist in identifying the alternative solutions prior to detailed design and construction costs.
g) For residential areas, Prince George's County, Maryland, has developed a detailed illustration of an approach for conducting a hydrologic evaluation based on the NRCS TR-55 method. Where NRCS methods (TR-20, TR-55) are accepted for hydrologic evaluation, the effect of LID features should be reflected in the curve numbers and times of concentration selected for the analysis. A full description of this process is available from Prince George's County (*Low-Impact Development Hydrologic Analysis*, Reference 2.)

LID Concept Design or Master Plan:

1) Maximize the efficiency of the existing site. Place impervious areas in poorer soils and retain existing trees where practical.
2) Sketch a design concept that distributes the LID practices appropriately around the project site. Keep in mind the multifunctional capability of LID technologies (i.e., parking lot with detention facility underground).
3) Develop a master plan that identifies all key control issues (water quality, water quantity, water conservation) and implementation areas. Specify specific LID technologies and any connections they have to stormwater overflow units and sub-surface detention facilities.

Develop landscaping plans to maximize the efficiency of the LID-IMPs and reduce maintenance:

Use hardy, native plantings.

1) In areas where soils have low infiltration rates, as determined by percolation tests, average depth of bio-infiltration practices is determined such that the volume held would infiltrate within stated limits. For example, if the State criteria indicates 72 hours and in soils with a low permeability rate (hydrologic soil group's C and D) of 0.05 inches/hour, the depth of infiltration basin = 72 hrs x 0.05 in/hr = 3.6 inches. Conservatively, the designer may opt to

restrict this depth to 3.0 inches and provide a larger area to satisfy the LID volume requirement or may want to incorporate other LID practices, such as footprint reduction of impervious surfaces, permeable pavers, etc., in conjunction with sizing of bio-infiltration facilities. (Verify all actual design parameters with State BMP manual.)
2) Flood control is based on protecting life and property. Flood control criteria are ultimately determined locally based on drainage needs and flood risk of any particular area and may go beyond LID design criteria to achieve the necessary level of flood protection.
3) If project site has limited land area for bio-infiltration practices, in order to satisfy the LID volume criteria, a combination of structural practices such as rain barrels and cisterns may be employed in addition to bio-infiltration practices. At any time the outflow from the structural practices must be controlled to the sum total of assimilating capacity of bio-infiltration practices provided downstream. For example, if a downstream bio-retention facility is of size 600 sq.ft, in soil type C with an infiltration rate of 0.15 in/hr, then the cisterns or rain barrels provided on site will discharge into bio-retention facility at a rate = 0.15 in/hr * 600 sq.ft /(12 in/ft * 3600 sec/hr) = 0.0021 cfs.
4) LID-IMP features are to be incorporated into the site plan at locations as close as possible to the origin of surface runoff from impervious areas. For example, runoff from roof drains is to be collected around the building (depending on ATFP requirements, a minimum of 10-ft offset from the face of the building is required, refer to bio-retention design manuals for more details on specifications), and runoff from parking lots will be held in traffic islands and all along the perimeter. The central idea is to mimic pre-development hydrology.
5) Prefer planting of bio-retention facilities with native vegetation; refer to local plant specialists and horticulturists.
6) Design positive overflow system to capture excess rainfall-runoff.

Develop Operation and Maintenance Procedures:
Development of Operation and Maintenance Support Information documentation (OMSI) is critical to ensure LID-IMPs are properly maintained in order to function properly. LID-IMPs should be viewed as environmental systems that have specific maintenance requirements. O&M procedures for each of the LID practices implemented in the site plan should be developed as part of the OMSI documents. Different types of LID-IMPs will have different maintenance requirements, but some general principles will apply:
1) Keep LID-IMPs and flow paths clear of debris.
2) Regular trash pickup will be required.
3) Use native, drought-tolerant plantings that can tolerate periods of saturation. If required, water vegetation regularly during dry periods. Use special care in selecting plants in areas of tidal influence.
4) Consider impact on plants by road salts.
5) Grassed areas should be mowed regularly using a longer length cut.
6) Plantings should be pruned as needed.
7) Deep raking and tilling of depression storage should be done on a yearly basis or as indicated.

