DEVELOPMENT OF A SIMPLIFIED SUSTAINABLE FACILITIES GUIDE

THESIS

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Abstract

The Air Force has adopted the United States Green Building Council's Leadership in Energy and Environmental Design (LEED™) Green Building Rating System as the preferred self-assessment metric for sustainable development. LEED™ is designed for new construction and major renovations, and, within the Air Force, is most applicable for Military Construction (MILCON) projects. The Air Force Center for Environmental Excellence developed the Air Force Sustainable Facilities Guide to provide guidance and strategies to meet LEED™ requirements. The Air Force has not adopted a sustainable development guide or rating system that is most applicable for construction projects that are relatively low (compared to MILCON projects) in cost or complexity.

This research developed a Simplified Sustainable Facilities Guide that can identify and assess sustainable development opportunities in all facility and infrastructure projects. This guide, modeled after the Air Force Sustainable Facilities Guide, simplifies most LEED™ requirements to reduce the time, cost, and expertise level required to incorporate sustainable development concepts while preserving the intent of LEED™. This guide is designed to quickly identify opportunities in projects that are relatively low in cost and complexity; where using the more robust LEED™ requirements may not be justified. The Simplified Sustainable Facilities Guide, in conjunction with existing Air Force guidance, provides a means to address sustainable development issues in all facility and construction projects regardless of cost or complexity.

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I. Introduction

1.1 Background

The United Nations World Commission on Environment and Development 1987 report titled Our Common Future introduced the now common and widely used definition of sustainable development.

> Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. (World Commission on Environment and Development, 1987)

Our Common Future was the catalyst for the passage of Agenda 21 – Global Program of Action on Sustainable Development during the 1992 United Nations Conference on Environment and Development held in Rio de Janeiro, Brazil. During this conference, also known as the Earth Summit, over 178 countries, including the United States, adopted Agenda 21; agreeing to the principles and importance of sustainable development (United Nations, 2002). Agenda 21 addresses many subsets of sustainable development, including sustainable agriculture, sustainable economies, sustainable human populations, and sustainable ecosystems, to name just a few. For this research, sustainable development is limited to the built environment, which is man-made structures and the land they are built on.

Since the adoption of Agenda 21, the President of the United States of America issued Executive Orders (EO) mandating the incorporation of sustainable development

concepts within the federal government. Four EOs are currently in effect (Air Force Center for Environmental Excellence, 2003b).

> EO 13101 Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition, September 14, 1998
> EO 13123 Greening the Government Through Efficient Energy Management, June 3, 1999
> EO 13148 Greening the Government Through Leadership in Environmental Management, April 21, 2000
> EO 13149 Greening the Government Through Federal Fleet and Transportation Efficiency, April 21, 2000

While all of these EOs mandate various concepts of sustainable development, the one EO that is of greatest concern to this research is EO 13123. Section 403(d) of EO 13123 states:

> Sustainable Building Design. DOD and GSA, in consultation with DOE and EPA, shall develop sustainable design principles. Agencies shall apply such principles to the siting, design, and construction of new facilities. Agencies shall optimize life-cycle costs, pollution, and other environmental and energy costs associated with the construction, life-cycle operation, and decommissioning of the facility. (Clinton, 1999)

In 1999, the Department of Defense (DoD), realizing the need "to establish a common understanding of sustainable development that can be applied to planning, and to use that understanding to assess opportunities to include sustainability in military planning" released the Feasibility Study for Implementing Sustainable Development Concepts and Principles into the Army, Navy, Air Force and Marine Corps Land and Facilities Planning Processes and Programs (Department of Defense, 1999). This report is also known by the more commonly used short title, Sustainable Planning: A Multi-Service Assessment 1999.

Sustainable Planning: A Multi-Service Assessment 1999 is written from a conceptual approach, defining broad sustainability concepts rather than "how to accomplish" checklists. This report defines sustainable development as:

> "satisfying human needs and desires for physical development, while maintaining a balance with natural systems that are limited in their ability to accommodate that development" (Department of Defense, 1999)

The holistic view of sustainable development in Sustainable Planning: A Multi-Service Assessment 1999 establishes a common understanding of sustainability at the policy level for the Department of Defense. This report focuses on sustainable development issues and opportunities and leaves the responsibility to the individual services to implement solutions.

In 1997, the Air Force became the first service to publish a working guide for sustainable development when the Air Force Environmentally Responsible Facilities Guide was released. This guide was meant to be "a practical tool for implementing environmentally responsible practices" throughout a facilities life cycle from design to disposal. The Air Force Environmentally Responsible Facilities Guide describes sustainability as:

> Sustainability is responsible stewardship of our natural, human and financial resources through a practical and balanced approach. Sustainability requires changes to the facility delivery process to ensure the "best fit" of the built environment to the natural and cultural environment. Sustainability integrates "green" or environmentally responsible practices into the process from the very beginning. Sustainable practices are an investment in the future. Through conservation, improved maintainability, recycling, reduction, reuse and other actions and innovations, we can meet today's needs without compromising the ability of future generations to meet their own. (Air Force Center for Environmental Excellence, 1997)

The Air Force Environmentally Responsible Facilities Guide provided a series of checklists of sustainable practices that can be implemented within a facility's life cycle, from initial planning, to defining requirements, construction, occupancy and maintenance, and finally disposal. There are checklists that focus on water, energy, building materials, and waste management. Each checklist is followed by an extensive reference list.

In December 2001, four years after the Air Force first published guidance on sustainable development, and after a few sustainable building test projects, a formal sustainable development policy was adopted. This policy, signed by the Air Force Civil Engineer (AF/ILE), states:

> It is Air Force policy to apply sustainable development concepts in the planning, design, construction, environmental management, operation, maintenance and disposal of facilities and infrastructure projects, consistent with budget and mission requirements. (Robbins, 2001)

and defines sustainable development as:

> Sustainable development is an investment in the future. Through conservation, improved maintainability, recycling, reuse, reduction and other actions and innovations, we can meet today's needs without compromising the ability of future generations to meet their own. Sustainable development supports an increased commitment to environmental stewardship and conservation, and results in an optimal balance of cost, environmental, societal and human benefits while meeting the mission and function of the intended facility or infrastructure. (Robbins, 2001)

The Air Force Sustainable Development Policy requires the sustainable development principles to be incorporated into military construction (MILCON) projects starting in FY04. Compliance with this policy will be measured by MILCON projects meeting the qualifications for certification under the United States Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED™) Green Building

Rating. The policy also states that Unspecified Minor Construction and housing privatization projects should also be considered when implementing sustainable development. LEED™ is designed for new construction and major renovations and is most applicable for high dollar cost projects similar to MILCON projects.

In September 2002, the Air Force Center for Environmental Excellence (AFCEE) released the Air Force Sustainable Facilities Guide, which replaces the Air Force Environmentally Responsible Facilities Guide (Air Force Center for Environmental Excellence, 2003a). The Air Force Sustainable Facilities Guide is an on-line website based guide based on LEED™. The Air Force Sustainable Facilities Guide addresses LEED™ requirements within the context of a facility's life cycle.

The concepts of sustainable development are not new to the Air Force. There are many existing Air Force programs supporting sustainable developments concepts, even though the term sustainable development is not in the title. The Air Force Energy Management Program, the Air Force Water Management Program, the Air Force Affirmative Procurement Program and the Compliance Through Pollution Prevention Program are examples of existing programs that support sustainable development concepts.

1.2 Problem Statement

LEED™ and the Air Force Sustainable Facilities Guide are best suited for MILCON and other high cost projects. The Air Force Civil Engineer community does not have a management system in place to identify and incorporate sustainable development concepts into all facility and infrastructure projects, regardless of cost.

1.3 Research Objectives

1. Explore sustainable development concepts and methods of evaluating at a systems level.

2. Develop a management system that can identify, compare, and promote the sustainable development opportunities of all Air Force facility and infrastructure projects.

3. Test and validate developed system.

4. Make recommendations for Air Force wide adoption of developed system.

1.4 Research Methodology

1. Conduct literature review to understand current principles and practices of sustainable development both within and outside of the Department of Defense.

2. Research sustainable development managements systems currently in use.

3. Develop a sustainable development management system that can identify sustainable development opportunities in all facility and infrastructure projects.

5. Test and validate developed sustainable development management system by applying system to actual facility and infrastructure projects.

6. Recommend sustainable development management system for adoption by the Civil Engineer community, or identify additional research questions necessary before recommending management system adoption.

1.5 Relevance

Key ingredients in the Air Force's ability to meet current and future missions are quality facilities and infrastructure. By incorporating sustainable development concepts into facility and infrastructure projects, it is possible to have quality facilities and

infrastructure that use fewer natural resources and/or have less damaging impact to the environment as compared to traditional construction methods. The Air Force has been directed by both the President and the Department of Defense to incorporate sustainable development principles. A sustainable development management system as proposed in this thesis would be a means for the Air Force Civil Engineer community to incorporate sustainable development concepts into all facility and infrastructure projects.

1.6 Thesis Overview

The remainder of this thesis is divided into the following four chapters: background, methodology, research results, and conclusion and recommendations. Chapter 2 presents information on sustainable development guidance, programs, and assessment methods. Chapter 3 outlines the method used to create a sustainable development management system that is applicable for all facility and infrastructure projects. Chapter 4 contains the results of the developed sustainable development management system. Chapter 5 provides a summary of the research, identifies limitations of the research, and describes areas for future research.

II. Background

This background contains detailed information on topics that are relevant to this research effort. The following topics are discussed: Air Force Sustainable Development Policy, sustainable development guides and assessment programs currently in use, existing Air Force programs that support sustainable development concepts, sustainable development opportunities, and the role of the base development programmer.

2.1 Air Force Sustainable Development Policy

Maj Gen Robbins, the Air Force Civil Engineer, signed the Air Force Sustainable Development Policy on 19 Dec 02. This section will briefly highlight some of the key areas of the policy. The full policy is located in Appendix A.

The Air Force Sustainable Development Policy introduces three goals of sustainable development (Table 1) and six principles of sustainable development (Table 2). The sustainable development goals are self-explanatory and are not discussed in greater detail in the Air Force Sustainable Development Policy.

Table 1. Air Force Sustainable Development Policy Goals of Sustainable Development

1. Conserve energy, water, and raw materials.
2. Prevent environmental degradation caused by construction, operations, and disposal of facilities.
3. Create built environments which are livable, healthy, maintainable, and productive.

Table 2. Air Force Sustainable Development Policy Principles of Sustainable Development

1. Optimize Site Potential
2. Minimize Energy Consumption
3. Protect and Conserve Water
4. Use Environmentally Preferable Products
5. Enhance Indoor Environmental Quality
6. Optimize Operational and Maintenance Practices

The sustainable development principles in Table 2 are further explained in Appendix A. Knowledge of these goals and principles provides a foundation for understanding the intent of the Air Force Sustainable Development Policy.

In addition to providing goals and principles of sustainable development, the Air Force Sustainable Development Policy provides a metric for measuring sustainable development. The policy mentions LEED™ as the Air Force preferred self-assessment metric for measuring sustainable development. The Air Force policy is to have 20% of each MAJCOM's FY04 MILCON projects qualify for the minimum LEED™ certification, increasing to 100% of FY09 MILCON projects. Actual LEED™ certification from the USGBC is not required, just the ability to meet the certification criteria. Each MAJCOM has the choice to obtain actual LEED™ certification for their projects if they desire.

The first sentence of the Air Force Sustainable Development Policy states:

> It is Air Force policy to apply sustainable development concepts in the planning, design, construction, environmental management, operation, maintenance and disposal of facilities and infrastructure projects, consistent with budget and mission requirements (Robbins, 2001).

The key sections of the Air Force Sustainable Development Policy that are the basis for this research is the phrase "consistent with budget and mission requirements" found in the first sentence of the policy, and the choice of using LEED™ as the metric. The use of

LEED™ is required with only MILCON projects; yet, there are many other projects that Civil Engineers are responsible for that are lower in cost than MILCON projects. LEED™ is not listed as a metric to be used with all projects because meeting the complex LEED™ requirements in lower cost projects would, in most cases, not be "consistent with budget and mission requirements." The objective of this thesis is to create a metric, similar in the intent of LEED™, that can be universally applied to all facility and infrastructure projects "consistent with budget and mission requirements."

2.2 Sustainable Development Guides

There are numerous sustainable development guides in use by various departments of the federal government, state and local governments, and private industry. Fourteen sustainable development guides were selected for review because they were available for free download on the internet and they represent a cross sampling of the sustainable development guides available. Table 3 lists the guides selected. LEED™ Version 2.1 and the Air Force Sustainable Facilities Guide are discussed in the most detail because LEED™ is the Air Force preferred self-assessment metric and because the Air Force Sustainable Facilities Guide was developed specifically for Air Force use.

2.2.1 LEED™ Version 2.1

The United States Green Building Council's (USGBC) Leadership in Energy & Environmental Design (LEED™) Green Building Rating System is probably the most common used rating system for sustainable building design in the United States. The USGBC was founded in 1993 as a nonprofit organization to promote sustainable design.

Table 3. Reviewed Sustainable Development Guides

Title	Published
LEED™ Version 2.1	September 2002
Air Force Sustainable Facilities Guide	September 2002
U.S. Army Sustainable Project Rating Tool (SPiRiT)	June 2002
LEED™ for Existing Buildings Version (draft)	January 2002
LEED™ Rating System for Commercial Interiors (draft)	July 2002
LEED™ - Canada Guide	September 2002
BREEAM/Green Leaf	1998
Commonwealth of Pennsylvania Guidelines for Creating Green Buildings	1999
High Performance Guidelines: City of New York	April 1999
Greening Federal Facilities	May 2001
High Performance Guidelines: Triangle Region Public Facilities	September 2001
Minnesota Sustainable Design Guide	November 2001
City of Scottsdale Green Building Program	May 2002
City of Boulder Green Points Building	January 2003

Current USGBC membership consists of architecture and engineering firms, builders, manufacturers, government entities, universities, utilities, developers, and others. In 1995, USGBC, with funding from the Department of Energy, began developing the first version of LEED™, which was released in December 1998. The purpose of LEED™ is to define "green buildings" by providing a standard for measurement (U.S. Green Building Council, 2002c). The current version of LEED™, Version 2.1, was released in November 2002.

Various design and construction choices that support sustainable development earn points under the LEED™ program. There are four levels of LEED™ certification based on the number total number of points earned (Table 4). As of December 2002, 38 facilities worldwide have earned LEED™ certification with another 601 projects registered for certification.

Table 4. LEED™ Certification Levels

1. Certified	26 - 32 points
2. Silver	33 - 38 points
3. Gold	39 - 51 points
4. Platinum	52+ points (69 possible)

Points are earned by completing the requirements of credits in six different categories. Additionally, certain categories have mandatory prerequisites that are not worth any points, but are required for LEED™ certification. Table 5 summaries the different categories. The Air Force Sustainable Facilities Guide, discussed next, is based

Table 5. Summary of LEED™ Categories

LEED™ Version 2.1 Categories	Number of Prerequisites	Number of Credits	Credit Points Available
Sustainable Sites	1	14	14
Water Efficiency	0	5	5
Energy and Atmosphere	3	8	17
Materials and Resources	1	13	13
Indoor Environmental Quality	2	15	15
Innovation and Design Process	0	5	5
Total Prerequisites and Credits	**7**	**60**	**69**

on LEED™ Version 2.0. LEED™ Version 2.1 is basically identically to version 2.0 except some of the requirements have been slightly reworded for clarification and five of the credits under Energy and Atmosphere in version 2.0 have been combined into one credit in version 2.1 with no change in requirements or points available.

Available free to the public is a 74-page LEED™ Version 2.1 checklist, which lists the LEED™ requirements. For an additional fee, members of the USGBC can purchase a 270-page LEED™ reference guide, which provides design guidance and strategies to meet each of the 69 available points. The USGBC also provides individuals the opportunity to become a LEED™ Accredited Professional. A LEED™ Accredited

Professional has met certain proficiency requirements in the concepts of sustainable development and the LEED™ certification process.

2.2.2 Air Force Sustainable Facilities Guide

The Air Force Sustainable Development Policy states that AFCEE will be the provider of Air Force guidance on sustainable development. AFCEE's guidance is the Air Force Sustainable Facilities Guide, which is an online web based guide. The Air Force Sustainable Facilities Guide is based on LEED™ 2.0, which was the current version of LEED™ in use at the time of publication. LEED™ 2.1 clarifies some of the requirements in LEED™ 2.0; however, the two documents are essentially the same. The Air Force Sustainable Facilities Guide, similar to LEED™, contains five categories with each category containing prerequisites and credits (Table 6).

The Air Force Sustainable Facilities Guide and LEED™ requirements are identical except for an "Air Force Supplement". These supplemental items are design requirements that are not included in the LEED™ system, but are important to the Air Force. These additional credits are the reason the number of prerequisites and credits are different from those shown in Table 5.

Table 6. Air Force Sustainable Facilities Guide Categories

Air Force Sustainable Facilities Guide Categories	Number of Prerequisites	Number of Credits	Credit Points Available
Sustainable Sites	4	14	14
Water Efficiency	0	5	5
Energy and Atmosphere	4	12	17
Materials and Resources	2	14	13
Indoor Environmental Quality	3	15	15
Innovation and Design Process	0	5	5
Total Prerequisites and Credits	**13**	**65**	**69**

Table 4 showed that 26 out of a possible 69 points are required for the minimum level of LEED™ certification. Not all of the points require the same level of effort to obtain. In order to help Air Force civil engineers focus their efforts, the Air Force Sustainable Facilities Guide provides a recommendation for each LEED™ criteria. The recommendations are "highly recommended", "recommended" and "conditionally recommended". Each of these recommendations is color coded for clarity, and a justification statement provides the specific reason for the recommendation. The criteria identified as "highly recommended" are generally accepted good practice that either does not add cost, or has strong life cycle cost justification. The criteria identified as "recommended" provide benefits that can generally be easily justified, however must be tested in the context of the specific design solution. The criteria identified as "conditionally recommended" will be beneficial in some applications, however may be inappropriate in others (Air Force Center for Environmental Excellence, 2003a).

Figure 1 shows the front page of the Air Force Sustainable Facilities Guide. The Air Force Sustainable Facilities Guide is located at http://www.afcee.brooks.af.mil/dc/dcd/arch/rfg/index.html. Not all of the available data links contained within the Air Force Sustainable Facilities Guide are discussed. The following discussion focus on the data links that are most applicable to this research.

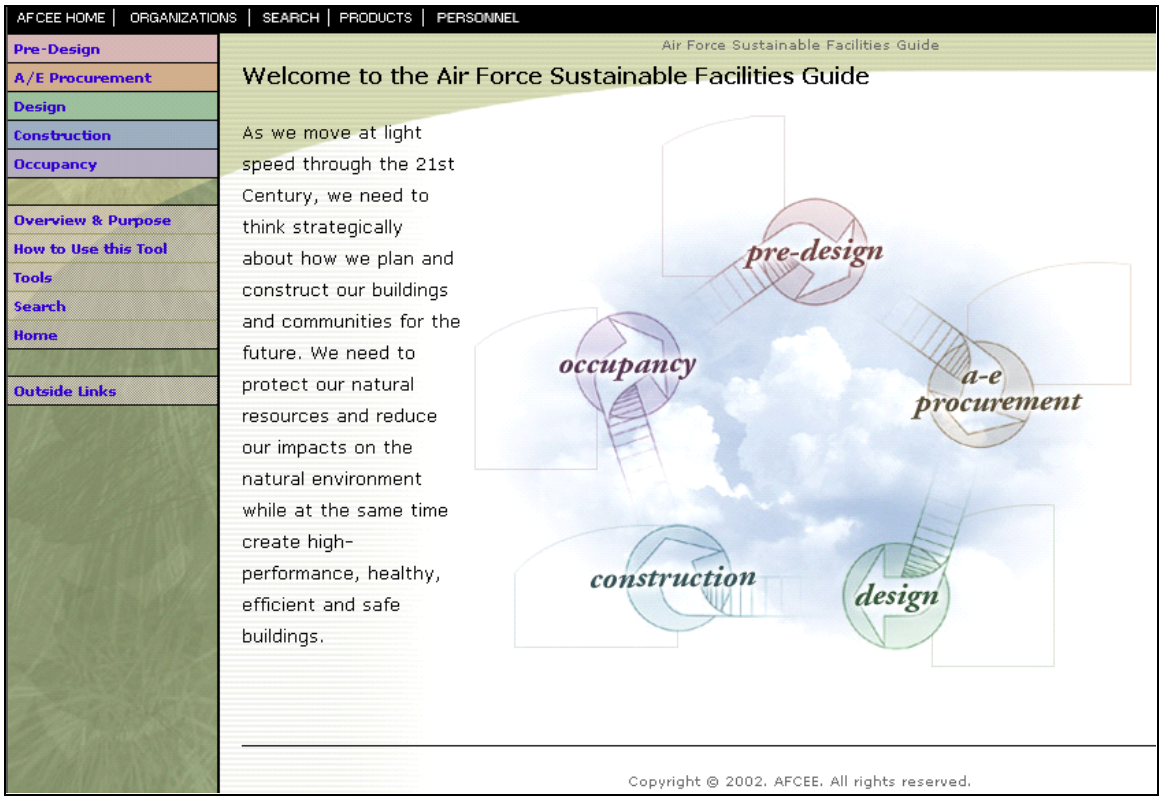


Figure 1. Air Force Sustainable Facilities Guide – Front Page

The requirements in LEED™ are grouped into six functional areas (Table 5). However, the LEED™ requirements are not clear as to what step in the design process each requirement is best addressed. The Air Force Sustainable Facilities Guide addresses this issue by cross-referencing the LEED™ requirements with the different design phases of a facility. The Air Force Sustainable Facilities Guide is organized in five major design process categories (Table 7).

Table 7. Air Force Sustainable Facilities Guide Design Process Categories

1. Pre-Design
2. A/E Procurement
3. Design
4. Construction
5. Occupancy

Figure 2 shows the front page with the links to the five design process categories highlighted. Clicking on one of the categories in Item 1 will jump to the selected category. Alternatively, clicking on the category name in Item 2 will also jump to the selected category.

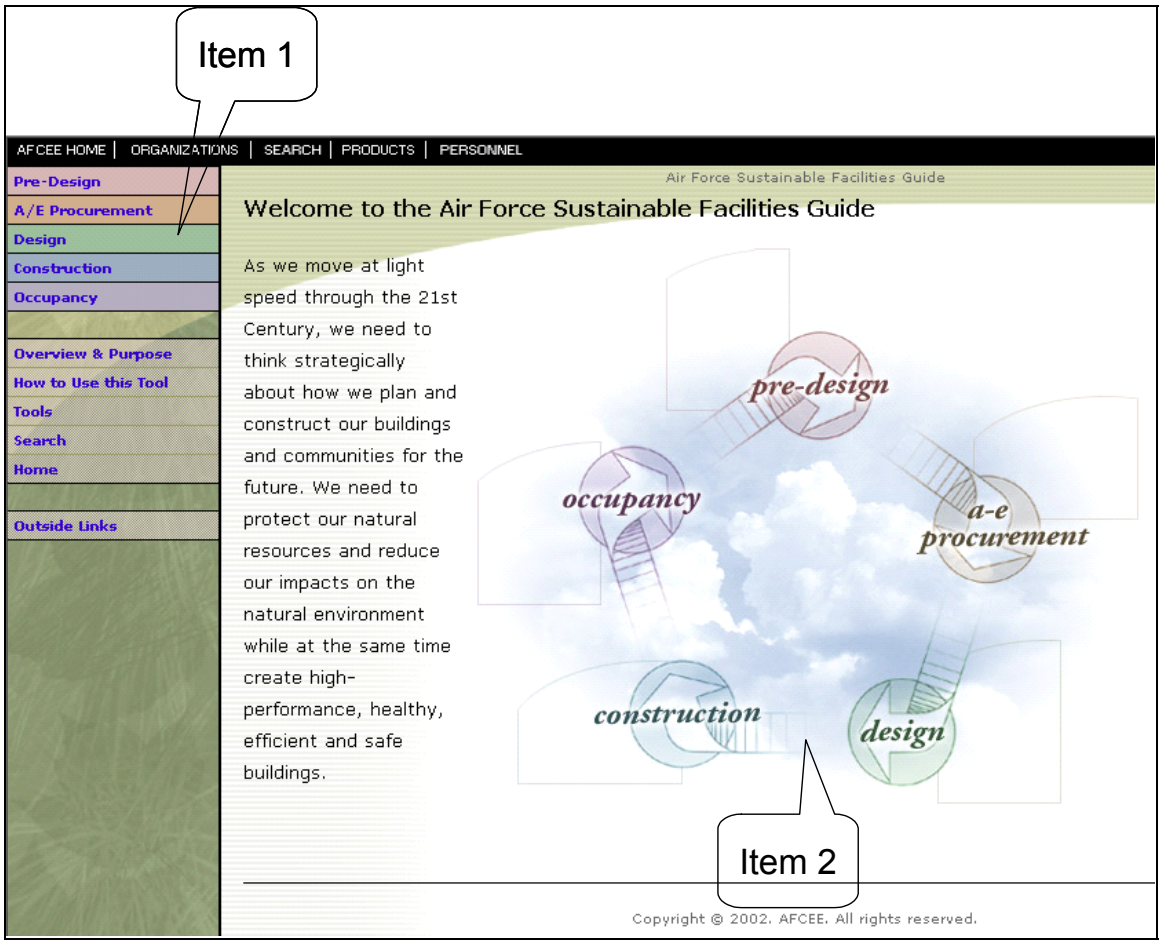


Figure 2. Air Force Sustainable Facilities Guide - Front Page with the Design Process Category Links Highlighted

Figure 3 shows the "Construction Phase" page of the Air Force Sustainable Facilities Guide. This page is obtained by clicking on "Construction" as shown in Item 1 or Item 2 of Figure 2. Item 1 in Figure 3 shows the LEED™ categories. In this example, clicking on the LEED™ category "Water" will show the applicable LEED™ "Water" requirements for the "Construction" category (Figure 4).

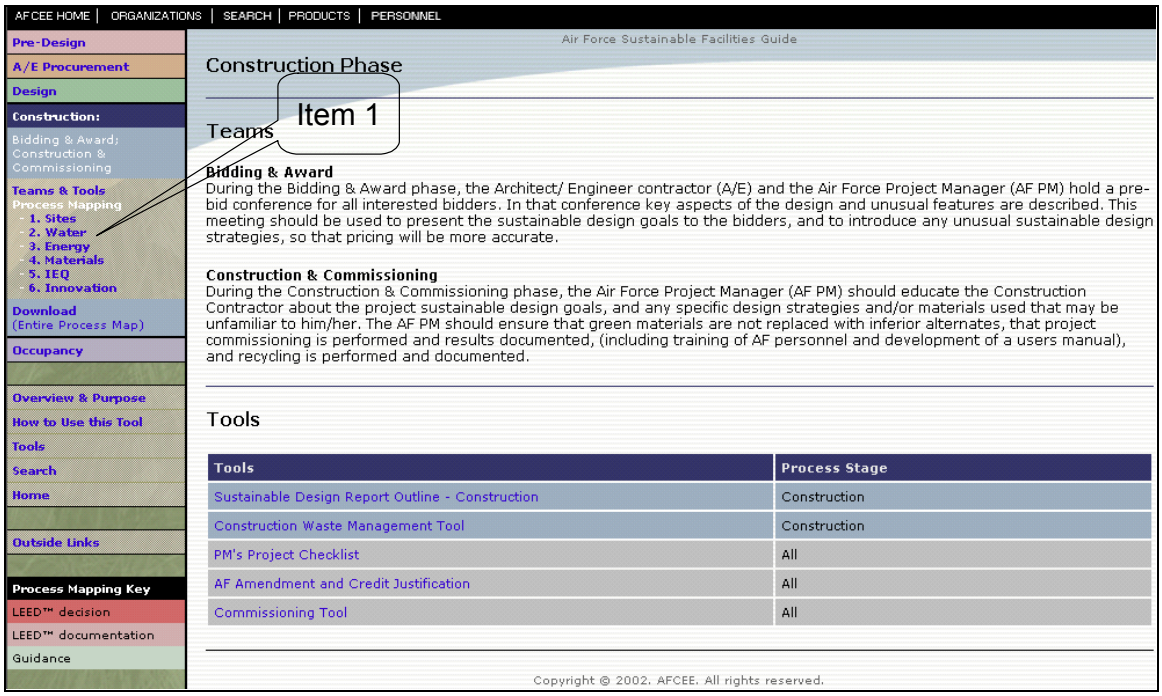


Figure 3. Air Force Sustainable Facilities Guide - Front Page of the Construction Category

Figure 4 has some key components that need further explanation. Item 1 is a hyperlink to a pop-up window that shows the actual LEED™ requirement (Figure 5). Item 2 is an area that provides guidance and strategies to meet the LEED™ requirements which were obtained by clicking on the hyperlink in Item 1. All of the LEED™ requirements that are available online (Item 1 in Figure 5) can also be downloaded as a single Adobe Acrobat file called AFLEEDprocessmap.pdf. Item 3 shows the hyperlink for this download. The AFLEEDprocessmap.pdf file may be easier for some individuals to use because it contains all LEED™ requirements in a spreadsheet style format as opposed to multiple web pages.

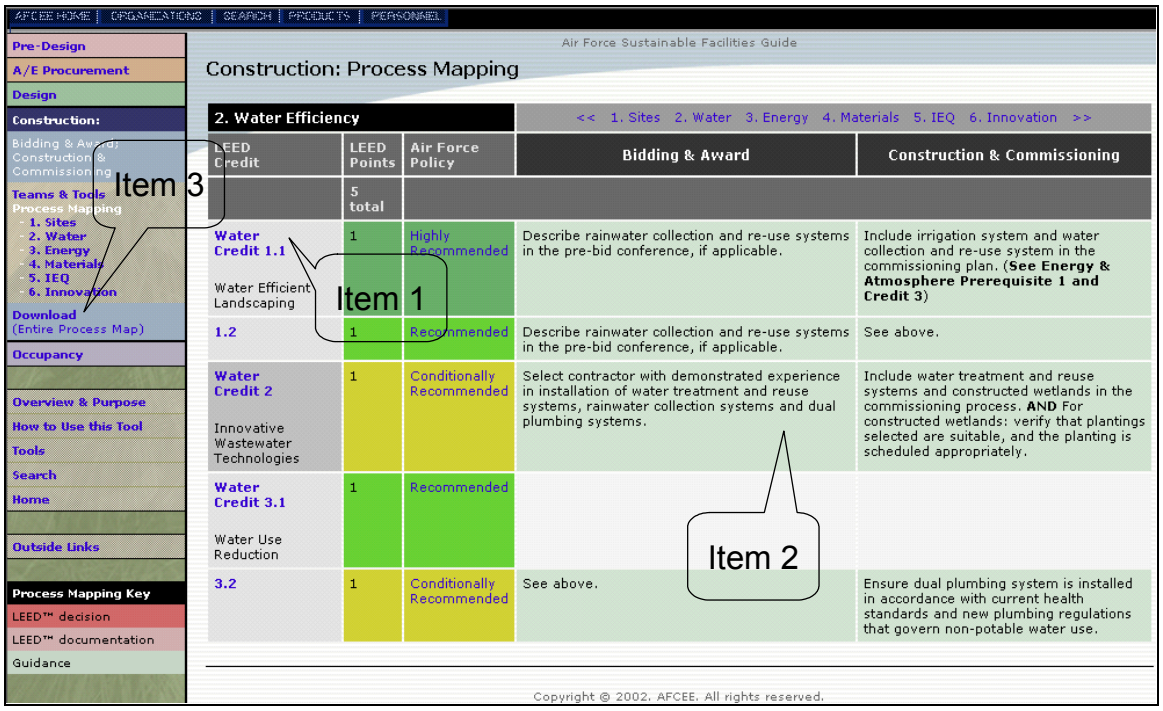


Figure 4. Air Force Sustainable Facilities Guide - LEED™ Water Category Guidance for the Construction Design Process

The information contained in Item 1 in Figure 5 is the foundation for this research. The intent, requirements, and justification for each of the credits found in the Air Force Sustainable Facilities Guide were evaluated for inclusion into a sustainable development management system that is applicable to all facility and infrastructure projects. The AFLEEDprocessmap.pdf file was downloaded, printed and used for the evaluation.

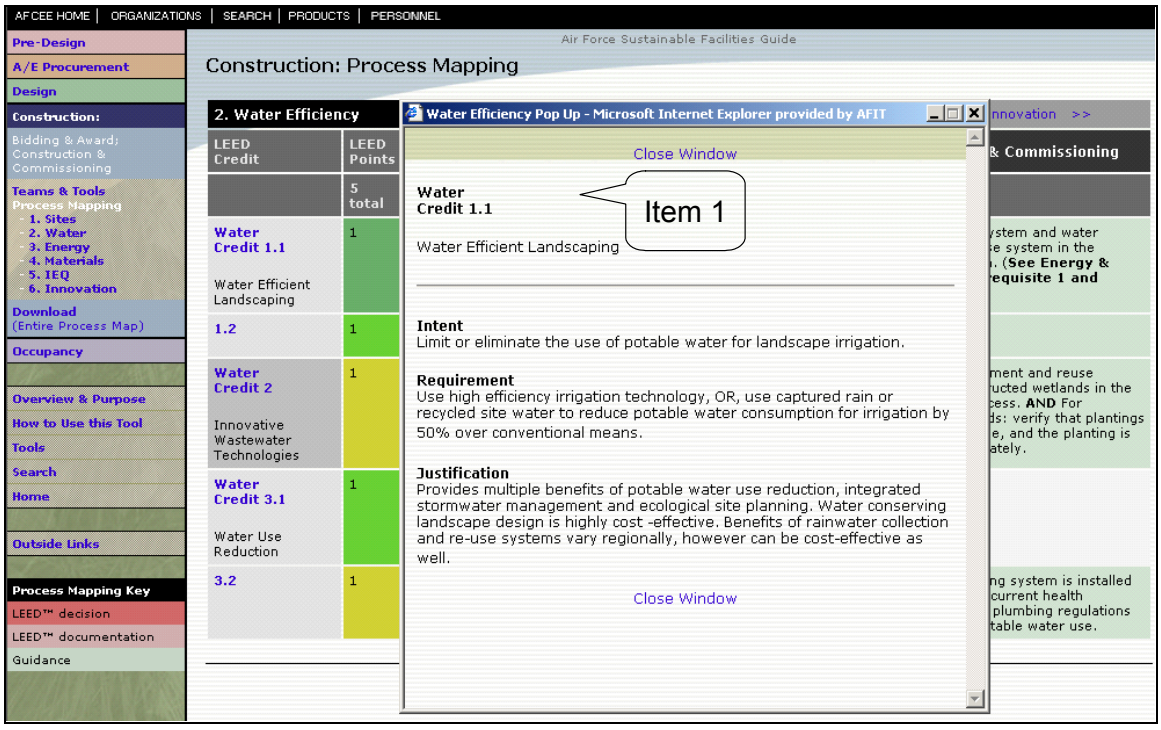


Figure 5. Air Force Sustainable Facilities Guide – LEED™ Water Credit 1.1 Requirement

2.2.3 Other Sustainable Development Guides

LEED™ Version 2.1 and the Air Force Sustainable Facilities Guide were the two primary sustainable development guides reviewed in this research. The remaining guides reviewed in this section, while basically the same as the two primary guides, have slight differences in requirements that reflect the intended use of the guide developer. The differences between the various sustainable development guides are not the focus of this research. However, these differences were reviewed for best practices that could be incorporated into the developed sustainable development management system. This section provides a brief description of the target audience for each of the remaining sustainable development guides, unique items within the guides, and a table showing the

sustainable development categories. Any best practice taken from these guides is noted in Chapter 4.

2.2.3.1 U.S. Army Sustainable Project Rating Tool (SPiRiT) Version 1.4.1

The Army's guide for sustainable development, SPiRiT Version 1.4.1 is similar to the Air Force Sustainable Facilities Guide. Both guides are based on LEED™ Version 2.0 and have extra requirements that are unique to each service's needs that are not found in LEED™. SPiRiT contains the same basic five categories as LEED™ (Table 5) plus two additional categories: current mission and future mission (U.S. Army Corps of Engineers, 2002). In addition to the two new categories, SPiRiT has changed some of the LEED™ requirements to reflect Army unique concerns.

2.2.3.2 LEED™ for Existing Buildings Version 2.0 (draft)

Currently, LEED™ only applies to new facility construction. The USGBC is working on a rating system for existing buildings. LEED™ for Existing Buildings (draft) is a set of performance standards for the sustainable operations of existing buildings and will cover both daily operations processes and system upgrades (U.S. Green Building Council, 2002b). LEED™ for Existing Buildings (draft) maintains the same five categories as LEED™ (Table 5). Certain credit requirements have been adjusted to focus on building renovations and daily operations as opposed to new construction.

2.2.3.3 LEED™ for Commercial Interiors Version 2.1 (draft)

In July 2002, the USGBC released LEED™ for Commercial Interiors (draft). LEED™ for Commercial Interiors (draft) addresses the specifics of tenant spaces primarily in office and institutional buildings; providing the opportunity for building

tenants to design and certify high performance, healthy, durable, affordable and environmentally sound workplaces (U.S. Green Building Council, 2002a). LEED™ for Commercial Interiors (draft) maintains the same five categories as LEED™ (Table 5). Certain credit requirements have been adjusted to focus on building interiors as opposed to new construction.

2.2.3.4 LEED™ - Canada Guide

LEED™ - Canada Guide, developed by the ATHENA™ Sustainable Materials Institute, follows the same approach as the U.S. Army and Air Force approach. LEED™ - Canada is based on LEED™ Version 2.1 and has been adapted to meet unique Canadian requirements (ATHENA Sustainable Materials Institute, 2002a). LEED™ - Canada Guide maintains the same five categories as LEED™ (Table 5). Certain credit requirements have been adjusted to reflect the Canadian construction environment as opposed to the U.S. construction environment.

2.2.3.5 BREEAM/Green Leaf

BREEAM/Green Leaf was developed in 1998 by ECD Energy and Environment Canada Ltd. and TerraChoice Environmental Services Inc. for multi-unit residential buildings and office buildings (ATHENA Sustainable Materials Institute, 2002b). BREEAM/Green Leaf is an adaptation of Building Research Environmental Assessment Method (BREEAM), which was originally developed in 1990 by the Building Research Establishment in the United Kingdom.

The basic premise of BREEAM/Green Leaf is the same as LEED™; points are earned for meeting listed sustainable development objectives that are grouped into

categories (Table 8). A major difference from LEED™ is BREEAM/Green Leaf is an environmental award program instead of a certification program. As an award program, less documentation or proof of meeting objectives is required and only spot checks are completed in the award decision process (ATHENA Sustainable Materials Institute, 2002b).

Table 8. BREEAM/Green Leaf Categories

Project Management
Energy
Water
Resources
Site
Emissions, Effluents and Other Environmental Impacts
Indoor Environment

2.2.3.6 Commonwealth of Pennsylvania Guidelines for Creating Green Buildings

The Commonwealth of Pennsylvania Guidelines for Creating Green Buildings provides concepts of sustainable development, checklist of activities, steps to take during different phases of a facility life cycle, case studies, and references (Pennsylvania Department of Environmental Protection, 1999). While this guide does have checklists for sustainable development requirements grouped into categories (Table 9), there is not an associated points system or rating system.

Table 9. Commonwealth of Pennsylvania Guidelines for Creating Green Buildings Categories

Green Team Building and Goal Setting
Site
Enclosure
Mechanical
Interiors
Materials

2.2.3.7 High Performance Building Guidelines: City of New York

The High Performance Building Guidelines: City of New York contains sustainable development information in ten categories (Table 10). The City of New York guide does not have a point system or rating system. Within each of the ten categories (Table 10), the City of New York guide lists objectives, benefits, technical strategies, examples, building integration (relationships to other categories), performance goals, tools, deliverables, regulatory constraints, and references (City of New York, 1999).

Table 10. High Performance Building Guidelines: City of New York Categories

City Process
Design Process
Site Design and Planning
Building Energy Use
Indoor Environment
Material and Product Selection
Water Management
Construction Administration
Commissioning
Operations and Maintenance

2.2.3.8 Greening Federal Facilities

Greening Federal Facilities: An Energy, Environmental, and Economic Resource Guide for Federal Facility Managers and Designers, Second Edition is a product of the Department of Energy and is intended for use by all federal facility managers (U.S. Department of Energy, 2001). Greening Federal Facilities provides sustainable development concepts and strategies, but it is not a rating system nor does it include a point system. Greening Federal Facilities is divided into eight categories (Table 11). Within each category, information is presented under the following headings: opportunities, technical information, and references.

Table 11. Greening Federal Facilities Categories

Environmental and Energy Decision-Making
Site and Landscape Issues
Building Design
Energy Systems
Water and Wastewater
Materials, Waste Management, and Recycling
Indoor Environmental Quality
Managing Buildings

2.2.3.9 High Performance Guidelines: Triangle Region Public Facilities Version 2.0

The High Performance Guidelines: Triangle Region Public Facilities was developed as joint effort of the following counties in North Carolina: Chatham, Durham, Johnston, Lee, Orange, and Wake. This document was modeled after LEED™ Version 2.0 and also drew heavily from the City of New York's High Performance Building

Guidelines and the Commonwealth of Pennsylvania's Guidelines for creating High-Performance Buildings (Triangle J Council of Governments, 2001).

One unique feature of this guide is the incorporation of case studies. Embedded within each of the six LEED™ categories are "Technology Example" sections that present case studies limited to the corresponding category. Additionally, eight full case studies of facilities that were certified under High Performance Guidelines: Triangle Region Public Facilities Version 1.0 are presented. High Performance Guidelines: Triangle Region Public Facilities maintains the same six categories as LEED™ (Table 5). Certain credit requirements have been changed to meet local requirements.