4-4 GAINING ACCEPTANCE OF LID OPTIONS

Low Impact Development projects will require a higher level of communication to keep stakeholders informed during the planning and design phase. From building tenant commands to O&M personnel, communicating intent and purpose is the key to successful LID implementation. In addition, for some period, feedback on implementation and program success will be required for all new facilities through the local Environmental Office.

4-5 CONSTRUCTION PERMIT PROCESS

Conventional SWM is a patterned response to maximize the efficiency of site landscaping and site design to achieve a reduction in the volume, duration, and pollutant loading of rainfall that ends up as runoff due to human development. The EPA's CWA defined an appropriate level of SWM to help to keep our rivers, lakes, and shorelines clean. The CWA established the base guidelines for SWM, but for the most part turned the execution of those guidelines over to the local, state, and/or municipal regulatory agencies. The States then promulgated additional or clarifying requirements to a minimum level as the EPA requirements to meet the needs of the local geographic conditions. For example, SWM techniques suitable for Florida are not necessarily appropriate to the arid Southwest. Almost all projects will require Local or State construction permit in order to begin work. As such, the LID requirements must be complementary, and will overlay the State and Local requirements for SWM. Without the regulatory acceptance and approval of the SWM plan, a project cannot be constructed. However, with the continuing development and destruction of natural settings, most of these regulatory bodies have recognized that additional measures must be taken. For the State environmental regulators to improve stormwater discharge quality they must adopt alternative management methods or build treatment systems at the outfalls to treat the water. In order to avoid those large, expensive end-of-pipe treatment systems, an example was taken from nature to begin a process of retention, detention, infiltration, and treatment at the point of intersection (the point where a raindrop hits the earth). LID has gained widespread acceptance in the commercial and municipal arenas and is beginning to show up in most of the Local and State regulations as an appropriate response to assist with traditional SWM. As the States adopt and change their requirements, DoD's LID policies will increasingly align with the State's SWM requirements.

4-6 CONCLUSIONS

The methods for calculating, modeling, and sizing stormwater runoff are based on the *design storm*. The design storm is a designation that defines a unit depth of rainfall in order to quantify the volume of rainfall generated for a given site. This data is needed in order to calculate the impact of development on a particular piece of land.

The site designer shall use higher of either the 95th percentile rainfall depth, or the required water quality depth (as locally legislated) as the design storm event when calculating the LID volumes. This will result in a practical and reasonable approach (as being suggested by the EPA in their preliminary findings) in determining LID volumes. The design storm event is based on the regional 95th percentile, annual 24-hour rainfall depth averaged over several years (a minimum of 10-year daily, 24-hour precipitation events would be used). The 'design storm' will be used to calculate pre- and post-development LID volumes in order to determine the amount of excess runoff that must be controlled on-site so that the site contributes no net increase downstream. LID integrated management techniques will be encouraged throughout the site design to ensure control and water quality objectives.

Three practical design methodologies were evaluated in this guidance manual to compare and contrast the methodologies. The first two that were evaluated used accepted practices within the engineering community and demonstrated acceptable results. The third methodology examined was based on regulatory guidance regarding water quality volumes.

DoD has chosen to adopt the EPA's 95th percentile methodology to determine the design storm. Choosing the 95th percentile storm event as the LID design storm would result in a conservative design of LID-IMP features. Table 7 compares the three analysis methods for a few sample locations, by soil and type. Table 8 provides a summary of rainfall analysis for selected locations. Additional references for sources of rainfall data include NRCS TR20 manual rainfall maps and Air Force 14th Weather Squadron rainfall data for installations.

DoD criteria also recommend the use of industry standard methodologies for determining the LID volumes, such as TR-55 (Soil Conservation Services, 1986) or other recognized modeling software.

Table 7: Analysis Method Comparison

Existing Site Conditions	Existing Site Composite CN	Method 1.	Method 2.	Method 3.	Selected Design Storm Rainfall Depth (inches)	Developed Conditions[2] Composite CN	Depth of increase in Stormwater Runoff (inches)
Woods - good condition, HSG B	55	2.45	1.63[a]	1.00	1.63	76.5	0.25
Woods - poor condition, HSG D	83	0.61	1.45[b]	1.00	1.45	90.5	0.32
Pasture, grasslands - good condition, HSG B	61	1.92	1.63[a]	1.00	1.63	79.5	0.32
Pasture, grasslands - fair condition, HSG C	79	0.80	1.45[b]	1.00	1.45	88.5	0.33
Open space - lawns, park in fair condition, HSG B	69	1.35	1.63[a]	1.00	1.63	83.5	0.37
Residential districts - 1/3 acre, 30% impervious, HSG B	72	1.17	1.63[a]	1.00	1.63	85.0	0.38
Residential districts - 1/3 acre, 30% impervious, HSG C	81	0.70	1.45[b]	1.00	1.45	89.5	0.33
Industrial area - 72% impervious, HSG B	88	0.41	1.63[a]	1.00	1.63	93.0	0.30

Method 1: Design Rainfall Depth Based on Initial Abstraction (inches)

Method 2: Region1 - 95 Percentile Rainfall Depth (inches);

Method 3: First-Flush Rainfall Depth (inches)

1. In this example, regional refers to: a - Norfolk region; b- Cincinnati Region.

2. The developed conditions composite curve number is calculated as equal to existing composite CN plus a 50% of maximum full development potential of the parcel. A full development potential is where the entire parcel is developed with impervious surface resulting in a composite curve number of 98. Here, it is assumed 50% of maximum full development and calculated as = existing CN+0.5*(98-existing CN).

Table 8: Summary of Rainfall Analysis (1978-1997)