2.2.3.10 Minnesota Sustainable Design Guide

The Minnesota Sustainable Design Guide (University of Minnesota, 2002) is similar to the Air Force Sustainable Facilities Guide. Both are based on LEED™, contain a point system, are on-line web based products, and match LEED™ requirements with different phases of a facility lifecycle. The Minnesota Sustainable Design Guide also provides facility case studies, which are not found in the Air Force Sustainable Facilities Guide. Although based on LEED™, the Minnesota Sustainable Development Guide groups their requirements into slightly different categories (Table 12).

Table 12. Minnesota Sustainable Design Guide Categories

Site
Water
Energy
Indoor Environmental Quality
Materials
Waste

2.2.3.11 City of Scottsdale Green Building Program

The City of Scottsdale Arizona Green Building Program (City of Scottsdale, 2002) is designed for single-family residential housing and is a point based assessment program. The credits in this program are grouped into 14 categories (Table 13). The requirements of the City of Scottsdale Green Building Program are relatively simple and straight forward requirements that can easily be incorporated into residential housing design and construction.

Table 13. City of Scottsdale Green Building Program Categories

Site Use
Structural Elements
Building Envelop
Heating, Cooling, and Ventilation
Electrical Power, Lighting, and Appliances
Plumbing Systems
Roofing
Exterior Finishes
Interior Finishes
Interior Doors, Cabinetry, and Trim
Finish Floor
Pools and Spas
Solid Waste
Special Operations

2.2.3.12 City of Boulder Green Points Building Program

The City of Boulder Green Points Building Program (City of Boulder, 2002) is similar to the City of Scottsdale Green Building Program. Both are designed for residential housing, are a points based system, and provide relatively straight forward requirements. One major difference between the two programs is that the City of Boulder's program has nine different point standards based on three types of construction

(new construction, interior renovations, and additions) and on three thresholds of square footage. The City of Scottsdale program, for comparison, has two point standards (entry and advanced). The City of Boulder Green Points Building Program contains ten categories (Table 14).

Table 14. City of Boulder Green Points Building Program Categories

Construction, Demolition, and Use of Recycled Materials
Land Use and Water Conservation
Framing
Plumbing
Electrical
Windows and Insulation
Heating, Ventilating and Air Conditioning
Solar
Indoor Air Quality and Interior Finishes
Innovation Points

2.2.4 Point Summary of Sustainable Development Guides

Eleven of the 14 selected guides use a point system to measure sustainable development. Not all of the guides reviewed use the same sustainable development categories. In order to compare the various guides with common categories, the requirements from each guide were grouped into the LEED™ categories. A summary of the points available are shown in Table 15 and the relative weighting (by percent of total points) is shown in Table 16. These comparison tables were developed to compare the reviewed guides with the guide developed in this research.

Table 15. Point Summary of Reviewed Sustainable Development Guides based on LEED™ Categories

	LEED™ Categories						
Guide	Sustainable Sites	Water Efficiency	Energy & Atmosphere	Materials & Resources	Indoor Environmental Quality	Innovation & Design Process	Point Total
LEED 2.1	14	5	17	13	15	5	69
Air Force	14	5	17	13	15	5	69
Army	20	5	28	13	17	17	100
LEED-EB	16	5	22	10	18	5	76
LEED-CI	7	2	14	14	15	5	57
LEED - Canada	14	5	17	13	15	5	69
BREEAM/Green Leaf	220	85	325	100	220	50	1000
Triangle Region	244	197	207	157	95	100	1000
Minnesota	12	10	26	18	27	7	100
Scottsdale, AZ	17	18	142	78	64	20	339
Boulder, CO	25	6	207	75	77	10	400

Table 16. Relative Weightings of Reviewed Sustainable Development Guides based on LEED™ Categories

	LEED™ Categories						
Guide	Sustainable Sites	Water Efficiency	Energy & Atmosphere	Materials & Resources	Indoor Environmental Quality	Innovation & Design Process	Total
LEED 2.1	20%	7%	25%	19%	22%	7%	100%
Air Force	20%	7%	25%	19%	22%	7%	100%
Army	20%	5%	28%	13%	17%	17%	100%
LEED-EB	21%	7%	29%	13%	24%	7%	100%
LEED-CI	12%	4%	25%	25%	26%	9%	100%
LEED - Canada	20%	7%	25%	19%	22%	7%	100%
BREEAM Green Leaf	22%	9%	33%	10%	22%	5%	100%
Triangle Region	24%	20%	21%	16%	10%	10%	100%
Minnesota	12%	10%	26%	18%	27%	7%	100%
Scottsdale, AZ	5%	5%	42%	23%	19%	6%	100%
Boulder, CO	6%	2%	52%	19%	19%	3%	100%

The placement of the requirements from the various guides into the LEED™ categories was completed by the author. Not all requirements lined up clearly with the LEED™ categories and best estimates on the appropriate categories was necessary. Tables 15 and 16 should be used only as a guide as it is the author's opinion and was not validated by a third party.

2.3 Existing Air Force Programs Supporting Sustainable Development Concepts

While the Air Force Sustainable Development Policy is relatively new, there are several existing Air Force programs, predating the Air Force Sustainable Development

Policy, that support the concepts of sustainable development. These programs are briefly described below. The intent of reviewing these programs is to show that the Air Force has supported the concepts of sustainable development prior to the Air Force Sustainable Development Policy. The topics and intent of these programs are also included in LEED™.

2.3.1 Air Force Energy Management Program

The purpose of Air Force Energy Program Procedural Memorandum (AFEPPM) 96-1, Air Force Energy Management Plan is to comply with the reduction goals mandated by the Energy Policy Act of 1992 and Executive Order (EO) 13123, Greening the Government Through Efficient Energy Management (Department of the Air Force, 1996). The Air Force energy program covers energy used by aircraft, vehicles, and utilities. The Air Force Civil Engineer Support Agency (AFCESA) is responsible for implementing the utilities portion. The reminder of this section will only discuss utilities.

The goals of Air Force Energy Management are the same as listed in EO 13123. EO 13123 requires federal agencies to reduce energy consumption per gross square feet by 30 percent by 2005 and 35 percent by 2010 relative to 1985 baseline. Other goals of EO 13123 include using off-grid generations sources including wind and solar, purchasing electricity from renewable energy sources, and constructing facilities that meet the Environmental Protection Agency ENERGY STAR® program criteria for energy performance. ENERGY STAR® is a government-backed program helping businesses and individuals protect the environment through superior energy efficiency (U.S. Environmental Protection Agency, 2003c).

The majority of the energy projects under this program are funded by Energy Savings Performance Contracts (ESPCs). ESPCs use a private contractor to fund energy audits, construct/implement energy saving projects, and operate and maintain installed systems. The contractor and the Air Force share in the financial savings.

2.3.2 Air Force Water Management Program

AFEPPM 96-2, Air Force Water Management Program is a subset of the Air Force Energy Management plan. The Department of Energy (DOE) established the goals of Air Force Water Management Program and AFCESA is responsible for implementing the water management plan. On 31 July 2000, the DOE released the document Guidance to Establish Water Efficiency Improvement for Federal Agencies. The water conservation goals set by DOE require installations to create a water management plan and to implement at least four of 10 listed Best Management Practices (BMPs). The goal is to have 100 percent of Air Force bases to implement a water management plan by 2005 and to implement at least four BMPs based on the following schedule: 5 percent of the bases by 2002, 15 percent by 2004, 30 percent by 2006, 50 percent by 2008, and 80 percent by 2010. As with energy projects, ESPCs are recommend for water conservation projects. More information on the water program can be found in the Air Force Water Conservation Guidebook (Air Force Civil Engineer Support Agency, 2002).

2.3.3 Affirmative Procurement Program

EO 13101, Greening the Government through Waste Prevention, Recycling, and Federal Acquisition mandates the purchasing of recycled and environmentally preferable products. The EPA Comprehensive Procurement Guideline (CPG) program is

responsible for determining environmentally preferable products (U.S. Environmental Protection Agency, 2002). The CPG program is part of EPA's continuing effort to promote the use of materials recovered from solid waste. The Air Force Affirmative Procurement Program requires the Air Force to purchase products listed in the EPA CPG program. Construction related products covered by the EPA CPG program include insulation, carpet, cement and concrete, paint, and floor tiles (Environmental Protection Agency, 2002).

2.3.4 Compliance Through Pollution Prevention

The purpose of Air Force Compliance Assurance and Pollution Prevention (P2) program is to sustain and enhance mission readiness by implementing sound cost-effective strategies for complying with existing or new environmental requirements while minimizing or eliminating potential hazards to human health and the environment (HQ USAF/ILEV, 1999). Historically, complying with environmental regulations and P2 were considered separate programs. The Compliance Through Pollution Prevention program seeks to reduce the compliance requirements by reducing the number of compliance sites through P2 measures; to use P2 as the preferred solution for assuring environmental compliance (HQ USAF/ILEV, 1999). Compliance sites are defined as any regulated facility, regulated process, or a discharge to a regulated facility or process. Compliance issues include air and water emissions. Reducing air and water emissions is included in LEED™.

2.4 Sustainable Development Opportunities

The Air Force currently operates and maintains a $169 billion physical plant consisting of over 731 million square feet of facilities on 166 installations around the world. The Air Force Facilities Investment Plan describes investment principles, tools, and processes aimed at achieving the Air Force installations vision of facilitates that are available when and where needed and with the right capabilities (HQ USAF/ILE, 2002). This thesis is not concerned with the different funding programs and facility prioritization methods described in the Air Force Facilities Investment Plan per se, but with the opportunities for incorporating sustainable development as represented by the funding requirements.

2.4.1 Installations' Readiness Report

The Installations' Readiness Report (IRR) is an annual report to Congress that provides information on the capability of facilities and infrastructure to support forces in the conduct of their mission. The IRR is a commander's assessment of whether facilities meet minimum acceptable performance, as well as the cost to restore facility classes to minimal acceptable performance (HQ USAF/ILE, 2002). The IRR ratings are C-1 to C-4 with C-1 the best. In FY 2001, 63% of all facility classes were rated below C-2. It is the Air Force's goal to have all facility classes C-2 or higher by the end of FY 2010, at an estimated cost of $18 billion.

2.4.2 Facility Investment Metric

The Facility Investment Metric (FIM) (HQ USAF/ILE, 2002) is used to identify and prioritize O&M funding requirements. Each facility is grouped into one of four

mission areas: primary mission, mission support, base support, and community support. For each project within a mission area, commanders rate the mission impact of the project not being funded. A critical rating means significant loss of mission capability, degraded means limited loss of mission, and enhancement means little or no loss of mission.

This thesis is concerned with developing a sustainable development management system that is applicable to all facility and infrastructure projects, especially lower cost facility and infrastructure projects that are not covered by the Air Force Sustainable Development Policy. The latest FIM data contains 19,220 projects valued at $6.12 billion. Of this number, 16,784 projects, valued at $3.7 billion dollars total, have a project program cost under $500 thousand (HQ USAF/ILER, 2002).

2.5 Base Development Programmer

The base development programmer is critical to implementing a sustainable development program. The programmer is responsible for developing project requirements, cost estimates, and justification (Department of the Air Force, 1999). Senior leadership use this information in deciding what projects to fund. Identifying the sustainable development opportunities in facility and infrastructure projects should start with the base development programmer. In developing project requirements, along with project scope and cost estimates, sustainable development opportunities and goals should be identified. The product of this thesis is designed for early identification of sustainable development opportunities by the base development programmer.

The Automated Civil Engineer System (ACES) is the real time work management system used in Civil Engineering. ACES is a computer database system where project information, to include project description, requirements and cost, are maintained by the base development programmer. This information is accessible to not only base level CE, but Major Commands, and Air Staff as well. The information collected on sustainable development opportunities could also be included in ACES.

III. Methodology

The end product of this research is a sustainable development guide titled "Simplified Sustainable Facilities Guide". This chapter outlines the steps used to construct the Simplified Sustainable Facilities Guide. First, objectives to guide the development of the Simplified Sustainable Facilities Guide were identified. Second, an appropriate data medium for the guide was selected. Third, a source document was selected as a reference for the Simplified Sustainable Facilities Guide. Fourth, an evaluation process of the source document was developed. Fifth, the organization of the Simplified Sustainable Facilities Guide was developed. Sixth, a validation process was developed. Seventh, an implementation strategy was identified. Each of these steps is discussed in detail in this chapter.

3.1 Objectives

Chapter 2 describes various sustainable development guides, each for a specific use and audience. In order to construct a sustainable development guide to be used by Air Force personal to evaluate Air Force facility and infrastructure projects, a series of objectives for the guide must be defined. These objectives are needed to guide the development of the guide and provide a basis to understand the intent of the developed guide. The objectives provide insight into how the developed guide is different from existing guides. Table 17 lists the four objectives developed for the Simplified Sustainable Facilities Guide. These four objectives were created by the author and are discussed in greater detail in Chapter 4.

Table 17. Simplified Sustainable Development Guide Objectives

1. Identify sustainable development opportunities.
2. Support published Air Force policy and guidance.
3. Provide a quick evaluation process.
4. Provide clear requirements.

3.2 Medium of Developed Guide

There are different mediums that can be used to convey information. Two of the most common are paper based products and computer based products. In choosing a medium for the Simplified Sustainable Facilities Guide, several factors need to be considered. One factor is how conducive is the chosen medium to building the guide. A medium that allows the guide to built with relative ease is desired. Another factor is how well the medium conveys the information. Conveying the information includes not only the physical appearance of the information, but also how easy it is to navigate through the information. Finally, the chosen medium should also be one that is readily transferable to and useable by Air Force personal.

Microsoft Excel® was chosen as the medium for the Simplified Sustainable Facilities Guide. Microsoft Excel® is a component of the Microsoft Office suite of applications that is common throughout the Air Force. Additionally, it is assumed that most Air Force personal that would use the Simplified Sustainable Facilities Guide have a basic understanding of how to use Microsoft Excel®. The use of hyperlinks and automatically filled in data fields were further incorporated to facilitate ease of use.

3.3 Source Document

As discussed in Chapter 2, there are numerous guides and models on assessing sustainable development in facilities. Since the reviewed sustainable development guides are fundamentally the same, it was determined that a single source document should be used as the primary basis for the developed guide with the other guides available for best practices not included in the source document. The source document should be comprehensive, readily available, and recognized by the Air Force. Table 3 lists the documents that were considered. The Air Force Sustainable Facilities Guide was selected as the source document because it is the approved Air Force guide to implement sustainable development concepts into MILCON projects.

3.4 Evaluation Process

With a set of objectives defined, and a source document selected, the next step was to develop an actual evaluation process. The source document, the Air Force Sustainable Facilities Guide, contains 78 evaluation criteria divided into 13 prerequisites and 65 credits (Table 6). Prerequisites are mandatory items that do not receive any points for completing. Credits are optional items that receive points for completing. Unless noted, the term credit will be used for both prerequisites and credits. Each of these 78 credits from the Air Force Sustainable Facilities Guide was evaluated individually for inclusion in the Simplified Sustainable Facilities Guide using the objectives listed in Table 17. This process started with reviewing the intent, requirement, and justification for each credit (Item 1, Figure 5). Five questions were asked in evaluating each credit's requirements (Table 18).

Table 18. Evaluation Questions

1. Does the credit's requirements meet the objectives in Figure 17?
2. If the requirements do not meet the objectives, should the credit be included in the guide?
3. If the credit should be included, how can the requirements be modified to meet the objectives?
4. What is the justification for the decisions made in questions 2 and 3?
5. Is there additional information that can provide guidance on the requirements?

Questions 1-4 were initially answered based on the expertise of the author of this thesis. The author is a Civil Engineer officer with eight years of base level civil engineering experience in identifying, programming, and executing facility and infrastructure projects. In situations where the author did not have the appropriate expertise to answer questions 1-4, additional research was conducted. This research was completed primarily by reviewing similar requirements contained in the other sustainable development guides and by performing internet searches on the topic. Question 5 was answered by identifying internet websites, Air Force and other government documents, and industry standards that related to the credit in question.

3.5 Organization of Developed Guide

In developing the Simplified Sustainable Facilities Guide, the decision needed to be made concerning the organization of the guide within Excel®. Four primary components of the guide were selected (Figure 6). These components were selected to facilitate use of the Simplified Sustainable Facilities Guide by separating different types of information. The arrows in Figure 6 indicate hyperlinks used to navigate between the various components. The introduction page is the starting point for using the Simplified Sustainable Facilities Guide and provides hyperlinks to navigate to the other three

components of the guide. The instructions component describes the purpose of the guide, suggested uses, and instructions on how to use the guide. The checklist component provides a series of criteria to identify sustainable development opportunities. The source document component contains a hyperlink to the online Air Force Sustainable Facilities Guide.

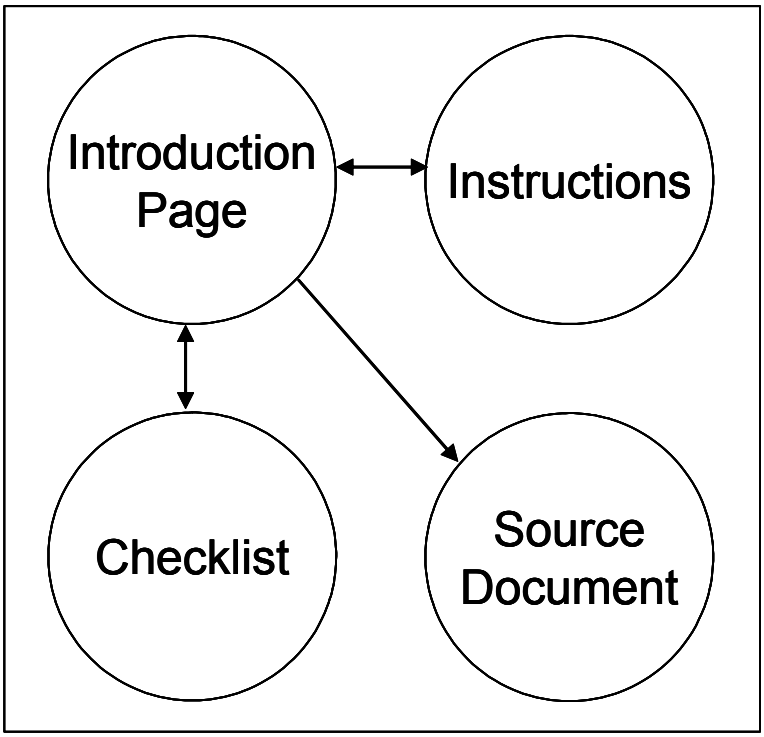


Figure 6. Components of the Simplified Sustainable Facilities Guide

3.6 Validation

A method to validate the developed guide was required. Each evaluation criterion of the Air Force Sustainable Facilities Guide was evaluated for inclusion into the Simplified Sustainable Facilities Guide. Along with the decision to include or not, many of the evaluation criteria were changed. These decisions were made by the researcher.

The purpose of validation is to ensure that the develop guide met the objectives in Table 17. Three different validation methods are presented.

3.6.1 Subject Matter Experts

There are three levels of subject matter experts, policy, technical, and execution, which are available to validate the Simplified Sustainable Facilities Guide (Figure 7).

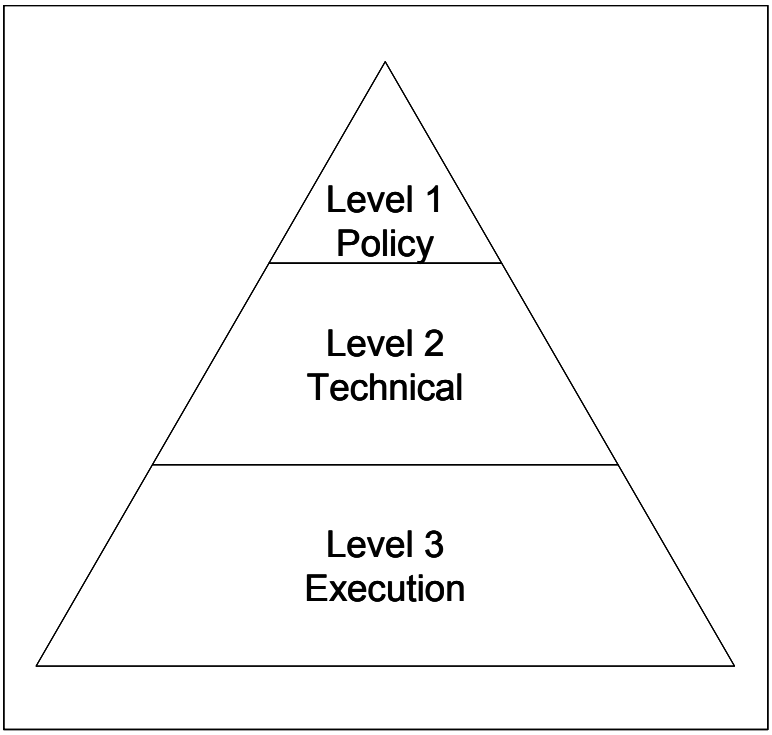


Figure 7. Levels of Subject Matter Experts

The first level, policy, is the office of the Civil Engineer of the Air Force (AF/ILE). AF/ILE is the office that developed the Air Force Sustainable Development Policy and can validate if the Simplified Sustainable Facilities Guide supports Air Force Policy.

The second level, technical, is the Air Force Sustainable Facilities Guide project manager at the Air Force Center for Environmental Excellence (AFCEE). AFCEE is the

office that developed the Air Force Sustainable Facilities Guide to support the Air Force Sustainable Development Policy. Personnel at AFCEE, in conjunction with the Air Force Civil Engineer Support Agency (AFCESA), developed the evaluation criteria contained in the Air Force Sustainable Facilities Guide. Personal at AFCEE can validate if the Simplified Sustainable Facilities Guide is technically correct and supports Air Force strategies that support the Air Force Sustainable Development Policy.

The third level, execution, are Major Command (MAJCOM) Civil Engineers and Base Civil Engineers (BCE). MAJCOM and BCEs are the offices that develop execution methods to implement the use of the Air Force Sustainable Facilities Guide. MAJCOM and BCEs can validate if the Simplified Sustainable Facilities Guide is a usable product that enhances the execution of the Air Force Sustainable Development Policy.

3.6.2 Relative Weightings

The evaluation criteria of the Simplified Sustainable Facilities Guide are grouped into the six LEED™ categories (Table 5). An analysis of the relative weighting of the point totals by percent for each of these categories, compared to the Air Force Sustainable Facilities Guide and the other guides, would reveal if the emphasis of the Simplified Sustainable Facilities Guide is similar to the existing guides. For example, if the existing guides weight the importance of water efficiency as 5-10% of the total, the Simplified Sustainable Facilities Guide should be approximately the same or, if not, provide an explanation of the difference.

3.6.3 Support Air Force Sustainable Development Policy Goals and Principles

The Air Force Sustainable Development Policy lists three goals and six principles of sustainable development (Table 1 and Table 2 respectively). Each of the evaluation criteria for the Simplified Sustainable Facilities Guide was evaluated to ensure that the guide supported the goals and principles.

This was accomplished by first reviewing each evaluation criterion contained in the Air Force Sustainable Facilities Guide and determining which goals and principles each evaluation criterion supported. This same process was performed using the evaluation criteria found in the Simplified Sustainable Facilities Guide. The results of this process were compared to each other to validate if the Simplified Sustainable Facilities Guide supported the Air Force Sustainable Development Policy in the same manner as the Air Force Sustainable Facilities Guide. This validation process is an internal process completed by the author and is not the same as receiving feedback directly from AF/ILE.

3.7 Implementation Strategy

For widespread adoption of the Simplified Sustainable Facilities Guide, an implementation strategy needs to be developed and implemented. Five components of an implementation strategy were identified: a requirements driver, training, access, results, and feedback (Figure 8). First, a requirements driver is required for adoption. The requirements driver could be voluntary, such as a personal desire to adopt, or mandatory, such as a policy or MAJCOM requirement. Adequate training is also required for adoption. Training should address both "Why are we doing this" and "How do I do it"

questions. Access to the guide must be available. Meaningful results from using the guide need to be identified. Meaningful results are important for sustained support and continued use. Finally, a feedback mechanism is required. Incorporating feedback provides a means to maintain and adapt the guide as requirements drivers change, training needs change, access requirements change and meaningfulness of results change.

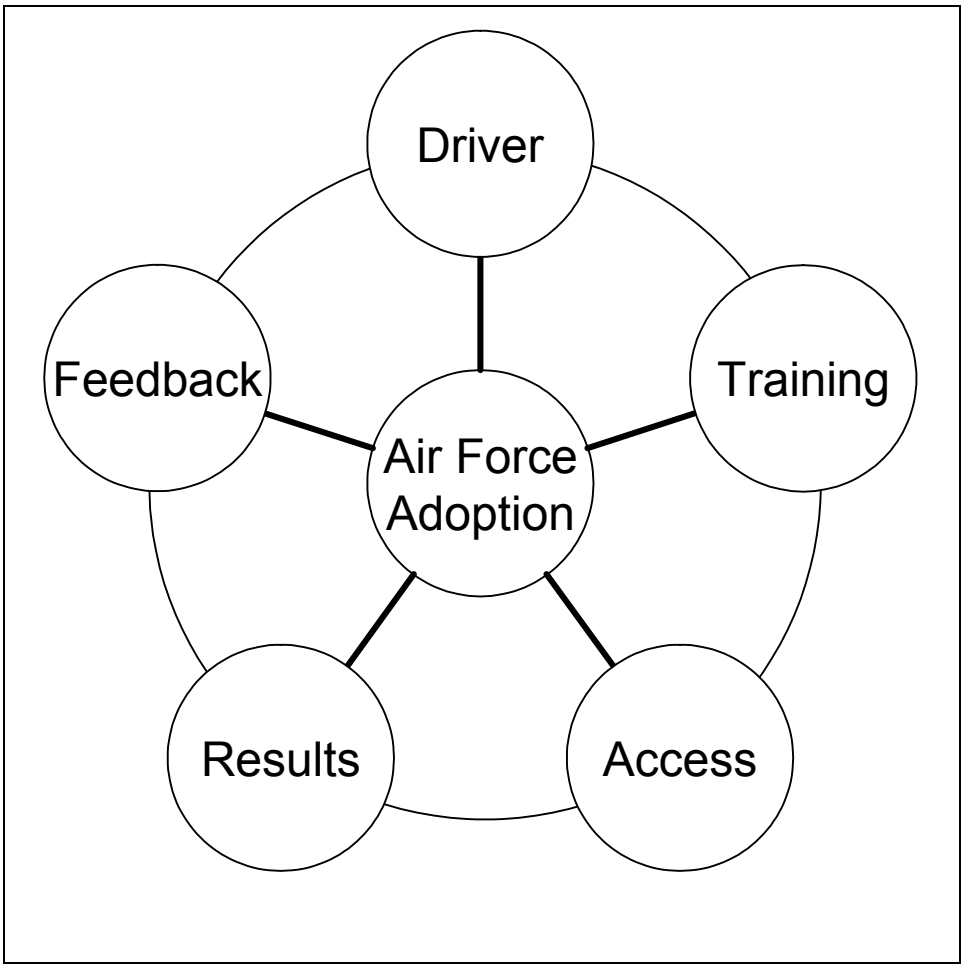


Figure 8. Implementation Components

IV. Research Results

The purpose of this chapter is to report the outcome of the seven-step process used to create the Simplified Sustainable Facilities Guide as outlined in Chapter 3.

4.1 Objectives

To guide the development of the Simplified Sustainable Facilities Guide, four objectives for the guide were initially identified (Table 17). Early in the Simplified Sustainable Facilities Guide development process, it became obvious that the objectives only described the contents of the guide. Three basic fundamental questions had not been clearly addressed: 1. What is the purpose of the guide? 2. What is the applicability of the guide? and 3. When should the guide be used? These three questions needed to be addressed first. This section answers these three fundamental questions and expands on the originally identified objectives.

4.1.1 Purpose of Simplified Sustainable Facilities Guide

The purpose of the Simplified Sustainable Facilities Guide is discussed in various sections of the thesis. However, it was decided that a single sentence that summed up the overarching purpose of the guide needed to be created. A single sentence would provide a goal and roadmap for the entire process. The following sentence is the purpose of the Simplified Sustainable Facilities Guide.

> The Simplified Sustainable Facilities Guide supports the Air Force Sustainable Development Policy by providing guidance and strategies to identify and incorporate sustainable development concepts in facility and infrastructure projects.

4.1.2 Applicability of the Simplified Sustainable Facilities Guide

The Air Force Sustainable Facilities Guide was developed for MILCON projects. Credit points are earned for performing required activities that promote sustainable development. Many of these credits require detailed engineering studies that would not be practical to perform in a relatively low cost project. However, many of these lower cost projects have the potential to incorporate sustainable development practices. The Simplified Sustainable Facilities Guide is similar to the Air Force Sustainable Facilities Guide. The main difference is that most of the credit areas have been simplified to provide guidance on sustainable development opportunities that require little to no detailed engineering studies.

There is not a defined cutoff point on when to use the Simplified Sustainable Facilities Guide or the Air Force Sustainable Development Guide. The overall scope of the project, the programmed amount, the level of engineering expertise available, and time available are all factors to consider in determining which guide to use. The Air Force Sustainable Facilities Guide is more robust and should be considered first.

4.1.3 When to Use the Simplified Sustainable Facilities Guide

The first time the Simplified Sustainable Facilities Guide should be used is when defining project requirements. At the same time that the scope of work, cost estimate, and other initial project data is colleted for an individual project, the Simplified Sustainable Facilities Guide should be used to identify and assess sustainable development opportunities. The various credits are designed to be "quick answers" and the entire assessment process should require minimal additional time to complete. The

completed assessment should become part of the project files. This step is expected to be completed by the programming section of engineering flight.

The next time the Simplified Sustainable Facilities Guide should be used is when the project is ready for design. Many projects are not funded for months or years after they were initially programmed. In the same manner that the scope of work and cost estimate provides a starting point for design, so should the sustainable development opportunities. During the design process, the scope of work and cost are validated and may change. Likewise, the sustainable development opportunities should also be validated and incorporated if possible. This step is expected to be completed by the project manager.

4.1.4 Objective 1 – Identify Sustainable Development Opportunities

The Simplified Sustainable Facilities Guide assesses the potential areas for incorporating sustainable development in facility and infrastructure projects. This assessment provides additional project information, sustainable development opportunities, that in conjunction with the project scope, cost estimate, and other project information defines the project requirements. The sustainable development opportunities identified is meant to be a guide towards sustainability, not a final authoritative answer. Similar to how the cost estimate will be revised in more detail once the project enters the design phase, so shall the potential areas for sustainable development be revised.

4.1.5 Objective 2 – Support Published Air Force Policy and Guidance

AFCEE created the Air Force Sustainable Facilities Guide to support the Air Force Sustainable Development Policy. The Simplified Sustainable Facilities Guide is

also created to support the Air Force Sustainable Development Policy. The main difference between the two guides is the Air Force Sustainable Facilities Guide is designed for identifying and incorporating sustainable development concepts into MILCON projects while the Simplified Sustainable Facilities Guide is designed for all facility and infrastructure projects. The validation section in this chapter provides details on this topic.

4.1.6 Objective 3 – Provide a Quick Evaluation Process

The checklist contained in the Simplified Sustainable Facilities Guide is designed to be initially completed in less than 30 minutes by the base development programmer. Since there may be a long lag time between initial project creation and project design, it is an objective to provide a quick method to identify sustainable development opportunities. Once a project enters the design phase, the Simplified Sustainable Facilities Guide should be used again to validate the initial assessment. This secondary assessment is not expected be completed in less than 30 minutes.

It is expected that there will be a learning curve to become familiar with both the Simplified Sustainable Facilities Guide and sustainable development concepts in general. During this learning phase, it is not expected that an initial assessment can be completed in 30 minutes. The Simplified Sustainable Facilities Guide is designed to minimize the familiarization period by providing hyperlinks to websites that provide additional information on sustainable development concepts. This leaning curve highlights the importance of having a well-developed training program.

4.1.7 Objective 4 – Provide Clear Requirements

The Simplified Sustainable Facilities Guide is designed to provide clear requirements that can be quickly evaluated. During the initial assessment, users of the guide should not have to guess or spend much time determining if the sustainable development requirements can be met, nor should they have to undertake detailed engineering studies to meet the requirements. While many requirements will require more than 30 minutes to actually accomplish in the design phase, the Simplified Sustainable Facilities Guide is designed to quickly identify the requirements and provide guidance to minimize the accomplishment time.

4.2 Medium of Simplified Sustainable Facilities Guide

Microsoft Excel® was chosen as the medium for the Simplified Sustainable Facilities Guide. Microsoft Excel® is a component of the Microsoft Office suite of applications that is common throughout the Air Force. Additionally, it is assumed that most Air Force personal that would use the Simplified Sustainable Facilities Guide have a basic understanding of how to use Microsoft Excel®. The use of hyperlinks and automatically filled in data fields were further incorporated to facilitate ease of use. The Simplified Sustainable Facilities Guide also contains an instruction page to facilitate use.

4.3 Source Document

The Air Force Sustainable Facilities Guide was selected as the source document. The Air Force Sustainable Development Policy states that LEED™ is the preferred self-assessment method (Robbins, 2001). The Air Force Sustainable Facilities Guide is based on LEED™ version 2.0 and provides policy and guidance to meet the LEED™ 2.0

requirements. Additionally, the Air Force Sustainable Facilities Guide includes additional requirements that are not included in LEED™ 2.0. These additional requirements are mandatory Air Force requirements or Air Force sustainable development focus areas not covered in LEED™ 2.0. Since the Air Force Sustainable Facilities Guide was specifically designed to support the Air Force Sustainable Development Policy, it was determined that this document is the ideal source document used to build the Simplified Sustainable Facilities Guide.

4.4 Evaluation Results

This section presents the results of the evaluation. First discussed is the format used for the evaluation. Next is a discussion of the evaluation results. Since there were 78 credits evaluated, the decision was made for readability purposes to place the actual results in a separate appendix (Appendix B). Contained in this section is a detailed sample of an evaluation plus tables that highlight where changes were made.

Chapter 3 discussed the five questions that guided the evaluation process and the methodology to answer the questions. During the time of developing the evaluation process, thought was not given to how to present the evaluation results. After a few iterations of presenting the data were attempted, it become clear that the information would be best presented in four information groups: source document information, Simplified Sustainable Facilities Guide information, justification information, and additional information. Figure 9 is the template used to present the evaluation results. The source document information contains information taken verbatim from the Air Force Sustainable Facilities Guide. The Simplified Sustainable Facilities Guide

Source Document Information

Title of Credit: Verbatim from Air Force Sustainable Facilities Guide.

Intent: Verbatim from Air Force Sustainable Facilities Guide.

Requirements: Verbatim from Air Force Sustainable Facilities Guide.

Air Force Policy and Justification: Verbatim from Air Force Sustainable Facilities Guide.

Simplified Sustainable Facilities Guide Information

Simplified Sustainable Facilities Guide Credit Title: Credit titles were not changed, but the credit number may change because not all the credits in the Air Force Sustainable Facilities Guide were included. Therefore the new credit numbers do not match the Air Force Sustainable Facilities Guide.

New Requirements: The requirements of the Simplified Sustainable Facilities Guide

Changes: A quick review of any changes in requirements from the Air Force Sustainable Facilities Guide. Choices listed here are "No Changes", "Minor Changes", "Major Changes", or "Not Included".

No Changes – No change in requirements

Minor Change – Requirements were adjusted. In most cases, the adjustment was simplifying requirements that required % calculations or detailed studies.

Major Change – A new requirement was added or an existing requirement was deleted.

Not Included – Credit was not included in the Simplified Sustainable Facilities Guide.

Justification Information

Justification: This section explains why changes were made.

Additional Information

Additional Information: Any additional information is listed here. Most of the additional information is further guidance to meet the requirement or a reference if requirement is adopted from other than the Air Force Sustainable Facilities Guide.

Figure 9. Template of Evaluation Information

information contains the credit number and title name found in the Simplified Sustainable Facilities Guide along with the requirements. The justification information discusses why any changes in requirements from the Air Force Sustainable Facilities Guide were

made. The additional information provides additional guidance and strategies for meeting the requirements. Each of these four information groups is explained in more detail within Figure 9.

It should be noted that the template shown in Figure 9 is not from the actual Simplified Sustainable Facilities Guide. This template was used to evaluate each credit. After all of the credits were evaluated, then the information was transferred to The Simplified Sustainable Facilities Guide, which is an Excel® spreadsheet. A discussion of the spreadsheet itself in contained in the next section.

Seventy-eight credits from the Air Force Sustainable Facilities Guide were evaluated for inclusion in the Simplified Sustainable Facilities Guide. For readability purposes, the decision was made to place the actual evaluation results into an appendix. Appendix B contains these results. Appendix B also contains a separate table of contents to quickly locate the evaluated credits. Figure 10 is a sample evaluation result from Appendix B.

The sample shown in Figure 10 is the 55th overall credit from the Air Force Sustainable Facilities Guide: Materials and Resources Credit 7 – Certified Wood. The intent, requirement, and Air Force policy and justification are verbatim from the Air Force Sustainable Facilities Guide. Next is the credit title contained in the Simplified Sustainable Facilities Guide. In this case, the credit number is the same as the Air Force Sustainable Facilities Guide. This is not always the case because some of the credits evaluated were not used in the Simplified Sustainable Facilities Guide. Next is the new requirement with the new points available. In this evaluation, the number of available

B.55 Materials and Resources Credit 7 – Certified Wood

Intent: Encourage environmentally responsible forest management.

Requirement: (1 Point)
Use a minimum of 50% of woodbased materials certified in accordance with the Forest Stewardship Council guidelines for wood building components including but not limited to framing, flooring, finishes, furnishings, and non-rented temporary construction applications such as bracing, concrete form work and pedestrian bridges.

Air Force Policy and Justification: Conditionally Recommended
Use of certified sustainable wood is environmentally beneficial and imposes only a nominal installed cost premium compared to conventional wood installations.

Simplified Sustainable Facilities Guide Credit Title: Materials and Resources Credit 7 – Certified Wood

New Requirements: (2 Points)
1 point for each type of wood product certified by the Forest Stewardship Council for a maximum of 2 points.

Changes: Minor Change: Deleted % calculations.

Justification: Removing the requirement to calculate percentages simplifies this requirement while preserving the intent of the credit.

Additional Information: The following website list products certificated by the Forest Stewardship Council.
http://www.certifiedwood.org/search-modules/ProductHierarchy.ASP

Figure 10. Sample Evaluation Result from Appendix B

points changed from one to two. In addition, the requirement itself has been changed. The requirement has been simplified from using a minimum of 50% certified wood products to simply using certified wood products. This simplification is a minor change, as explained in Figure 9. The justification for this change is listed along with additional information. The additional information is important because an end-user of this guide, in this sample, may not know what wood products are certified by the Forest Stewardship Council as required by the requirements.

Although the individual credit evaluation results are located in Appendix B, a series of summary tables of the evaluation results are presented here (Tables 19-31). Table 19 is a top-level view summary comparison of the prerequisites, credits, and available credit points of both the Air Force Sustainable Facilities Guide and the Simplified Sustainable Facilities Guide. Table 19 shows that the Simplified Sustainable Facilities Guide contains one less prerequisite, 15 less credits, and 9 more credit points available than the Air Force Sustainable Facilities Guide.

Table 19. Comparison of the Air Force Sustainable Facilities Guide and the Simplified Sustainable Facilities Guide

Air Force Sustainable Facilities Guide Categories	Number of Prerequisites	Number of Credits	Credit Points Available
Sustainable Sites	4	14	14
Water Efficiency	0	5	5
Energy and Atmosphere	4	12	17
Materials and Resources	2	14	13
Indoor Environmental Quality	3	15	15
Innovation and Design Process	0	5	5
Total Prerequisites and Credits	**13**	**65**	**69**
Simplified Sustainable Facilities Guide Categories	**Number of Prerequisites**	**Number of Credits**	**Credit Points Available**
Sustainable Sites	4	11	15
Water Efficiency	0	6	7
Energy and Atmosphere	4	10	18
Materials and Resources	2	7	17
Indoor Environmental Quality	2	12	15
Innovation and Design Process	0	4	6
Total Prerequisites and Credits	**12**	**50**	**78**

Tables 20-31 provide a breakdown summary of each category shown in Table 19. An explanation of Tables 20 and 21 are presented to understand how to interpret the data contained in Tables 20-31. Table 20 is a summary of the Sustaining Sites credits. The left hand column is the credit number from the Air Force Sustainable Facilities Guide. The next column is the Air Force recommendation for this credit from the Air Force

Table 20. Sustaining Sites Requirement Changes Summary

Air Force Sustainable Facilities Guide		Title	Simplified Sustainable Facilities Guide	
Credit #	Policy		Credit #	Requirement Changes
Prerequisite 1	Highly Recommended	Erosion and Sediment Control	Prerequisite 1	No Change
Prerequisite 2	Required	Environmental Protection	Prerequisite 2	No Change
Prerequisite 3	Required	Cultural Resources Protection	Prerequisite 3	No Change
Prerequisite 4	Required	Cleanwater Protection	Prerequisite 4	No Change
Credit 1	Highly Recommended	Site Selection	Credit 1	Major Change
Credit 2	Recommended	Urban Development	N/A	Not Included
Credit 3	Conditionally Recommended	Brownfield Redevelopment	N/A	Not Included
Credit 4.1	Recommended	Alternative Transportation	Credit 2.1	Major Change
Credit 4.2	Highly Recommended	Alternative Transportation	Credit 2.2	Major Change
Credit 4.3	Recommended	Alternative Transportation	Credit 2.3	Major Change
Credit 4.4	Recommended	Alternative Transportation	Credit 2.4	Major Change
Credit 5.1	Conditionally Recommended	Reduce Site Disturbance	Credit 3.1	Major Change
Credit 5.2	Recommended	Reduce Site Disturbance	Credit 3.2	Minor Change
Credit 6.1	Recommended	Stormwater Management	Credit 4	Minor Change
Credit 6.2	Recommended	Stormwater Management	N/A	Not Included
Credit 7.1	Highly Recommended	Landscape and Exterior Design to Reduce Heat Islands	Credit 5.1	Major Change
Credit 7.2	Highly Recommended	Landscape and Exterior Design to Reduce Heat Islands	Credit 5.2	Minor Change
Credit 8	Highly Recommended	Light Pollution Reduction	Credit 6	Minor Change

Sustainable Facilities Guide. The middle column is the title, which is the same for each guide. The next column is the credit number from the Simplified Sustainable Facilities Guide. The right hand column is a summary of the requirement change (definitions of the changes are in Figure 9, Simplified Sustainable Facilities Guide information block). Reviewing Table 20 shows that Credit 4.2, Alternative Transportation, is highly recommended and major requirement changes were made. The actual changes and the justification for the changes are located in Appendix B under Sustaining Sites Credit 4.2 – Alternative Transportation.

Table 21 is the summary of the points available in each of the two guides for the Sustainable Sites category. The two left hand columns are information from the Air Force Sustainable Facilities Guide and the two right hand columns are information from the Simplified Sustainable Facilities Guide. The middle column is the title, which is the same for both guides. Table 20 shows that Credit 4 consists of four sub-credits, 4.1-4.4. In table 21, only the main credit number is shown. Table 21 shows that the Simplified Sustainable Facilities Guide has only one addition available point than the Air Force Sustainable Facilities Guide. However, reviewing the table shows that the points within each credit are different. Credit 4, Alternative Transportation, for example, increases from four to eight points. The actual point values are located in Appendix B. Tables 22-31 contain summaries of the remaining five categories and follow the same format as Tables 20 and 21.

Table 21. Sustaining Sites Point Changes Summary

Air Force Sustainable Facilities Guide		Title	Simplified Sustainable Facilities Guide	
Credit #	**Points**		**Credit #**	**Points**
Prerequisite 1	0	Erosion and Sediment Control	Prerequisite 1	0
Prerequisite 2	0	Environmental Protection	Prerequisite 2	0
Prerequisite 3	0	Cultural Resources Protection	Prerequisite 3	0
Prerequisite 4	0	Cleanwater Protection	Prerequisite 4	0
Credit 1	1	Site Selection	Credit 1	1
Credit 2	1	Urban Development	Not Included	0
Credit 3	1	Brownfield Redevelopment	Not Included	0
Credit 4	4	Alternative Transportation	Credit 2	8
Credit 5	2	Reduce Site Disturbance	Credit 3	2
Credit 6	2	Stormwater Management	Credit 4	1
Credit 7	2	Landscape and Exterior Design to Reduce Heat Islands	Credit 5	2
Credit 8	1	Light Pollution Reduction	Credit 6	1
Total	**14**		**Total**	**15**

Table 22. Water Efficiency Requirement Changes Summary

Air Force Sustainable Facilities Guide		Title	Simplified Sustainable Facilities Guide	
Credit #	Policy		Credit #	Requirement Changes
Credit 1.1	Highly Recommended	Water Efficient Landscaping	Credit 1.1	Minor Change
Credit 1.2	Recommended	Water Efficient Landscaping	Credit 1.2	Major Change
Credit 2	Conditionally Recommended	Innovative Technologies	N/A	Not Included
Credit 3.1	Recommended	Water Use Reduction	Credit 2	Minor Change
Credit 3.2	Conditionally Recommended	Water Use Reduction	N/A	Not Included

Table 23. Water Efficiency Point Changes Summary

Air Force Sustainable Facilities Guide		Title	Simplified Sustainable Facilities Guide	
Credit #	Points		Credit #	Points
Credit 1	2	Water Efficient Landscaping	Credit 1	2
Credit 2	1	Innovative Technologies	N/A	0
Credit 3	2	Water Use Reduction	Credit 2	5
Total	**5**		**Total**	**7**

Table 24. Energy and Atmosphere Requirement Changes Summary

Air Force Sustainable Facilities Guide		Title	Simplified Sustainable Facilities Guide	
Credit #	Policy		Credit #	Requirement Changes
Prerequisite 1	Highly Recommended	Fundamental Building Systems Commissioning	Prerequisite 1	Minor Change
Prerequisite 2	Required	Minimum Energy Performance	Prerequisite 2	None
Prerequisite 3	Highly Recommended	CFC Reduction in HVAC&R Equipments	Prerequisite 3	Minor Change
Prerequisite 4	Required	Atmospheric Air Quality Protections	Prerequisite 4	Minor Change
Credit 1.1	Highly Recommended	Optimize Energy Performance	Credit 1	Minor Change
Credit 1.2	Recommended	Optimize Energy Performance	N/A	Not Included
Credit 1.3	Recommended	Optimize Energy Performance	N/A	Not Included
Credit 1.4	Conditionally Recommended	Optimize Energy Performance	N/A	Not Included
Credit 1.5	Conditionally Recommended	Optimize Energy Performance	N/A	Not Included
Credit 2.1	Conditionally Recommended	Renewable Energy	Credit 2	Minor Change
Credit 2.2	Conditionally Recommended	Renewable Energy	N/A	Not Included
Credit 2.3	Conditionally Recommended	Renewable Energy	N/A	Not Included
Credit 3	Highly Recommended	Additional Commissioning	N/A	Not Included
Credit 4	Conditionally Recommended	Elimination of HCFC's and Halons	Credit 3	Major Change
Credit 5	Highly Recommended	Measurement and Verification	Credit 4	Minor Change
Credit 6	Conditionally Recommended	Green Power	N/A	Not Included

Table 25. Energy and Atmosphere Point Changes Summary

Air Force Sustainable Facilities Guide		Title	Simplified Sustainable Facilities Guide	
Credit #	Points		Credit #	Points
Prerequisite 1	0	Fundamental Building Systems Commissioning	Prerequisite 1	0
Prerequisite 2	0	Minimum Energy Performance	Prerequisite 2	0
Prerequisite 3	0	CFC Reduction in HVAC&R Equipments	Prerequisite 3	0
Prerequisite 4	0	Atmospheric Air Quality Protections	Prerequisite 4	0
Credit 1	10	Optimize Energy Performance	Credit 1	15
Credit 2	3	Renewable Energy	Credit 2	1
Credit 3	1	Additional Commissioning	N/A	0
Credit 4	1	Elimination of HCFC's and Halons	Credit 3	1
Credit 5	1	Measurement and Verification	Credit 4	1
Credit 6	1	Green Power	N/A	0
Total	**17**		**Total**	**18**

Table 26. Materials and Resources Requirements Changes Summary

Air Force Sustainable Facilities Guide		Title	Simplified Sustainable Facilities Guide	
Credit #	Policy		Credit #	Requirement Changes
Prerequisite 1	Highly Recommended	Storage and Collection of Recyclables	Prerequisite 1	Minor Change
Prerequisite 2	Required	Hazardous Materials and Waste Management	Prerequisite 2	None
Credit 1.1	Conditionally Recommended	Building Reuse	N/A	Not Included
Credit 1.2	Conditionally Recommended	Building Reuse	Credit 1	Minor Change
Credit 1.3	Conditionally Recommended	Building Reuse	N/A	Not Included
Credit 2.1	Highly Recommended	Construction Waste Management	Credit 2	Minor Change
Credit 2.2	Recommended	Construction Waste Management	N/A	Not Included
Credit 2.3	Recommended	Construction Waste Management	N/A	Not Included
Credit 3.1	Conditionally Recommended	Resource Reuse	Credit 3	Minor Change
Credit 3.2	Conditionally Recommended	Resource Reuse	N/A	Not Included
Credit 4.1	Strongly Recommended	Recycled Content	Credit 4	Major Change
Credit 4.2	Recommended	Recycled Content	N/A	Not Included
Credit 5.1	Highly Recommended	Local/Regional Materials	Credit 5	Minor Change
Credit 5.2	Recommended	Local/Regional Materials	N/A	Not Included
Credit 6	Conditionally Recommended	Rapidly Renewable Materials	Credit 6	Minor Change
Credit 7	Recommended	Certified Wood	Credit 7	Minor Change

Table 27. Materials and Resources Point Changes Summary

Air Force Sustainable Facilities Guide		Title	Simplified Sustainable Facilities Guide	
Credit #	Points		Credit #	Points
Prerequisite 1	0	Storage and Collection of Recyclables	Prerequisite 1	0
Prerequisite 2	0	Hazardous Materials and Waste Management	Prerequisite 2	0
Credit 1	3	Building Reuse	Credit 1	1
Credit 2	2	Construction Waste Management	Credit 2	3
Credit 3	2	Resource Reuse	Credit 3	3
Credit 4	2	Recycled Content	Credit 4	3
Credit 5	2	Local/Regional Materials	Credit 5	2
Credit 6	1	Rapidly Renewable Materials	Credit 6	3
Credit 7	1	Certified Wood	Credit 7	2
Total	**13**		**Total**	**17**

Table 28. Indoor Environmental Quality Requirement Changes Summary

Air Force Sustainable Facilities Guide		Title	Simplified Sustainable Facilities Guide	
Credit #	Policy		Credit #	Requirement Changes
Prerequisite 1	Highly Recommended	Minimum IAQ Performance	Prerequisite 1	None
Prerequisite 2	Required	Environmental Tobacco Smoke (ETS) Control	N/A	Not Included
Prerequisite 3	Required	Acoustics and Noise Control	Prerequisite 2	None
Credit 1	Conditionally Recommended	Carbon Dioxide (CO2) Monitoring	Credit 1	Major Change
Credit 2	Conditionally Recommended	Increase Ventilation Effectiveness	Credit 2	None
Credit 3.1	Highly Recommended	Construction IAQ Management Plan	Credit 2	None
Credit 3.2	Highly Recommended	Construction IAQ Management Plan	Credit 3	Adjust
Credit 4.1	Highly Recommended	Low-Emitting Materials	Credit 4.1	None
Credit 4.2	Highly Recommended	Low-Emitting Materials	Credit 4.2	Major Change
Credit 4.3	Highly Recommended	Low-Emitting Materials	Credit 4.3	None
Credit 4.4	Highly Recommended	Low-Emitting Materials	Credit 4.4	None
not in guide		Low-Emitting Materials	Credit 4.5	Major Change
Credit 5	Highly Recommended	Indoor Chemical and Pollutant Source Control	Credit 5	Major Change
Credit 6.1	Conditionally Recommended	Controllability of Systems	Credit 6	Minor Change
Credit 6.2	Conditionally Recommended	Controllability of Systems	Credit 6	Minor Change
Credit 7.1	Recommended	Thermal Comfort	Credit 2	None
Credit 7.2	Conditionally Recommended	Thermal Comfort	Credit 2	None
Credit 8.1	Highly Recommended	Daylight and Views	Credit 7.1	Minor Change
Credit 8.2	Recommended	Daylight and Views	Credit 7.2	Minor Change

Table 29. Indoor Environmental Quality Point Changes Summary

Air Force Sustainable Facilities Guide		Title	Simplified Sustainable Facilities Guide	
Credit #	**Points**		**Credit #**	**Points**
Prerequisite 1	0	Minimum IAQ Performance	Prerequisite 1	0
Prerequisite 2	0	Environmental Tobacco Smoke (ETS) Control	N/A	0
Prerequisite 3	0	Acoustics and Noise Control	Prerequisite 2	0
Credit 1	1	Carbon Dioxide (CO2) Monitoring	Credit 1	1
Credit 2	1	Increase Ventilation Effectiveness	Credit 2	1
Credit 3.1	1	Construction IAQ Management Plan	Credit 2	1
Credit 3.2	1	Construction IAQ Management Plan	Credit 3	1
Credit 4	4	Low-Emitting Materials	Credit 4	5
Credit 5	1	Indoor Chemical and Pollutant Source Control	Credit 5	1
Credit 6	2	Controllability of Systems	Credit 6	1
Credit 7	2	Thermal Comfort	Credit 2	2
Credit 8	2	Daylight and Views	Credit 7	2
Total	**15**		**Total**	**15**

Table 30. Innovation & Design Requirement Changes Summary

Air Force Sustainable Facilities Guide		Title	Simplified Sustainable Facilities Guide	
Credit #	**Policy**		**Credit #**	**Requirement Changes**
Credit 1	Conditionally Recommended	Innovation in Design	Credit 1	Minor Change
Credit 2	Highly Recommended	LEED Accredited Professional	Credit 2	None
Credit 3	Recommended	Integrated Landscape Management	N/A	Not Included
Credit 4	Recommended	Deconstruction	Credit 3	Minor Change
Credit 5	Recommended	Advance Resource Efficiency	Credit 4	None

Table 31. Innovation & Design Process Point Changes Summary

Air Force Sustainable Facilities Guide		Title	Simplified Sustainable Facilities Guide	
Credit #	**Points**		**Credit #**	**Points**
Credit 1	1	Innovation in Design	Credit 1	3
Credit 2	1	LEED Accredited Professional	Credit 2	1
Credit 3	1	Integrated Landscape Management	N/A	0
Credit 4	1	Deconstruction	Credit 3	1
Credit 5	1	Advance Resource Efficiency	Credit 4	1
Total	**5**		**Total**	**6**

4.5 Organization of the Simplified Sustainable Facilities Guide

This section describes the information contained in the Simplified Sustainable Facilities Guide and the physical layout of the information. Four information components were previously identified (Figure 6): introduction page, instructions, checklist, and source document. Each of these four information components is discussed with screen shots from the Simplified Sustainable Facilities Guide. A full printout of the Simplified Sustainable Facilities Guide is contained in Appendix C.

Figure 11 shows the introduction page of the Simplified Sustainable Facilities Guide. The introduction page is the starting point when using the guide. Item 1 in Figure 11 is where basic project data is entered. The base development programmer would fill in this information. The worksheets tabs normally found on the bottom of an Excel® spreadsheet are hidden. Instead of using the sheet tabs for navigation, which

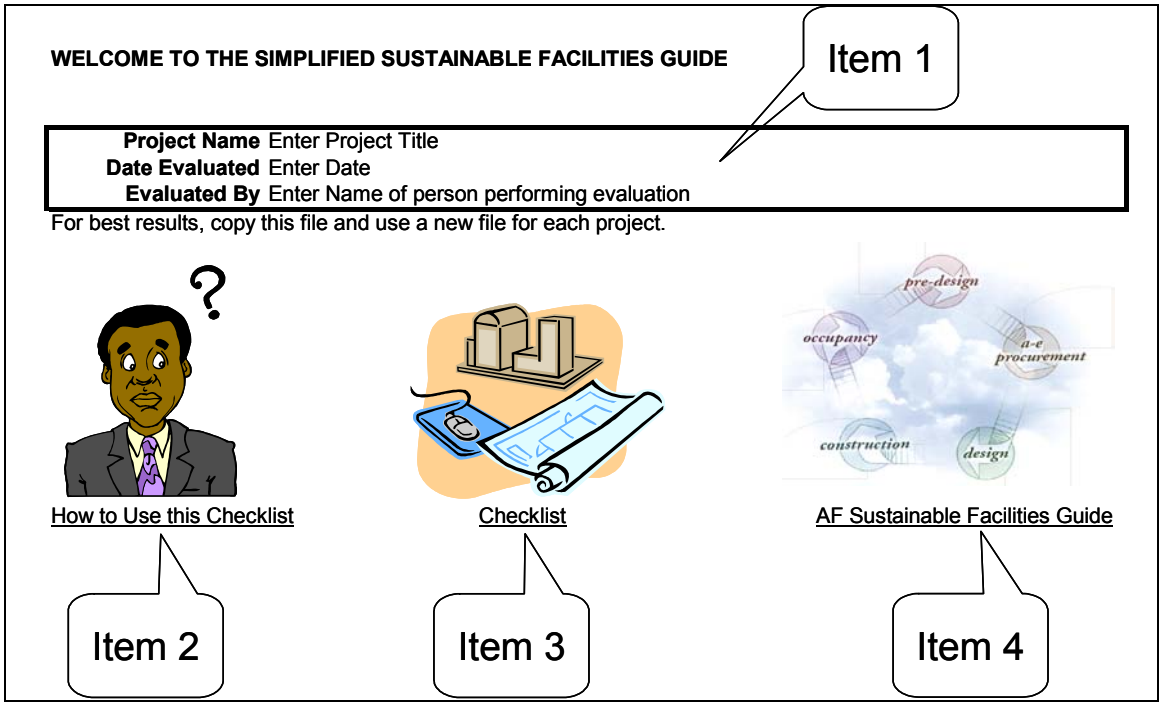


Figure 11. Introduction Page of the Simplified Sustainable Facilities Guide

allows jumping to any desired information component, hyperlinks were added for navigation. This was done because thought was put into the layout of the information and navigating by hyperlinks controls how one navigates throughout the guide. Item 2 is a hyperlink to the instructions component. Item 3 is a hyperlink to the checklist component. Item 4 is a hyperlink to the online Air Force Sustainable Facilities Guide. Each of the hyperlink pages contain hyperlinks to return to the introduction page.

Figure 12 shows the instructions component. The instructions contain information on the purpose of the Simplified Sustainable Facilities Guide, applicability, when to use, and directions on how to use the guide. The instructions are available if needed, or they can be skipped if one is familiar with the guide.

The checklist component was originally created by copying and pasting the evaluation results as shown in Figure 10 into Excel®. It quickly became apparent that this method did not meet the objective of providing clear requirements. While all the information was there, it was hard to understand. Through trial and error of how best to present the information, it was decided that the checklist component needed to have four levels of data. Figure 13 is a modification of Figure 6 and shows these new checklist data levels. The arrows in Figure 13 represent hyperlinks between the different information components and checklist data levels.

The checklist summary is a summary of the entire assessment. Category summaries provide a summary of each of the six categories (Table 19). The evaluation criteria contain the requirements for each of the prerequisites and credits. Supporting information contains additional guidance for each of the evaluation criteria.

Purpose

This guide supports the Air Force Sustainable Development Policy by providing guidance and strategies to identify and incorporate sustainable development concepts in facility and infrastructure projects.

Applicability

The Air Force Sustainable Facilities guide has been developed for MILCON projects. "Credits" are earned for performing required activities that promote sustainable development. Many of these credits require detailed engineering studies that would not be practical to perform in a relatively low cost project. However, many of these lower cost projects have the potential to incorporate sustainable development practices. This checklist is similar to the Air Force Sustainable Facilities guide. The main difference is that most of the credit areas have been simplified to provide guidance on sustainable development opportunities that require little to no detailed engineering studies.

There is not a defined cutoff point on when to use this guide or the Air Force Sustainable Development Guide. The overall scope of the project, the programmed amount, the level of engineering expertise available, and time available are all factor to consider in determining which guide to use. The Air Force Sustainable Facilities Guide is more robust and should be considered first.

When to Use

The first time this checklist should be used is when defining project requirements. At the same time that the scope of work, cost estimate, and other initial project data is colleted, this checklist should be used to identify sustainable development opportunities. The various credits are designed to be "quick answers" and the entire checklist should require minimal additional time to complete. The completed checklist should become part of the project files. This step is expected to be completed by the programming section of engineering flight.

The next time this checklist should be used is when the project is ready for design. Many projects may not be funded for months or years after they were initially programmed. In the same manner that the scope of work and cost estimate provides a starting point for design, so should the sustainable development opportunities. During the design process, the scope of work and cost are validated and may change. Likewise, so should the sustainable development opportunities be validated and incorporated if possible. This step is expected to be completed by the project manager.

How to Use

The checklist is a series of credits with defined requirements that must be met in order to earn the credit. The top section of the checklist is a summary of the points earned. The summary scores are automatically calculated. After the summary section, are the individual credits. The individual credits are where you enter the number of points earned. If there is a choice in how to meet the requirement, then you must also enter in the choices made. An example of a filled in individual credit is below. Additional information about the requirements can be seen by clicking on the "More Information" link.

Materials and Resources	Points	Earned	More Information
Credit 7	2	2	1 point for each type of wood product certified by the Forest Stewardship Council for a maximum of 2 points.
Certified Wood			
Maximum Points	2	2	**Points Earned**
			List items for Credit 7. Interior office doors, 5 ea. Breakroom cabinets

Figure 12. Instruction Page of the Simplified Sustainable Facilities Guide

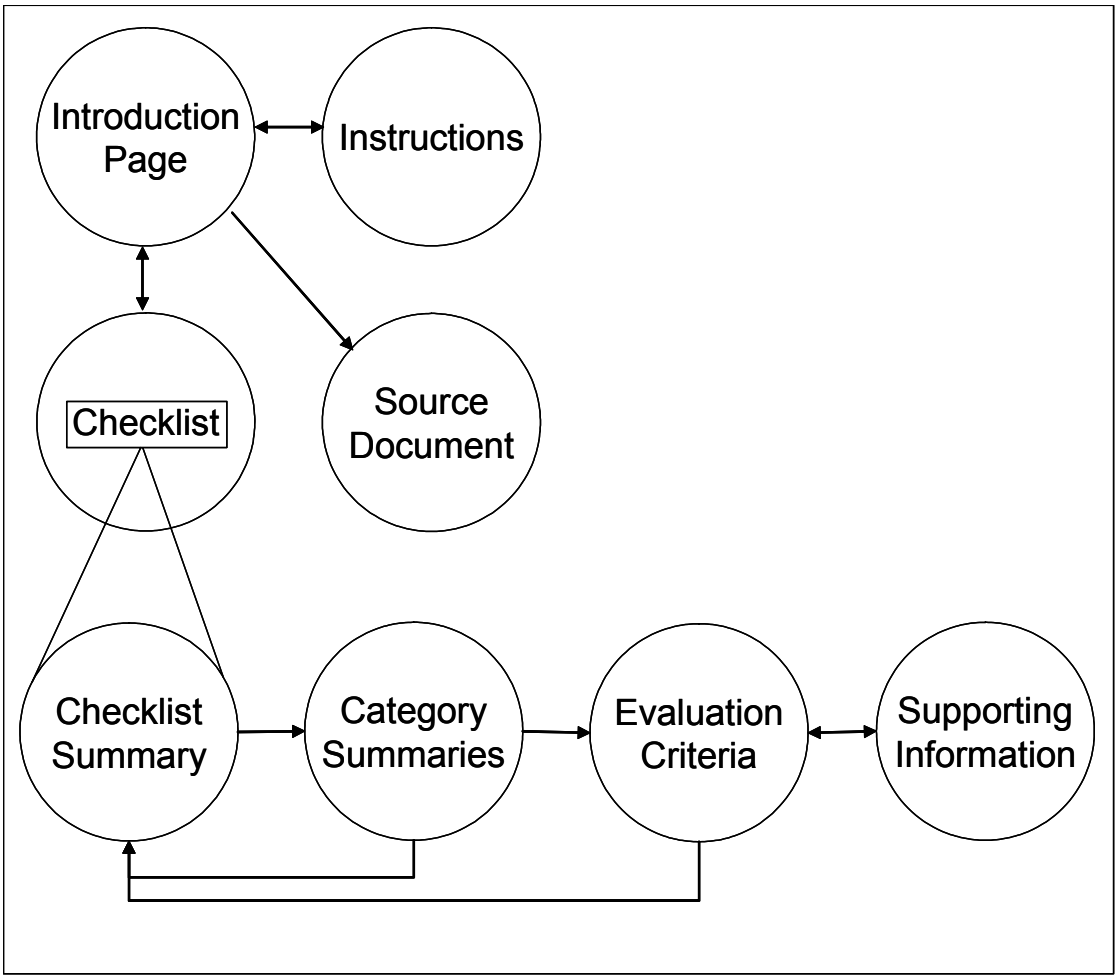


Figure 13. Modified Components of the Simplified Sustainable Facilities Guide

The checklist summary, category summaries and evaluation criteria are physically located on a single Excel® worksheet. Figure 14, shows the checklist summary information. Items 1 and 2 in Figure 14 are always at the top of the screen within this worksheet. Item 1 contains a hyperlink back to the welcome (introduction) page and a hyperlink to the checklist summary. To facilitate ease of use, the checklist is color-coded. Yellow fields are for entering text, blue fields are for entering points, and gray fields are for information. Item 2 is the legend for the color-coding. Items 3-5 are components of the checklist summary. Item 3 lists the six categories that the evaluation

criteria are grouped into. Item 4 shows point totals for each category. The left column is points possible and the right column is points earned. Clicking on a category name in Item 5 will link to the category summaries. The entire checklist summary is color coded gray. The points possible and points earned are automatically calculated.

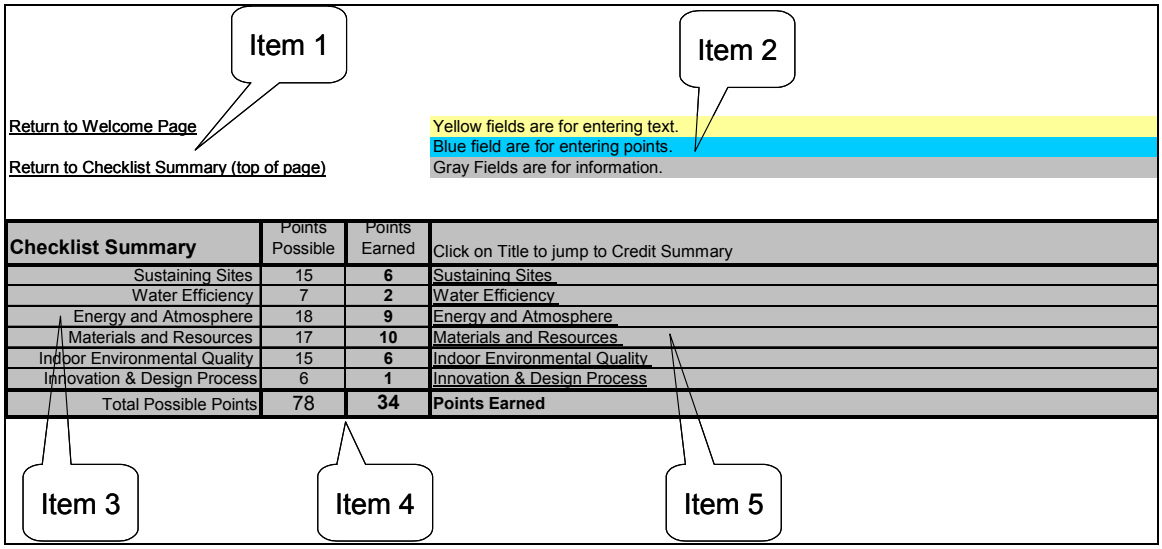
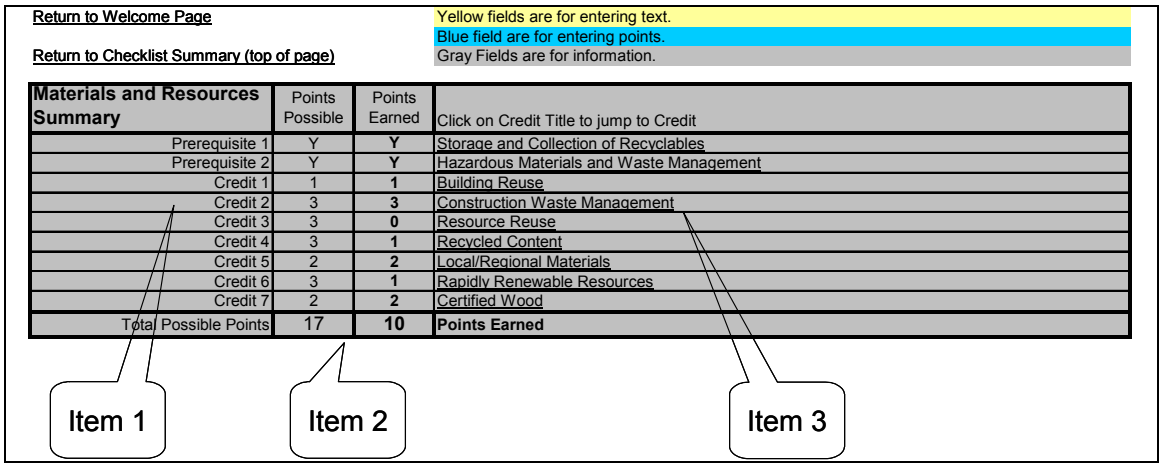


Figure 14. Simplified Sustainable Facilities Guide Checklist Summary Example

In the example shown in Figure 14, 34 points out of a possible 78 have been earned. Within the Materials and Resources category, 10 out of 17 points have been earned. A click on the Materials and Resources category name (Item 5) will jump to the summary for that category.

Figure 15 is an example of the category summaries, in this case the Materials and Resources category. Item 1 in Figure 15 shows the prerequisites and credits contained in this category. Item 2 shows point totals for the category. The left column shows points possible and the right column shows points earned. Clicking on the name of credit title (Item 3) will jump to the evaluation requirements for that credit. Each of the six category

summaries contain the same features and are color-coded gray. The points possible and points earned are automatically calculated.



Materials and Resources Summary	Points Possible	Points Earned	Click on Credit Title to jump to Credit
Prerequisite 1	Y	Y	Storage and Collection of Recyclables
Prerequisite 2	Y	Y	Hazardous Materials and Waste Management
Credit 1	1	1	Building Reuse
Credit 2	3	3	Construction Waste Management
Credit 3	3	0	Resource Reuse
Credit 4	3	1	Recycled Content
Credit 5	2	2	Local/Regional Materials
Credit 6	3	1	Rapidly Renewable Resources
Credit 7	2	2	Certified Wood
Total Possible Points	17	10	Points Earned

Figure 15. Simplified Sustainable Facilities Guide Category Summary Example

In the example shown in Figure 15, 10 points out of a possible 17 have been earned within the Materials and Resources category. For Credit 7, 2 out of 2 points have been earned. Credit 7's title, Certified Wood, is a hyperlink that will jump to the evaluation criteria for that credit.

Figure 16 is example of the evaluation criteria, in this case the evaluation criteria for Materials and Resources Credit 7 – Certified Wood. Item 1 in Figure 16 shows the category, prerequisite or credit number, and title. Item 2 shows point totals for the credit. The left column shows points possible and the right column shows points earned. The point totals are automatically calculated. Additionally, if more points than allowed are entered, or points are entered in the wrong place, an error messages appears (In Figure 17, three points were entered when the maximum available is two. Item 1 in Figure 17 shows error message). Item 3 contains the requirements to earn points. Items 1-3 are color coded gray. Item 4 is color-coded blue, which means it is the place to enter the

number of points earned for this credit. Item 5 is color-coded yellow, which means text is entered. The requirements for some credits are explicitly defined, meaning there is no choice in how to meet the requirement. Some credits allow users to choose how to meet the requirement. In the case where there are choices, item 5 is the location of the strategy or choice to meet the requirement is entered. If there are no choices available, item 5 is not present. Item 6 contains a hyperlink to the supporting information. All evaluation criteria for each of the 62 prerequisites and credits contained in the Simplified Sustainable Facilities Guide contain the same features presented in Figure 16 except for Item 5, which is included as required.

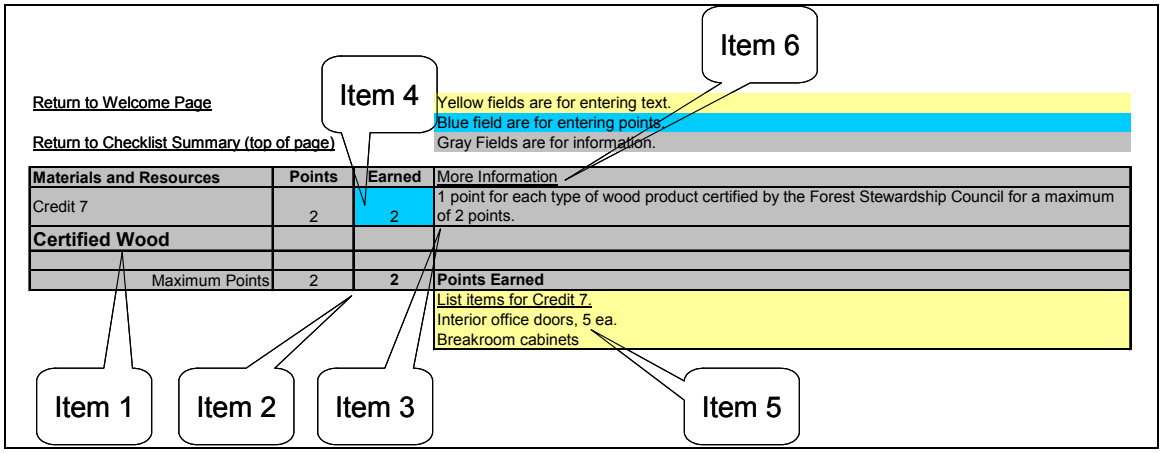


Figure 16. Simplified Sustainable Facilities Guide Credit Requirements Example

In the example shown in Figure 16, 2 points out of a possible 2 points have been earned. Interior office doors and break room cabinets will be used to meet this requirement (Item 5). Additional information to understand this requirement, such as what are certified wood products, is obtained by clicking on the More Information hyperlink (Item 6).

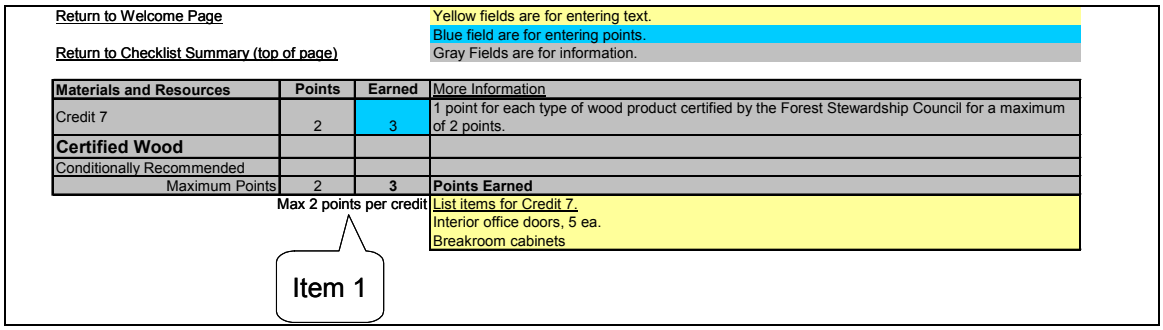


Figure 17. Error Message Example

Figure 18 is an example of the supporting information, in this case for Materials and Resources Credit 7 – Certified Wood. The supporting information is contained on a separate Excel® worksheet and accessed by hyperlink (Item 6 in Figure 16). The purpose of the supporting information is to show which credit from the Air Force Sustainable Facilities Guide this credit was derived from and provide additional information to meet the requirements. Item 1 data in Figure 18, intent, reference, reference requirement, Air Force policy, and justification, is verbatim from the Air Force Sustainable Facility Guide. Item 2, additional information, provides further guidance to meet the requirement. In many cases, websites or other references are provided as the additional information. The information in item 2 is a strength of the Simplified Sustainable Facilities Guide.

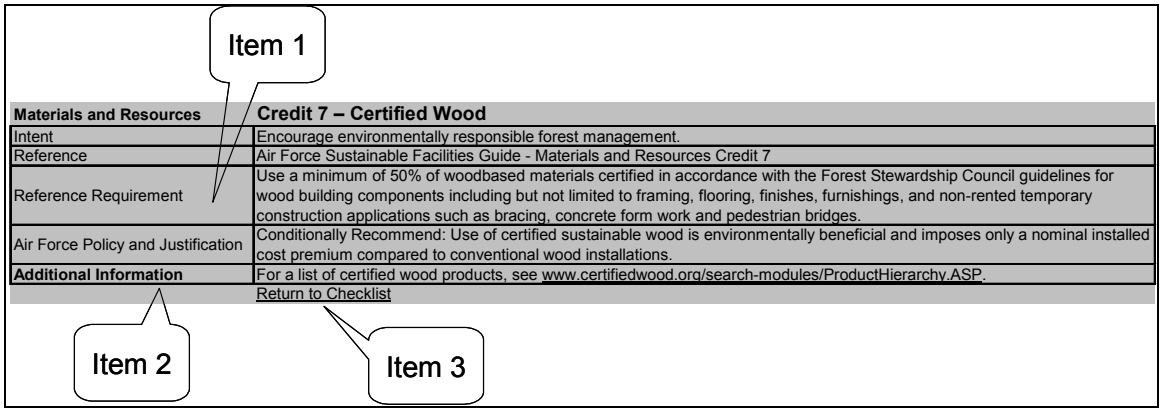


Figure 18. Simplified Sustainable Facilities Guide Supporting Information Example

These links to additional information are a key component of meeting the objective of providing clear requirements. Item 3 is a hyperlink back to the prerequisite or credit requirements (Figure 16). Each of the 62 prerequisites and credits contained in the Simplified Sustainable Facilities Guide contains supporting information with the same features shown in Figure 18. All of the supporting information is color coded gray.

In the example shown in Figure 18, Materials and Resources Credit 7 from the Air Force Sustainable Facility Guide is the referenced information for this credit. Going to the website listed in the additional information field produces the website shown in Figure 19 (Certified Forest Products Council, 2003). Following the links contained within this website will lead to manufactures of different types of certified wood products. In the example used above (Figure 16), two different certified wood products are required to earn maximum the maximum amount of points. The website in Figure 19 contains 24 different main categories of certified wood products and each of these main categories is broken down into sub-categories. In this example, it should not be difficult to identify two different certified wood products to meet the requirements.

The final component of the Simplified Sustainable Facilities Guide is a hyperlink to the source document, the Air Force Sustainable Facilities Guide. Figure 11, the introduction page, shows this hyperlink. As discussed throughout this thesis, the Simplified Sustainable Facilities Guide is derived primarily from the Air Force Sustainable Facilities Guide. Section 4.1.2 mentioned that the Air Force Sustainable Facilities Guide contains more robust requirements than the Simplified Sustainable Facilities Guide and should be considered first when incorporating sustainable

development concepts into facility and infrastructure projects. This hyperlink provides a quick means to access the Air Force Sustainable Facilities Guide.

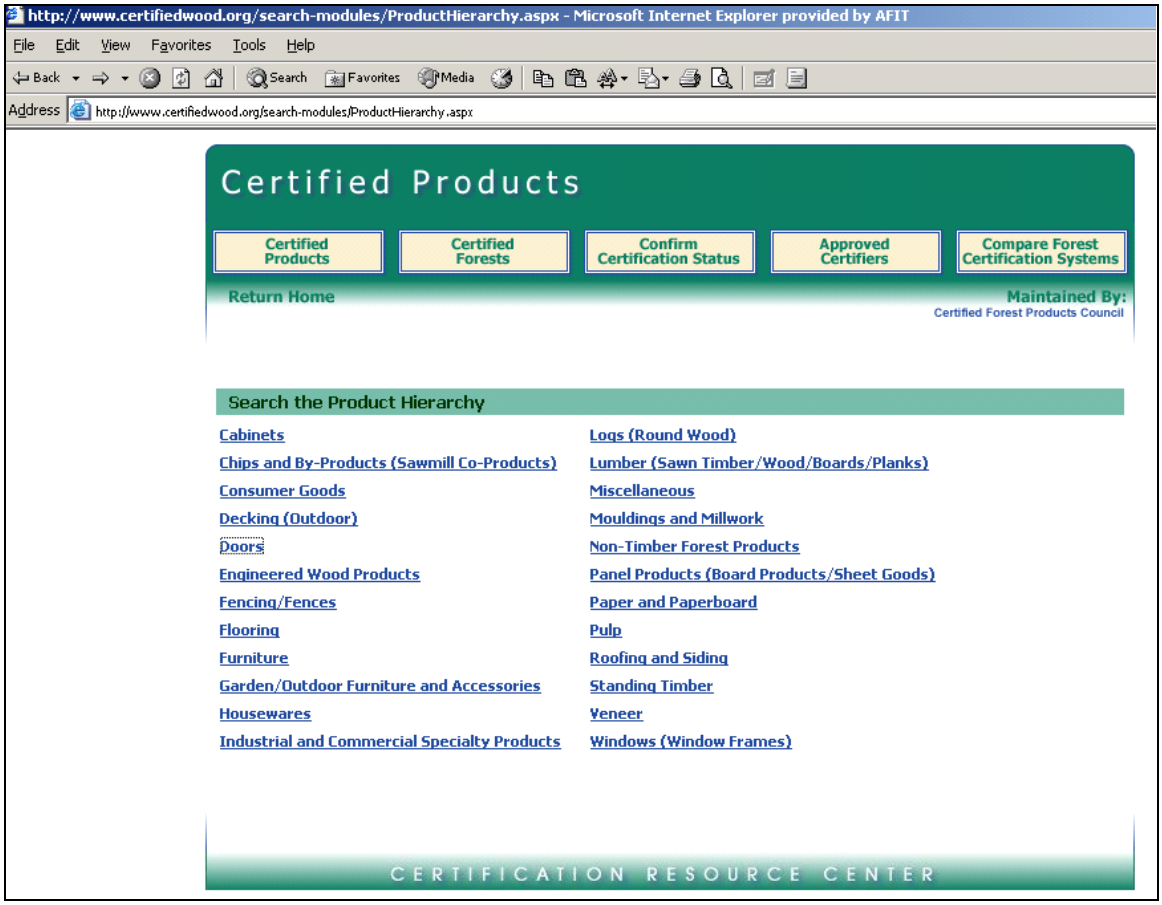


Figure 19. Additional Information Website Example

4.6 Validation

These sections detail the process used to validate the Simplified Sustainable Facilities Guide. Three different validation methods were used: subject matter expert, relative weightings, and analysis of support for the Air Force Sustainable Development Policy goals and principles.