Description	State	Weather Station ID	Applicable Unit Identification Code						Annual Rainfall Depth (in)	99th Percentile	98th Percentile	95th Percentile	90th Percentile	75th Percentile	Rainy Days (>0.1")	Years of Available Record (1978-1997)
YUMA WSO AP	Arizona	029660	62974 (1 mi.)						3.38	2.20	1.46	0.98	0.73	0.43	8	17
BOULDER CREEK LOCAT RANCH	California	041005	44269 (mi.)						51.36	5.14	4.64	3.70	2.50	1.50	44	20
EL CENTRO 2 SSW	California	042713	45211 (1 mi.)						2.83	2.30	1.91	1.30	1.00	0.58	5	20
FAIRFIELD 3 NNE	California	042935	45653 (1 mi.)						21.55	3.26	2.48	1.80	1.30	0.90	31	20
FRESNO AIR TERMINAL	California	043257	44259 (27 mi.)						11.80	1.51	1.31	0.99	0.80	0.51	28	20
HETCH HETCHY	California	043939	64495 (36 mi.)						31.42	3.27	2.73	1.96	1.59	0.90	42	20
LOS ANGELES WSO ARPT	California	045114	44267 (17 mi.)	67399 (80 mi.)					13.95	2.56	2.30	1.64	1.23	0.77	23	20
MONTEREY NWSFO	California	045802	45210 (5 mi.)						20.10	1.70	1.47	1.37	1.14	0.85	31	2
SAN DIEGO WSO AIRPORT	California	047740	62473 (1 mi.)	00681 (30 mi)					11.69	1.74	1.58	1.28	1.01	0.60	23	20
VICTORVILLE PUMP PLANT	California	049325	3594A (60 mi.)	62204 (30 mi.)					6.47	1.73	1.60	1.12	0.90	0.60	12	19
COLORADO SPRINGS WSO AP	Colorado	051778	3455A (0 mi.)						17.06	2.11	1.59	1.12	0.85	0.48	37	20
JACKSONVILLE WSO AP	Florida	084358	57061 (18.75 mi.)	68931 (18 mi.)	68248 (25 mi.)	46134 (17.5 mi.)			52.35	3.46	2.86	2.12	1.59	0.87	74	20
KEY WEST WSO AIRPORT	Florida	084570	44222 (2 mi.)						39.68	3.76	2.95	1.92	1.41	0.76	59	20
MIAMI WSCMO AIRPORT	Florida	085663	30931 (2.5 mi.)						59.17	3.53	2.94	2.20	1.62	0.86	82	20
PANAMA CITY 5 NE	Florida	086842	44223 (9.5 mi.)	44224 (97 mi.)					56.51	4.24	3.30	2.40	1.80	1.10	63	20
TALLAHASSEE WSO AP	Florida	088758	67004 (83 mi.)						62.14	4.26	3.58	2.37	1.76	1.07	76	20
TAMPA WSO AIRPORT	Florida	088788	47030 (8 mi.)						46.24	3.22	2.70	1.92	1.48	0.88	66	20
SAVANNAH WSO AIRPORT	Georgia	097847	00263 (32 mi.)	44227 (35 mi.)					49.54	3.17	2.80	2.03	1.52	0.85	70	20
GUAM WSMO	Guam	914229	62395 (5 mi.)						95.12	4.24	3.27	2.20	1.45	0.70	143	14
HOKULOA 725.2	Hawaii	511540	44251 (mi.)						33.02	5.11	4.00	2.64	1.70	0.80	40	20
HONOLULU WSFO AP 703	Hawaii	511919	62742 (3 mi.)	47771 (9.5 mi.)					19.07	3.72	3.08	2.11	1.31	0.61	29	20
KEKAHA 944	Hawaii	514272	30614 (mi.)						20.08	4.83	3.86	2.80	1.91	0.90	24	20
CHICAGO OHARE WSO AP	Illinois	111549	65113 (23 mi.)						36.24	2.57	1.90	1.49	1.09	0.65	67	20
EVANSVILLE WSO AP	Indiana	122738	44204 (58 mi.)						43.72	2.78	2.16	1.74	1.25	0.78	71	20
NEW ORLEANS WSMO AIRPORT	Louisiana	166660	44218 (9 mi.)						65.10	4.38	3.33	2.48	1.81	1.06	77	20
SHREVEPORT AP	Louisiana	168440	45603 (11 mi.)						52.06	3.94	3.32	2.33	1.76	1.01	66	20
PORTLAND WSFO AP	Maine	176905	44214 (24 mi.)						42.49	2.88	2.23	1.55	1.17	0.71	71	20
BALTIMORE WSO ARPT	Maryland	180465	44201 (15.5 mi.)	0417A (14 mi.)					40.29	2.36	1.94	1.53	1.16	0.71	71	20
PATUXENT RIVER	Maryland	186915	00019 (0 mi.)	47370 (33 mi.)					24.97	2.90	2.58	1.80	1.30	0.80	36	20
BILOXI 9 WNW	Mississippi	220797	62604 (4 mi.)						60.53	5.64	4.04	2.74	2.07	1.20	59	9
TRENTON STATE COLLEGE	New Jersey	288880	3806A (30 mi.)						38.50	2.80	2.60	1.90	1.40	0.90	54	20
ALBUQUERQUE WSFO AIRPORT	New Mexico	290234	65460 (3 mi.)						9.74	1.15	1.06	0.88	0.65	0.39	25	20
MOREHEAD CITY	North Carolina	315830	00146 (16 mi.)	67001 (34 mi.)					38.57	4.10	3.30	2.40	1.70	1.00	46	20
HARRISBURG CAPITAL CITY	Pennsylvania	363699	68378 (6 mi.)						32.91	2.40	2.18	1.57	1.11	0.65	60	8
HARRISBURG WSO CITY OFFICE	Pennsylvania	363710	68378 (4.5 mi.)						30.58	2.05	1.84	1.32	1.08	0.70	56	8
MIDDLETOWN HARRISBURG INTL AP	Pennsylvania	365703	68378 (10 mi.)						34.91	2.46	2.25	1.39	1.10	0.69	62	7
PHILADELPHIA WSO AP	Pennsylvania	366889	45727 (2.5 mi.)						40.68	2.46	2.05	1.60	1.18	0.70	70	20
BLOCK ISLAND WSO AP	Rhode Island	370896	44210 (29 mi.)						33.37	2.54	2.08	1.52	1.23	0.74	56	16
NEWPORT ROSE	Rhode Island	375215	44211 (1.5 mi.)						32.86	2.80	2.30	1.79	1.30	0.80	46	20
CHARLESTON WSO AIRPORT	South Carolina	381544	69229 (4 mi.)						50.79	3.76	3.14	1.97	1.49	0.82	73	20
MEMPHIS WSFO	Tennessee	405954	44221 (18 mi.)						53.19	3.37	2.83	2.14	1.70	0.96	70	18
CORPUS CHRISTI WSO AP	Texas	412015	45974 (27 mi.)	68891 (11 mi.)	44215 (10 mi.)				32.44	4.40	3.42	2.50	1.73	0.91	42	20
NORFOLK WSO AIRPORT	Virginia	446139	62470 (5.7 mi.)						44.36	2.67	2.26	1.63	1.23	0.73	74	20
WASHINGTON NATL WSO AP	Virginia	448906	00025 (2.5 mi.)	00029 (1.5 mi.)	44252 (9.5 mi.)	44200 (22 mi.)	48429 (11 mi.)	45967 (25 mi.)	38.37	1.94	1.76	1.37	1.12	0.69	70	20
WILLIAMSBURG 2 N	Virginia	449151	44247 (11 mi.)						34.17	2.50	2.20	1.61	1.30	0.80	50	20
SEATTLE TACOMA AP WBAS	Washington	457473	44255 (17 mi.)						37.11	1.76	1.40	1.03	0.79	0.50	87	20
SEATTLE EMSU WSO	Washington	457458	44219 (mi.)						36.04	1.82	1.44	1.00	0.78	0.47	84	20
FRANKLIN 2 N	West Virginia	463215	31188 (5 mi.)						24.08	1.80	1.70	1.30	1.00	0.70	41	17