4.6.1 Subject Matter Expert

There are three levels of subject matter experts, policy, technical, and execution, which are available to validate the Simplified Sustainable Facilities Guide (Figure 7). Only the technical level subject matter expert was contacted to validate the Simplified Sustainable Facilities Guide. AFCEE is the office that produced the Air Force Sustainable Facilities Guide, which provides execution guidance for the Air Force Sustainable Development Policy. The project manager for the Air Force Sustainable Facilities Guide at AFCEE was contacted to validate the research from a technical perspective.

The AFCEE project manager was provided a synopsis of the research objectives, a copy of the evaluation results (as shown in Appendix B), and an Excel® spreadsheet copy of the Simplified Sustainable Facilities Guide. Three questions were presented to the AFCEE project manager to guide the validation. One, are there credits from the Air Force Sustainable Facilities Guide that were excluded from the Simplified Sustainable Facilities Guide that should have been included? Two, are there credits from the Air Force Sustainable Facilities Guide that were included in the Simplified Sustainable Facilities Guide that should have been excluded? Many of the credit requirements contained in the Air Force Sustainable Facilities Guide are modified in the Air Force Sustainable Facilities Guide. Three, in these cases, are the modifications technically sound considering the objectives of the Simplified Sustainable Facilities Guide?

The AFCEE project manager performed a thorough review of the evaluation results. Twenty-four recommendations were provided by the project manager, ranging from simple clarifications to including requirements from the Air Force Sustainable

Facilities Guide that were not originally included in the Air Force Sustainable Facilities Guide. All recommendations from the project manager were incorporated into the final version of the Simplified Sustainable Facilities Guide.

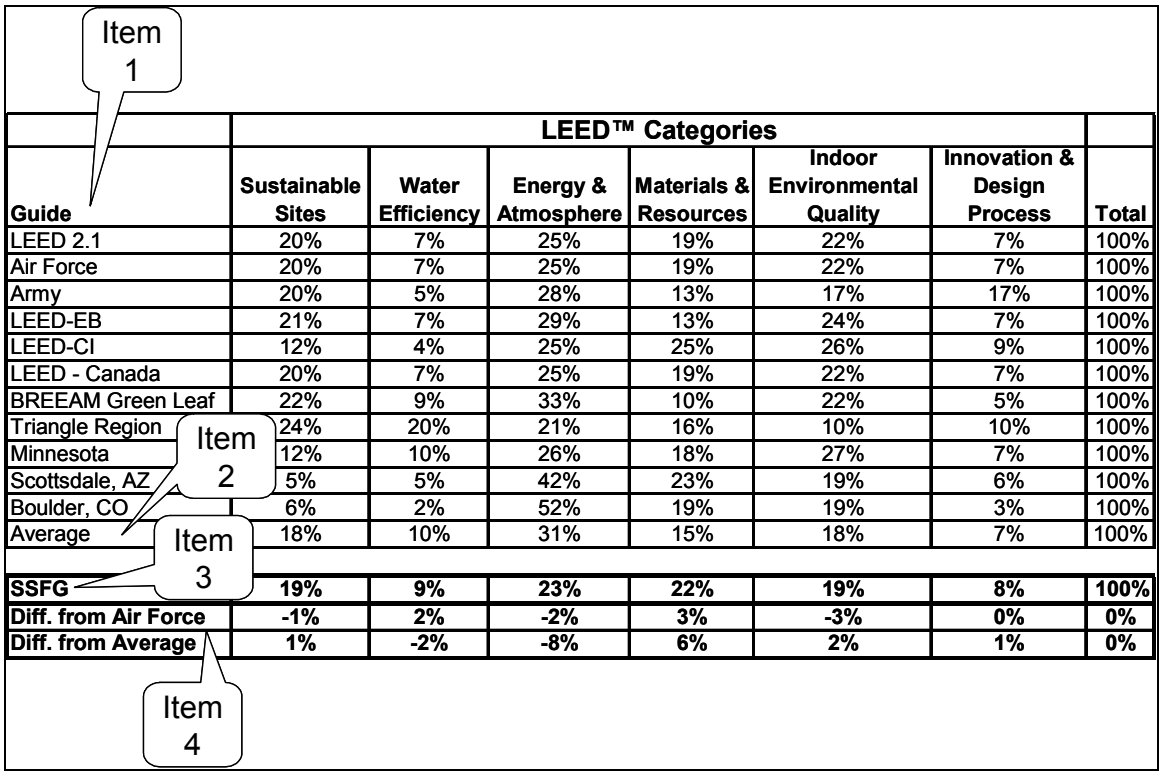
The AFCEE project manager also reviewed the Simplified Sustainable Facilities Guide in the Excel® spreadsheet format. This review was focused on the physical layout and presentation of the information. Feedback on the Simplified Sustainable Facilities Guide was positive with no change recommendations.

4.6.2 Relative Weightings

The Simplified Sustainable Facilities Guide is a point based sustainable development guide. Eleven of the 14 reviewed sustainable development guides are also point based. A relative weight comparison of the points available in these guides was performed. The purpose of this comparison is to ensure that the emphasis of each category, as determined by point totals percentage weighting, of the Simplified Sustainable Facilities Guide is approximately the same as the Air Force Sustainable Facilities Guide and other sustainable development guides. Approximately is defined as a percentage difference of 10% or less. For example, if the existing guides weight the importance of water efficiency as 5-10% of the total, the Simplified Sustainable Facilities Guide should be approximately the same or, if not, an explanation of the difference is presented.

The first step in this analysis was to group the evaluation criteria of all documents into the same six categories as the Simplified Sustainable Facilities Guide. Next, a simple percentage weighting of the point totals in each category was calculated based on

the total number of points available. This process was initially conducted without including the Simplified Sustainable Facilities Guide (Table 16). The results shown in Figure 20 include the Simplified Sustainable Facilities Guide.



	LEED™ Categories						
Guide	Sustainable Sites	Water Efficiency	Energy & Atmosphere	Materials & Resources	Indoor Environmental Quality	Innovation & Design Process	Total
LEED 2.1	20%	7%	25%	19%	22%	7%	100%
Air Force	20%	7%	25%	19%	22%	7%	100%
Army	20%	5%	28%	13%	17%	17%	100%
LEED-EB	21%	7%	29%	13%	24%	7%	100%
LEED-CI	12%	4%	25%	25%	26%	9%	100%
LEED - Canada	20%	7%	25%	19%	22%	7%	100%
BREEAM Green Leaf	22%	9%	33%	10%	22%	5%	100%
Triangle Region	24%	20%	21%	16%	10%	10%	100%
Minnesota	12%	10%	26%	18%	27%	7%	100%
Scottsdale, AZ	5%	5%	42%	23%	19%	6%	100%
Boulder, CO	6%	2%	52%	19%	19%	3%	100%
Average	18%	10%	31%	15%	18%	7%	100%
SSFG	**19%**	**9%**	**23%**	**22%**	**19%**	**8%**	**100%**
Diff. from Air Force	**-1%**	**2%**	**-2%**	**3%**	**-3%**	**0%**	**0%**
Diff. from Average	**1%**	**-2%**	**-8%**	**6%**	**2%**	**1%**	**0%**

Figure 20. Category Relative Weight Comparison

Figure 20 has four items that require further explanation. Item 1 is a list of all of the sustainable development guides compared. The names have been edited to fit within the figure. The full names are shown in Table 3. Item 2 is the average weights for the listed guides in Item 1. Item 3 is the weight percentages for the Simplified Sustainable Facilities Guide. Item 4 is the percent point difference of the Simplified Sustainable Facilities Guide compared to the Air Force Sustainable Facilities Guide and the average of all documents. Percentages as shown may not add up to 100% due to rounding.

Figure 20 shows, as an example, that the Air Force Sustainable Facilities Guide weights Sustainable Sites as 20% of the total point value. The Simplified Sustainable Facilities Guide weights Sustainable Sites as 19%, or one percentage point lower than the Air Force Sustainable Facilities Guide and one percentage point higher than the average weight. In all categories, the Simplified Sustainable Facilities Guide is weighted approximately the same as the Air Force Sustainable Facilities Guide and the average of all sustainable development guides referenced that contained a point system.

4.6.3 Support Air Force Sustainable Development Policy Goals and Principles

The Air Force Sustainable Development Policy lists three goals and six principles of sustainable development (Tables 32 and 33 respectively). Each of the evaluation criteria for both the Air Force Sustainable Facilities Guide and the Simplified Sustainable Facilities Guide were evaluated and compared to determine which goals and principles were supported. The purpose of this evaluation is to validate if the Simplified Sustainable Facilities Guide meets the objective of supporting published Air Force policy and guidance (Table 17).

Table 32. Air Force Sustainable Development Policy Goals of Sustainable Development

1. Conserve energy, water, and raw materials.
2. Prevent environmental degradation caused by construction, operations, and disposal of facilities.
3. Create built environments which are livable, healthy, maintainable, and productive.

Table 33. Air Force Sustainable Development Policy Principles of Sustainable Development

1. Optimize Site Potential
2. Minimize Energy Consumption
3. Protect and Conserve Water
4. Use Environmentally Preferable Products
5. Enhance Indoor Environmental Quality
6. Optimize Operational and Maintenance Practices

The first step in this process was reading each evaluation criteria from the Air Force Sustainable Facilities Guide and determining which goals and principles were supported. This step was repeated with the Simplified Sustainable Facilities Guide. The goals and principles supported is the opinion of the author and were not validated by a third party. This evaluation process for the sustainable sites category is shown in Figure 21.

Figure 21 has many items that need explanation. Item 1 is the credit number from the Air Force Sustainable Facilities Guide. Item 2 are the goals supported by the Air Force Sustainable Facilities Guide and Item 3 are the principles supported. The number in the column is the associated goal and principles from Tables 32 and 33, respectively. Item 4 is the credit title, which is the same for both guides. Item 5 is the credit number from the Simplified Sustainable Facilities Guide. Item 6 are the goals supported by the Simplified Sustainable Facilities Guide and Item 7 are the principles supported.

Air Force Sustainable Facilities Guide Credit 8, Light Pollution Reduction, is used as an example on how to interpret the data in Figure 21. Item 2 in Figure 21 shows that the evaluation criteria from the Air Force Sustainable Facilities Guide for Credit 8 supports the Air Force Sustainable Development Policy goals number 1 and 2 (Table 32). Item 3 shows that Credit 8 supports the Air Force Sustainable Development Policy

Air Force Sustainable Facilities Guide			Sustainable Sites	Simplified Sustainable Facilities Guide		
Credit #	3 Goals	6 Principles	Credit Title	Credit #	3 Goals	6 Principles
Prerequisite 1	2	3,6	Erosion and Sediment Control	Prerequisite 1	2	3
Prerequisite 2	2	1	Environmental Protection	Prerequisite 2	2	1
Prerequisite 3	None	None	Cultural Resources Protection	Prerequisite 3	None	None
Prerequisite 4	2	3	Cleanwater Protection	Prerequisite 4	2	3
Credit 1	2	1	Site Selection	Credit 1	2	1
Credit 2	2	1	Urban Development	N/A	N/A	N/A
Credit 3	2	1	Brownfield Redevelopment	N/A	N/A	N/A
Credit 4.1	1	1	Alternative Transportation	Credit 2.1	1	1
Credit 4.2	1,3	1	Alternative Transportation	Credit 2.2	1	1
Credit 4.3	1	6	Alternative Transportation	Credit 2.3	1	6
Credit 4.4	1	6	Alternative Transportation	Credit 2.4	1	6
Credit 5.1	2	1	Reduce Site Disturbance	Credit 3.1	2	1
Credit 5.2	1,2	1	Reduce Site Disturbance	Credit 3.2	2	1
Credit 6.1	2	3	Stormwater Management	Credit 4	2	3
Credit 6.2	2	3	Stormwater Management	N/A	N/A	N/A
Credit 7.1	2	1,6	Landscape and Exterior Design to Reduce Heat Islands	Credit 5.1	2	1,6
Credit 7.2	1,2	2,6	Landscape and Exterior Design to Reduce Heat Islands	Credit 5.2	1,2	2,6
Credit 8	1,2	2,6	Light Pollution Reduction	Credit 6	2	6

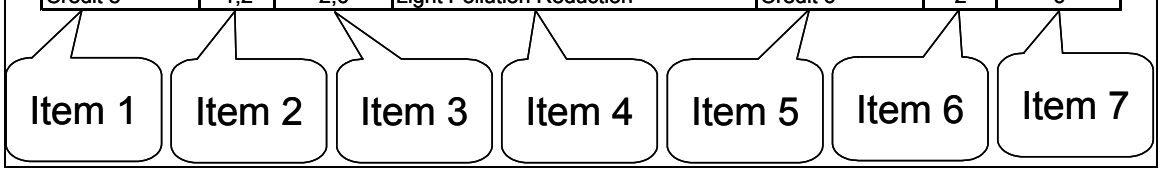


Figure 21. Comparison of Support for Air Force Sustainable Development Goals and Principles Example

principles number 2 and 6 (Table 33). Item 5 shows that this credit in the Simplified Sustainable Facilities Guide is Credit 6. Item 6 shows that the evaluation criteria from the Simplified Sustainable Facilities Guide supports goal number 2. Item 7 shows that this credit supports principle number 6. In this example, it is observed that the goals and principles supported are not the same for each of the guides. This indicates that there is a change in the evaluation criteria. This process was repeated for all of the six categories. The results for all categories are located in Appendix D.

Figure 22 is the summary of this evaluation process. Item 1 is the number of times each goal and principle is supported by the credits in the Air Force Sustainable

Facilities Guide. Item 2 is the percentage of credits in the Air Force Sustainable Facilities Guide that support each goal and principle. Item 3 is the number of times each goal and principle is supported by the credits in the Simplified Sustainable Facilities Guide. Item 4 is the percentage of credits in the Simplified Sustainable Facilities Guide that support each goal and principle. The percentages do not total to 100% because many credits support more than one goal and principle.

	Air Force Sustainable Facilities Guide		Simplified Sustainable Facilities Guide	
	Number of Supporting Credits	Percent of Supporting Credits	Number of Supporting Credits	Percent of Supporting Credits
Goal 1	39	50%	32	52%
Goal 2	40	51%	26	42%
Goal 3	24	31%	22	35%
Principle 1	13	17%	11	18%
Principle 2	13	17%	13	21%
Principle 3	11	14%	12	19%
Principle 4	28	36%	19	31%
Principle 5	23	29%	22	35%
Principle 6	15	19%	17	27%
	Total Credits	78	Total Credits	62

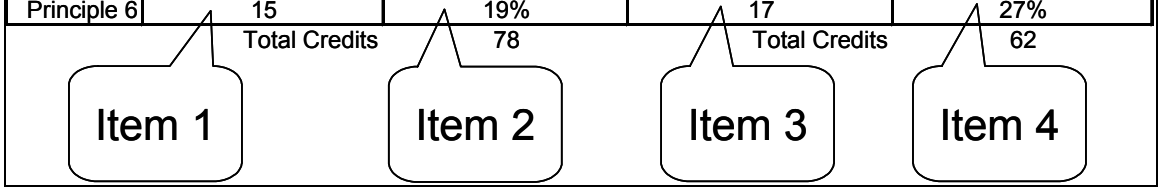


Figure 22. Summary of Support for Air Force Sustainable Development Goals and Principles

Using principle number 6 as an example, Item 1 in Figure 22 shows that 15 credits in the Air Force Sustainable Facilities Guide support principle number 6. Item 2 shows that 19% of the credits in the Air Force Sustainable Facilities Guide support principle number 6. This percentage is calculated by dividing the number of supporting credits by the total number of credits. Item 3 shows that 17 credits in the Simplified Sustainable Facilities Guide support principle number 6. Item 4 shows that 27% of the credits in the Simplified Sustainable Facilities Guide support principle number 6.

The Simplified Sustainable Facilities Guide supports the Air Force sustainable development goals and principles approximately the same as the Air Force Sustainable Facilities Guide. Approximately is defined as a percentage difference of 10% or less between the two guides for each goal and principle. This validation analysis is an internal analysis completed by the author and is not the same as receiving feedback directly from AF/ILE.

4.7 Implementation Strategy

Figure 8 identified five components of a successful implementation strategy: a requirements driver, training, access, results, and feedback. A thorough study of implementation strategies as discussed in Chapter 3 was not completed as part of this research. Two of these components, training and access, were implemented.

Sustainable development concepts and strategies are incorporated into many of the classes taught by the Air Force Institute of Technology (AFIT) Civil Engineer and Services School. In the March 2003 offering of the school's MGT 422, Project Management Course, the author taught a 1.5 hour class on Sustainable Development attended by 84 students. This class focused on the Air Force Sustainable Development Policy, LEED™, and sustainable development concepts in general. The Simplified Sustainable Facilities Guide was introduced and described during this class.

AFCEE will provide access to the Simplified Sustainable Facilities Guide by posting and promoting the guide on their website. In this initial implementation stage, the guide will be available for use on a voluntary basis. Suggestions for a more robust implementation strategy are discussed in Chapter 5.

V. Conclusions and Recommendations

This chapter summarizes the research, discusses limitations, provides suggestions for implementing the Simplified Sustainable Facilities Guide, and introduces opportunities for future research.

5.1 Research Summary

The Air Force Sustainable Development Policy states that LEED™ is the preferred self-assessment metric for measuring sustainable development. The Air Force goal is to have 20% of FY04 MILCON projects meet the requirements for LEED™ certification (increasing to 100% by FY09). AFCEE created the Air Force Sustainable Facilities Guide, which is based on LEED™ 2.0, to provide guidance and strategies to meet this goal. The Air Force Sustainable Facilities Guide is best suited for MILCON and other high cost projects. Many of the requirements of the Air Force Sustainable Facilities Guide require professional engineering studies and analysis to complete.

All facility and infrastructure projects have opportunities to incorporate sustainable development concepts; however, using the Air Force Sustainable Facilities Guide requirements are not necessarily feasible in lower cost and less complex projects. This research simplified the requirements of the Air Force Sustainable Facilities Guide to be applicable to all projects, regardless of cost.

Four objectives for the Simplified Sustainable Facilities Guide were identified. These objectives guided the process of simplifying the requirements of the Air Force Sustainable Facilities Guide to ensure that the Simplified Sustainable Facilities Guide provide clear requirements that support the concepts of sustainable development while

requiring minimal time and expertise to incorporate. The Simplified Sustainable Facilities Guide was created using Microsoft Excel®. Attention was paid to the physical layout of the guide to facilitate use. Hyperlinks were incorporated to navigate throughout the guide. The guide is point based and project scores are automatically calculated.

Validation methods were used to ensure the Simplified Sustainable Facilities Guide was technically sound and supported Air Force Policy. The validation methods used, while beneficial, were not as robust as possible. A thorough implementation strategy was identified, but not fully developed. A voluntary use strategy, placement of the Simplified Sustainable Facilities Guide on the AFCEE website, was adopted.

The first sentence of the Air Force Sustainable Development Policy (Robbins, 2001) states:

> It is Air Force policy to apply sustainable development concepts in the planning, design, construction, environmental management, operation, maintenance and disposal of facilities and infrastructure projects, consistent with budget and mission requirements.

The developed product of this research, the Simplified Sustainable Facilities Guide, provides a means to identify and apply sustainable development concepts into all facility and infrastructure products, regardless of cost. Using the LEED™ requirements for all facility and infrastructure projects is not always consistent with budget and mission requirements, especially in the case of low cost or relatively simple projects. The Simplified Sustainable Facilities Guide supports the Air Force Sustainable Development Policy by providing a tool that is consistent with budget and mission requirements.

5.2 Research Limitations

There are a number of research limitations. One is the sustainable development guides used as references. There may be other guides available that would have provided a different insight into current sustainable development practices and assessment procedures currently in use. Validation of the Simplified Sustainable Facilities Guide was only performed at a technical level; ensuring the technical requirements are sound. There was no validation from Air Force policy makers and end-users. Feedback from policy makers would ensure the Simplified Sustainable Facilities Guide supported the Air Force Sustainable Development Policy. Feedback from end-users would ensure that the Simplified Sustainable Facilities Guide was a value added tool.

A complete implementation strategy was not developed. A fully developed implementation strategy supported at the policy maker decision would promote the use and success of the Simplified Sustainable Facilities Guide. Cost or funding issues were not addressed. Some sustainable development concepts incur higher upfront cost. These higher upfront costs were not identified and associated payback time periods were not researched.

5.3 Suggested Implementation Strategies

Figure 8 identified five components of a successful implementation strategy: a requirements driver, training, access, results, and feedback. A thorough study of implantation strategies was not completed as part of this research. However, some suggested ideas are presented. These ideas are the author's and have not been reviewed by a third party.

5.3.1 Requirements Driver

There are two main ways the Simplified Sustainable Facilities Guide could be implemented: voluntary and mandatory. Voluntary implementation would indicate that end-users were familiar with, understood and supported the ethic of including sustainable development concepts into facility and infrastructure projects and that the Simplified Sustainable Facilities Guide was a useful tool for incorporating sustainable development concepts. Research has shown that past voluntary use of LEED™ within the Department of Defense is not widespread and is limited to cases where there has been a single champion to promote sustainable development (ATHENA Sustainable Materials Institute, 2002c). A mandatory requirements driver would most likely be required for widespread implementation of the Simplified Sustainable Facilities Guide.

This mandatory requirements driver could be incorporated into the current Air Force Sustainable Development Policy or a policy issued by MAJCOM Civil Engineers. Mandatory use of the Simplified Sustainable Facilities Guide could also be incorporated into AFI 32-1023, Design and Construction Standards and Execution of Facility Construction Projects. Alternatively, AFCEE could adopt and promote the use of the Simplified Sustainable Facilities Guide. This last suggestion would not be mandatory and may be the best choice since the Simplified Sustainable Facilities Guide has not been validated at the execution level. This last suggestion has been adopted.

5.3.2 Training

For effective implementation of the Simplified Sustainable Facilities Guide, training on how to use the guide and training on sustainable development concepts are

required. The Air Force Sustainable Development Policy is less than 18 months old and the requirement to incorporate sustainable development concepts into facility and infrastructure projects is not required until the FY04 MILCON program design cycle. It is the author's opinion that most Air Force personal at base level who will execute the Air Force Sustainable Development Policy are not fully trained in the concepts of sustainable development and the use of LEED™ as an assessment tool. Training on sustainable development concepts and LEED™ has been introduced into classes taught by the Civil Engineer and Services School at the Air Force Institute of Technology. Incorporating specific training on the Simplified Sustainable Facilities Guide could also be introduced into these classes. Another means of training is to produce an on-line or CD-ROM interactive computer based training program. The Simplified Sustainable Facilities Guide does contain instructions on how and why to use the guide. However, these instructions are brief and should not take the place of a more robust training program.

5.3.3 Access

The Air Force Sustainable Facilities Guide is available from the AFCEE website. The Simplified Sustainable Facilities Guide is designed for use in situations where the Air Force Sustainable Facilities Guide may not be the best choice in guides to incorporate sustainable development concepts in facility and infrastructure projects. AFCEE's website is the ideal location to gain access to both guides. The Simplified Sustainable Facilities Guide will be available for download from the AFCEE website.

Another area of access not previously discussed is access to results from a project evaluation. The results of a project evaluation should be printed out and maintained in

the project folder. A computer data folder can be created on local area network containing the Excel® files for each project evaluation. Additionally, a "sustainable development" data field could be created in the ACES Project Management module where the sustainable development point total could be entered. ACES Project Management also allows the attachment of computer files. The Excel® file for each project could be attached to the ACES project file.

5.3.4 Results

After the use of the Simplified Sustainable Facilities Guide is implemented, meaningful results from using the guide are required for continual support and use. The Simplified Sustainable Facilities Guide should promote the use of sustainable development concepts and not become a non-value added process. Ideally, the opportunities identified by using the Simplified Sustainable Facilities Guide would be incorporated into the decision making process of which facility and infrastructure projects to fund. Each base has their own process on ranking potential projects for funding. Common ranking parameters include programmed cost and mission impact. The project's sustainable development impact could be another parameter to rank facility and infrastructure projects.

4.6.5 Feedback

A feedback mechanism is important for continual support and use of the Simplified Sustainable Facilities Guide. Sustainable development concepts and best practices change over time. The Simplified Sustainable Facilities Guide should be reviewed on a regular basis by a team of subject matter experts representing policy

makers, technical experts, and end-users. A review process would ensure the Simplified Sustainable Facilities Guide is updated to incorporate ideas from end-users, contains current strategies and technologies, and meets the needs of the Air Force.

5.4 Areas for Future Research

The next logical step for further research is to perform a case study of the use of the Simplified Sustainable Facilities Guide. A case study should involve mandatory use of the Simplified Sustainable Facilities Guide at base level for all projects that are not MILCON projects for at least six months. A case study would address many open questions. One, does the use of the Simplified Sustainable Facilities Guide actually promote incorporating sustainable development concepts into facility and infrastructure projects? Two, can the sustainable development concepts be identified in 30 minutes or less? Three, are the points earned meaningful and does the sustainable development point total help wing leadership decide what projects to fund? Four, are the information and credit requirements applicable to Air Force facility and infrastructure projects? Five, is the physical layout of the Simplified Sustainable Facilities Guide the best way to convey the information? Another area that could be researched in a case study is the issue of cost. Which requirements incur higher upfront cost and what is the payback period for the higher upfront cost? A case study would answer the basic question of whether or not this is a value added process for facility and infrastructure projects.

Appendix A. Air Force Sustainable Development Policy

MEMORANDUM FOR SEE DISTRIBUTION

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

SUBJECT: Sustainable Development Policy

It is Air Force policy to apply sustainable development concepts in the planning, design, construction, environmental management, operation, maintenance and disposal of facilities and infrastructure projects, consistent with budget and mission requirements. A sustainable facility achieves optimum resource efficiency and constructability while minimizing adverse impacts to the built and natural environments through all phases of its life cycle. The goals of sustainable development are to conserve energy, water, and raw materials; prevent environmental degradation caused by construction, operations, and disposal of facilities; and create built environments which are livable, healthy, maintainable, and productive. Refer to Attachment 1 for more information on sustainable development.

Sustainable development requires integrated programming and project planning that can best be accomplished by a multidisciplinary team of planners, designers, end users, construction and maintenance specialists, and environmental specialists. Comprehensive planning should take into account those principles promoted in the Office of the Secretary of Defense (OSD) Sustainable Planning Guide referenced in Attachment 2. Setting sustainable development goals early in the planning, programming and budgeting process and ensuring these goals are attained during design and construction is critical to project success. Selection of knowledgeable and experienced consultants is another key to success. According to the Federal Acquisition Regulation (FAR), consultants for planning, environmental, design and related professional services shall be selected partially on the basis of their "specialized experience and technical competence in the type of work required, including, where appropriate, experience in energy conservation, pollution prevention, waste reduction, and the use of recovered materials." This selection criterion shall be given importance when used jointly with the other criteria specified in the FAR.

The United States Green Building Council's (USGBC) "Leadership in Energy and Environmental Design (LEED™)" Green Building Rating System is the Air Force preferred self-assessment metric. It may also be used as a tool to help apply the principles of sustainable development. LEED™ is a self-assessment system designed for rating new and existing commercial, institutional, and high-rise residential buildings. The system awards points based on the number of LEED™ credits earned. These credits are earned by using products, systems, strategies, or technologies described in LEED™.

The LEED™ credits are opportunities, not requirements. Where actions or criteria identified in LEED™ are not applicable to a specific project, are not cost effective, or are not in compliance with current Air Force criteria, LEED™ allows use of alternative features or practices. LEED™ is in use nationwide and is already familiar to many architectural-engineer and construction firms employed by the Air Force.

Each MAJCOM should review their future projects beginning with the FY04 MILCON program (including non-privatized housing), and incorporate sustainable development using LEED™ criteria. At least twenty percent of each MAJCOM's projects should be selected as LEED™ pilot projects in FY04, with increasing percentages of projects qualifying for a certification in subsequent years. The Air Force Sustainable Facilities Guide will provide tools and suggested guidelines for selecting candidate projects. The goal is to have all (no Host Nation or NATO) MILCON projects in the FY09 program capable of achieving LEED™ certification. Submission to the USGBC for actual LEED™ certification is at MAJCOM discretion. Unspecified Minor Construction (P-341) and housing privatization projects should also be considered when implementing sustainable development. This policy does not apply to Host Nation or NATO funded projects.

Sustainable development concepts will benefit the Air Force by creating high-performance buildings with long-term value. They are to be integrated into the development process and balanced with all other design criteria to achieve best value for the Air Force. The economic analysis process need not change, but the elements to consider will now include sustainable technologies and their potential for long-term savings.

HQ AFCEE and HQ AFCESA provide guidance documents and technical support to help you execute this sustainable development policy. AFCEE's expertise includes planning, the facility delivery process, and environmental management. AFCESA provides expertise for design criteria, construction standards, life cycle and sustainable costs, energy and water conservation, and operations and maintenance issues. This policy will be incorporated in the next revision of AFI 32-1023, Design and Construction Standards and Execution of Facility Construction Projects. Additional information regarding Air Force specific references/guidance is included at Attachment 2. If the members of your staff have any questions, please have them contact your respective POC at HQ AFCEE or HQ AFCESA/CES.

//signed, 19 Dec 01//

EARNEST O. ROBBINS II, Maj Gen, USAF
The Civil Engineer
DCS/Installations & Logistics

Attachments
1. Defining and Describing Sustainable Development
2. References for Incorporating Sustainable Development Concepts into Air Force Projects

DISTRIBUTION:

ALMAJCOM/CE
USAFA/CE
11WG/CE
AFCEE/CC/EQ/EC/DC
AFCESA/CC/CES
SAF/IEE/IEI/AQC/FMBI
AF/ILEC/ILEV/ILEP/ILEH/ILEX/ILER
AFIT/CE
HQ USAF/ILV
HQ AFSVA/CC
HQ AAFES-CF
HQ DECA-CIF
HQ USACE/CEMP-MA
HQ NAVFAC/MCN

Attachment 1

Defining and Describing Sustainable Development

Sustainable development is an investment in the future. Through conservation, improved maintainability, recycling, reuse, reduction and other actions and innovations, we can meet today's needs without compromising the ability of future generations to meet their own. Sustainable development supports an increased commitment to environmental stewardship and conservation, and results in an optimal balance of cost, environmental, societal and human benefits while meeting the mission and function of the intended facility or infrastructure.

Sustainable development produces facilities and infrastructure that meet mission requirements in a cost-effective manner while minimizing resource loss and damage to the environment. Conscientious site planning and use of renewable or recycled resources will minimize environmental impacts and resource loss during construction. Designers can minimize operational impacts by selecting materials and systems that reduce the demand for energy and water, allow renewable energy use, and avoid maintenance practices that require the use of undesirable raw materials or chemicals. Sustainable development optimizes each project's total economic and environmental impacts and performance throughout its life cycle.

Sustainable development is achieved through a process of minimizing each project's adverse economic and environmental impacts and optimizing performance throughout its life cycle. It requires changes to the facility delivery process to ensure the "best fit" of the built environment to the natural environment. These changes include:

- Setting sustainable development goals early in project planning, and following through during design and construction to ensure their achievement;
- Including planners, programmers, and environmental managers as active participants in the project management team;
- Selecting architectural-engineer firms with knowledge and experience in sustainable design;
- Educating the construction contractor about the sustainable development goals of the project.

Sustainable development in the built environment includes six fundamental principles:

(1) Optimize Site Potential. Creating sustainable buildings starts with proper site selection, including consideration of the reuse or rehabilitation of existing buildings. The location, orientation, and landscaping of a building affect the local ecosystems, transportation methods, and energy use.

(2) Minimize Energy Consumption. A building should rely on optimizing system efficiencies and employing conservation measures. Renewable energy technologies should be used in facility projects whenever feasible and cost effective. New facilities should meet or exceed current Air Force energy performance goals.

(3) Protect and Conserve Water. Fresh water is an increasingly scarce resource near many of our bases. A sustainable building should reduce, control or treat site runoff, use water efficiently, and implement as many Federal Energy Management Program Water Efficiency Improvement Best Management Practices as practicable.

(4) Use Environmentally Preferable Products. Buildings should be constructed of materials that minimize lifecycle environmental impacts such as global warming, resource depletion, and toxicity. In a materials context, life cycle includes raw materials acquisition, product manufacturing, packaging, transportation, installation, use, and ultimate disposal.

(5) Enhance Indoor Environmental Quality (IEQ). The IEQ of a building has a significant impact on occupant health, comfort, and productivity. Among other attributes, a building should optimize daylighting, be well ventilated, control moisture, and avoid the use of materials with high-VOC emissions.

(6) Optimize Operational and Maintenance Practices. Buildings should be designed to take into account the energy and environmental impacts of operating and maintaining the building. Designers are encouraged to specify materials and systems that reduce maintenance requirements, and/or require less water, energy, and toxic chemicals to maintain.

The Construction Criteria Base (CCB) has for many years been the official DoD distribution system for all facilities-related criteria. CCB is currently being expanded into a new system called the Whole Building Design Guide (WBDG) that will offer far greater capability as a design tool. The WBDG will be the primary portal for sustainable development information and methodologies. It can be accessed at http://www.wbdg.org/index.htm.

Attachment 2

References for Incorporating Sustainable Development Concepts into Air Force Projects

Planning

The *Feasibility Study for Implementing Sustainable Development Concepts and Principles into the Army, Navy, Air Force, and Marine Corps Land and Facilities Planning Processes and Programs* or **Sustainable Planning: A Multi-Service Assessment 1999**, was sponsored by the Office of the Secretary of Defense and is the first Department-wide attempt by the DOD to address sustainability and sustainable planning at a policy level. The purpose of the study was to establish a common understanding of sustainable development principles, and to use that understanding to assess opportunities to include sustainability in military planning. A key aspect of the report is the joint DOD approach in seeking practical applications of sustainability within the unique culture of the military. Other governmental guidance is provided through the US HUD and USEPA's "Smart Growth" program and planning guidance. Additionally, the American Planning Association has published a guide for sustainable planning.

- OSD Sustainable Planning: A Multi-Service Assessment 1999 http://www.denix.osd.mil/denix/DOD/Library/Sustain/assessment99.pdf

- Smart Growth Network: http://www.smartgrowth.org/index2.html

- American Planning Association, Policy Guide on Planning for Sustainability: http://www.planning.org/govt/sustdvpg.htm

Design

- The Whole Building Design Guide (WBDG) is an Internet resource providing a portal to a wide range of building-related design guidance, criteria and technology. It is intended for use by federal, military and private sector architects, engineers, and project managers.

- The United States Green Building Council (USGBC) has created the "Leadership in Energy and Environmental Design (LEED™)" Rating System. It may be used as a guide to apply the principles of sustainable development. The LEED™" Rating System may also be utilized simply as a voluntary self-assessment tool for measuring a project's achievements in sustainable development without submitting for a certified rating. Points are awarded for achievements in five areas: Sustainable Sites; Water Efficiency; Energy and Atmosphere; Materials and Resources; and Indoor Environmental Quality. Some

parts or sections may not be appropriate for AF use. One specific part under the Energy and Atmosphere section, *Optimize Energy Performance,* is not recommended for Air Force use. This part should not be used because it uses energy **cost** budget as the method for developing the performance of a building. The preferred Air Force method is to use the energy **use** budget to design facilities based on BTU/SF/YR.

AFCEE's Sustainable Development web page provides single point access to Air Force guidance and a variety of supporting information. AFCESA's web pages provide similar single point access for Air Force Energy and Water Management guidance and a variety of supporting information

- Whole Building Design Guide: http://www.wbdg.org/index.htm
- United States Green Building Council (USGBC) LEED™ Green Building Rating System: http://www.usgbc.org/
- PRO-ACT Fact Sheet on Sustainable Development: http://www.afcee.brooks.af.mil/pro_act/fact/Aug98a.htm
- Air Force *Environmentally Responsible Facilities Guide* and *Sustainable Development Toolbox* (to be replaced by the "AF Sustainable Facilities Guide" in FY02): http://www.afcee.brooks.af.mil/green/greenhome.asp
- Air Force *Guide to Green Purchasing*: http://www.afcee.brooks.af.mil/EQ/ap/gg/default.asp
- Air Force *Construction and Demolition Waste Management Guide*: http://www.afcee.brooks.af.mil/green/resources/resources.asp
- Energy policy and guidance: http://www.afcesa.af.mil/Directorate/CES/Mechanical/Energy/default.htm
- Federal Energy Management Program (FEMP), Technical Assistance: http://www.eren.doe.gov/femp/techassist.html
- Water Efficiency policy and guidance and Improvement BMPs http://www.afcesa.af.mil/Directorate/CES/Civil/Water/Water.htm.

Environmental Management

There is a wide range of source material addressing natural resources, pollution prevention and environmental quality. Both governmental and non-governmental sources are of value. The US Department of Energy has played a significant role in this field

through its Federal Energy Management Program and the DOE Center of Excellence for Sustainable Development. Many more government and nonprofit conservation organizations are concerned about waste and environmental abuse of the nation's natural resources. Links to many of these sites are included on the sites listed below.

- The Sustainable Communities Network, a clearinghouse for a wide range of sustainable concepts and applications: http://www.sustainable.org/

- DOE Center of Excellence for Sustainable Development: http://www.sustainable.doe.gov/

- Federal Energy Management Program (FEMP), Technical Assistance: http://www.eren.doe.gov/femp/techassist.html

- FEMP Water Efficiency Improvement BMPs are also available on the AFCESA website at http://www.afcesa.af.mil/Directorate/CES/Civil/Water/Water.htm

Appendix B. Evaluation of the Air Force Sustainable Facilities Guide

The prerequisites and credits below are from the Air Force Sustainable Facilities Guide. Section 4.4 discusses this appendix and should be used as a guide to interpret the information.

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B.1 Sustaining Sites Prerequisite 1 – Erosion and Sediment Control

Intent: Control erosion to reduce negative impacts on water and air quality.

Requirement: Design a site sediment and erosion control plan that conforms to best management practices in the EPA's Storm Water Management for Construction Activities, EPA Document No. EPA-832-R-92-005, Chapter 3, OR local Erosion and Sedimentation Control standards and codes, whichever is more stringent. The plan shall meet the following objectives:
- Prevent loss of soil during construction by storm water runoff and/or wind erosion, including protecting topsoil by stockpiling for reuse.
- Prevent sedimentation of storm sewer or receiving streams and/or air pollution with dust and particulate matter.

Air Force Policy and Justification: Highly Recommended
Provides a standard for best practice site design where local codes and standards for Erosion and Sediment Control are insufficient. This standard prevents topsoil from being washed off site, and protects slopes from erosion and destabilization, thereby protecting watersheds from excess sediments and nutrients.

Simplified Sustainable Facilities Guide Credit Title: Sustaining Sites Prerequisite 1 – Erosion and Sediment Control

New Requirements: No Change

Changes: None

Justification: N/A

Additional Information: Measures that help prevent erosion include silt fencing, sediment traps and basins, maintaining vegetated ground cover, stabilization of steep slopes, and ground covers.

B.2 Sustaining Sites Prerequisite 2 – Environmental Protection

Intent: Maintain environmental integrity of natural areas.

Requirement: Meet requirements of the National Environmental Policy Act (NEPA), Underground Storage Tank (UST) regulations, and all related state and local laws.

Air Force Policy and Justification: Required
This is a regulatory requirement. Compliance is mandatory.

Simplified Sustainable Facilities Guide Credit Title: Sustaining Sites Prerequisite 2 – Environmental Protection

New Requirements: No Change

Changes: None

Justification: N/A

Additional Information: Check with base environmental office for requirements.

B.3 Sustaining Sites Prerequisite 3 – Cultural Resources Protection

Intent: Maintain historical and cultural integrity of the structures and surrounding areas.

Requirement: Meet requirements of the National Historic Preservation Act.

Air Force Policy and Justification: Required
This is a regulatory requirement. Compliance is mandatory.

Simplified Sustainable Facilities Guide Credit Title: Sustaining Sites Prerequisite 3 – Cultural Resources Protection

New Requirements: No Change

Changes: None

Justification: N/A

Additional Information: Check with base environmental office for requirements.

B.4 Sustaining Sites Prerequisite 4 – Clean Water Protection

Intent: Maintain environmental integrity of all water resources that are impacted by the construction and operations of the building and worksite.

Requirement: Meet requirements of the Clean Water Act (CWA), the Safe Drinking Water Act (SDWA), and all related state and local laws.

Air Force Policy and Justification: Required
This is a regulatory requirement. Compliance is mandatory.

Simplified Sustainable Facilities Guide Credit Title: Sustaining Sites Prerequisite 4 – Clean Water Protection

New Requirements: No Change

Changes: None

Justification: N/A

Additional Information: Check with base environmental office for requirements.

B.5 Sustaining Sites Credit 1 – Site Selection

Intent: Avoid development of inappropriate sites and reduce the environmental impact from the location of a building on a site.

Requirement: (1 point)
Do not develop buildings on portions of sites that meet any one of the following criteria:
1. Prime farmland as defined by the American Farmland Trust.
2. Land whose elevation is lower than 5 feet above the elevation of the 100-year flood as defined by FEMA.
3. Land which provides habitat for any species on the Federal or State threatened or endangered list.
4. Within 100 feet of any wetland as defined by 40 CFR, Parts 230-233 and Part 22, OR as defined by local or state rule or law, whichever is more stringent.
5. Land which prior to acquisition for the project was public parkland, unless land of equal or greater value as parkland is accepted in trade by the public landowner (Park Authority projects are exempt).

Air Force Policy and Justification: Highly Recommended
Protects valuable public assets such as agricultural land, habitat for threatened or endangered species, wetlands, and parkland. Protect against future damage from flooding. See also: AFI 32-1021, Chapter 2.

Simplified Sustainable Facilities Guide Credit Title: Sustaining Sites Credit 1 – Site Selection

New Requirements: (1 Point)
For new construction, no development on farmland, flood plains, threatened species habitat, wetlands, or public parkland OR project does not increase the footprint of an existing facility.

Changes: Major Change: Added not increasing existing footprint.

Justification: Giving credit for not changing the existing footprint of a facility preserves non-built up land. This credit addition is similar to but not the same as Materials and Resources Credit 1 - Building Reuse (Appendix B.44). Materials and Resources Credit 1 requires the entire project to be within the confines of an existing facility (i.e. no increase in facility square footage). This credit allows additions as long as the footprint is not increased.

Additional Information: Adding credit for not increasing the footprint of an existing facility is similar to the Minnesota Sustainable Design Guide Site Strategy 1.1, which gives credit for using previously developed land (University of Minnesota, 2002). An example of adding square footage without changing the footprint would be adding a second story to a one-story building.

B.6 Sustaining Sites Credit 2 – Urban Development

Intent: Channel development to urban areas with existing infrastructures, protecting greenfields and preserving habitat and natural resources.

Requirement: (1 point)
Increase localized density to conform to existing or desired density goals by utilizing sites that are located within an existing minimum development density of 60,000 square feet per acre (2-story downtown development).

Air Force Policy and Justification: Recommended
Sites with existing infrastructure generally reduce project cost, vehicle miles of travel between housing and work, as well habitat loss and fragmentation. However, infill sites may not be available in all localities. Note: Potential conflict with Anti-Terrorism Guidelines. See Also: AFI 32-1021; AFI 32-7062.

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: The objectives of this guide are to make the guide easy to use and to not perform detailed studies. Determining if development density is 60,000 square feet per acre may not be a quick calculation to perform. This credit is best used for new construction. It is estimated that most projects covered by this guide will be within or added to an existing facility. Credit for not increasing the facility footprint is given under Sustainable Sites Credit 1 – Site Selection (Appendix B.5). Credit for not increasing the size of the facility is given under Materials and Resources Credit 1 - Building Reuse (Appendix B.44).

B.7 Sustaining Sites Credit 3 – Brownfield Redevelopment

Intent: Rehabilitate damaged sites where development is complicated by real or perceived environmental contamination, reducing pressure on undeveloped land.

Requirement: (1 Point)
Develop on a site classified as a Brownfield and provide remediation as required by EPA's Sustainable Redevelopment of Brownfields Program requirements

Air Force Policy and Justification: Conditionally Recommended
Improvement of brownfield sites transforms negative assets, while also reducing pressure on undeveloped land. EPA funding may be available to support remediation and development. This credit is intended to encourage/reward the selection of sites that require remediation, which means that it will only be available for sites that are contaminated.

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: This credit is best used for new construction. It is estimated that most projects covered by this guide will be within or to an existing facility. LEED™ for Existing Buildings (draft) determines this requirement as not applicable (U.S. Green Building Council, 2002b). For these reasons, plus the conditional recommendation, this credit is not included.

B.8 Sustaining Sites Credit 4.1 – Alternative Transportation

Intent: Reduce pollution and land development impacts from automobile use.

Requirement: (1 point)
Locate building within ½ mile of a commuter rail, light rail or subway station or ¼ mile of 2 or more bus lines

Air Force Policy and Justification: Recommended
Location of facility with proximity to rail, subway and buses reduces reliance on the automobile, and provides transportation alternatives. However, this credit will not be available in all locations. Note: Potential conflict with Ant-Terrorism Guidelines.

Simplified Sustainable Facilities Guide Credit Title: Sustaining Sites Site Credit 2.1 – Alternative Transportation

New Requirements: (2 Points)
Facility is within 1/4 mile of bus or shuttle service (additional point if bus/shuttle stop provides shelter from weather) , OR, if a new facility, the new facility is located with 1/4 mile of an existing facility used by the same unit.

Changes: Major Change: Added shelters and new facility within ¼ mile of existing facility.
Delete: commuter rail/subway, 2 bus lines

Justification: Credit within ¼ mile of bus services in unchanged. It is highly unlikely that commuter rail lines are on base, therefore it is not included. Credit for providing shelter encourages use of alternative transportation during inclement weather. Credit could also be earned if new construction is within ¼ mile of existing facility already occupied by same unit. This credit is earned under the assumption that the new facility supports the mission of the existing facility and users would walk between the two facilities.

Additional Information: Credit for providing shelter adopted from BREEAM/Green Leaf (ATHENA(tm) Sustainable Materials Institute, 2002b).

B.9 Sustaining Sites Credit 4.2 – Alternative Transportation

Intent: Reduce pollution and land development impacts from automobile use.

Requirement: (1 point)
Provide suitable means for securing bicycles, with convenient changing/shower facilities for use by cyclists, for 5% or more of building occupants.

Air Force Policy and Justification: Highly Recommended
Accommodation for bicycle commuters promotes transportation alternatives and can reduce reliance on the automobile. Bicycle facilities are appropriate for all building types and locations.

Simplified Sustainable Facilities Guide Credit Title: Sustaining Sites Site Credit 2.2 – Alternative Transportation

New Requirements: (2 Points)
Facility currently has, or as part of project, will install a bicycle rack for 10 bicycles. Additional point if changing/shower facilities are within 1/4 mile.

Changes: Minor Change: Defined distance to changing/shower facilities and deleted 5% requirement.

Justification: Determining the facility population may not be a quick task to accomplish. Credit is given if there is bicycle parking space for at least 10 bicycles. The requirement for changing/shower facilities has been changed from "nearby" to ¼ mile, the same for distance used for bus/shuttle service (see Appendix B.8). These changes preserve the intent of this credit.

Additional Information: The ¼ mile requirement for changing/shower facilities is adopted from LEED™ 2.1 (U.S. Green Building Council, 2002c).

B.10 Sustaining Sites Credit 4.3 – Alternative Transportation

Intent: Reduce pollution and land development impacts from automobile use.

Requirement: (1 point)
Install alternative-fuel refueling station(s) for 3% of the total vehicle parking capacity of the site. Liquid or gaseous fueling facilities must be separately ventilated or located outdoors.

Air Force Policy and Justification: Recommended
Integration of refueling stations for alternative fuel vehicles supports the market for alternative vehicles, and reduces air and water pollution from vehicle exhaust. May not be readily usable in all locations, however installation of alternative fuel refueling stations builds in future flexibility.

Simplified Sustainable Facilities Guide Credit Title: Sustaining Sites Site Credit 2.3 – Alternative Transportation

New Requirements: (2 Points)
Facility provides preferred parking for alternative fueled vehicles. Additional point for providing electrical vehicle charging stations.

Changes: Major Change: Added preferred parking and electrical vehicle charging stations. Deleted refueling stations.

Justification: Providing preferred parking for alternative fueled vehicles rewards facility occupants that are reducing the consumption of petroleum-based fuels.

Alternative fueled vehicle refueling stations are installed at a central point for government vehicle use and the program is administrated on a base wide scale. It is not practical for low cost O&M projects to be concerned with the base wide program for alternative fueled vehicles.

Additional Information: Preferred parking for alternative-fueled vehicles is adopted from LEED™ 2.1 (U.S. Green Building Council, 2002c). Alternative fueled vehicles are defined as vehicles that use low-polluting, non-petroleum based fuels such as electricity, propane or compressed natural gas, liquid natural gas, methanol, and ethanol (ATHENA(tm) Sustainable Materials Institute, 2002a). Gas/electric hybrid vehicles are also included.

B.11 Sustaining Sites Credit 4.4 – Alternative Transportation

Intent: Reduce pollution and land development impacts from automobile use.

Requirement: (1 point)
Size parking capacity not to exceed minimum local zoning requirements AND provide preferred parking for carpools or van pools capable of serving 5% of the building occupants, OR, add no new parking for rehabilitation projects AND provide preferred parking for carpools or van pools capable of serving 5% of the building occupants. AF Amendment: Refer to AFH 32-1084, Facility Standards, instead of local zoning for parking capacity requirements.

Air Force Policy and Justification: Recommended
Reduction of overall parking capacity can contribute lessen reliance on the automobile, while also decreasing impervious and stormwater runoff. Reduction in parking capacity needs to be balanced against a comprehensive assessment of transportation options. See also: AFH 32-1084

Simplified Sustainable Facilities Guide Credit Title: Sustaining Sites Site Credit 2.4 – Alternative Transportation

New Requirements: (2 Points)
Facility provides preferred parking for car/van pools (additional point if car/van pool waiting area provides shelter from the weather) or motorcycle parking, or designated parking will be added as part of project.

Changes: Major Change: Added motorcycles.
Minor Change: Deleted 5% requirement.

Justification: Meeting the requirements of this credit may not be practical for low cost projects. By giving credit for the existence of preferred parking spaces meets the intent of encouraging car/van pooling. Giving credit for preferred motorcycle parking is added because motorcycles require less space to park than automobiles and they are more fuel-efficient.

B.12 Sustaining Sites Credit 5.1 – Reduce Site Disturbance

Intent: Conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.

Requirement: (1 point)
On greenfield sites, limit site disturbance including earthwork and clearing of vegetation to 40 feet beyond the building perimeter, 5 feet beyond primary roadway curbs, walkways, and main utility branch trenches, and 25 feet beyond pervious paving areas that require additional staging areas in order to limit compaction in the paved area; OR, on previously developed sites, restore a minimum of 50% of the remaining open area by planting native or adapted vegetation.

Air Force Policy and Justification: Conditionally Recommended Reduction/elimination of impervious areas lessens site disturbance and facilities site restoration of existing sites. Benefits include reduced ambient air temperature on the site, protection and conservation of open spaces, and restoration of habitat and biodiversity. Sustainable design benefits need to balanced against cost and program requirements for parking and/or plazas.

Simplified Sustainable Facilities Guide Credit Title: Sustaining Sites Site Credit 3.1 – Reduce Site Disturbance

New Requirements: (1 Point)
Site disturbance does not extended beyond 40 feet of existing facility or footprint of construction and disturbed area is restored to natural state.

Changes: Major Change: Deleted restore remaining open area.
Minor Change: Simplified distances from project site.

Justification: Simplified site disturbance to just one measurement. Restoring open areas is covered under Sustaining Sites Site Credit 3.1 – Reduce Site Disturbance (see Appendix B. 13). These changes maintain the intent of the original requirement while simplifying requirements.

B.13 Sustaining Sites Credit 5.2 – Reduce Site Disturbance

Intent: Conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.

Requirement: (1 point)
Reduce the development footprint (including building, access roads and parking) to exceed the local zoning's open space requirement for the site by 25%. AF Amendment: Reduce the development footprint to exceed the base requirements by 25%. For bases without open space requirements, base civil engineer shall set a target open space ration to serve as the baseline.

Air Force Policy and Justification: Conditionally Recommended
Increased proportions of open space on the site reduce imperviousness, thereby improving water quality, groundwater recharge, and potential habitat for wildlife. To realize full benefit of increased open space use of low maintenance native vegetation is preferred. Potential benefits can be offset by high cost and environmental impacts if open space is developed as "lawn area" that requires irrigation, fertilizers, and pesticides. NOTE: Potential synergy with Anti-Terrorism Guidelines.

Simplified Sustainable Facilities Guide Credit Title: Sustaining Sites Site Credit 3.1 – Reduce Site Disturbance

New Requirements: (1 Point)
Project includes returning any amount of built-up area to a natural state.

Changes: Minor Change: Deleted % calculation.

Justification: By returning any amount of land to a natural state, the intent of this credit is preserved while simplifying the requirements.

B.14 Sustaining Sites Credit 6.1 – Stormwater Management

Intent: Limit disruption of natural water flows by minimizing stormwater runoff, increasing on-site infiltration and reducing contaminants.

Requirement: (1 point)
Implement a stormwater management plan that results in no net increase in the rate and quantity of stormwater runoff from existing to developed conditions; OR, if existing imperviousness is greater than 50%, implement a stormwater management plan that results in a 25% decrease in the rate and quantity of stormwater runoff.

Air Force Policy and Justification: Recommended
On-site stormwater management reduces negative impacts on watersheds and aquatic life, and contributes to groundwater recharge. If integrated into the design at the beginning of site design, and sufficient land area is available, natural stormwater management systems can be developed cost-effectively.

Simplified Sustainable Facilities Guide Credit Title: Sustaining Sites Site Credit 4 – Stormwater Management

New Requirements: (1 Point)
Incorporate the use of permeable pavements, bioretention systems, grass swales, or other technology that reduces stormwater runoff.

Changes: Minor Change: Deleted % calculations.

Justification: It is not practical to develop a comprehensive stormwater management plan for small projects. The intent of this credit is to minimize stormwater runoff. The use of permeable pavements, bioretention systems, or grass swales will reduce stormwater runoff. These changes preserve the intent of this credit.

Additional Information: For additional information and strategies, see the EPA Low Impact Development (LID) website at http://www.epa.gov/owow/nps/lid/ (U.S. Environmental Protection Agency, 2003a).

B.15 Sustaining Sites Credit 6.2 – Stormwater Management

Intent: Limit disruption of natural water flows by minimizing stormwater runoff, increasing on-site infiltration and reducing contaminants.

Requirement: (1 point)
Treatment systems designed to remove 80% of the average annual post development total suspended solids (TSS), and 40% of the average annual post development total phosphorous (TP), by implementing Best Management Practices (BMPs) outlined in EPA's Guidance Specifying Management Measures for Sources of Non-point Pollution in Coastal Waters (EPA 840-B-92-002 1/93).

Air Force Policy and Justification: Recommended
Localized low impact development strategies can improve the quality of stormwater leaving the site thereby reducing negative impacts on watersheds and aquatic life. These strategies can also reduce the cost and liability of large scale stormwater infrastructure. If integrated into the design at the beginning of site design, and sufficient land area is available, natural stormwater management systems can be developed cost-effectively.

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: It is not practical to meet the requirements of this credit for low cost projects.

B.16 Sustaining Sites Credit 7.1 – Landscape and Exterior Design to Reduce Heat Islands

Intent: Reduce heat islands (thermal gradient differences between developed and undeveloped areas) to minimize impact on microclimate and human and wildlife habitat.

Requirement: (1 point)
Provide shade (within 5 years) on at least 30% of non-roof impervious surface on the site, including parking lots, walkways, plazas, etc., OR, use light-colored/high-albedo materials (reflectance of at least 0.3) for 30% of the site's non-roof impervious surfaces, OR place a minimum of 50% of parking space underground OR use open-grid pavement system (net impervious area of LESS than 50%) for a minimum of 50% of the parking lot area.

Air Force Policy and Justification: Highly Recommended
Shade trees and shade structures, light-colored paving materials, and strategies to reduce use of paving materials on site all contribute to lower ambient temperatures, and reduced urban heat islands effect. If integrated at the beginning of site design, strategies to reduce the urban heat island effect can be developed cost-effectively.

Simplified Sustainable Facilities Guide Credit Title: Sustaining Sites Site Credit 5.1 – Landscape and Exterior Design to Reduce Heat Islands

New Requirements: (1 Point)
Plant trees that will shade paved areas, use light-colored/high-albedo materials (reflectance of at least 0.3) in the site's non-roof impervious surfaces, or use open-grid pavement systems.

Changes: Major Change: Deleted underground parking.
Minor Change: Deleted % calculations.

Justification: In keeping with this guide's objectives of making the guide easy and quick to use, requirements based on percentages are avoided. Planting trees that will provide shade on paved areas or using high-albedo materials for paved surfaces or using open-gird paving systems, regardless of percent of area covered, preserves the intent of this credit while simplifying the requirements.

Credit for underground parking spaces is not included because it assumed that constructing an underground parking garage would be of higher cost then projects that will be evaluated by this guide.

B.17 Sustaining Sites Credit 7.2 – Landscape and Exterior Design to Reduce Heat Islands

Intent: Reduce heat islands (thermal gradient differences between developed and undeveloped areas) to minimize impact on microclimate and human and wildlife habitat.

Requirement: (1 point)
Use ENERGY STAR Roof-compliant, high-reflectance AND high emissivity roofing (initial reflectance of at least 0.65 and three-year-aged reflectance of at least 0.5 when tested in accordance with ASTM E903 and emissivity of at least 0.9 when tested in accordance with ASTM 408) for a minimum of 75% of the roof surface; OR, install a "green" (vegetated) roof for at least 50% of the roof area.

Air Force Policy and Justification: Highly Recommended
Use of "cool roof" technology improves energy efficiency and comfort, and is cost-effective. White colored roofs do not conform to *Force Protection Guidelines,* however a vegetated roof may be an optimal solution for *Force Protection* where groundcover and roof vegetation are similar in appearance. NOTE: potential conflict/synergy with *Anti-terrorism Guidelines.*

Simplified Sustainable Facilities Guide Credit Title: Sustaining Sites Site Credit 5.2 – Landscape and Exterior Design to Reduce Heat Islands

New Requirements: (1 Point)
Use an EPA Energy Star labeled roofing material that has emissivity of at least 0.9 or install a "green" (vegetated) roof.

Changes: Minor Change: Deleted % calculations.

Justification: In keeping with this guide's objectives of making the guide easy and quick to use, requirements based on percentages are avoided. To simplify this requirement, percentage of roof covered is eliminated. If an entire roof is new or replaced, it is assumed that the entire roof would be the same material. If only a part of the roof is replaced, credit is given for meeting the requirements regardless of how much of the roof is replaced. By incorporating "cool roof" technology, the intent of this credit is preserved.

Additional Information: EPA Energy Star labeled roofing material can be found at www.energystar.gov (U.S. Environmental Protection Agency, 2003c). The EPA Energy Star program only addresses reflectance, and does not address emissivity in roofing. Not all of the EPA Energy Star approved roofing materials are high emissivity.

B.18 Sustaining Sites Credit 8 – Light Pollution Reduction

Intent: Eliminate light trespass from the building site, improve night sky access, and reduce development impact on nocturnal environments.

Requirement: (1 point)
Do not exceed Illuminating Engineering Society of North America (IESNA) footcandle level requirements as stated in the Recommended Practice Manual: Lighting for Exterior Environments, AND design interior and exterior lighting such that zero direct-beam illumination leaves the building site.

Air Force Policy and Justification: Highly Recommended
The LEED™ referenced standard for exterior lighting reduces negative effects of light pollution, while also contributing to energy efficiency. This strategy does not add cost, and may result in reduced first cost. NOTE: potential conflict with *Anti-terrorism Guidelines*. SEE ALSO: AFMAN 32-1082.

Simplified Sustainable Facilities Guide Credit Title: Sustaining Sites Credit 6 – Light Pollution Reduction

New Requirements: (1 Point)
All exterior luminaries with more than 1000 initial lamp lumens are shielded and all luminaries with more than 3500 initial lamp lumens meet the Full Cutoff IESNA Classification.

Changes: Minor Change: Simplified requirements.

Justification: This change is adopted from LEED™ 2.1 and clarifies actions to take (U.S. Green Building Council, 2002c).

Additional Information: For additional information, see Illuminating Engineering Society of North America (IESNA) website http://www.iesna.org/ (Illuminating Engineering Society of North America, 2003) and the International Dark Sky-Association website at http://www.darksky.org/ (International Dark Sky Association, 2003).

B.19 Water Efficiency Credit 1.1 – Water Efficient Landscaping

Intent: Limit or eliminate the use of potable water for landscape irrigation.

Requirement: (1 point)
Use high efficiency irrigation technology, OR, use captured rain or recycled site water, to reduce potable water consumption for irrigation by 50% over conventional means.

Air Force Policy and Justification: Highly Recommended
Provides multiple benefits of potable water use reduction, integrated stormwater management and ecological site planning. Water conserving landscape design is highly cost-effective. Benefits of rainwater collection and reuse systems vary regionally, however can be cost-effective as well.

Simplified Sustainable Facilities Guide Credit Title: Water Efficiency Credit 1.1 – Water Efficient Landscaping

New Requirements: (1 point)
Reduce the use of potable water used for irrigation.

Changes: Minor Change: Deleted % calculations.

Justification: By earning credit for reducing the amount of water needed for irrigation preserves the intent of the credit without the need to do a water use analysis.

Additional Information: Technologies to meet this requirement include using high-efficiency irrigation method, planting indigenous plants or replacing non-indigenous plants with indigenous plants, or collecting rainwater for irrigation. For more information, see www.irrigation.org (Irrigation Association, 2003).

B.20 Water Efficiency Credit 1.2 – Water Efficient Landscaping

Intent: Limit or eliminate the use of potable water for landscape irrigation.

Requirement: (1 point)
Use only captured rain or recycled site water for an additional 50% reduction (100% total reduction) of potable water for site irrigation needs, OR, do not install permanent landscape irrigation systems.

Air Force Policy and Justification: Recommended
Combines potable water use reduction with effective and efficient stormwater management as part of ecological site planning.

Simplified Sustainable Facilities Guide Credit Title: Water Efficiency Credit 1.2 – Water Efficient Landscaping

New Requirements: (1 point)
Eliminate the use of potable water for irrigation.

Changes: Major Change: Deleted not installing permanent irrigation system.

Justification: Eliminating the use of potable water for irrigation preserves the intent of this credit. Giving credit for not installing a permanent landscape irrigation system is removed because this act alone does not mean the area would not be watered using potable water in portable sprinklers or other non-permanent methods.

Additional Information: This credit can be accomplished by using collected rainwater, graywater, or a management decision not to water the landscape. For more information, see the Air Force Water Conservation Guidebook (Air Force Civil Engineer Support Agency, 2002).

B.21 Water Efficiency Credit 2 – Innovative Wastewater Technologies

Intent: Reduce the generation of wastewater and potable water demand, while increasing the local aquifer recharge.

Requirement: (1 point)
Reduce the use of municipally provided potable water for building sewage conveyance by a minimum of 50%, OR, treat 100% of wastewater on site to tertiary standards.

Air Force Policy and Justification: Conditionally Recommended
Facilities that use large quantities of water can realize sizable economic and environmental benefit from graywater reuse systems. In areas with no municipal sewage system, constructed wetland wastewater treatment systems can generate both economic and environmental benefits. Water treatment and reuse systems reduce sewer/septic infrastructure and reuse treated effluent for non-potable uses (e.g. exterior landscape irrigation, toilet flushing, cooling tower makeup) to further reduce potable water use.

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: The requirements of this credit are beyond the scope of the level of projects that this guide is targeted for. Credit is given for water use reduction (Appendix B.22), which will reduce the amount of wastewater.

B.22 Water Efficiency Credit 3.1 – Water Use Reduction

Intent: Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

Requirement: (1 point)
Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation) after meeting Energy Policy Act of 1992 fixture performance requirements.

Air Force Policy and Justification: Recommended
Water efficient plumbing fixtures, appliances, and HVAC equipment reduce potable water use, water/wastewater fees, energy consumption for water treatment and pumping, as well as chemicals that would have been used as the conventional treatment alternative. This 20% improvement target can generally be met with conventional technology. SEE ALSO**:** A-Gram 01-03

Simplified Sustainable Facilities Guide Credit Title: Water Efficiency Credit 2 – Water Use Reduction

New Requirements: (5 points)
(1 Point) Credit 2.1 - All toilets and urinals that are installed as part of project are less than 1.6 gallons per flush (gpf) for toilets and less than 1.0 gpf for urinals. All faucets and showerheads that are installed as part of project use less than 2.5 gallons per minute (gpm).
(1 Point) Credit 2.2 - All faucets that are installed as part of project use motion-sensor or metered faucets that use no more than 0.25 gallons per cycle (gpc).
(1 Point) Credit 2.3 - Waterless or composting toilets are installed as part of project.
(2 Points) Credit 2.4 - Any other equipment or technologies installed that reduces water consumption. 1 point for each item for a maximum of 2 points.

Changes: Minor Change: Deleted % calculations.

Justification: This credit deletes the need for reducing by a certain percentage and gives credit for installing low-water demand products. This preserves the intent of the credit while simplifying the requirements.

Additional Information: See Air Force Water Conservation Guidebook for suggestions (Air Force Civil Engineer Support Agency, 2002). In Credit 2.1, 1.6 gpf for toilets, 1 gpf for urinals, and 2.5 gpm for shower heads and faucets are the standards in the Energy Policy Act of 1992. To earn points for Credit 2.1, toilets, urinals, showerheads, and faucets must use less energy than the standard.

B.23 Water Efficiency Credit 3.2 – Water Use Reduction

Intent: Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

Requirement: (1 point)
Exceed the potable water use reduction by an additional 10% (30% total efficiency increase).

Air Force Policy and Justification: Conditionally Recommended
Water efficient plumbing fixtures, appliances, and HVAC equipment reduce potable water use, water/wastewater fees, energy consumption for water treatment and pumping, as well as chemicals that would have been used as the conventional treatment alternative. Use of rainwater collection and/or water re-use systems also contributes to water use reduction (see Water Credit 2) This 30% reduction target generally requires use of some unconventional technology (e.g. waterless urinals, composting toilets, graywater recycling), however project specific analysis must be completed to determine which strategies should be used to fulfill this credit.

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: Credit is given under Water Efficiency Credit 3.1 – Water Use Reduction for installing low demand products. See Appendix B.22.

B.24 Energy and Atmosphere Prerequisite 1 – Fundamental Building Systems Commissioning

Intent: Verify and ensure that fundamental building elements and systems are designed, installed and calibrated to operate as intended.

Requirement: Implement the following fundamental best practice commissioning procedures:
-Engage a commissioning authority
-Review design intent and basis of design documentation
-Include commissioning requirements in the construction documents
-Develop and utilize a commissioning plan
-Verify installation, functional performance, training and documentation
-Complete a commissioning report

Air Force Policy and Justification: Highly Recommended
Commissioning is highly recommended for all projects. Investment in commissioning can be justified by lower maintenance costs over the first few years, as problems are discovered and addressed pro-actively prior to occupancy, and lower energy costs (studies show that energy costs are reduced by an average of 20% because equipment operates as designed.) Refer to the WBDG for a detailed discussion of commissioning.
SEE ALSO: ETL 90-10

Simplified Sustainable Facilities Guide Credit Title: Energy and Atmosphere Prerequisite 1 – Fundamental Building Systems Commissioning

New Requirements: Ensure all installed building elements and systems are designed, installed, and calibrated to operate as intended before accepting project AND all applicable O&M manuals are provided by contractor AND ensure that a warranty plan is in place.

Changes: Minor Change: Simplified requirements.

Justification: A full-scale building commissioning is beyond the scope of the projects this guide is targeted for. The new requirements listed above simplify the original requirement while preserving the intent of this prerequisite. The requirements listed are the basic building commissioning products that are already required for contracted projects.

B.25 Energy and Atmosphere Prerequisite 2 – Minimum Energy Performance

Intent: Establish the minimum level of energy efficiency for the base building and systems.

Requirement: Design to meet building energy efficiency and performance as required by ASHRAE/IESNA 90.1-1999 or the local energy code, whichever is the more stringent. (note: The requirements of 10 CFR 434 are equivalent to ASHRAE/IESNA 90.1-1999)

Air Force Policy and Justification: Required
The 1999 version of ASHRAE/IESNA 90.1 supercedes the earlier version, ASHRAE/IESNA 90.1-1989. While it has not yet been adopted by many jurisdictions, it represents current best-practice standards that should form the minimum level of energy efficiency. Use of this improved minimum standard will reduce use of fossil fuels, and produce life cycle cost savings. SEE ALSO: ETL 94-4

Simplified Sustainable Facilities Guide Credit Title: Energy and Atmosphere Prerequisite 2 – Minimum Energy Performance

New Requirements: No Changes

Changes: None

Justification: No change in requirements.

Additional Information: ETL 94-4 is applicable for new facilities, all additions, and major renovations/repairs. Major renovations/repairs is further defined as "Changes in the building envelope, and/or replacement of any one or more of the following systems: lighting, HVAC, and water heating" (Air Force Civil Engineer Support Agency, 1994).

B.26 Energy and Atmosphere Prerequisite 3 – CFC Reduction in HVAC&R Equipments

Intent: Reduce ozone depletion.

Requirement: Zero use of CFC-based refrigerants in new building HVAC&R base building systems. When reusing existing base building HVAC equipment, complete a comprehensive CFC phaseout conversion.

Air Force Policy and Justification: Highly Recommended
Manufacture of CFC's and Halons has been completely phased-out as required by section 604 of the Clean Air Act. In new buildings it is standard practice to use non-CFC equipment. In existing buildings CFC-based equipment may continue to be used however refrigerants must be purchased from reclaimed sources, and sources are limited. Existing equipment that uses CFC-based refrigerants should be replaced at the time of building renovation to avoid need for future replacement, to reduce environmental impacts, and for added benefit of greater energy efficiency. SEE ALSO: ETL:91-7

Simplified Sustainable Facilities Guide Credit Title: Energy and Atmosphere Prerequisite 3 – CFC Reduction in HVAC&R Equipments

New Requirements: Zero use of CFC-based refrigerants in new HVAC&R equipment. If modifying or upgrading existing CFC-based HVAC&R follow local base guidance on phasing out CFC-based refrigerants.

Changes: Minor Change: Simplified CFC phaseout requirements.

Justification: Removed the requirement that a comprehensive CFC phaseout conversion plan be developed. It assumed that the base already has a plan to phaseout CFC-based equipment.

Additional Information: The justification references ETL 91-7. According to the AFCESA website, this ETL has been cancelled and has not been superceded.

B.27 Energy and Atmosphere Prerequisite 4 – Atmospheric Air Quality Protections

Intent: Minimize adverse impacts to atmospheric air quality.

Requirement: Comply with the regulatory guidance governing atmospheric air quality, including the federal Clean Air Act, and related state and local laws.

Air Force Policy and Justification: Required
This is a regulatory requirement. Compliance is mandatory.

Simplified Sustainable Facilities Guide Credit Title: Energy and Atmosphere Prerequisite 4 – Atmospheric Air Quality Protections

New Requirements: No changes.

Changes: None

Justification: This is a required item.

Additional Information: Contact base environmental office for more information.

B.28 Energy and Atmosphere Credit 1.1-1.5 – Optimize Energy Performance

Intent: Achieve increasing levels of energy performance above the prerequisite standard to reduce environmental impacts associated with excessive energy use.

Requirement: Reduce design energy cost compared to the energy cost budget for regulated energy components described in the requirements of ASHRAE/IESNA Standard 90.1-1999, as demonstrated by a whole building simulation using the energy Cost Budget Method described in Section 11. Regulated energy components include HVAC systems, building envelope, service hot water systems, lighting and other regulated systems defined by ASHRAE. (note: The requirements of 10 CFR 434 are equivalent to ASHRAE/IESNA 90.1-1999)

Air Force Justification: Energy conservation reduces reliance on fossil fuels, reduces associated pollution, and reduces utility costs. Federal projects are required by the Energy Policy Act of 1992, to incorporate energy saving design strategies that can be cost justified with a payback period of 10 years or less.

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: See individual credits (Appendixes B.29-B.33).

Justification: N/A

B.29 Energy and Atmosphere Credit 1.1 – Optimize Energy Performance

Intent: Achieve increasing levels of energy performance above the prerequisite standard to reduce environmental impacts associated with excessive energy use.

Requirement: (2 points)
New buildings 20% or existing buildings 10%.

Air Force Policy and Justification: Highly Recommended
A 20% improvement for new buildings and a 10% improvement for existing buildings is a good minimum target for energy efficiency. Improvement is measured based on reduced energy cost, compared to the LEED™ minimally required energy standard (See Energy Prerequisite 2).

Simplified Sustainable Facilities Guide Credit Title: Energy and Atmosphere Credit 1 – Optimize Energy Performance

New Requirements: (15 Points)
(1 point) Credit 1.1 All lighting installed or replaced is ENERGY STAR labeled or are Federal Energy Management Program (FEMP) recommended products.
(1 point) Credit 1.2 Use automatic on/off lights for exterior lighting.
(1 point) Credit 1.3 Use automatic on/off lights or automatic daylight dimming controls for interior lighting.
(1 point) Credit 1.4 Use electronic ballast for fluorescent lamps.
(1 point) Credit 1.5 Use compact fluorescent lamps (cfl) instead of incandescent lamps.
(1 point) Credit 1.6 Use Energy Star labeled commercial, industrial, or utility distribution transformers.
(15 points) Credit 1.7 Use of any other energy savings devices. 1 credit for each type of item for a maximum of 15 points. Note maximum points for all of Credit 1 is 15 points.

Changes: Minor Change: Simplified requirements.

Justification: The requirements are simplified to delete the need for percent calculations. Credits 1.1-1.6 provide a list of strategies that may be common to a renovation projects. Credit 1.7 provides the opportunity to list other strategies that reduce energy consumption. Depending on the scope of work, there are many more possible strategies than listed here.

Additional Information: For general lighting strategies see The Lightning Research Center website at http://www.lrc.rpi.edu/ (Rensselaer Polytechnic Institute, 2003).
Credit 1.1 For a list of Energy Star labeled products see http://www.energystar.gov (U.S. Environmental Protection Agency, 2003c). For a list of FEMP recommended products, see http://www.eere.energy.gov/femp/ (U.S. Department of Energy, 2003a).
Credit 1.2 Use motions sensors, time clocks, photocells, or other devices that will automatically turn on/off exterior lighting.

Credit 1.3 Use occupancy sensors or automatic day lighting dimming controls for interior lighting.
Credit 1.6 For a list of Energy Star labeled products see http://www.energystar.gov (U.S. Environmental Protection Agency, 2003c).
Credit 1.7 Depending on the scope of work, there are numerous opportunities to reduce energy use; far more than is listed here. Some areas to consider are insulation, high efficiency windows and window glazing systems, electrical motors, refrigeration equipment, boilers, and chillers. For additional guidance and strategies see Greening Federal Facilities at http://www.eere.energy.gov/femp/techassist/green_fed_facilities.html (U.S. Department of Energy, 2001), Energy Star Program at http://www.energystar.gov (U.S. Environmental Protection Agency, 2003c), Federal Energy Management Program at http://www.eere.energy.gov/femp/ (U.S. Department of Energy, 2003a), and AFCESA Facility Energy Program at http://www.afcesa.af.mil/Directorate/CES/Mechanical/Energy/default.htm (Air Force Civil Engineer Support Agency, 2003).

B.30 Energy and Atmosphere Credit 1.2 – Optimize Energy Performance

Intent: Achieve increasing levels of energy performance above the prerequisite standard to reduce environmental impacts associated with excessive energy use.

Requirement: (4 points)
New buildings 30% or existing buildings 20%.

Air Force Policy and Justification: Recommended
A 30% improvement for new buildings and a 20% improvement for existing buildings is generally achievable using cost-effective, off-the-shelf technologies that are well integrated with passive solar design strategies. Improvement is measured based on reduced energy cost, compared to the LEED™ minimally required energy standard (See Energy Prerequisite 2).

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: In order to simplify this requirement, determining percentages of improvement have been eliminated. All credits for energy saving practices are listed under Energy and Atmosphere Credit 1.1 – Optimize Energy Performance. See Appendix B.29 for more information.

B.31 Energy and Atmosphere Credit 1.3 – Optimize Energy Performance

Intent: Achieve increasing levels of energy performance above the prerequisite standard to reduce environmental impacts associated with excessive energy use.

Requirement: (6 points)
New buildings 40% or existing buildings 30%.

Air Force Policy and Justification: Recommended
A 40% improvement for new buildings and a 30% improvement for existing buildings is generally achievable using cost-effective, off-the-shelf technologies that are well integrated with passive solar design strategies. Improvement is measured based on reduced energy cost, compared to the LEED™ minimally required energy standard (See Energy Prerequisite 2).

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: In order to simplify this requirement, determining percentages of improvement have been eliminated. All credits for energy saving practices are listed under Energy and Atmosphere Credit 1.1 – Optimize Energy Performance. See Appendix B.29 for more information.

B.32 Energy and Atmosphere Credit 1.4 – Optimize Energy Performance

Intent: Achieve increasing levels of energy performance above the prerequisite standard to reduce environmental impacts associated with excessive energy use.

Requirement: (8 points)
New buildings 50% or existing buildings 40%.

Air Force Policy and Justification: Conditionally Recommended
Depending on the building type, and the climate zone, a 50% improvement for new buildings and a 40% improvement for existing buildings may or may not be achievable using conventional technology. Improvement is measured based on reduced energy cost, compared to the LEED™ minimally required energy standard (See Energy Prerequisite 2).

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: In order to simplify this requirement, determining percentages of improvement have been eliminated. All credits for energy saving practices are listed under Energy and Atmosphere Credit 1.1 – Optimize Energy Performance. See Appendix B.29 for more information.

B.33 Energy and Atmosphere Credit 1.5 – Optimize Energy Performance

Intent: Achieve increasing levels of energy performance above the prerequisite standard to reduce environmental impacts associated with excessive energy use.

Requirement: (10 points)
New buildings 60% or existing buildings 50%.

Air Force Policy and Justification: Conditionally Recommended
Depending on the building type, and the climate zone, a 60% improvement for new buildings and a 50% improvement for existing buildings may or may not be achievable using conventional technology. Improvement is measured based on reduced energy cost, compared to the LEED™ minimally required energy standard (See Energy Prerequisite 2).

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: In order to simplify this requirement, determining percentages of improvement have been eliminated. All credits for energy saving practices are listed under Energy and Atmosphere Credit 1.1 – Optimize Energy Performance. See Appendix B.29 for more information.

B.34 Energy and Atmosphere Credit 2.1-2.2 – Renewable Energy

Intent: Encourage and recognize increasing levels of self-supply through renewable technologies to reduce environmental impacts associated with fossil fuel energy use.

Requirement: Supply a net fraction of the building's total energy use (as expressed as a fraction of annual energy cost) through the use of on-site renewable energy systems.

Air Force Justification: Renewable energy sources include solar, wind, and biomass generation technologies. These technologies provide clean, renewable sources of energy, and increase energy independence in the US. When renewable energy strategies are integrated on-site, electricity transmission losses are eliminated. Some sites will be more compatible with renewable strategies than others. In some parts of the country, renewable energy systems are beginning to be a cost-effective option. These include areas where electricity rates are high (or, high demand charges exist), and access to sun, wind, or biomass is good. In some parts of the country, programs exist to reduce the first cost of renewable energy systems. SEE ALSO: 10USC 2857; AFI 32-1023, C5.4

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: See individual credits (Appendixes B.35-B.36).

Justification: N/A

B.35 Energy and Atmosphere Credit 2.1 – Renewable Energy

Intent: Encourage and recognize increasing levels of self-supply through renewable technologies to reduce environmental impacts associated with fossil fuel energy use.

Requirement: (1 point)
5% of total energy cost in renewables.

Air Force Policy and Justification: Conditionally Recommended
Renewable energy sources include solar, wind, and biomass generation technologies. These technologies provide clean, renewable sources of energy, and increase energy independence in the US. When renewable energy strategies are integrated on-site, electricity transmission losses are eliminated. Some sites will be more compatible with renewable strategies than others. In some parts of the country, renewable energy systems are beginning to be a cost-effective option. These include areas where electricity rates are high (or, high demand charges exist), and access to sun, wind, or biomass is good. In some parts of the country, programs exist to reduce the first cost of renewable energy systems. SEE ALSO: 10USC 2857; AFI 32-1023, C5.4

Simplified Sustainable Facilities Guide Credit Title: Energy and Atmosphere Credit 2 – Renewable Energy

New Requirements: (1 Point)
Any amount of energy is supplied by renewable energy sources.

Changes: Minor Change: Deleted % calculations.

Justification: The adjustment to the requirement removes the need to calculate what percentage of energy is from renewable sources. By giving credit for installing renewable energy sources, regardless of percentages, simplifies this requirement while preserving the intent.

Additional Information: Examples of renewable energy sources include photovoltaic panels, high temperature solar and/or geothermal, wind, biomass, and biogas. For more information see the Department of Energy's National Renewable Energy Laboratory web site at http://www.nrel.gov/ (U.S. Department of Energy, 2003b).

B.36 Energy and Atmosphere Credit 2.2 – Renewable Energy

Intent: Encourage and recognize increasing levels of self-supply through renewable technologies to reduce environmental impacts associated with fossil fuel energy use.

Requirement: (2 points)
10% of total energy cost in renewables.

Air Force Policy and Justification: Conditionally Recommended
Renewable energy sources include solar, wind, and biomass generation technologies. These technologies provide clean, renewable sources of energy, and increase energy independence in the US. When renewable energy strategies are integrated on-site, electricity transmission losses are eliminated. Some sites will be more compatible with renewable strategies than others. In some parts of the country, renewable energy systems are beginning to be a cost-effective option. These include areas where electricity rates are high (or, high demand charges exist), and access to sun, wind, or biomass is good. In some parts of the country, programs exist to reduce the first cost of renewable energy systems. SEE ALSO: 10USC 2857; AFI 32-1023, C5.4

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: Credit is given under Energy and Atmosphere Credit 2.1 – Renewable Energy. The requirement of calculating percentages has been removed to simplify the process. See appendix B.35 for more information.

B.37 Energy and Atmosphere Credit 3 – Additional Commissioning

Intent: Verify and ensure that entire building is designed, constructed, and calibrated to operate as intended.

Requirement: (1 point)
In addition to the Fundamental Building Commissioning prerequisite, implement the following additional commissioning tasks:
- Conduct a focused review of the design prior to the construction documents phase.
- Conduct a focused review of the construction documents when close to completion.
- Conductive a selective review of contractor submittals of commissioned equipment.
- Develop a system and energy management manual.
- Have a contractor in place for a near-warranty or post occupancy review.
- Items 1, 2, and 3 must be performed by someone other than the designer.