4-7 RESOURCE INDEX

1. *BMP Modeling Concepts and Simulation* (USEPA, 2006): www.epa.gov/nrmrl/pubs/600r06033/epa600r-06033toc.pdf
2. *Low-Impact Development Hydrologic Analysis* (Prince George's County, MD, Dept. of Environmental Resources, 1999): www.epa.gov/nps/lid_hydr.pdf
3. A Design Guide for Implementers and Reviewers Low Impact Development Manual for Michigan (Southeast Michigan Council of Governments, SEMCOG 2008): www.semcog.org
4. Urban Hydrology for Small Watersheds, TR-55 (Soil Conservation Services, 1986)
5. Technical Guidance on Implementing Section 438 of the Energy Independence and Security Act (February 2009)

Acknowledgements:

This document would not be possible without the guidance and assistance of Mr. Leonard Harrell and Mr. Paul Kidd of NAVFAC Atlantic's Capital Improvements Business Line, and the LID team throughout the NAVFAC FECs that generously assisted with time and suggestions.

Document prepared by:

URS Group, Inc.

277 Bendix Road, Suite 500
Virginia Beach, Virginia 23452
(757) 499-4224

Under contract to the National Institute of Building Sciences (NIBS).

APPENDIX C – DUSD (IE) Policy Memo 19 JAN 2010

OFFICE OF THE UNDER SECRETARY OF DEFENSE
3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION,
TECHNOLOGY
AND LOGISTICS

JAN 19 2010

MEMORANDUM FOR ACTING ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS AND ENVIRONMENT)
ACTING ASSISTANT SECRETARY OF THE NAVY (INSTALLATIONS AND ENVIRONMENT)
ACTING ASSISTANT SECRETARY OF THE AIR FORCE (INSTALLATIONS, LOGISTICS, AND ENVIRONMENT)

SUBJECT: DoD Implementation of Storm Water Requirements under Section 438 of the Energy Independence and Security Act (EISA)

Reducing the impacts of storm water runoff associated with new construction helps to sustain our water resources. In October 2004, DoD issued Unified Facilities Criteria on Low Impact Development (LID) (UFC 3-210-10), a storm water management strategy designed to maintain the hydrologic functions of a site and mitigate the adverse impacts of storm water runoff from DoD construction projects. Using LID techniques on DoD facility projects can also assist in fulfilling environmental regulatory requirements under the Clean Water Act. Since 2004, DoD has implemented LID techniques for controlling storm water runoff on a number of projects.

EISA Section 438 (Title 42, US Code, Section 17094) establishes into law new storm water design requirements for Federal development and redevelopment projects. Under these requirements, Federal facility projects over 5,000 square feet must "maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow." Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance* (October 5, 2009), directed the U.S. Environmental Protection Agency (EPA) to issue EISA Section 438 guidance. DoD shall implement EISA Section 438 and the EPA *Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act*, using LID techniques in accordance with the policy outlined in the attachment.

EISA Section 438 requirements are independent of storm water requirements under the Clean Water Act and should not be included in permits for storm water unless a State (or EPA) has promulgated regulations for certain EISA Section 438 requirements (i.e., temperature/heat criteria) that are applicable to all regulated entities under its Clean Water Act authority.

The attached policy will be incorporated into applicable DoD Unified Facilities Criteria within six months. My points of contact are Thadd Buzan at (703) 571-9079 and Ed Miller at (703) 604-1765.

Dorothy Robyn
Deputy Under Secretary of Defense
(Installations and Environment)

Attachment:
As stated

DoD Policy on Implementing Section 438 of the Energy Independence and Security Act (EISA)

1. EISA Section 438 requirements apply to projects that construct facilities with a footprint greater than 5,000 gross square feet, or expand the footprint of existing facilities by more than 5,000 gross square feet. The project footprint consists of all horizontal hard surfaces and disturbed areas associated with the project development, including both building area and pavements (such as roads, parking, and sidewalks). These requirements do not apply to internal renovations, maintenance, or resurfacing of existing pavements.

2. The overall design objective for each project is to maintain predevelopment hydrology and prevent any net increase in storm water runoff. DoD defines "predevelopment hydrology" as the pre-project hydrologic conditions of temperature, rate, volume, and duration of storm water flow from the project site. The analysis of the predevelopment hydrology must include site-specific factors (such as soil type, ground cover, and ground slope) and use modeling or other recognized tools to establish the design objective for the water volume to be managed from the project site.

3. Project site design options shall be evaluated to achieve the design objective to the maximum extent technically feasible. The "maximum extent technically feasible" criterion requires full employment of accepted and reasonable storm water retention and reuse technologies (e.g., bio-retention areas, permeable pavements, cisterns/recycling, and green roofs), subject to site and applicable regulatory constraints (e.g., site size, soil types, vegetation, demand for recycled water, existing structural limitations, state or local prohibitions on water collection). All site-specific technical constraints that limit the full attainment of the design objective shall be documented. If the design objective cannot be met within the project footprint, LID measures may be applied at nearby locations on DoD property (e.g., downstream from the project) within available resources.

4. Prior to finalizing the design for a redevelopment project, DoD Components shall also consider whether natural hydrological conditions of the property can be restored to the extent practical.

5. Estimated design and construction costs for implementing EISA Section 438 shall be documented in the project cost estimate as a separate line item. Final implementation costs will be documented as part of the project historical file. Post-construction analysis shall also be conducted to validate the effectiveness of as-built storm water features.

The following flowchart illustrates the DoD implementation process for EISA Section 438, consistent with the U.S. Environmental Protection Agency's *Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act* (December 2009) (http://www.epa.gov/owow/nps/lid/section438/.

Flowchart for EISA §438 Implementation