Air Force Policy and Justification: Highly Recommended
Full systems commissioning is highly recommended for all projects. Investment in commissioning can be justified by lower maintenance costs over the first few years, as problems are discovered and addressed pro-actively prior to occupancy. Studies show that energy costs are also reduced in buildings with full systems commissioning because equipment operates as designed. Refer to the WBDG for a detailed discussion of commissioning.

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: The basic requirements of building commissioning are required under Energy and Atmosphere Prerequisite 1 – Fundamental Building Systems Commissioning (appendix B.24). A full scale building commissioning is outside of the scope of the scale of the targeted projects of this guide. Two of the proposed requirements for this credit under the draft LEED™ for Existing Buildings are:

- Establish/maintain contracts or in-house resources in place for post warranty equipment maintenance.
- Implement/maintain a comprehensive best practice and continuous preventative maintenance program. (U.S. Green Building Council, 2002b)

It is assumed that these requirements would be met by incorporating the affected items into the Recurring Work Program after the warranty has expired.

B.38 Energy and Atmosphere Credit 4 – Elimination of HCFC's and Halons

Intent: Reduce ozone depletion and support early compliance with the Montreal Protocol.

Requirement: (1 point)
Install base building level HVAC and refrigeration equipment and fire suppression systems that do not contain HCFC's or Halon.

Air Force Policy and Justification: Conditionally Recommended
A balance must be struck between the goals of reducing ozone depletion, and reducing impacts on global warming. Some solutions, such as ground source heat pumps, or passive technologies that eliminate the need to use refrigerants can contribute to both goals. HCFC-based refrigerants are the only choice of refrigerant-based equipment for smaller buildings. Some of the non-HCFC-based refrigerants are less efficient than their HCFC-based. Halons are no longer a legally permissible option for fire suppression systems. Existing systems will need to be replaced.

Simplified Sustainable Facilities Guide Credit Title: Energy and Atmosphere Credit 3 – Elimination of HCFC's and Halons

New Requirements: (1 point)
None of the installed HVAC and refrigeration and fire suppression equipment contains HCFC's or Halon OR if equipment containing HCFC's or Halon is removed.

Changes: Major Change: Added removing HCFC's or Halon systems.

Justification: The first part of the new requirement is the same as the existing requirement. The existing requirements do not explicitly give credit for simply removing equipment containing HCFC's or Halon. This has been added. An example of when equipment could be removed and new equipment not re-installed would be in the case of demolition.

B.39 Energy and Atmosphere Credit 5 – Measurement and Verification

Intent: Provide for the ongoing accountability and optimization of building energy and water consumption performance over time.

Requirement: (1 point)
Comply with the installed equipment requirements for continuous metering as stated in Option B: Methods by Technology of the US DOE's International Performance Measurement and Verification Protocol (IPMVP) for the following:
- Lighting systems and controls.
- Constant and variable motor loads.
- Variable frequency drive (VFD) operation.
- Chiller efficiency at variable loads (kW/ton).
- Cooling load.
- Air and water economizer and heat recovery cycles.
- Air distribution static pressures and ventilation air volumes.
- Boiler efficiencies.
- Building specific process energy efficiency systems and equipment.
- Indoor water risers and outdoor irrigation systems.

Air Force Policy and Justification: Highly Recommended
The LEED™ referenced Measurement and Verification (M&V) standard was developed primarily for verifying performance contracts related to building retrofits, however the protocol also is relevant to new buildings as a method to ensure that predicted energy and water savings are actually producing savings to the owner. Adoption of this standard provides an effective quality control method for managing energy and water efficiency throughout the life of the building.

Simplified Sustainable Facilities Guide Credit Title: Energy and Atmosphere Credit 4 – Measurement and Verification

New Requirements: (1 point)
HVAC, lighting, or other building systems are connected to an Energy Management and Control System (ECMS).

Changes: Minor Change: Types of monitored systems.

Justification: An ECMS can monitor and optimize energy use. The requirements adjustment simplifies the requirement while preserving the intent of the credit. See AFM 32-1093 Energy Monitoring and Control Systems (ECMS) for additional information (Department of the Air Force, 1991).

B.40 Energy and Atmosphere Credit 6 – Green Power

Intent: Encourage the development and use of grid-source, renewable energy technologies on a net zero pollution basis.

Requirement: (1 point)
Engage in a two year contract to purchase power generated from renewable sources that meet the Center for Resource Solutions (CRS) Green-E requirements.

Air Force Policy and Justification: Conditionally Recommended
Green electricity has been defined by the Center for Resource Solutions (CRS) Green-e products certification process. Commitment to use green electricity helps to build the market for renewable power generation. Current costs for green power are slightly greater than conventional power, however over time these sources may prove to have more stable pricing than conventional sources. Green power is not currently available in all localities.

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: It is assumed that projects that this guide is targeted for would receive power from the base electrical grid. Decisions on how that power is obtained are outside of the scope of this guide. However, there may be cases where individual projects have the opportunity to incorporate renewable energy supplies. Credit for renewable energy sources is discussed in appendix B.35.

B.41 Materials and Resources Prerequisite 1 – Storage and Collection of Recyclables

Intent: Facilitate the reduction of waste generated by building occupants that is hauled to and disposed of in landfills.

Requirement: Provide an easily accessible area that serves the entire building that is dedicated to the separation, collection and storage of materials for recycling including (at a minimum) paper, glass, plastics, and metals.

Air Force Policy and Justification: Highly Recommended
Reduces waste to landfills, and supports the market for recycled materials. Recycling is legally required in many jurisdictions, and revenue from recycling is increasing. Even if recycling is not available in the locality, design to accommodate recycling will enable building to respond to future opportunities.

Simplified Sustainable Facilities Guide Credit Title: Materials and Resources Prerequisite 1 – Storage and Collection of Recyclables

New Requirements: Required
Follow existing base procedures for recycling.

Changes: Minor Change: Simplified requirements.

Justification: Bases already have a recycling program in place.

Additional Information: Check with the base environmental office for further guidance.

B.42 Materials and Resources Prerequisite 2 – Hazardous Materials and Waste Management

Intent: Ensure proper handling of hazardous waste materials.

Requirement: Comply with the requirements of the federal Toxic Substances Control Act (TSCA), Resource Conservation and Recovery Act (RCRA), and the Occupational Safety and Health Act (OSHA) guidelines.

Air Force Policy and Justification: Required
This is a regulatory requirement. Compliance is mandatory.

Simplified Sustainable Facilities Guide Credit Title: Materials and Resources Prerequisite 2 – Hazardous Materials and Waste Management

New Requirements: No Changes

Changes: None

Justification: N/A

Additional Information: Check with the base environmental office for further guidance.

B.43 Materials and Resources Credit 1.1 – Building Reuse

Intent: Extend the life cycle of existing building stock, conserve resources, retain cultural resources, reduce waste, and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport.

Requirement: (1 Point)
Maintain at least 75% of existing building structure and shell (exterior skin and framing excluding window assemblies).

Air Force Policy and Justification: Conditionally Recommended
Conserves resources, and reduces waste materials going to landfills. Also reduces development pressures on Greenfield sites. However, this credit can only be earned by projects utilizing sites with an existing building that can be reused.

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: Credit is giving if existing project is 100% within an existing building structure. See Appendix B.44 for more details.

B.44 Materials and Resources Credit 1.2 – Building Reuse

Intent: Extend the life cycle of existing building stock, conserve resources, retain cultural resources, reduce waste, and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport.

Requirement: (1 Point)
Maintain an additional 25% (100% of total) of existing building structure and shell (exterior skin and framing excluding window assemblies).

Air Force Policy and Justification: Conditionally Recommended
Conserves resources, and reduces waste materials going to landfills. Also reduces development pressures on Greenfield sites. However, this credit can only be earned by projects utilizing sites with an existing building that can be reused.

Simplified Sustainable Facilities Guide Credit Title: Materials and Resources Credit 1 – Building Reuse

New Requirements: (1 Point)
100% of the project is within an existing building structure.

Changes: Minor Change: Deleted % calculations.

Justification: The only change is in wording; deleted "Maintain an additional 25%". This all or none adjusted requirement is based on the draft LEED™ for Existing Buildings which reduces the three possible credits for building reuse into one requirement; use 100% of an existing building.

Additional Information: This credit addition is similar to but not the same as Sustaining Sites Credit 1 – Site Selection (Appendix B.5). Sustaining Sites Credit 1 does not allow the footprint of a facility to be increased. This credit is more restrictive by not allowing additional square footage.

B.45 Materials and Resources Credit 1.3 – Building Reuse

Intent: Extend the life cycle of existing building stock, conserve resources, retain cultural resources, reduce waste, and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport.

Requirement: (1 Point)
Maintain 100% of existing building structure and shell AND 50% non-shell (walls, floor coverings, and ceiling systems).

Air Force Policy and Justification: Conditionally Recommended
Conserves resources, and reduces waste materials going to landfills. Also reduces development pressures on Greenfield sites. However, this credit can only be earned by projects utilizing sites with an existing building that can be reused.

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: Credit is giving if existing project is 100% within an existing building structure. See Appendix B.44 for more details.

B.46 Materials and Resources Credit 2.1 – Construction Waste Management

Intent: Divert construction, demolition, and land clearing debris from landfill disposal. Redirect recyclable material back to the manufacturing process.

Requirement: (1 Point)
Recycle and/or salvage at least 50% (by weight) of construction, demolition, and land clearing waste.

Air Force Policy and Justification: Highly Recommended
Recycling of demolition and construction waste diverts waste from landfill. The available infrastructure to support recycling will vary regionally, however, concrete, metal, asphalt, cardboard and plastics are cost effective to recycle in most parts of the country.

Simplified Sustainable Facilities Guide Credit Title: Materials and Resources Credit 2 – Construction Waste Management

New Requirements: (3 Points)
1 point for each item of construction waste product that can be recycled or diverted from the landfill for a maximum of 3 points.

Changes: Minor Change: Deleted % calculations.

Justification: The intent of this guide is to identify sustainable development opportunities. Identifying percent of waste diverted from landfill is best completed after the material has been removed. It is difficult to estimate before a project begins the weight of recyclable material and the weight of all construction waste. By identifying types of materials that can be recycled, the intent of this credit is preserved.

Additional information: Examples of items that may be recycled include wood products, concrete, metal, asphalt, cardboard and plastics. Check with base environmental office for list of items that can be recycled or diverted.

B.47 Materials and Resources Credit 2.2 – Construction Waste Management

Intent: Divert construction, demolition, and land clearing debris from landfill disposal. Redirect recyclable material back to the manufacturing process.

Requirement: (1 Point)
Recycle and/or salvage an additional 25% (75% total by weight) of the construction, demolition, and land clearing debris.

Air Force Policy and Justification: Highly Recommended
Recycling of demolition and construction waste diverts waste from landfill. The available infrastructure to support recycling will vary regionally, however, concrete, metal, asphalt, cardboard and plastics are cost effective to recycle in most parts of the country.

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: See Appendix B.46.

B.48 Materials and Resources Credit 3.1 – Resource Reuse

Intent: Extend the life cycle of targeted building materials, reducing environmental impacts related to materials manufacturing and transport.

Requirement: (1 Point)
Specify salvaged or refurbished materials for 5% of building materials.

Air Force Policy and Justification: Conditionally Recommended
Re-use of salvaged or refurbished materials is environmentally beneficial and generally reduces construction cost, however availability is limited and sometimes difficult to coordinate with construction of larger projects. Re-use of existing furniture must be considered carefully, as use of older furniture or non-standardized furniture can negatively impacts space planning efficiencies.

Simplified Sustainable Facilities Guide Credit Title: Materials and Resources Credit 3 – Resource Reuse

New Requirements: (3 Points)
1 point for each type of item that is removed as part of project and later re-installed or 1 point for each type of salvaged construction material used for a maximum of 3 points.

Changes: Minor Change: Deleted % calculations.

Justification: Removing the requirement to calculate percentages simplifies the requirements while preserving the intent of this credit.

Additional Information: LEED™ 2.1 list of items that may be salvaged include: office furniture, built-in shelving, beams and posts, flooring, paneling, doors and frames, cabinetry and furniture, other wood products, and brick and decorative items (U.S. Green Building Council, 2002c). For a list of currently available salvaged construction materials, see http://build.recycle.net (RecycleNet Corporation, 2003).

B.49 Materials and Resources Credit 3.2– Resource Reuse

Intent: Extend the life cycle of targeted building materials, reducing environmental impacts related to materials manufacturing and transport.

Requirement: (1 Point)
Specify salvaged or refurbished materials for 10% of building materials.

Air Force Policy and Justification: Conditionally Recommended
Re-use of salvaged or refurbished materials is environmentally beneficial and generally reduces construction cost, however availability is limited and sometimes difficult to coordinate with construction of larger projects. Re-use of existing furniture must be considered carefully, as use of older furniture or non-standardized furniture can negatively impacts space planning efficiencies.

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: See Appendix B.48.

B.50 Materials and Resources Credit 4.1 – Recycled Content

Intent: Increase demand for building products that have incorporated recycled content material, reducing the impacts resulting from extraction of new material.

Requirement: (1 Point)
Specify a minimum of 25% of building materials that contain in aggregate a minimum weighted average of 20% post-consumer recycled content material, OR, a minimum weighted average of 40% post-industrial recycled content material.

Air Force Policy and Justification: Strongly Recommended
Use of recycled content materials helps support the market for recycled content materials. Many high quality recycled content products are readily available for use. Some of these are new products; however many are standard products in the industry. Federal projects are required to meet the EPA Comprehensive Procurement Guidelines (CPG). SEE ALSO: AFI 32-7080; ETL 00-1.

Simplified Sustainable Facilities Guide Credit Title: Materials and Resources Credit 4 – Recycled Content

New Requirements: (3 Points)
1 point for using products that are listed on the EPA CPG Program OR 1 point for each product not listed in the EPA CPG program that contains in aggregate a minimum weighted average of 20% post-consumer recycled content material, OR, a minimum weighted average of 40% post-industrial recycled content material, for a maximum of 3 products.

Changes: Major Change: Added EPA CPG Program.
Minor Change: Deleted % calculations.

Justification: The new requirements follow the guidelines of the Air Force Affirmative Procurement Program concerning the use of EPA CPG Program designated products (Air Force Center for Environmental Excellence, 2002). The requirement has been simplified by removing the requirements to perform percentage calculations of specifying minimum building materials content while preserving the intent of this credit.

Additional Information: Applicable products listed under the EPA CPG program must be use. The list of products under the EPA CPG Program can be found at http://www.epa.gov/cpg/products.htm (U.S. Environmental Protection Agency, 2002). Also see Guide To Green Purchasing: The Air Force Affirmative Procurement Program at http://www.afcee.brooks.af.mil/eq/ap/gg/default.asp (Air Force Center for Environmental Excellence, 2002).

B.51 Materials and Resources Credit 4.2 – Recycled Content

Intent: Increase demand for building products that have incorporated recycled content material, reducing the impacts resulting from extraction of new material.

Requirement: (1 Point)
Specify an additional 25% (50% of total) of building materials that contain in aggregate a minimum weighted average of 20% post-consumer recycled content material, OR, a minimum weighted average of 40% post-industrial recycled content material.

Air Force Policy and Justification: Recommended
Ability to provide 50% of materials with recycled content will vary depending on building location. Use of recycled content materials helps support the market for recycled content materials. Many high quality recycled content products are readily available for use. Some of these are new products, however many are standard products in the industry. Federal projects are required to meet the EPA Comprehensive Procurement Guidelines (CPG). SEE ALSO: AFI 32-7080; ETL 00-1.

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: See Appendix B.50.

B.52 Materials and Resources Credit 5.1 – Local/Regional Materials

Intent: Increase demand for building products that are manufactured locally, reducing the environmental impacts resulting from transportation, and supporting the local economy.

Requirement: (1 Point)
Specify a minimum of 20% of building materials that are manufactured regionally within a radius of 500 miles.

Air Force Policy and Justification: Highly Recommended
Use of local and regionally sourced and manufactured materials reduces transportation requirements, and usually reduces cost as well. When integrated into decision making early in design, use of regionally sourced and manufactured materials can be accommodated in nearly all parts of the US.

Simplified Sustainable Facilities Guide Credit Title: Materials and Resources Credit 5 – Local/Regional Materials

New Requirements: (2 Points)
1 point for each product used that is manufactured regionally within a radius of 500 miles for a maximum of 2 points. Credit is not earned for concrete or asphalt.

Changes: Minor Change: Deleted % calculations.

Justification: By giving credit for simply using products that are manufactured regionally preserves the intent of this credit while eliminating the requirement to calculate percentages. Due to the requirements of mixing concrete and asphalt, they will always be locally produced and therefore not included.

Additional Information: Manufactured regionally means where the product is manufactured, not the location of the raw materials that go into the product. Due to the requirements of mixing concrete and asphalt, they will always be locally produced. For a possible list of locally manufactured products, see the Blue Book of Building and Construction web site at http://www.thebluebook.com/ (Contractors Register Inc., 2003). This website lists companies that provide construction materials in a regional area, but does not state whether the company actually produces the products or just distributes the products.

B.53 Materials and Resources Credit 5.2 – Local/Regional Materials

Intent: Increase demand for building products that are manufactured locally, reducing the environmental impacts resulting from transportation, and supporting the local economy.

Requirement: (1 Point)
Of those regionally manufactured materials, specify a minimum of 50% that are extracted, harvested, or recovered within 500 miles.

Air Force Policy and Justification: Recommended
Ability to meet LEED™ requirement will vary depending on location. Use of local and regionally sourced and manufactured materials reduces transportation requirements, and usually reduces cost as well. When integrated into decision making early in design, use of regionally sourced and manufactured materials can be accommodated in nearly all parts of the US.

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: See Appendix B.52.

B.54 Materials and Resources Credit 6 – Rapidly Renewable Resources

Intent: Reduce the use and depletion of finite raw and long cycle renewable materials by replacing them with rapidly renewable materials.

Requirement: (1 Point)
Specify rapidly renewable building materials for 5% of total building materials.

Air Force Policy and Justification: Conditionally Recommended
Use of rapidly renewable materials (straw, bamboo, some types of wood, etc) reduces environmental impacts, and may help meet the requirements of Executive Order 13101, guidance that encourages increased use of biobased products. However, these materials are not appropriate for all building types and availability is limited.

Simplified Sustainable Facilities Guide Credit Title: Materials and Resources Credit 6 – Rapidly Renewable Resources

New Requirements: (1 Point)
1 point for each use of rapidly renewable building materials or products for a maximum of 3 points.

Changes: Minor Change: Deleted % calculations.

Justification: Removed the requirement to perform percent calculations. This simplification preserves the intent of this credit.

Additional Information: Rapidly renewable building materials and products are made from plants that are typically harvested within a ten-year cycle or shorter. Examples include bamboo flooring, wool carpets, straw board, cotton batt insulation, linoleum flooring, poplar OSB, sunflower seed board, and wheatgrass cabinetry (U.S. Green Building Council, 2002c). For a list of rapidly renewable products, see the USDA Biobased Industrial Products Site at http://www.usda-biobasedproducts.net/public/ (U.S. Department of Agriculture, 2003). (Note: at the time of publication of this thesis, the USDA website was under construction and did not contain any actual products.)

B.55 Materials and Resources Credit 7 – Certified Wood

Intent: Encourage environmentally responsible forest management.

Requirement: (1 Point)
Use a minimum of 50% of woodbased materials certified in accordance with the Forest Stewardship Council guidelines for wood building components including but not limited to framing, flooring, finishes, furnishings, and non-rented temporary construction applications such as bracing, concrete form work and pedestrian bridges.

Air Force Policy and Justification: Conditionally Recommended
Use of certified sustainable wood is environmentally beneficial and imposes only a nominal installed cost premium compared to conventional wood installations.

Simplified Sustainable Facilities Guide Credit Title: Materials and Resources Credit 7 – Certified Wood

New Requirements: (2 Points)
1 point for each type of wood product certified by the Forest Stewardship Council for a maximum of 2 points.

Changes: Minor Change: Deleted % calculations.

Justification: Removing the requirement to calculate percentages simplifies this requirement while preserving the intent of the credit.

Additional Information: The following website list products certificated by the Forest Stewardship Council:
http://www.certifiedwood.org/search-modules/ProductHierarchy.ASP (Certified Forest Products Council, 2003).

B.56 Indoor Environmental Quality Prerequisite 1 – Minimum IAQ Performance

Intent: Establish minimum IAQ performance to prevent the development of indoor air quality problems in buildings, maintaining the health and well being of the occupants.

Requirement: Meet the minimum requirements of voluntary consensus standard ASHRAE 62-1999, Ventilation for Acceptable Indoor Air Quality and approved Addenda.

Air Force Policy and Justification: Highly Recommended
This standard represents best practices widely accepted by industry. The new 1999 version of the standard provides greater flexibility for designers to meet the standard, than the previous 1989 version. It has been well documented that improved indoor air quality contributes to well-being and productivity in the workplace.

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Prerequisite 1 – Minimum IAQ Performance

New Requirements: No Change.

Changes: None

Justification: N/A

Additional Information: This prerequisite is most applicable to projects that involve new HVAC systems or major modifications to an existing HVAC system.

B.57 Indoor Environmental Quality Prerequisite 2 – Environmental Tobacco Smoke (ETS) Control

Intent: Prevent exposure of building occupants and systems to Environmental Tobacco Smoke (ETS).

Requirement: Zero exposure of nonsmokers to ETS by prohibition of smoking in the building, OR, by providing a designated smoking room designed to effectively contain, capture and remove ETS from the building. At a minimum, the smoking room shall be directly exhausted to the outdoors with no recirculation of ETS-containing air to the non-smoking area of the building, enclosed with impermeable structural deck-to-deck partitions and operated at a negative pressure compared with the surrounding spaces of at least 7 Pa (0.03 inches of water gauge). Performance of smoking rooms shall be verified using tracer gas testing methods as described in ASHRAE Standard 129-1997. Acceptable exposure in non-smoking areas is defined as less than 1% of the tracer gas concentration in the smoking room detectable in the adjoining non-smoking areas. Smoking room testing as described in the ASHRAE Standard 129-1997 is required in the contract documents and critical smoking facility systems testing results.

Air Force Policy and Justification: Required
Smoking is not permitted in US Government facilities.

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: Not included because smoking is not permitted in US Government facilities.

B.58 Indoor Environmental Quality Prerequisite 3 – Acoustics and Noise Control

Intent: Protect building occupants from exposure to excessive noise.

Requirement: Comply with applicable regulatory guidance governing noise, including the federal Occupational, Safety and Health Act (OSHA), which sets limits on noise levels in certain types of workplaces, and local laws that regulate noise levels of various land uses.

Air Force Policy and Justification: Required
Poor acoustics and excessive noise are detrimental to health and productivity AND Compliance with OSHA and related local laws is a mandatory regulatory requirement.

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Prerequisite 3 – Acoustics and Noise Control

New Requirements: No change.

Changes: None

Justification: N/A

Additional Information: Contact base Bio-Environmental Engineering for additional guidance.

B.59 Indoor Environmental Quality Credit 1 – Carbon Dioxide (CO_2) Monitoring

Intent: Provide capacity for indoor air quality (IAQ) monitoring to sustain long term occupant health and comfort.

Requirement: (1 Point)
Install a permanent carbon dioxide (CO_2) monitoring system that provides feedback on space ventilation performance in a form that affords operational adjustments, AND specify initial operational set point parameters that maintain indoor carbon dioxide levels no higher than outdoor levels by more than 530 parts per million at any time.

Air Force Policy and Justification: Conditionally Recommended
CO_2 monitoring verifies that air quality is maintained, and can contribute to energy efficiency, especially when occupancy is highly variable. This may not be a cost-effective strategy in facilities that have very low occupancy.

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Credit 1 – Carbon Dioxide (CO_2) Monitoring

New Requirements: (1 point)
Install a permanent carbon dioxide (CO_2) monitoring system that provides feedback on space ventilation performance in a form that affords operational adjustments.

Changes: Major Change: Deleted 530 parts per million.

Justification: The new requirement and additional information is adopted from LEED™ 2.1.

Additional Information: Refer to the CO_2 differential for all types of occupancy in accordance with ASHRAE 62-2001, Appendix D.

B.60 Indoor Environmental Quality Credit 2 – HVAC

Intent: Provide for the effective delivery and mixing of fresh air to building occupants to support their health, safety, and comfort.

Requirement: (1 Point)
For mechanically ventilated buildings, design ventilation systems that result in an air change effectiveness (E) greater than or equal to 0.9 as determined by ASHRAE 129-1977. For naturally ventilated spaces demonstrate a distribution and laminar flow pattern that involves not less than 90% of the room or zone area in the direction of air flow for at least 95% of hours of occupancy.

Air Force Policy and Justification: Conditionally Recommended
Ventilation effectiveness contributes to a healthy indoor environment. The LEED™ ventilation criteria can be met in buildings with underfloor air distribution systems, and in buildings with naturally ventilated systems with effective cross-ventilation patterns. Standard ceiling supply and return air systems do not meet this criteria.

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Credit 2 – HVAC

New Requirements: (4 points)
There are a many indoor environmental quality issues that relate directly to HVAC systems use and control. If project involves HVAC systems, 1 point (max 4 points) can be earned for each of the following Indoor Environmental Quality credits listed in the Air Force Sustainable Facilities Guide: Credit 2, Credit 3.1, Credit 7.1, and Credit 7.2.

Changes: None – Consolidated with other credits.

Justification: These four requirements involve engineering analysis and design requirements that are outside the scope of this guide. However, if the project is primarily HVAC related, then these requirements may be applicable.

B.61 Indoor Environmental Quality Credit 3.1 – Construction IAQ Management Plan

Intent: Prevent indoor air quality problems resulting from the construction/renovation process, to sustain long term installer and occupant health and comfort.

Requirement: (1 Point)
Develop and implement an Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases of the building as follows:
During construction meet or exceed the minimum requirements of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guideline for Occupied Buildings under Construction, 1995, AND protect stored on-site or installed absorptive materials from moisture damage, AND replace all filtration media immediately prior to occupancy (Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 13 as determined by ASHRAE 52.2-1999).

Air Force Policy and Justification: Highly Recommended
The LEED™ referenced Indoor Air Quality Management Plan represents a "best-practice" approach to protecting indoor air quality during construction.

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Credit 2 – HVAC

New Requirements: See Appendix B.60.

Changes: None – Consolidated with other credits.

Justification: See Appendix B.60.

B.62 Indoor Environmental Quality Credit 3.2 – Construction IAQ Management Plan

Intent: Prevent indoor air quality problems resulting from the construction/renovation process, to sustain long term installer and occupant health and comfort.

Requirement: (1 Point)
Develop and implement an Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases of the building as follows:
Conduct a minimum two-week building flushout with new filtration media at 100% outside air after construction ends and prior to occupancy, OR, conduct a baseline indoor air quality testing procedure consistent with current EPA protocol for Environmental Requirements, Baseline IAQ and Materials, for the Research Triangle Park Campus, Section 01445.

Air Force Policy and Justification: Highly Recommended
The LEED™ referenced Flush-Out or Baseline IAQ Testing represents two options for ensuring that indoor air quality is acceptable prior to occupancy, that are highly recommended. Baseline IAQ testing provides the added value of a baseline to compare to future IAQ investigations.

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Credit 3 – Construction IAQ Management Plan

New Requirements: (1 point)
Develop and implement an Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases of the project. Plan should address safety and bioenvironmental issues for both construction workers and non-construction personnel in the vicinity of the project.

Changes: Minor Change: Simplified requirements.

Justification: The requirements have been simplified while preserving the intent.

Additional Information: Contact base safety and bioenvironmental engineering for local guidance. The EPA protocol for Environmental Requirements, Baseline IAQ and Materials, for the Research Triangle Park Campus, Section 01445 is located at the following website: http://www.epa.gov/rtp/new-bldg/environmental/s_01445.htm (U.S. Environmental Protection Agency, 2003b).

B.63 Indoor Environmental Quality Credit 4.1 – Low-Emitting Materials

Intent: Reduce the quantity of indoor air contaminants that are odorous or potentially irritating to provide installer and occupant health and comfort.

Requirement: (1 Point)
Meet or exceed the VOC limits for adhesives, sealants, paints, composite wood products, and carpet systems as follows:
Adhesives must meet or exceed the VOC limits of South Coast Air Quality Management District Rule #1168, AND all sealants used as a filler must meet or exceed Bay Area Air Resources Board Reg. 8, Rule 51.

Air Force Policy and Justification: Highly Recommended
Use of low-emitting materials is part of a proactive approach to maintaining good indoor air quality. Materials meeting the LEED™ criteria are readily available, have no adverse impact on performance, and little or no impact on cost.

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Credit 4.1 – Low-Emitting Materials

New Requirements: No change.

Changes: None

Justification: N/A

Additional Information:
Link to South Coast Air Quality Management District Rule #1168:
http://www.aqmd.gov/rules/html/r1168.html (South Coast Air Quality Management District, 2003)

Link to Bay Area Air Resources Board Reg. 8, Rule 51:
http://www.baaqmd.gov/regs/rulereg.htm (Bay Area Air Quality Management District, 2003)

B.64 Indoor Environmental Quality Credit 4.2 – Low-Emitting Materials

Intent: Reduce the quantity of indoor air contaminants that are odorous or potentially irritating to provide installer and occupant health and comfort.

Requirement: (1 Point)
Meet or exceed the VOC limits for adhesives, sealants, paints, composite wood products, and carpet systems as follows:
Paints and coatings must meet or exceed the VOC and chemical component limits of Green Seal requirements.

Air Force Policy and Justification: Highly Recommended
Use of low-emitting materials is part of a proactive approach to maintaining good indoor air quality. Materials meeting the LEED™ criteria are readily available, have no adverse impact on performance, and little or no impact on cost.

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Credit 4.2 – Low-Emitting Materials

New Requirements: (1 point)
Paints and coatings must meet or exceed the VOC and chemical component limits of Green Seal GS-11 requirements or Master Painter Institute (MPI) E2 or E3 rated products.

Changes: Major Change: Added MPI rated products.

Justification: Paints approved by the Master Painter Institute have been added. The U.S. Department of Defense Uniform Facilities Guide Specification (UFGS) has adopted the MPI standards (National Institute of Building Sciences, 2003).

Additional Information:
Link to Green Seal: http://www.greenseal.org/recommendations.htm#product (Green Seal, 2003)

Link to MPI: http://www.paintinfo.com/mpi/approved/index.htm (Master Painters Institute, 2003)

B.65 Indoor Environmental Quality Credit 4.3 – Low-Emitting Materials

Intent: Reduce the quantity of indoor air contaminants that are odorous or potentially irritating to provide installer and occupant health and comfort.

Requirement: (1 Point)
Meet or exceed the VOC limits for adhesives, sealants, paints, composite wood products, and carpet systems as follows:
Carpet Systems must meet or exceed the Carpet and Rug Institute Green Label Indoor Air Quality Test Program.

Air Force Policy and Justification: Highly Recommended
Use of low-emitting materials is part of a proactive approach to maintaining good indoor air quality. Materials meeting the LEED™ criteria are readily available, have no adverse impact on performance, and little or no impact on cost.

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Credit 4.3 – Low-Emitting Materials

New Requirements: No Change

Changes: None

Justification: N/A

Additional Information:
Link to Carpet and Rug Institute Green Label Indoor Air Quality Test Program: http://www.carpet-rug.com/drill_down_2.cfm?page=8&sub=4 (Carpet and Rug Institute, 2003)

B.66 Indoor Environmental Quality Credit 4.4 – Low-Emitting Materials

Intent: Reduce the quantity of indoor air contaminants that are odorous or potentially irritating to provide installer and occupant health and comfort.

Requirement: (1 Point)
Meet or exceed the VOC limits for adhesives, sealants, paints, composite wood products, and carpet systems as follows:
Composite wood or agrifiber products must contain no added urea-formaldehyde resins.

Air Force Policy and Justification: Highly Recommended
Use of low-emitting materials is part of a proactive approach to maintaining good indoor air quality. Materials meeting the LEED™ criteria are readily available, have no adverse impact on performance, and little or no impact on cost.

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Credit 4.4 – Low-Emitting Materials

New Requirements: No Change

Changes: None

Justification: N/A

<u>New Credit Not Contained in the Air Force Sustainable Facilities Guide</u>

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Credit 4.5 – Low-Emitting Materials

New Requirements: Use systems furniture and office seating that is GreenGuard certified or registered.

Changes: Major Change: This credit is new and is not in LEED™ 2.0 or Air Force Sustainable Facilities Guide.

Justification: This new requirement is adopted from LEED™ Rating System for Commercial Interiors (Pilot Draft) (U.S. Green Building Council, 2002a)

Additional Information: Link to GreenGuard: www.greenguard.org (GreenGuard Environmental Institute, 2003). Some UNICOR products have met GreenGuard standards.

B.67 Indoor Environmental Quality Credit 5 – Indoor Chemical and Pollutant Source Control

Intent: Avoid exposure of building occupants to potentially hazardous chemicals that adversely impact air quality.

Requirement: (1 Point)
Design to minimize cross-contamination of regularly occupied areas by chemical pollutants: Employ permanent entryway systems (grills, grates, etc.) to capture dirt, particulates, etc. from entering the building at all high volume entryways, AND provide areas with structural deck to deck partitions with separate outside exhausting, no air recirculation and negative pressure where chemical use occurs (including housekeeping areas and copying /print rooms), AND provide drains plumbed for appropriate disposal of liquid waste in spaces where water and chemical concentrate mixing occurs.

Air Force Policy and Justification: Highly Recommended
Careful design and operation of buildings to isolate and ventilate sources of contamination is a pro-active approach to maintaining good indoor air quality. The cost of these measures is minimal, and integration of these design features can be accommodated in all types and sizes of buildings.

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Credit 5 – Pollutant Source Control

New Requirements: (1 point)
Provide/install entryway systems (grills, grates, mats, etc) to prevent dirt, dust, pollen and other particles from entering the building at all entryways.

Changes: Major Change: Deleted structural deck to deck partitions and drains for liquid waste.

Justification: Hazardous materials and waste are covered in Materials and Resources Prerequisite 2 – Hazardous Materials and Waste Management (see Appendix B.42)

B.68 Indoor Environmental Quality Credit 6.1 – Controllability of Systems

Intent: Provide a high level of individual occupant control of thermal, ventilation, and lighting systems to support optimum health, productivity, and comfort conditions.

Requirement: (1 Point)
Provide a minimum of one operable window and one lighting control zone per 200 s.f. for all occupied areas within 15 feet of the perimeter wall.

Air Force Policy and Justification: Conditionally Recommended
Individual occupant control of thermal, ventilation, and lighting systems support well-being and productivity. However the benefit must be weighed against the cost. Individual controls in the perimeter zone provide the most benefit in closed office environments.

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Credit 6 – Controllability of Systems

New Requirements: (1 point)
Increase the number of operable windows or number of lighting control zones or number of HVAC system control zones.

Changes: Minor Change: Simplified requirements.

Justification: The new requirement has been simplified while preserving the intent of the credit.

Additional Information: This credit is a combination of Indoor Environmental Quality Credit 6.1 and 6.2 (see Appendix B.69)

B.69 Indoor Environmental Quality Credit 6.2 – Controllability of Systems

Intent: Provide a high level of individual occupant control of thermal, ventilation, and lighting systems to support optimum health, productivity, and comfort conditions.

Requirement: (1 Point)
Provide controls for each individual for airflow, temperature, and lighting for 50% of the non perimeter, regularly occupied areas.

Air Force Policy and Justification: Conditionally Recommended
Individual occupant control of thermal, ventilation, and lighting systems support well-being and productivity. However the benefit must be weighed against the cost.

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Credit 6 – Controllability of Systems

New Requirements: See Appendix B. 68.

Changes: Minor Change: Deleted % calculations.

Justification: The new requirement has been simplified while preserving the intent of the credit.

Additional Information: This credit is a combination of Indoor Environmental Quality Credit 6.1 (see Appendix B.68) and 6.2.

B.70 Indoor Environmental Quality Credit 7.1 – Thermal Comfort

Intent: Provide for a thermally comfortable environment that supports the productive and healthy performance of the building occupants.

Requirement: (1 Point)
Comply with ASHRAE Standard 55-1992, Addenda 1995 for thermal comfort standards including humidity control within established ranges per climate zone.

Air Force Policy and Justification: Recommended
Adoption of thermal comfort standards improves comfort and productivity, however maintaining optimal temperature and humidity in a building can increase the HVAC load, and increase construction costs as well. Use of this standard is most beneficial for buildings in climates with humidity extremes and occupants that spend the majority of the day in the building.

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Credit 2 – HVAC

New Requirements: See Appendix B.60

Changes: None – Consolidated with other credits.

Justification: See Appendix B.60

B.71 Indoor Environmental Quality Credit 7.2 – Thermal Comfort

Intent: Provide for a thermally comfortable environment that supports the productive and healthy performance of the building occupants.

Requirement: (1 Point)
Install a permanent temperature and humidity monitoring system configured to provide operators control over thermal comfort performance and effectiveness of humidification and/ or dehumidification systems in the building.

Air Force Policy and Justification: Conditionally Recommended
Monitoring is the best method for ensuring that temperature and humidity requirements are being met. Humidity monitors can also be used to alert building operations personnel to unusual sources of moisture, thereby avoiding possible mold and mildew. The cost of monitoring must be balanced against the benefits.

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Credit 2 – HVAC

New Requirements: See Appendix B.60

Changes: None – Consolidated with other credits.

Justification: See Appendix B.60

B.72 Indoor Environmental Quality Credit 8.1 – Daylight and Views

Intent: Provide a connection between indoor spaces and the outdoor environment through the introduction of sunlight and views into the occupied areas of the building.

Requirement: (1 Point)
Achieve a minimum Daylight Factor of 2% (excluding all direct sunlight penetration) in 75% of all space occupied for critical visual tasks, not including copy rooms, storage areas, mechanical, laundry, and other low occupancy support areas. Exceptions include those spaces where tasks would be hindered by the use of daylight or where accomplishing the specific tasks within a space would be enhanced by the direct penetration of sunlight.

Air Force Policy and Justification: Highly Recommended
Daylighting contributes to energy efficiency, as well as occupant well-being and productivity. Close coordination of architecture, interior space planning with daylighting strategy is required. Daylighting goals need to be balanced against space planning efficiency goals. NOTE: potential conflict with *Anti-terrorism Guidelines.*

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Credit 7.1 – Daylight and Views

New Requirements: (1 point)
Increase the amount of natural sunlight available to interior of facility without increasing glare or adding unwanted heat.

Changes: Minor Change: Simplified requirements.

Justification: The new requirement simplifies the original requirement while preserving the intent of this credit.

Additional Information: Some of the methods to increase the amount of natural sunlight include additional windows, larger windows, light shelves, skylights, clerestories, courtyards and atriums.

B.73 Indoor Environmental Quality Credit 8.2 – Daylight and Views

Intent: Provide a connection between indoor spaces and the outdoor environment through the introduction of sunlight and views into the occupied areas of the building.

Requirement: (1 Point)
Direct line of sight to vision glazing from 90% of all regularly occupied spaces, not including copy rooms, storage areas, mechanical, laundry, and other low occupancy support areas.

Air Force Policy and Justification: Recommended
Views provide a connection between the indoor and the outdoor environment. Access to views impacts occupant well-being and productivity. Close coordination of architecture and interior space planning is required, and the goal to provide views needs to be balanced against space planning efficiency goals.

Simplified Sustainable Facilities Guide Credit Title: Indoor Environmental Quality Credit 7.2 – Daylight and Views

New Requirements: (1 point)
Increase the amount of facility interior occupied space that has direct line of sight to vision glazing.

Changes: Minor Change: Simplified requirements.

Justification: Removing the percent calculations simplifies this credit while preserving the intent.

B.74 Innovation & Design Process Credit 1 – Design Process

Intent: To provide design teams and projects the opportunity to be awarded points for exceptional performance above requirements set by the LEED™ Green Building Rating System and/or innovative performance in green building categories not specifically addressed by the LEED™ Green Building Rating System.

Requirement: (1 Point)
In writing, using the LEED™ Credit Equivalence process, identify the intent of the proposed innovation credit, the proposed requirement for compliance, the proposed submittals to demonstrate compliance, and the design approach used to meet the required elements.

Air Force Policy and Justification: Conditionally Recommended
Innovative design solutions can add value to the project, however these options must be evaluated on a case by case basis. Innovative solutions must support the overall mission of the facility.

Simplified Sustainable Facilities Guide Credit Title: Innovation & Design Process Credit 1 – Design Process

New Requirements: (3 points)
One point for any item, process, or technology not already addressed that (1) conserves energy, water, or raw materials, or (2) prevents environmental degradation caused by construction, operations, and disposal of facilities or (3) contributes to built environments which are livable, healthy, maintainable, and productive for a maximum of three points.

Changes: Minor Change: Redefined requirements.

Justification: The requirements of this credit have been adjusted while preserving the intent of the original credit.

Additional Information: The credit is a catch-all credit for any item that supports the goals of sustainable development that has not already been addressed.

B.75 Innovation & Design Process Credit 2 – LEED™ Accredited Professional

Intent: To support and encourage the design integration required by a LEED™ Green Building project and to streamline the application and certification process.

Requirement: (1 Point)
At least one principal participant of the project team that has successfully completed the LEED™ Accredited Professional exam.

Air Force Policy and Justification: Highly Recommended
LEED™ Accredited Professionals add value to the design effort because they understand the integrated design process and are familiar with high-performance sustainable design solutions.

Simplified Sustainable Facilities Guide Credit Title: Innovation & Design Process Credit 2 – LEED™ Accredited Professional

New Requirements: No Changes

Changes: None

Justification: N/A

Additional Information: The LEED™ Accredited Professional can be government or contractor.

B.76 Innovation & Design Process Credit 3 – Integrated Landscape Management

Intent: Restore habitat areas through a comprehensive approach to landscape design and long-term management.

Requirement: (1 Point)
Develop an integrated design and management plan to restore habitat and improve ecosystem health. Plan must include native plant selection; EPA approved non-chemical fertilizers, application procedures and rates; integrated pest management (IPM) plan; mulching, pruning and mowing practices; maximum tree size; optimum ground cover height; and composting methods.

Air Force Policy and Justification: Recommended
Integrated design and management of landscaped areas reduces maintenance costs over time and improves ecosystem health.

Simplified Sustainable Facilities Guide Credit Title: N/A

New Requirements: N/A

Changes: Not Included

Justification: This credit is not included because of the level of detail involved in the plan is beyond the scope of the projects this guide is designed for. Credit is given for restoring previously built-up land to a native state under Sustaining Sites Credit 5.2 (see Appendix B.13). Native plant selection is encouraged under Water Efficiency Credit 1.1 – Water Efficient Landscaping (see Appendix B. 19). IPM is already an Air Force standard practice.

B.77 Innovation & Design Process Credit 4 – Deconstruction

Intent: Extend the useful life of building materials and reduce construction and demolition waste.

Requirement: (1 Point)
Employ deconstruction methods to dismantle an existing building, and reuse a minimum of 50% of the materials by weight.

Air Force Policy and Justification: Recommended
Deconstruction can be a highly cost-effective and resource efficient solution.

Simplified Sustainable Facilities Guide Credit Title: Innovation & Design Process Credit 3 – Deconstruction

New Requirements: (1 point)
Employ deconstruction methods to dismantle an existing building.

Changes: Minor Changes: Removed % requirements.

Justification: Removing percent calculations simplifies the credit while preserving the intent.

Additional Information: The U.S. Army Corps of Engineers' Public Works Technical Bulletin 420-49-32, Selection of Methods for the Reduction, Reuse, and Recycling of Demolition Waste, contains information on deconstruction (U.S. Army Corps of Engineers, 2001). This bulletin can be found at http://www.hnd.usace.army.mil/techinfo/CPW/pwtb.htm.

B.78 Innovation & Design Process Credit 5 – Advance Resource Efficiency

Intent: Extend the useful life of building materials, and reduce time required to accommodate change.

Requirement: (1 Point)
Incorporate mobile building components with an interior design master plan to maximize flexibility for future uses.

Air Force Policy and Justification: Recommended
Design for flexibility reduces facility down time, and reduces life cycle cost. *Note:* potential synergy with *Anti-terrorism Guidelines.*

Simplified Sustainable Facilities Guide Credit Title: Innovation & Design Process Credit 4 – Advance Resource Efficiency

New Requirements: No Changes

Changes: None

Justification: N/A

Appendix C. Print Copy of the Simplified Sustainable Facilities Guide

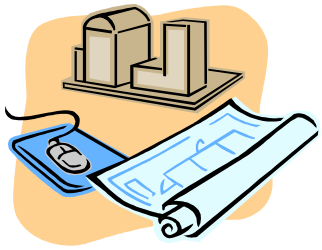
The Simplified Sustainable Facilities Guide was created using Microsoft Excel®. This appendix is a print copy of the guide. The Simplified Sustainable Facilities Guide uses hyperlinks to form relationships between various information components and is color-coded to facilitate use. The hyperlinks and relationships between the various information components are not preserved in this print copy. The color-coding was removed for readability. This print copy is for reference only, may be difficult to follow, and should not be used to assess projects. To obtain an electronic copy of the Simplified Sustainable Facilities Guide, contact the Air Force Center for Environmental Excellence (AFCEE). Section 4.5 discusses the Simplified Sustainable Facilities Guide.

WELCOME TO THE SIMPLIFIED SUSTAINABLE FACILITIES GUIDE

Project Name	Enter Project Title
Date Evaluated	Enter Date
Evaluated By	Enter Name of person performing evaluation

For best results, copy this file and use a new file for each project.

[How to Use this Guide]



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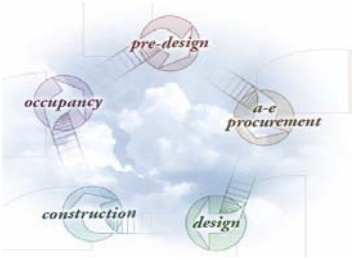

[AF Sustainable Facilities Guide]

Return to Welcome Page

Return to Checklist Summary

Yellow fields are for entering text.
Blue field are for entering points.
Gray Fields are for information.

Checklist Summary	Points Possible	Points Earned	Click on Title to Jump to Credit Summary
Sustaining Sites	15	**0**	Sustaining Sites
Water Efficiency	7	**0**	Water Efficiency
Energy and Atmosphere	18	**0**	Energy and Atmosphere
Materials and Resources	17	**2**	Materials and Resources
Indoor Environmental Quality	15	**0**	Indoor Environmental Quality
Innovation & Design Process	6	**0**	Innovation & Design Process
Total Possible Points	78	**2**	**Points Earned**

Sustaining Sites Summary	Points Possible	Points Earned	Click on Credit Title to Jump to Credit
Prerequisite 1	Y or N/A	**0**	Erosion And Sediment Control
Prerequisite 2	Y	**Y**	Environmental Protection
Prerequisite 3	Y	**Y**	Cultural Resources Protection
Prerequisite 4	Y	**Y**	Clean Water Protection
Credit 1	1	**0**	Site Selection
Credit 2	8	**0**	Alternative Transportation
Credit 3	2	**0**	Reduced Site Disturbance
Credit 4	1	**0**	Stormwater Management
Credit 5	2	**0**	Landscape and Exterior Design to Reduce Heat Islands
Credit 6	1	**0**	Light Pollution Reduction
Total Possible Points	15	**0**	**Points Earned**

Water Efficiency Summary	Points Possible	Points Earned	Click on Credit Title to Jump to Credit
Credit 1	2	**0**	Water Efficient Landscaping
Credit 2	5	**0**	Water Use Reduction
Total Possible Points	7	**0**	**Points Earned**

Energy and Atmosphere Summary	Points Possible	Points Earned	Click on Credit Title to Jump to Credit
Prerequisite 1	Y	**Y**	Fundamental Building Systems Commissioning
Prerequisite 2	Y	**Y**	Minimum Energy Performance
Prerequisite 3	Y or N/A	**0**	CFC Reduction in HVAC&R Equipments
Prerequisite 4	Y	**Y**	Atmospheric Air Quality Protections
Credit 1	15	**0**	Optimize Energy Performance
Credit 2	1	**0**	Renewable Energy
Credit 3	1	**0**	Elimination of HCFC's and Halons
Credit 4	1	**0**	Measurement and Verification
Total Possible Points	18	**0**	**Points Earned**

Materials and Resources Summary	Points Possible	Points Earned	Click on Credit Title to Jump to Credit
Prerequisite 1	Y	**Y**	Storage and Collection of Recyclables
Prerequisite 2	Y	**Y**	Hazardous Materials and Waste Management
Credit 1	1	**0**	Building Reuse
Credit 2	3	**0**	Construction Waste Management
Credit 3	3	**0**	Resource Reuse
Credit 4	3	**0**	Recycled Content
Credit 5	2	**0**	Local/Regional Materials
Credit 6	3	**0**	Rapidly Renewable Resources
Credit 7	2	**2**	Certified Wood
Total Possible Points	17	**2**	**Points Earned**

Indoor Environmental Quality Summary	Points Possible	Points Earned	Click on Credit Title to Jump to Credit
Prerequisite 1	Y or N/A	**0**	Minimum IAQ Performance
Prerequisite 2	Y	**Y**	Acoustics and Noise Control
Credit 1	1	**0**	Carbon Dioxide (CO2) Monitoring
Credit 2	4	**0**	HVAC
Credit 3	1	**0**	Construction IAQ Management Plan
Credit 4	5	**0**	Low-Emitting Materials
Credit 5	1	**0**	Indoor Chemical and Pollutant Source Control
Credit 6	1	**0**	Controllability of Systems
Credit 7	2	**0**	Daylight and Views
Total Possible Points	15	**0**	**Points Earned**

Innovation & Design Process Summary	Points Possible	Points Earned	Click on Credit Title to Jump to Credit
Credit 1	3	**0**	Design Process
Credit 2	1	**0**	LEED Accredited Professional
Credit 3	1	**0**	Deconstruction
Credit 4	1	**0**	Advance Resource Efficiency
Total Possible Points	6	**0**	**Points Earned**

Sustaining Sites	Points	Earned	More Information
Prerequisite 1			
Erosion And Sediment Control			Design a site sediment and erosion control plan that conforms to best management practices in the EPA's Storm Water Management for Construction Activities, EPA Document No. EPA-832-R-92-005, Chapter 3, OR local Erosion and Sedimentation Control standards and codes, whichever is more stringent.
		N/A	No points are earned.
Included ?	Y or N/A		**Enter Y if included in project or N/A.**

Sustaining Sites	Points	Earned	More Information
Prerequisite 2			
Environmental Protection			Meet requirements of the National Environmental Policy Act (NEPA), Underground Storage Tank (UST) regulations, and all related state and local laws.
		N/A	No points are earned.
Included ?	Y	**Y**	**Required item.**

Sustaining Sites	Points	Earned	More Information
Prerequisite 3			
Cultural Resources Protection			Meet requirements of the National Historic Preservation Act.
	N/A	N/A	No points are earned.
Included ?	Y	**Y**	**Required item.**

Sustaining Sites	Points	Earned	More Information
Prerequisite 4			
Clean Water Protection			Meet requirements of the Clean Water Act (CWA), the Safe Drinking Water Act (SDWA), and all related state and local laws.
		N/A	No points are earned.
Included ?	Y	**Y**	**Required item.**

Sustaining Sites	Points	Earned	More Information
Credit 1	1		For new construction, no development on farmland, flood plains, threatened species habitat, wetlands, or public parkland OR project does not increase the footprint of an existing facility.
Site Selection			
Maximum Points	1	**0**	**Points Earned**

Sustaining Sites	Points	Earned	More Information
Credit 2	2		Credit 2.1 Facility is within 1/4 mile of bus or shuttle service (additional point if bus/shuttle stop provides shelter from weather) , OR, if a new facility, the new facility is located with 1/4 mile of an existing facility used by the same unit.
Alternative Transportation	2		Credit 2.2 Facility currently has, or as part of project, will install a bicycle rack for 10 bicycles. Additional point if changing/shower facilities are within 1/4 mile.
	2		Credit 2.3 Facility provides preferred parking for alternative fueled vehicles. Additional point for providing electrical vehicle charging stations.
	2		Credit 2.4 Facility provides preferred parking for car/van pools (additional point if car/van pool waiting area provides shelter from the weather) or motorcycle parking, or designated parking will be added as part of project.
Maximum Points	8	**0**	**Points Earned**

Sustaining Sites	Points	Earned	More Information
Credit 3	1		Credit 3.1 Site disturbance does not extended beyond 40 feet of existing facility or footprint of construction and disturbed area is restored to natural state.
Reduced Site Disturbance	1		Credit 3.2 Project includes returning any amount of built-up area to a natural state.
Maximum Points	2	**0**	**Points Earned**

Sustaining Sites	Points	Earned	More Information
Credit 4	1		Credit 4.1 Incorporate the use of permeable pavements, bioretention systems, grass swales, or other technology that reduces stormwater runoff.
Stormwater Management			
Maximum Points	1	**0**	**Points Earned**
			List item for Credit 4.1

Sustaining Sites	Points	Earned	More Information
Credit 5	1		Credit 5.1 Plant trees that will shade paved areas or use light-colored/high-albedo materials (reflectance of at least 0.3) in the site's non-roof impervious surfaces or use open-grid pavement systems.
Landscape and Exterior Design to Reduce Heat Islands	1		Credit 5.2 Use an EPA Energy Star labeled roofing material that has emissivity of at least 0.9 or install a "green" (vegetated) roof.
Maximum Points	2	**0**	**Points Earned**

Sustaining Sites	Points	Earned	More Information
Credit 6	1		All exterior luminaries with more than 1000 initial lamp lumens are shielded and all luminaries with more than 3500 initial lamp lumens meet the Full Cutoff IESNA Classification.
Light Pollution Reduction			
Maximum Points	1	**0**	**Points Earned**

Water Efficiency	Points	Earned	More Information
Credit 1	1		Credit 1.1 Reduce the use of potable water used for irrigation.
Water Efficient Landscaping	1		Credit 1.2 Eliminate the use of potable water for irrigation.
Maximum Points	2	**0**	**Points Earned**
			List items or technologies used to meet Credit 1.1 and 1.2.

Water Efficiency	Points	Earned	More Information
Credit 2	1		Credit 2.1 - All toilets and urinals that are installed as part of project are less than 1.6 gallons per flush (gpf) for toilets and less than 1.0 gpf for urinals. All faucets and showerheads that are installed as part of project use less than 2.5 gallons per minute (gpm).
Water Use Reduction	1		Credit 2.2 All faucets that are installed as part of project use motion-sensor or metered faucets that use no more than 0.25 gallons per cycle (gpc).
	1		Credit 2.3 Waterless or composting toilets are installed as part of project.
	2		Credit 2.4 Any other equipment or technologies installed that reduces water consumption. 1 point for each item for a maximum of 2 points.
Maximum Points	5	**0**	**Points Earned**
			List items for Credit 2.4

Energy and Atmosphere	Points	Earned	More Information
Prerequisite 1			
Fundamental Building Systems Commissioning			Ensure all installed building elements and systems are designed, installed, and calibrated to operate as intended before accepting project AND all applicable O&M manuals are provided by contractor AND ensure that a warranty plan is in place.
	N/A	N/A	No points are earned.
Included ?	Y	**Y**	**Required item.**

Energy and Atmosphere	Points	Earned	More Information
Prerequisite 2			
Minimum Energy Performance			Design to meet building energy efficiency and performance as required by ASHRAE/IESNA 90.1-1999 or the local energy code, whichever is the more stringent.
	N/A	N/A	No points are earned.
Included ?	Y	**Y**	**Required item.**

Energy and Atmosphere	Points	Earned	More Information
Prerequisite 3			
CFC Reduction in HVAC&R Equipments			Zero use of CFC-based refrigerants in new HVAC&R equipment. If modifying or upgrading existing CFC-based HVAC&R follow local base guidance on phasing out CFC-based refrigerants.
	N/A	N/A	No points are earned.
Included ?	Y or N/A		**Enter Y if included in project or N/A.**

Energy and Atmosphere	Points	Earned	More Information
Prerequisite 4			
Atmospheric Air Quality Protections			Comply with the regulatory guidance governing atmospheric air quality, including the federal Clean Air Act, and related state and local laws.
	N/A	N/A	No points are earned.
Included ?	Y	**Y**	**Required item.**

Energy and Atmosphere	Points	Earned	More Information
Credit 1	1		Credit 1.1 All lighting installed or replaced is ENERGY STAR labeled or are Federal Energy Management Program (FEMP) recommended products.
Optimize Energy Performance	1		Credit 1.2 Use automatic on/off lights for exterior lighting.
	1		Credit 1.3 Use automatic on/off lights or automatic daylight dimming controls for interior lighting.
	1		Credit 1.4 Use electronic ballast for fluorescent lamps.
	1		Credit 1.5 Use compact fluorescent lamps (cfl) instead of incandescent lamps.
	1		Credit 1.6 Use Energy Star labeled commercial, industrial, or utility distribution transformers.
	15		Credit 1.7 Use of any other energy savings devices. 1 credit for each type of item for a maximum of 15 points. Note maximum points for all of Credit 1 is 15 points. See additional information under the more information link above.
Maximum Points	15	**0**	**Points Earned**
			List items for Credit 1.7

Energy and Atmosphere	Points	Earned	More Information
Credit 2	1		Any amount of energy is supplied by renewable energy sources.
Renewable Energy			
Maximum Points	1	**0**	**Points Earned**
			List items for Credit 2.

Energy and Atmosphere	Points	Earned	More Information
Credit 3	1		None of the installed HVAC and refrigeration and fire suppression equipment contains HCFC's or Halon OR if equipment containing HCFC's or Halon are removed.
Elimination of HCFC's and Halon			
Maximum Points	1	**0**	**Points Earned**

Energy and Atmosphere	Points	Earned	More Information
Credit 4	1		HVAC, lighting, or other building systems are connected to an Energy Management and Control System (ECMS).
Measurement and Verification			
Maximum Points	1	**0**	**Points Earned**

Materials and Resources	Points	Earned	More Information
Prerequisite 1			
Storage and Collection of Recyclables			Follow existing base procedures for recycling.
	N/A	N/A	No points are earned.
Included?	Y	**Y**	**Required item.**

Materials and Resources	Points	Earned	More Information
Prerequisite 2			
Hazardous Materials and Waste Management			Comply with the requirements of the federal Toxic Substances Control Act (TSCA), Resource Conservation and Recovery Act (RCRA), and the Occupational Safety and Health Act (OSHA) guidelines.
	N/A	N/A	No points are earned.
Included?	Y	**Y**	**Required item.**

Materials and Resources	Points	Earned	More Information
Credit 1	1		100% of the project is within an existing building structure.
Building Reuse			
Maximum Points	1	**0**	**Points Earned**

Materials and Resources	Points	Earned	More Information
Credit 2	1-3		1 point for each item of construction waste product that can be recycled or diverted from the landfill for a maximum of 3 points.
Construction Waste Management			
Maximum Points	3	**0**	**Points Earned**
			List items for Credit 2.

Materials and Resources	Points	Earned	More Information
Credit 3	1-3		1 point for each type of item that is removed as part of project and later re-installed or 1 point for each type of salvaged construction material used for a maximum of 3 points.
Resource Reuse			
Maximum Points	3	**0**	**Points Earned**
			List items for Credit 3.

Materials and Resources	Points	Earned	More Information
Credit 4	1-3		1 point for using products that are listed on the EPA CPG Program OR 1 point for each product not listed in the EPA CPG program that contains in aggregate a minimum weighted average of 20% post-consumer recycled content material, OR, a minimum weighted average of 40% post-industrial recycled content material, for a maximum of 3 products.
Recycled Content			
Maximum Points	3	**0**	**Points Earned**
			List items for Credit 4.

Materials and Resources	Points	Earned	More Information
Credit 5	1-2		1 point for each product used that is manufactured regionally within a radius of 500 miles for a maximum of 2 points. Credit is not earned for concrete or asphalt.
Local/Regional Materials			
Maximum Points	2	**0**	**Points Earned**
			List items for Credit 5.

Materials and Resources	Points	Earned	More Information
Credit 6	1-3		1 point for each use of rapidly renewable building materials or products for a maximum of 3 points.
Rapidly Renewable Resources			
Maximum Points	3	**0**	**Points Earned**
			List items for Credit 6.

Materials and Resources	Points	Earned	More Information
Credit 7	2	2	1 point for each type of wood product certified by the Forest Stewardship Council for a maximum of 2 points.
Certified Wood			
Maximum Points	2	**2**	**Points Earned**
			List items for Credit 7. Interior office doors, 5 ea. Breakroom cabinets

Indoor Environmental Quality	Points	Earned	More Information
Prerequisite 1			
Minimum IAQ Performance			Meet the minimum requirements of voluntary consensus standard ASHRAE 62-1999, Ventilation for Acceptable Indoor Air Quality and approved Addenda.
	N/A	N/A	No points are earned.
Included?	Y or N/A		**Enter Y if included in project or N/A.**

Indoor Environmental Quality	Points	Earned	More Information
Prerequisite 2			
Acoustics and Noise Control			Comply with applicable regulatory guidance governing noise, including the federal Occupational, Safety and Health Act (OSHA), which sets limits on noise levels in certain types of workplaces, and local laws that regulate noise levels of various land uses.
	N/A	N/A	No points are earned.
Included?	Y	**Y**	**Required Item**

Indoor Environmental Quality	Points	Earned	More Information
Credit 1	1		Install a permanent carbon dioxide (CO2) monitoring system that provides feedback on space ventilation performance in a form that affords operational adjustments.
Carbon Dioxide (CO2) Monitoring			
Maximum Points	1	**0**	**Points Earned**

Indoor Environmental Quality	Points	Earned	More Information
Credit 2	4		There are a many indoor environmental quality issues that relate directly to HVAC systems use and control. If project involves HVAC systems, 1 point (max 4 points) can be earned for each of the following Indoor Environmental Quality credits listed in the Air Force Sustainable Facilities Guide: Credit 2, Credit 3.1, Credit 7.1, Credit 7.2.
HVAC			
Maximum Points	4	**0**	**Points Earned**
			List items for Credit 2.

Indoor Environmental Quality	Points	Earned	More Information
Credit 3 **Construction IAQ Management Plan**	1		Develop and implement an Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases of the project. Plan should address safety and bio-environmental issues for both construction workers and non-construction personnel in the vicinity of the project.
Maximum Points	1	**0**	**Points Earned**

Indoor Environmental Quality	Points	Earned	More Information
Credit 4 **Low-Emitting Materials**	1		Credit 4.1 Adhesives must meet or exceed the VOC limits of South Coast Air Quality Management District Rule #1168, AND all sealants used as a filler must meet or exceed Bay Area Air Resources Board Reg. 8, Rule 51.
	1		Credit 4.2 Paints and coatings must meet or exceed the VOC and chemical component limits of Green Seal GS-11 requirements or use Master Painter Institute (MPI) E2 or E3 rated products.
	1		Credit 4.3 Carpet Systems must meet or exceed the Carpet and Rug Institute Green Label Indoor Air Quality Test Program.
	1		Credit 4.4 Composite wood or agrifiber products must contain no added urea-formaldehyde resins.
	1		Credit 4.5 Use systems furniture and office seating that is Greenguard certified or registered.
Maximum Points	5	**0**	**Points Earned**

Indoor Environmental Quality	Points	Earned	More Information
Credit 5	1		Increase the number of operable windows or number of lighting control zones or number of HVAC system control zones.
Pollutant Source Control			
Maximum Points	1	**0**	**Points Earned**

Indoor Environmental Quality	Points	Earned	More Information
Credit 6	1		Provide/install entryway systems (grills, grates, mats, etc) to prevent dirt, dust, pollen and other particles from entering the building at all entryways.
Controllability of Systems			
Maximum Points	1	**0**	**Points Earned**

Indoor Environmental Quality	Points	Earned	More Information
Credit 7	1		Credit 7.1 Increase the amount of natural sunlight available to interior of facility without increasing glare or adding unwanted heat.
Daylight and Views	1		Credit 7.2 Increase the amount of facility interior occupied space that has direct line of sight to vision glazing.
Maximum Points	2	**0**	**Points Earned**

Innovation & Design Process	Points	Earned	More Information
Credit 1	1-3		One point for any item, process, or technology not already addressed that (1) conserves energy, water, or raw materials, or (2) prevents environmental degradation caused by construction, operations, and disposal of facilities or (3) contributes to built environments which are livable, healthy, maintainable, and productive for a maximum of three points.
Design Process			
Maximum Points	3	**0**	**Points Earned**
			List items for Credit 1.

Innovation & Design Process	Points	Earned	More Information
Credit 2	1		At least one principal participant of the project team that has successfully completed the LEED Accredited Professional exam.
LEED Accredited Professional			
Maximum Points	1	**0**	**Points Earned**
			List LEED Accredited Professional for Credit 2.

Innovation & Design Process	Points	Earned	More Information
Credit 3	1		Employ deconstruction methods to dismantle an existing building.
Deconstruction			
Maximum Points	1	**0**	**Points Earned**

Innovation & Design Process	Points	Earned	More Information
Credit 4	1		Incorporate mobile building components with an interior design master plan to maximize flexibility for future uses.
Advance Resource Efficiency			
Maximum Points	1	**0**	**Points Earned**

Sustaining Sites	Prerequisite 1 - Erosion And Sediment Control
Intent	Control erosion to reduce negative impacts on water and air quality.
Reference	Air Force Sustainable Facilities Guide - Sustaining Sites Prerequisite 1
Reference Requirement	Design a site sediment and erosion control plan that conforms to best management practices in the EPA's Storm Water Management for Construction Activities, EPA Document No. EPA-832-R-92-005, Chapter 3, OR local Erosion and Sedimentation Control standards and codes, whichever is more stringent. The plan shall meet the following objectives: - Prevent loss of soil during construction by storm water runoff and/or wind erosion, including protecting topsoil by stockpiling for reuse. - Prevent sedimentation of storm sewer or receiving streams and/or air pollution with dust and particulate matter.
Air Force Policy and Justification	Highly Recommended: Provides a standard for best practice site design where local codes and standards for Erosion and Sediment Control are insufficient. This standard prevents topsoil from being washed off site, and protects slopes from erosion and destabilization, thereby protecting watersheds from excess sediments and nutrients.
Additional Information	Measures that help prevent erosion include silt fencing, sediment traps and basins, maintaining vegetated ground cover, stabilization of steep slopes, and ground covers.

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Sustaining Sites	Prerequisite 2 - Environmental Protection
Intent	Maintain environmental integrity of natural areas.
Reference	Air Force Sustainable Facilities Guide - Sustaining Sites Prerequisite 2
Reference Requirement	Meet requirements of the National Environmental Policy Act (NEPA), Underground Storage Tank (UST) regulations, and all related state and local laws.
Air Force Policy and Justification	Required: This is a regulatory requirement. Compliance is mandatory.
Additional Information	This item is mandatory. Check with base environmental office for requirements.

Return to Checklist

Sustaining Sites	Prerequisite 3 - Cultural Resources Protection
Intent	Maintain historical and cultural integrity of the structures and surrounding areas.
Reference	Air Force Sustainable Facilities Guide - Sustaining Sites Prerequisite 3
Reference Requirement	Meet requirements of the National Historic Preservation Act.
Air Force Policy and Justification	Required: This is a regulatory requirement. Compliance is mandatory.
Additional Information	This item is mandatory. Check with base environmental office for requirements.

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Sustaining Sites	Prerequisite 4 - Clean Water Protection
Intent	Maintain environmental integrity of all water resources that are impacted by the construction and operations of the building and worksite.
Reference	Air Force Sustainable Facilities Guide - Sustaining Sites Prerequisite 4
Reference Requirement	Meet requirements of the Clean Water Act (CWA), the Safe Drinking Water Act (SDWA), and all related state and local laws.
Air Force Policy and Justification	Required: This is a regulatory requirement. Compliance is mandatory.
Additional Information	This item is mandatory. Check with base environmental office for requirements.

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Sustaining Sites	**Credit 1 - Site Selection**
Intent	Avoid development of inappropriate sites and reduce the environmental impact from the location of a building on a site.
Reference	Air Force Sustainable Facilities Guide - Sustaining Sites Credit 1
Reference Requirement	Do not develop buildings on portions of sites that meet any one of the following criteria: 1. Prime farmland as defined by the American Farmland Trust. 2. Land whose elevation is lower than 5 feet above the elevation of the 100-year flood as defined by FEMA. 3. Land which provides habitat for any species on the Federal or State threatened or endangered list. 4. Within 100 feet of any wetland as defined by 40 CFR, Parts 230-233 and Part 22, OR as defined by local or state rule or law, whichever is more stringent. 5. Land which prior to acquisition for the project was public parkland, unless land of equal or greater value as parkland is accepted in trade by the public landowner (Park Authority projects are exempt).
Air Force Policy and Justification	Highly Recommended: Protects valuable public assets such as agricultural land, habitat for threatened or endangered species, wetlands, and parkland. Protect against future damage from flooding. See also: AFI 32-1021, Chapter 2.
Additional Information	If project decreases the existing footprint of the facility and the area restored to natural state, credit can be earned under Sustaining Sites Credit 3.2.

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Sustaining Sites	Credit 2 - Alternative Transportation
Intent	Reduce pollution and land development impacts from automobile use.
Reference	Air Force Sustainable Facilities Guide - Sustaining Sites Credit 4
Reference Requirement	Credit 4.1 Locate building within ½ mile of a commuter rail, light rail or subway station or ¼ mile of 2 or more bus lines. Credit 4.2 Provide suitable means for securing bicycles, with convenient changing/shower facilities for use by cyclists, for 5% or more of building occupants. Credit 4.4 Size parking capacity not to exceed minimum local zoning requirements AND provide preferred parking for carpools or van pools capable of serving 5% of the building occupants, OR, add no new parking for rehabilitation projects AND provide preferred parking for carpools or van pools capable of serving 5% of the building occupants. AF Amendment: Refer to AFH 32-1084, Facility Standards, instead of local zoning for parking capacity requirements.
Air Force Policy and Justification	Credit 4.1 – Recommended: Location of facility with proximity to rail, subway and buses reduces reliance on the automobile, and provides transportation alternatives,. However, this credit will not be available in all locations. Note: Potential conflict with Ant-Terrorism Guidelines. Credit 4.2 – Highly Recommended: Accommodation for bicycle commuters promotes transportation alternatives and can reduce reliance on the automobile. Bicycle facilities are appropriate for all building types and locations. Credit 4.4 – Recommended: Reduction of overall parking capacity can contribute lessen reliance on the automobile, while also decreasing impervious and stormwater runoff. Reduction in parking capacity needs to be balanced against a comprehensive assessment of transportation options. See also: AFH 32-1084
Additional Information	These credits have been simplified from the reference requirement. Review applicable force protection and anti-terrorism guidelines before selecting the location. Credit 2.1 and 2.4 - Providing shelter encourages use of alternative transportation during inclement weather. Credit 2.2 - Changing/shower facilities encourages bicycle use. Credit 2.3 - Alternative fueled vehicles are vehicles that use low-polluting, non-petroleum based fuels such as electricity, propane or compressed natural gas, liquid natural gas, methanol, and ethanol. Gas/electric hybrid vehicles are also included. Electric vehicle charging stations encourage use of electric vehicles.

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Sustaining Sites	**Credit 3 - Reduced Site Disturbance**
Intent	Conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.
Reference	Air Force Sustainable Facilities Guide - Sustaining Sites Credit 5
Reference Requirement	Credit 5.1 On greenfield sites, limit site disturbance including earthwork and clearing of vegetation to 40 feet beyond the building perimeter, 5 feet beyond primary roadway curbs, walkways, and main utility branch trenches, and 25 feet beyond pervious paving areas that require additional staging areas in order to limit compaction in the paved area; OR, on previously developed sites, restore a minimum of 50% of the remaining open area by planting native or adapted vegetation. Credit 5.2 Reduce the development footprint (including building, access roads and parking) to exceed the local zoning's open space requirement for the site by 25%. AF Amendment: Reduce the development footprint to exceed the base requirements by 25%. For bases without open space requirements, base civil engineer shall set a target open space ration to serve as the baseline.
Air Force Policy and Justification	Credit 5.1 – Conditionally Recommended: Reduction/elimination of impervious areas lessens site disturbance and facilities site restoration of existing sites. Benefits include reduced ambient air temperature on the site, protection and conservation of open spaces, and restoration of habitat and biodiversity. Sustainable design benefits need to balanced against cost and program requirements for parking and/or plazas. Credit 5.2 – Conditionally Recommended: Increased proportions of open space on the site reduce imperviousness, thereby improving water quality, groundwater recharge, and potential habitat for wildlife. To realize full benefit of increased open space use of low maintenance native vegetation is preferred. Potential benefits can be offset by high cost and environmental impacts if open space is developed as "lawn area" that requires irrigation, fertilizers, and pesticides. NOTE: Potential synergy with Anti-Terrorism Guidelines.
Additional Information	These credits have been simplified from the reference. Credit 3.1 Site disturbance does not extended beyond 40 feet of existing facility or footprint of construction and disturbed area is restored to natural state. Credit 3.2 Project includes returning any amount of built-up area to a natural state.

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Sustaining Sites	Credit 4 - Stormwater Management
Intent	Conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.
Reference	Air Force Sustainable Facilities Guide - Sustaining Sites Credit 6
Reference Requirement	Credit 6.1 Implement a stormwater management plan that results in no net increase in the rate and quantity of stormwater runoff from existing to developed conditions; OR, if existing imperviousness is greater than 50%, implement a stormwater management plan that results in a 25% decrease in the rate and quantity of stormwater runoff.
Air Force Policy and Justification	Credit 6.1 - Recommended: On-site stormwater management reduces negative impacts on watersheds and aquatic life, and contributes to groundwater recharge. If integrated into the design at the beginning of site design, and sufficient land area is available, natural stormwater management systems can be developed cost-effectively.
Additional Information	These credits have been simplified from the reference. It is not practical to develop a comprehensive stormwater management plan for small projects. Common uses of permeable pavements include parking areas and sidewalks. For additional information and strategies see the EPA Low Impact Development (LID) website at http://www.epa.gov/owow/nps/lid/.

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Sustaining Sites	Credit 5 - Landscape and Exterior Design to Reduce Heat Islands
Intent	Reduce heat islands (thermal gradient differences between developed and undeveloped areas) to minimize impact on microclimate and human and wildlife habitat.
Reference	Air Force Sustainable Facilities Guide - Sustaining Sites Credit 7
Reference Requirement	Credit 7.1 Provide shade (within 5 years) on at least 30% of non-roof impervious surface on the site, including parking lots, walkways, plazas, etc., OR, use light-colored/high-albedo materials (reflectance of at least 0.3) for 30% of the site's non-roof impervious surfaces, OR place a minimum of 50% of parking space underground OR use open-grid pavement system (net impervious area of LESS than 50%) for a minimum of 50% of the parking lot area. Credit 7.2 Use ENERGY STAR Roof-compliant, high-reflectance AND high emissivity roofing (initial reflectance of at least 0.65 and three-year-aged reflectance of at least 0.5 when tested in accordance with ASTM E903 and emissivity of at least 0.9 when tested in accordance with ASTM 408) for a minimum of 75% of the roof surface; OR, install a "green" (vegetated) roof for at least 50% of the roof area.
Air Force Policy and Justification	Credit 7.1 – Highly Recommended: Shade trees and shade structures, light-colored paving materials, and strategies to reduce use of paving materials on site all contribute to lower ambient temperatures, and reduced urban heat islands effect. If integrated at the beginning of site design, strategies to reduce the urban heat island effect can be developed cost-effectively. Credit 7.2 – Highly Recommended: Use of "cool roof" technology improves energy efficiency and comfort, and is cost-effective. White colored roofs do not conform to Force Protection Guidelines, however a vegetated roof may be an optimal solution for Force Protection where groundcover and roof vegetation are similar in appearance. NOTE: potential conflict/synergy with Anti-terrorism Guidelines.
Additional Information	These credits have been simplified from the reference. Credit 5.1 A guideline for planting trees is one tree for every 1,000 square foot of paved areas. Credit 5.2 Information on EPA Energy Star labeled roofing material: http://www.energystar.gov. NOTE: The EPA Energy Star program does not address emissivity. Not all of the EPA Energy Star approved roofing materials are high emissivity.

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Sustaining Sites	**Credit 6 - Light Pollution Reduction**
Intent	Eliminate light trespass from the building site, improve night sky access, and reduce development impact on nocturnal environments.
Reference	Air Force Sustainable Facilities Guide - Sustaining Sites Credit 8
Reference Requirement	Do not exceed Illuminating Engineering Society of North America (IESNA) footcandle level requirements as stated in the Recommended Practice Manual: Lighting for Exterior Environments, AND design interior and exterior lighting such that zero direct-beam illumination leaves the building site.
Air Force Policy and Justification	Credit 8 – Highly Recommended: The LEED referenced standard for exterior lighting reduces negative effects of light pollution, while also contributing to energy efficiency. This strategy does not add cost, and may result in reduced first cost. NOTE: potential conflict with Anti-terrorism Guidelines. SEE ALSO: AFMAN 32-1082.
Additional Information	These credits have been simplified from the reference. For additional information see Illuminating Engineering Society of North America (IESNA) website http://www.iesna.org/ and the International Dark Sky-Association website at http://www.darksky.org/.

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Water Efficiency	**Credit 1 - Water Efficient Landscaping**
Intent	Limit or eliminate the use of potable water for landscape irrigation.
Reference	Air Force Sustainable Facilities Guide - Water Efficiency Credit 1
Reference Requirement	Credit 1.1 Use high efficiency irrigation technology, OR, use captured rain or recycled site water to reduce potable water consumption for irrigation by 50% over conventional means. Credit 1.2 Use only captured rain or recycled site water for an additional 50% reduction (100% total reduction) of potable water for site irrigation needs, OR, do not install permanent landscape irrigation systems.
Air Force Policy and Justification	Credit 1.1 – Highly Recommended: Provides multiple benefits of potable water use reduction, integrated stormwater management and ecological site planning. Water conserving landscape design is highly cost -effective. Benefits of rainwater collection and re-use systems vary regionally, however can be cost-effective as well. Credit 1.2 – Highly Recommended: Facilities that use large quantities of water can realize sizable economic and environmental benefit from greywater reuse systems. In areas with no municipal sewage system, constructed wetland wastewater treatment systems can generate both economic and environmental benefits. Water treatment and reuse systems reduce sewer/septic infrastructure and reuse treated effluent for non-potable uses (e.g. exterior landscape irrigation, toilet flushing, cooling tower makeup) to further reduce potable water use.
Additional Information	These credits have been simplified from the reference. Credit 1.1 Credit is given for any method that reduces the need for potable water for irrigation regardless of amount of reduction. Examples would include using high-efficiency irrigation method, planting indigenous plants or replacing non-indigenous plants with indigenous plants, using graywater, or collecting rainwater for irrigation. For more information see http://www.irrigation.org. Credit 1.2 Credit is giving by completing eliminating the use of potable water for irrigation. This credit can be accomplished by using collected rainwater, graywater, or a management decision not to water the landscape. For more information see the Air Force Water Conservation Guidebook.

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Water Efficiency	**Credit 2 - Water Use Reduction**
Intent	Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.
Reference	Air Force Sustainable Facilities Guide - Water Efficiency Credit 3
Reference Requirement	Credit 3.1 Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 fixture performance requirements. Credit 3.2 Exceed the potable water use reduction by an additional 10% (30% total efficiency increase).
Air Force Policy and Justification	Credit 3.1 – Recommended: Water efficient plumbing fixtures, appliances, and HVAC equipment reduce potable water use, water/wastewater fees, energy consumption for water treatment and pumping, as well as chemicals that would have been used as the conventional treatment alternative. This 20% improvement target can generally be met with conventional technology. SEE ALSO: A-Gram 01-03 Credit 3.2 – Conditionally Recommended: Water efficient plumbing fixtures, appliances, and HVAC equipment reduce potable water use, water/wastewater fees, energy consumption for water treatment and pumping, as well as chemicals that would have been used as the conventional treatment alternative. Use of rainwater collection and/or water re-use systems also contributes to water use reduction (see Water Credit 2) This 30% reduction target generally requires use of some unconventional technology (e.g. waterless urinals, composting toilets, greywater recycling), however project specific analysis must be
Additional Information	These credits have been simplified from the reference. See Air Force Water Conservation Guidebook for suggestions. Credit 2.1 1.6 gpf for toilets, 1 gpf for urinals, and 2.5 gpm for shower heads and faucets are the standards in the Energy Policy Act of 1992. To earn credit, toilets, urinals, shower heads, and faucets must use less energy than the standard.

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Energy and Atmosphere	Prerequisite 1 - Fundamental Building Systems Commissioning
Intent	Verify and ensure that fundamental building elements and systems are designed, installed and calibrated to operate as intended.
Reference	Air Force Sustainable Facilities Guide - Energy and Atmosphere Prerequisite 1
Reference Requirement	Implement the following fundamental best practice commissioning procedures: -Engage a commissioning authority -Review design intent and basis of design documentation -Include commissioning requirements in the construction documents -Develop and utilize a commissioning plan -Verify installation, functional performance, training and documentation -Complete a commissioning report
Air Force Policy and Justification	Highly Recommended Commissioning is highly recommended for all projects. Investment in commissioning can be justified by lower maintenance costs over the first few years, as problems are discovered and addressed pro-actively prior to occupancy, and lower energy costs (studies show that energy costs are reduced by an average of 20% because equipment operates as designed.) Refer to the WBDG for a detailed discussion of commissioning. SEE ALSO: ETL 90-10
Additional Information	The requirements for this prerequisite have been simplified from the reference. The items listed under the requirements are minimum commissioning products that every should be included in every project. For further information on building commissioning see http://www.wbdg.org and ETL 90-10 Commissioning of Heating Ventilating, and Air-Conditioning (HVAC) Systems Guide Specification.

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Energy and Atmosphere	Prerequisite 2 – Minimum Energy Performance
Intent	Establish the minimum level of energy efficiency for the base building and systems.
Reference	Air Force Sustainable Facilities Guide - Energy and Atmosphere Prerequisite 2
Reference Requirement	Design to meet building energy efficiency and performance as required by ASHRAE/IESNA 90.1-1999 or the local energy code, whichever is the more stringent. (note: The requirements of 10 CFR 434 are equivalent to ASHRAE/IESNA 90.1-1999)
Air Force Policy and Justification	Required: The 1999 version of ASHRAE/IESNA 90.1 supercedes the earlier version, ASHRAE/IESNA 90.1-1989. While it has not yet been adopted by many jurisdictions, it represents current best-practice standards that should form the minimum level of energy efficiency. Use of this improved minimum standard will reduce use of fossil fuels, and produce life cycle cost savings.
Additional Information	If applicable to project, follow guidance in ETL 94-4 Energy Usage Criteria for Facilities in the Military Construction Program. ETL 94-4 is applicable to: new facilities, all additions, major renovations/repairs. Major renovations/repairs is further defined as “Changes in the building envelope, and/or replacement of any one or more of the following systems: lighting, HVAC, and water heating”. (ETL 94-4)

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Energy and Atmosphere	Prerequisite 3 – CFC Reduction in HVAC&R Equipments
Intent	Reduce ozone depletion.
Reference	Air Force Sustainable Facilities Guide - Energy and Atmosphere Prerequisite 3
Reference Requirement	Zero use of CFC-based refrigerants in new base building HVAC&R systems. When reusing existing base building HVAC equipment, complete a comprehensive CFC phase-out conversion.
Air Force Policy and Justification	Highly Recommended: Manufacture of CFC's and Halons has been completely phased-out as required by section 604 of the Clean Air Act. In new buildings it is standard practice to use non-CFC equipment. In existing buildings CFC-based equipment may continue to be used however refrigerants must be purchased from reclaimed sources, and sources are limited. Existing equipment that uses CFC-based refrigerants should be replaced at the time of building renovation to avoid need for future replacement, to reduce environmental impacts, and for added benefit of greater energy efficiency.
Additional Information	If applicable to project, follow local base guidelines for CFC-based refrigerant use.

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Energy and Atmosphere

Prerequisite 4 – Atmospheric Air Quality Protections

Intent	Minimize adverse impacts to atmospheric air quality.
Reference	Air Force Sustainable Facilities Guide - Energy and Atmosphere Prerequisite 4
Reference Requirement	Comply with the regulatory guidance governing atmospheric air quality, including the federal Clean Air Act, and related state and local laws.
Air Force Policy and Justification	Required: This is a regulatory requirement. Compliance is mandatory.
Additional Information	This item is mandatory. Contact base environmental office for more information.

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Energy and Atmosphere	**Credit 1 – Optimize Energy Performance**
Intent	Achieve increasing levels of energy performance above the prerequisite standard to reduce environmental impacts associated with excessive energy use.
Reference	Air Force Sustainable Facilities Guide - Energy and Atmosphere Credit 1
Reference Requirement	Reduce design energy cost compared to the energy cost budget for regulated energy components described in the requirements of ASHRAE/IESNA Standard 90.1-1999, as demonstrated by a whole building simulation using the energy Cost Budget Method described in Section 11. Regulated energy components include HVAC systems, building envelope, service hot water systems, lighting and other regulated systems defined by ASHRAE. (note: The requirements of 10 CFR 434 are equivalent to ASHRAE/IESNA 90.1-1999). Credit is earned for increasing levels of energy performance on a sliding scale from 10%-50%.
Air Force Policy and Justification	Highly Recommend: Energy conservation reduces reliance on fossil fuels, reduces associated pollution, and reduces utility costs. Federal projects are required by the Energy Policy Act of 1992, to incorporate energy saving design strategies that can be cost justified with a payback period of 10 years or less.
Additional Information	This credit has been simplified. For general lighting stratgies see The Lighting Reserach Center website at http://www.lrc.rpi.edu/. Credit 1.1 For a list of Energy Star labeled products see http://www.energystar.gov. For a list of FEMP recommended products, see http://www.eere.energy.gov/femp/. Credit 1.2 Use motions sensors, time clocks, photocells, or other devices that will automatically turn on/off exterior lighting. Credit 1.3 Use occupancy sensors or automatic daylighting dimming controls for interior lighting. Credit 1.6. For a list of Energy Star products see http://www.energystar.gov. Credit 1.7 Depending on the scope of work, there are numerous opportunities to reduce energy use; far more than is listed here. Some areas to consider are insulation, high efficiency windows and window glazing systems, electrical motors, refrigeration equipment, boilers, and chillers. For additional guidance and strategies see Greening Federal Facilities at http://www.eere.energy.gov/femp/techassist/green_fed_facilities.html, Energy Star Program at http://www.energystar.gov, Federal Energy Management Program at http://www.eere.energy.gov/femp/, and AFCESA Facility Energy Program at http://www.afcesa.af.mil/Directorate/CES/Mechanical/Energy/default.htm.

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Energy and Atmosphere	**Credit 2 – Renewable Energy**
Intent	Encourage and recognize increasing levels of self-supply through renewable technologies to reduce environmental impacts associated with fossil fuel energy use.
Reference	Air Force Sustainable Facilities Guide - Energy and Atmosphere Credit 2
Reference Requirement	Supply a net fraction of the building's total energy use (as expressed as a fraction of annual energy cost) through the use of on-site renewable energy systems. Credit is earned for increasing levels of renewable energies on a sliding scale from 5%-20%.
Air Force Policy and Justification	Conditionally Recommend: Renewable energy sources include solar, wind, and biomass generation technologies. These technologies provide clean, renewable sources of energy, and increase energy independence in the US. When renewable energy strategies are integrated on-site, electricity transmission losses are eliminated. Some sites will be more compatible with renewable strategies than others. In some parts of the country, renewable energy systems are beginning to be a cost-effective option. These include areas where electricity rates are high (or, high demand charges exist), and access to sun, wind, or biomass is good. In some parts of the country, programs exist to reduce the first cost of renewable energy systems. SEE ALSO: 10USC 2857; AFI 32-1023, C5.4
Additional Information	This credit has been simplified. Examples of renewable energy sources include photovoltaic panels, high temperature solar and/or geothermal, wind, biomass, and biogas. For more information see the Department of Energy's National Renewable Energy Laboratory web site at http://www.nrel.gov/.

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Energy and Atmosphere

Credit 3 – Elimination of HCFC's and Halon

Intent	Reduce ozone depletion and support early compliance with the Montreal Protocol.
Reference	Air Force Sustainable Facilities Guide - Energy and Atmosphere Credit 4
Reference Requirement	Install base building level HVAC and refrigeration equipment and fire suppression systems that do not contain HCFC's or Halon.
Air Force Policy and Justification	Conditionally Recommend: A balance must be struck between the goals of reducing ozone depletion, and reducing impacts on global warming. Some solutions, such as ground source heat pumps, or passive technologies that eliminate the need to use refrigerants can contribute to both goals. HCFC-based refrigerants are the only choice of refrigerant-based equipment for smaller buildings. Some of the non-HCFC-based refrigerants are less efficient than their HCFC-based. Halons are no longer a legally permissible option for fire suppression systems. Existing systems will need to be replaced.
Additional Information	Check with local base policies on using HCFC-based refrigerants and Halon.

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Energy and Atmosphere	**Credit 4 – Measurement and Verification**
Intent	Provide for the ongoing accountability and optimization of building energy and water consumption performance over time.
Reference	Air Force Sustainable Facilities Guide - Energy and Atmosphere Credit 5
Reference Requirement	Comply with the installed equipment requirements for continuous metering as stated in Option B: Methods by Technology of the US DOE's International Performance Measurement and Verification Protocol (IPMVP) for the following: - Lighting systems and controls. - Constant and variable motor loads. - Variable frequency drive (VFD) operation. - Chiller efficiency at variable loads (kW/ton). - Cooling load. - Air and water economizer and heat recovery cycles. - Air distribution static pressures and ventilation air volumes. - Boiler efficiencies. - Building specific process energy efficiency systems and equipment. - Indoor water risers and outdoor irrigation systems.
Air Force Policy and Justification	Highly Recommend: The LEED referenced Measurement and Verification (M&V) standard was developed primarily for verifying performance contracts related to building retrofits, however the protocol also is relevant to new buildings as a method to ensure that predicted energy and water savings are actually producing savings to the owner. Adoption of this standard provides an effective quality control method for managing energy and water efficiency throughout the life of the building.
Additional Information	The requirement has been simplified from the reference. See AFM 32-1093 Energy Monitoring and Control Systems (ECMS) for additional information

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Materials and Resources	**Prerequisite 1 – Storage and Collection of Recyclables**
Intent	Facilitate the reduction of waste generated by building occupants that is hauled to and disposed of in landfills.
Reference	Air Force Sustainable Facilities Guide - Materials and Resources Prerequisite 1
Reference Requirement	Provide an easily accessible area that serves the entire building that is dedicated to the separation, collection and storage of materials for recycling including (at a minimum) paper, glass, plastics, and metals.
Air Force Policy and Justification	Highly Recommend: Reduces waste to landfills, and supports the market for recycled materials. Recycling is legally required in many jurisdictions, and revenue from recycling is increasing. Even if recycling is not available in the locality, design to accommodate recycling will enable building to respond to future opportunities.
Additional Information	This item is required in this checklist. Follow local base procedures.

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Materials and Resources	**Prerequisite 2 – Hazardous Materials and Waste Management**
Intent	Ensure proper handling of hazardous waste materials.
Reference	Air Force Sustainable Facilities Guide - Materials and Resources Prerequisite 2
Reference Requirement	Comply with the requirements of the federal Toxic Substances Control Act (TSCA), Resource Conservation and Recovery Act (RCRA), and the Occupational Safety and Health Act (OSHA) guidelines.
Air Force Policy and Justification	Required: This is a regulatory requirement. Compliance is mandatory.
Additional Information	This item is required in this checklist. Check with base environmental for further guidance.

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Materials and Resources

Credit 1 – Building Reuse

Intent	Extend the life cycle of existing building stock, conserve resources, retain cultural resources, reduce waste, and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport.
Reference	Air Force Sustainable Facilities Guide - Materials and Resources Credit 1
Reference Requirement	Comply with the requirements of the federal Toxic Substances Control Act (TSCA), Resource Conservation and Recovery Act (RCRA), and the Occupational Safety and Health Act (OSHA) guidelines.
Air Force Policy and Justification	Conditionally Recommend: Conserves resources, and reduces waste materials going to landfills. Also reduces development pressures on Greenfield sites. However, this credit can only be earned by projects utilizing sites with an existing building that can be reused.
Additional Information	This item is highly recommended in this checklist because it does not allow for additional square footage of facility space that needs to be maintained. If credit is earned here, credit can also be earned for Sustaining Sites Credit 1.

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Materials and Resources

Credit 2 – Construction Waste Management

Intent	Divert construction, demolition, and land clearing debris from landfill disposal. Redirect recyclable material back to the manufacturing process.
Reference	Air Force Sustainable Facilities Guide - Materials and Resources Credit 2
Reference Requirement	Recycle and/or salvage at least 50% (by weight) of construction, demolition, and land clearing waste.
Air Force Policy and Justification	Highly Recommend: Recycling of demolition and construction waste diverts waste from landfill. The available infrastructure to support recycling will vary regionally, however, concrete, metal, asphalt, cardboard and plastics are cost effective to recycle in most parts of the country.
Additional Information	This credit does not require calculating % recycled as listed in the reference requirements. Examples of items that may be recycled include: wood products, concrete, metal, asphalt, cardboard and plastics. Check with base environmental office for list of materials that can be recycled or diverted.

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Materials and Resources

Credit 3 – Resource Reuse

Intent	Extend the life cycle of targeted building materials, reducing environmental impacts related to materials manufacturing and transport.
Reference	Air Force Sustainable Facilities Guide - Materials and Resources Credit 3
Reference Requirement	Specify salvaged or refurbished materials for 5% of building materials.
Air Force Policy and Justification	Conditionally Recommend: Re-use of salvaged or refurbished materials is environmentally beneficial and generally reduces construction cost, however availability is limited and sometimes difficult to coordinate with construction of larger projects. Re-use of existing furniture must be considered carefully, as use of older furniture or non-standardized furniture can negatively impacts space planning efficiencies.
Additional Information	This credit does not require calculating % of material reused as listed in the reference requirements. Examples of items that may be salvaged include: office furniture, built-in shelving, beams and posts, flooring, paneling, doors and frames, cabinetry and furniture, and brick and decorative items. For a list of currently available salvaged construction materials, see http://build.recycle.net.

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Materials and Resources

Credit 4 – Recycled Content

Intent	Increase demand for building products that have incorporated recycled content material, reducing the impacts resulting from extraction of new material.
Reference	Air Force Sustainable Facilities Guide - Materials and Resources Credit 4
Reference Requirement	Specify a minimum of 25% of building materials that contain in aggregate a minimum weighted average of 20% post-consumer recycled content material, OR, a minimum weighted average of 40% post-industrial recycled content material.
Air Force Policy and Justification	Strongly Recommend: Use of recycled content materials helps support the market for recycled content materials. Many high quality recycled content products are readily available for use. Some of these are new products, however many are standard products in the industry. Federal projects are required to meet the EPA Comprehensive Procurement Guidelines (CPG). SEE ALSO: AFI 32-7080; ETL 00-1.
Additional Information	Applicable products listed under the EPA CPG program must be use. The list of products under the EPA CPG Program can be found at http://www.epa.gov/cpg/products.htm. Also see *Guide To Green Purchasing: The Air Force Affirmative Procurement Program* at http://www.afcee.brooks.af.mil/eq/ap/gg/default.asp.

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Materials and Resources

Credit 5 – Local/Regional Products

Intent	Increase demand for building products that are manufactured locally, reducing the environmental impacts resulting from transportation, and supporting the local economy.
Reference	Air Force Sustainable Facilities Guide - Materials and Resources Credit 5
Reference Requirement	Specify a minimum of 20% of building materials that are manufactured regionally within a radius of 500 miles.
Air Force Policy and Justification	Highly Recommend: Use of local and regionally sourced and manufactured materials reduces transportation requirements, and usually reduces cost as well. When integrated into decision making early in design, use of regionally sourced and manufactured materials can be accommodated in nearly all parts of the US.
Additional Information	Manufactured regionally means where the product is manufactured, not the location of the raw materials that go into the product. Due to the requirements of mixing concrete and asphalt, they will always be locally produced. For a possible list of locally manufactured products, see the Blue Book of Building and Construction web site at http://www.thebluebook.com/. This website lists companies that provide construction materials in a regional area, but does not state whether the company actually produces the products or just distributes the products.

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Materials and Resources

Credit 6 – Rapidly Renewable Resources

Intent	Reduce the use and depletion of finite raw and long cycle renewable materials by replacing them with rapidly renewable materials.
Reference	Air Force Sustainable Facilities Guide - Materials and Resources Credit 6
Reference Requirement	Specify rapidly renewable building materials for 5% of total building materials.
Air Force Policy and Justification	Conditionally Recommend: Use of rapidly renewable materials (straw, bamboo, some types of wood, etc) reduces environmental impacts, and may help meet the requirements of Executive Order 13101, guidance that encourages increased use of biobased products. However, these materials are not appropriate for all building types and availability is limited.
Additional Information	The requirement has been simplified from the reference. Rapidly renewable building materials and products are made from plants that are typically harvested within a ten-year cycle or shorter. Examples include bamboo flooring, wool carpets, straw board, cotton batt insulation, linoleum flooring, poplar OSB, sunflower seed board, and wheatgrass cabinetry. For a lists of rapidly renewable products, see the USDA Biobased Industrial Products Site at http://www.usda-biobasedproducts.net/public/.

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Materials and Resources

Credit 7 – Certified Wood

Intent	Encourage environmentally responsible forest management.
Reference	Air Force Sustainable Facilities Guide - Materials and Resources Credit 7
Reference Requirement	Use a minimum of 50% of woodbased materials certified in accordance with the Forest Stewardship Council guidelines for wood building components including but not limited to framing, flooring, finishes, furnishings, and non-rented temporary construction applications such as bracing, concrete form work and pedestrian bridges.
Air Force Policy and Justification	Conditionally Recommend: Use of certified sustainable wood is environmentally beneficial and imposes only a nominal installed cost premium compared to conventional wood installations.
Additional Information	For a list of certified wood products, see http://www.certifiedwood.org/search-modules/ProductHierarchy.ASP.

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Indoor Environmental Quality

Prerequisite 1 – Minimum IAQ Performance

Intent	Establish minimum IAQ performance to prevent the development of indoor air quality problems in buildings, maintaining the health and well being of the occupants.
Reference	Air Force Sustainable Facilities Guide - Indoor Environmental Quality Prerequisite 1
Reference Requirement	Meet the minimum requirements of voluntary consensus standard ASHRAE 62-1999, Ventilation for Acceptable Indoor Air Quality and approved Addenda.
Air Force Policy and Justification	Highly Recommend: This standard represents best practices widely accepted by industry. The new 1999 version of the standard provides greater flexibility for designers to meet the standard, than the previous 1989 version. It has been well documented that improved indoor air quality contributes to well-being and productivity in the workplace.
Additional Information	No change from reference. This prerequisite is most applicable to projects that involve new HVAC systems or major modifications to an existing HVAC systems.

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Indoor Environmental Quality

Prerequisite 2 – Acoustics and Noise Control

Intent	Protect building occupants from exposure to excessive noise.
Reference	Air Force Sustainable Facilities Guide - Indoor Environmental Quality Prerequisite 3
Reference Requirement	Comply with applicable regulatory guidance governing noise, including the federal Occupational, Safety and Health Act (OSHA), which sets limits on noise levels in certain types of workplaces, and local laws that regulate noise levels of various land uses.
Air Force Policy and Justification	Required: Poor acoustics and excessive noise are detrimental to health and productivity. AND Compliance with OSHA and related local laws is a mandatory regulatory requirement.
Additional Information	No change from reference. Contact base Bio-Environmental Engineering for additional guidance.

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Indoor Environmental Quality

Credit 1 – Carbon Dioxide (CO2) Monitoring

Intent	Provide capacity for indoor air quality (IAQ) monitoring to sustain long term occupant health and comfort.
Reference	Air Force Sustainable Facilities Guide - Indoor Environmental Quality Credit 1
Reference Requirement	Install a permanent carbon dioxide (CO2) monitoring system that provides feedback on space ventilation performance in a form that affords operational adjustments, AND specify initial operational set point parameters that maintain indoor carbon dioxide levels no higher than outdoor levels by more than 530 parts per million at any time.
Air Force Policy and Justification	Conditionally Recommended: CO2 monitoring verifies that air quality is maintained, and can contribute to energy efficiency, especially when occupancy is highly variable. This may not be a cost-effective strategy in facilities that have very low occupancy.
Additional Information	The referenced requirement has been modified. Refer to the CO2 differential for all types of occupancy in accordance with ASHRAE 62-2001, Appendix D.

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Indoor Environmental Quality

Credit 2 – HVAC

Intent	See Air Force Sustainable Facilities Guide.
Reference	Air Force Sustainable Facilities Guide - Indoor Environmental Quality Credit 2, Credit 3.1, Credit 7.1, Credit 7.2
Reference Requirement	See Air Force Sustainable Facilities Guide.
Air Force Policy and Justification	See Air Force Sustainable Facilities Guide.
Additional Information	These credits may require professional engineering analysis and design.

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Indoor Environmental Quality	**Credit 3 – Construction IAQ Management Plan**
Intent	Prevent indoor air quality problems resulting from the construction/renovation process, to sustain long term installer and occupant health and comfort.
Reference	Air Force Sustainable Facilities Guide - Indoor Environmental Quality Credit 3.2
Reference Requirement	Develop and implement an Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases of the building as follows: Conduct a minimum two-week building flushout with new filtration media at 100% outside air after construction ends and prior to occupancy, OR, conduct a baseline indoor air quality testing procedure consistent with current EPA protocol for Environmental Requirements, Baseline IAQ and Materials, for the Research Triangle Park Campus, Section 01445.
Air Force Policy and Justification	Highly Recommended: The LEED referenced Flush-Out or Baseline IAQ Testing represents two options for ensuring that indoor air quality is acceptable prior to occupancy, that are highly recommended. Baseline IAQ testing provides the added value of a baseline to compare to future IAQ investigations.
Additional Information	Contact base safety and bio-environmental engineering for guidance. The EPA protocol for Environmental Requirements, Baseline IAQ and Materials, for the Research Triangle Park Campus, Section 01445 is located at the following website: http://www.epa.gov/rtp/new-bldg/environmental/s_01445.htm.

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Indoor Environmental Quality

Credit 4 – Low-Emitting Materials

Intent	Reduce the quantity of indoor air contaminants that are odorous or potentially irritating to provide installer and occupant health and comfort.
Reference	Air Force Sustainable Facilities Guide - Indoor Environmental Quality Credit 4
Reference Requirement	Credit 4.1 Adhesives must meet or exceed the VOC limits of South Coast Air Quality Management District Rule #1168, AND all sealants used as a filler must meet or exceed Bay Area Air Resources Board Reg. 8, Rule 51. Credit 4.2 Paints and coatings must meet or exceed the VOC and chemical component limits of Green Seal requirements. Credit 4.3 Carpet Systems must meet or exceed the Carpet and Rug Institute (CRI) Green Label Indoor Air Quality Test Program. Credit 4.4 Composite wood or agrifiber products must contain no added urea-formaldehyde resins.
Air Force Policy and Justification	Credit 4.1-4.4 - Highly Recommended: Use of low-emitting materials is part of a proactive approach to maintaining good indoor air quality. Materials meeting the LEED criteria are readily available, have no adverse impact on performance, and little or no impact on cost.
Additional Information	Credit 4.1 - Link to South Coast Air Quality Management District Rule #1168: http://www.aqmd.gov/rules/html/r1168.html. Link to Bay Area Air Resources Board Reg. 8, Rule 51: http://www.baaqmd.gov/regs/rulereg.htm. Credit 4.2 - Link to Green Seal: http://www.greenseal.org/recommendations.htm#product Link to MPI: http://www.paintinfo.com/mpi/approved/index.htm Credit 4.3 - Link to CRI Green Label Test Program: http://www.carpet-rug.com/drill_down_2.cfm?page=8&sub=4 Credit 4.5 - Link to GreenGuard: http://www.greenguard.org. Some UNICOR products have met GreenGuard standards.

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Indoor Environmental Quality

Credit 5 – Pollutant Source Control

Intent	Avoid exposure of building occupants to potentially hazardous chemicals that adversely impact air quality.
Reference	Air Force Sustainable Facilities Guide - Indoor Environmental Quality Credit 5
Reference Requirement	Design to minimize cross-contamination of regularly occupied areas by chemical pollutants: Employ permanent entryway systems (grills, grates, etc.) to capture dirt, particulates, etc. from entering the building at all high volume entryways, AND provide areas with structural deck to deck partitions with separate outside exhausting, no air recirculation and negative pressure where chemical use occurs (including housekeeping areas and copying /print rooms), AND provide drains plumbed for appropriate disposal of liquid waste in spaces where water and chemical concentrate mixing occurs.
Air Force Policy and Justification	Credit 5 - Highly Recommended: Careful design and operation of buildings to isolate and ventilate sources of contamination is a pro-active approach to maintaining good indoor air quality. The cost of these measures is minimal, and integration of these design features can be accommodated in all types and sizes of buildings.
Additional Information	Hazardous materials and waste are covered in Materials and Resources Prerequisite 2 – Hazardous Materials and Waste Management.

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Indoor Environmental Quality

Credit 6 – Controllability of Systems

Intent	Provide a high level of individual occupant control of thermal, ventilation, and lighting systems to support optimum health, productivity, and comfort conditions.
Reference	Air Force Sustainable Facilities Guide - Indoor Environmental Quality Credit 6.1, 6.2
Reference Requirement	Credit 6.1 Provide a minimum of one operable window and one lighting control zone per 200 sf.. for all occupied areas within 15 feet of the perimeter wall. Credit 6.2 Provide controls for each individual for airflow, temperature, and lighting for 50% of the non perimeter, regularly occupied areas.
Air Force Policy and Justification	Credit 6.1-6.2 - Conditionally Recommended: Individual occupant control of thermal, ventilation, and lighting systems support well-being and productivity. However the benefit must be weighed against the cost. Individual controls in the perimeter zone provide the most benefit in closed office environments.
Additional Information	The two referenced credit have been combined into one and the requirements have been simplified.

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Indoor Environmental Quality	**Credit 7 – Daylight and Views**
Intent	Provide a connection between indoor spaces and the outdoor environment through the introduction of sunlight and views into the occupied areas of the building.
Reference	Air Force Sustainable Facilities Guide - Indoor Environmental Quality Credit 8.1, 8.2
Reference Requirement	Credit 8.1 Achieve a minimum Daylight Factor of 2% (excluding all direct sunlight penetration) in 75% of all space occupied for critical visual tasks, not including copy rooms, storage areas, mechanical, laundry, and other low occupancy support areas. Exceptions include those spaces where tasks would be hindered by the use of daylight or where accomplishing the specific tasks within a space would be enhanced by the direct penetration of sunlight. Credit 8.2 Direct line of sight to vision glazing from 90% of all regularly occupied spaces, not including copy rooms, storage areas, mechanical, laundry, and other low occupancy support areas.
Air Force Policy and Justification	Credit 8.1 - Highly Recommended: Daylighting contributes to energy efficiency, as well as occupant well-being and productivity. Close coordination of architecture, interior space planning with daylighting strategy is required. Daylighting goals need to be balanced against space planning efficiency goals. NOTE: potential conflict with Anti-terrorism Guidelines. Credit 8.2 - Recommended: Views provide a connection between the indoor and the outdoor environment. Access to views impacts occupant well-being and productivity. Close coordination of architecture and interior space planning is required, and the goal to provide views needs to be balanced against space planning efficiency goals.
Additional Information	Credit 7.1 - Some of the methods to increase the amount of natural sunlight include additional windows, larger windows, light shelves, skylights, clerestories, courtyards and atriums.

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Innovation & Design Process

Credit 1 – Design Process

Intent	To provide design teams and projects the opportunity to be awarded points for exceptional performance above requirements set by the LEED Green Building Rating System and/or innovative performance in green building categories not specifically addressed by the LEED Green Building Rating System.
Reference	Air Force Sustainable Facilities Guide - Innovation & Design Process Credit 1
Reference Requirement	In writing, using the LEED Credit Equivalence process, identify the intent of the proposed innovation credit, the proposed requirement for compliance, the proposed submittals to demonstrate compliance, and the design approach used to meet the required elements.
Air Force Policy and Justification	Conditionally Recommended: Innovative design solutions can add value to the project, however these options must be evaluated on a case by case basis. Innovative solutions must support the overall mission of the facility.
Additional Information	The credit is a catch-all credit for any item that supports the goals of sustainable development that has not already been addressed.

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Innovation & Design Process

Credit 2 – LEED Accredited Professional

Intent	To support and encourage the design integration required by a LEED Green Building project and to streamline the application and certification process.
Reference	Air Force Sustainable Facilities Guide - Innovation & Design Process Credit 2
Reference Requirement	At least one principal participant of the project team that has successfully completed the LEED Accredited Professional exam.
Air Force Policy and Justification	Highly Recommended: LEED Accredited Professionals add value to the design effort because they understand the integrated design process and are familiar with high-performance sustainable design solutions.
Additional Information	The LEED Accredited Professional can be government or contractor.

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Innovation & Design Process

Credit 3 – Deconstruction

Intent	Extend the useful life of building materials and reduce construction and demolition waste.
Reference	Air Force Sustainable Facilities Guide - Innovation & Design Process Credit 4
Reference Requirement	Employ deconstruction methods to dismantle an existing building, and reuse a minimum of 50% of the materials by weight.
Air Force Policy and Justification	Recommended: Deconstruction can be a highly cost-effective and resource efficient solution.
Additional Information	The U.S. Army Corps of Engineers' Public Works Technical Bulletin 420-49-32 Selection of Methods for the Reduction, Reuse, and Recycling of Demolition Waste contains information on deconstruction. This bulletin can be found at http://www.hnd.usace.army.mil/techinfo/CPW/pwtb.htm.

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Innovation & Design Process

Credit 4 – Advance Resource Efficiency

Intent	Extend the useful life of building materials, and reduce time required to accommodate change.
Reference	Air Force Sustainable Facilities Guide - Innovation & Design Process Credit 5
Reference Requirement	Incorporate mobile building components with an interior design master plan to maximize flexibility for future uses.
Air Force Policy and Justification	Recommended: Design for flexibility reduces facility down time, and reduces life cycle cost. Note : potential synergy with Anti-terrorism Guidelines.
Additional Information	

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Purpose

This guide supports the Air Force Sustainable Development Policy by providing guidance and strategies to identify and incorporate sustainable development concepts in facility and infrastructure projects.

Applicability

The Air Force Sustainable Facilities guide has been developed for MILCON projects. "Credits" are earned for performing required activities that promote sustainable development. Many of these credits require detailed engineering studies that would not be practical to perform in a relatively low cost project. However, many of these lower cost projects have the potential to incorporate sustainable development practices. This checklist is similar to the Air Force Sustainable Facilities guide. The main difference is that most of the credit areas have been simplified to provide guidance on sustainable development opportunities that require little to no detailed engineering studies.

There is not a defined cutoff point on when to use this guide or the Air Force Sustainable Development Guide. The overall scope of the project, the programmed amount, the level of engineering expertise available, and time available are all factor to consider in determining which guide to use. The Air Force Sustainable Facilities Guide is more robust and should be considered first.

When to Use

The first time this checklist should be used is when defining project requirements. At the same time that the scope of work, cost estimate, and other initial project data is colleted, this checklist should be used to identify sustainable development opportunities. The various credits are designed to be "quick answers" and the entire checklist should require minimal additional time to complete. The completed checklist should become part of the project files. This step is expected to be completed by the programming section of engineering flight.

The next time this checklist should be used is when the project is ready for design. Many projects may not be funded for months or years after they were initially programmed. In the same manner that the scope of work and cost estimate provides a starting point for design, so should the sustainable development opportunities. During the design process, the scope of work and cost are validated and may change. Likewise, so should the sustainable development opportunities be validated and incorporated if possible. This step is expected to be completed by the project manager.

How to Use

The checklist is a series of credits with defined requirements that must be met in order to earn the credit. The top section of the checklist is a summary of the points earned. The summary scores are automatically calculated. After the summary section, are the individual credits. The individual credits are where you enter the number of points earned. If there is a choice in how to meet the requirement, then you must also enter in the choices made. An example of a filled in individual credit is below. Additional information about the requirements can be seen by clicking on the "More Information" link.

Materials and Resources	Points	Earned	More Information
Credit 7	2	2	1 point for each type of wood product certified by the Forest Stewardship Council for a maximum of 2 points.
Certified Wood			
Maximum Points	2	**2**	**Points Earned**
			List items for Credit 7. Interior office doors, 5 ea. Breakroom cabinets

Appendix D. Support of Air Force Sustainable Development Goals and Principles

Section 4.6.3 discusses the tables in this appendix and should be used as a guide to interpret the data.

Table 34. Sustainable Sites Support for Air Force Sustainable Development Goals and Principles

Air Force Sustainable Facilities Guide			Sustainable Sites	Simplified Sustainable Facilities Guide		
Credit #	3 Goals	6 Principles	Credit Title	Credit #	3 Goals	6 Principles
Prerequisite 1	2	3,6	Erosion and Sediment Control	Prerequisite 1	2	3
Prerequisite 2	2	1	Environmental Protection	Prerequisite 2	2	1
Prerequisite 3	None	None	Cultural Resources Protection	Prerequisite 3	None	None
Prerequisite 4	2	3	Cleanwater Protection	Prerequisite 4	2	3
Credit 1	2	1	Site Selection	Credit 1	2	1
Credit 2	2	1	Urban Development	N/A	N/A	N/A
Credit 3	2	1	Brownfield Redevelopment	N/A	N/A	N/A
Credit 4.1	1	1	Alternative Transportation	Credit 2.1	1	1
Credit 4.2	1,3	1	Alternative Transportation	Credit 2.2	1	1
Credit 4.3	1	6	Alternative Transportation	Credit 2.3	1	6
Credit 4.4	1	6	Alternative Transportation	Credit 2.4	1	6
Credit 5.1	2	1	Reduce Site Disturbance	Credit 3.1	2	1
Credit 5.2	1,2	1	Reduce Site Disturbance	Credit 3.2	2	1
Credit 6.1	2	3	Stormwater Management	Credit 4	2	3
Credit 6.2	2	3	Stormwater Management	N/A	N/A	N/A
Credit 7.1	2	1,6	Landscape and Exterior Design to Reduce Heat Islands	Credit 5.1	2	1,6
Credit 7.2	1,2	2,6	Landscape and Exterior Design to Reduce Heat Islands	Credit 5.2	1,2	2,6
Credit 8	1,2	2,6	Light Pollution Reduction	Credit 6	2	6

Table 35. Water Efficiency Support for Air Force Sustainable Development Goals and Principles

Air Force Sustainable Facilities Guide			Water Efficiency	Simplified Sustainable Facilities Guide		
Credit #	3 Goals	6 Principles	Credit Title	Credit #	3 Goals	6 Principles
Credit 1.1	1	3	Water Efficient Landscaping	Credit 1.1	1	3
Credit 1.2	1	3	Water Efficient Landscaping	Credit 1.2	1	3
Credit 2	1	3	Innovative Technologies	N/A	N/A	N/A
Credit 3.1	1	3	Water Use Reduction	Credit 2.1	1	3
N/A	N/A	N/A	Water Use Reduction	Credit 2.2	1	3
N/A	N/A	N/A	Water Use Reduction	Credit 2.3	1	3
N/A	N/A	N/A	Water Use Reduction	Credit 2.4	1	3
Credit 3.2	1	3	Water Use Reduction	N/A	N/A	N/A

Table 36. Energy and Atmosphere Support for Air Force Sustainable Development Goals and Principles

Air Force Sustainable Facilities Guide			Energy and Atmosphere	Simplified Sustainable Facilities Guide		
Credit #	3 Goals	6 Principles	Credit Title	Credit #	3 Goals	6 Principles
Prerequisite 1	1,3	2,3,5,6	Fundamental Building Systems Commissioning	Prerequisite 1	1,3	2,3,5,6,
Prerequisite 2	1	2	Minimum Energy Performance	Prerequisite 2	1	2
Prerequisite 3	2	4	CFC Reduction in HVAC&R Equipments	Prerequisite 3	2	4
Prerequisite 4	2	6	Atmospheric Air Quality Protections	Prerequisite 4	2	6
Credit 1.1	1	2	Optimize Energy Performance	Credit 1.1	1	2
Credit 1.2	1	2	Optimize Energy Performance	Credit 1.2	1	2
Credit 1.3	1	2	Optimize Energy Performance	Credit 1.3	1	2
Credit 1.4	1	2	Optimize Energy Performance	Credit 1.4	1	2
Credit 1.5	1	2	Optimize Energy Performance	Credit 1.5	1	2
N/A	N/A	N/A	Optimize Energy Performance	Credit 1.6	1	2
N/A	N/A	N/A	Optimize Energy Performance	Credit 1.7	1	2
Credit 2.1	2	4	Renewable Energy	Credit 2	2	4
Credit 2.2	2	4	Renewable Energy	N/A	N/A	N/A
Credit 2.3	2	4	Renewable Energy	N/A	N/A	N/A
Credit 3	1,3	2,3,5,6	Additional Commissioning	N/A	N/A	N/A
Credit 4	2	4	Elimination of HCFC's and Halons	Credit 3	2	4
Credit 5	1,3	2,3,5,6	Measurement and Verification	Credit 4	1,3	2,3,5,6
Credit 6	2	4	Green Power	N/A	N/A	N/A

Table 37. Materials and Resources Support for Air Force Sustainable Development Goals and Principles

Air Force Sustainable Facilities Guide			Materials and Resources	Simplified Sustainable Facilities Guide		
Credit #	3 Goals	6 Principles	Credit Title	Credit #	3 Goals	6 Principles
Prerequisite 1	1,2	4	Storage and Collection of Recyclables	Prerequisite 1	1,2	4
Prerequisite 2	2,3	5,6	Hazardous Materials and Waste Management	Prerequisite 2	2,3	5,6
Credit 1.1	1,2	1,4	Building Reuse	N/A	N/A	N/A
Credit 1.2	1,2	1,4	Building Reuse	Credit 1	1,2	1,4
Credit 1.3	1,2	1,4	Building Reuse	N/A	N/A	N/A
Credit 2.1	1,2	4	Construction Waste Management	Credit 2	1,2,	1,4
Credit 2.2	1,2	4	Construction Waste Management	N/A	N/A	N/A
Credit 2.3	1,2	4	Construction Waste Management	N/A	N/A	N/A
Credit 3.1	1,2	4	Resource Reuse	Credit 3	1,2	4
Credit 3.2	1,2	4	Resource Reuse	N/A	N/A	N/A
Credit 4.1	1,2	4	Recycled Content	Credit 4	1,2	4
Credit 4.2	1,2	4	Recycled Content	N/A	N/A	N/A
Credit 5.1	1,2	4	Local/Regional Materials	Credit 5	1,2	4
Credit 5.2	1,2	4	Local/Regional Materials	N/A	N/A	N/A
Credit 6	2	4	Rapidly Renewable Materials	Credit 6	2	4
Credit 7	2	4	Certified Wood	Credit 7	2	4

Table 38. Indoor Environmental Quality Support for Air Force Sustainable Development Goals and Principles

Air Force Sustainable Facilities Guide			Indoor Environmental Quality	Simplified Sustainable Facilities Guide		
Credit #	3 Goals	6 Principles	Credit Title	Credit #	3 Goals	6 Principles
Prerequisite 1	3	5	Minimum IAQ Performance	Prerequisite 1	3	5
Prerequisite 2	3	5	Environmental Tobacco Smoke (ETS) Control	N/A	N/A	N/A
Prerequisite 3	3	5	Acoustics and Noise Control	Prerequisite 2	3	5
Credit 1	1,3	5,6	Carbon Dioxide (CO2) Monitoring	Credit 1	1,3	5,6
Credit 2	3	5	Increase Ventilation Effectiveness	Credit 2	3	5
Credit 3.1	3	5	Construction IAQ Management Plan	Credit 2	3	5
Credit 3.2	3	5	Construction IAQ Management Plan	Credit 3	3	5
Credit 4.1	3	4,5	Low-Emitting Materials	Credit 4.1	3	4,5
Credit 4.2	3	4,5	Low-Emitting Materials	Credit 4.2	3	4,5
Credit 4.3	3	4,5	Low-Emitting Materials	Credit 4.3	3	4,5
Credit 4.4	3	4,5	Low-Emitting Materials	Credit 4.4	3	4,5
N/A	N/A	N/A	Low-Emitting Materials	Credit 4.5	3	4,5
Credit 5	3	5	Indoor Chemical and Pollutant Source Control	Credit 5	3	5
Credit 6.1	3	5	Controllability of Systems	Credit 6	3	5
Credit 6.2	3	5	Controllability of Systems	Credit 6	3	5
Credit 7.1	3	5	Thermal Comfort	Credit 2	3	5
Credit 7.2	3	5	Thermal Comfort	Credit 2	3	5
Credit 8.1	1,3	1,2,5,6	Daylight and Views	Credit 7.1	1,3	1,2,5,6
Credit 8.2	3	5	Daylight and Views	Credit 7.2	3	5

Table 39. Innovation and Design Process Support for Air Force Sustainable Development Goals and Principles

Air Force Sustainable Facilities Guide			Innovation and Design Process	Simplified Sustainable Facilities Guide		
Credit #	3 Goals	6 Principles	Credit Title	Credit #	3 Goals	6 Principles
Credit 1	1,2,3	1,2,3,4,5,6	Innovation in Design	Credit 1	1,2,3	1,2,3,4,5,6
Credit 2	None	None	LEED Accredited Professional	Credit 2	None	None
Credit 3	2	6	Integrated Landscape Management	N/A	N/A	N/A
Credit 4	1,2	4	Deconstruction	Credit 3	1,2	4
Credit 5	1,2	4	Advance Resource Efficiency	Credit 4	1,2	4

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Vita

Captain David F. Hargy graduated from Merrimack High School in Merrimack, New Hampshire in 1984. He entered the U.S. Army after graduation and served four years as a Signal Intelligence Analyst. After the Army, he entered Springfield Technical Community College in Springfield, Massachusetts where he earned an Associate of Science in Engineering and Science Transfer in May 1992. He graduated with a Bachelor of Science in Civil Engineering in May 1994 from Clarkson University in Potsdam, New York. He served in AFROTC Detachment 536 at Clarkson and was commissioned upon graduation.

Capt Hargy's first assignment was with the 27th Civil Engineer Squadron at Cannon AFB, New Mexico, serving as a Maintenance Engineer officer and Readiness Flight Commander. In April 1997, he transferred to the 51st Civil Engineer Squadron at Osan AB, Korea, serving as Chief of Base Development. In April 1998, he transferred to the 3rd Civil Engineer Squadron at Elmendorf AFB, Alaska, serving as a Maintenance Engineer officer, Chief of Pollution Prevention, and Chief of SABER. While stationed at Elmendorf, he deployed in December 1999 to the 332nd Expeditionary Civil Engineer Squadron at Ahmed Al Jaber AB, Kuwait for three months, serving as the Engineering Flight Chief. In August 2001, he entered the Graduate School of Engineering and Management, Air Force Institute of Technology at Wright-Patterson AFB, Ohio. Upon graduation, he will be assigned to the Civil Engineer Directorate, Headquarters Air Combat Command at Langley AFB, Virginia.

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14. ABSTRACT

The Air Force has adopted the United States Green Building Council's Leadership in Energy and Environmental Design (LEED™) Green Building Rating System as the preferred self-assessment metric for sustainable development. LEED™ is designed for new construction and major renovations, and, within the Air Force, is most applicable for Military Construction (MILCON) projects. The Air Force Center for Environmental Excellence developed the Air Force Sustainable Facilities Guide to provide guidance and strategies to meet LEED™ requirements. The Air Force has not adopted a sustainable development guide or rating system that is most applicable for construction projects that are relatively low (compared to MILCON projects) in cost or complexity. This research developed a Simplified Sustainable Facilities Guide that can identify and assess sustainable development opportunities in all facility and infrastructure projects. This guide, modeled after the Air Force Sustainable Facilities Guide, simplifies most LEED™ requirements to reduce the time, cost, and expertise level required to incorporate sustainable development concepts while preserving the intent of LEED™. This guide is designed to quickly identify opportunities in projects that are relatively low in cost and complexity; where using the more robust LEED™ requirements may not be justified. The Simplified Sustainable Facilities Guide, in conjunction with existing Air Force guidance, provides a means to address sustainable development issues in all facility and construction projects regardless of cost or complexity.

15. SUBJECT TERMS

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