LANDSCAPE ARCHITECTURE

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UNIFIED FACILITIES CRITERIA (UFC)

LANDSCAPE ARCHITECTURE

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UNIFIED FACILITIES CRITERIA (UFC)

LANDSCAPE ARCHITECTURE

U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

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

Change No.	**Date**	**Location**
1	November 5, 2009	Corrected UFC and UFGS designations throughout

This UFC supersedes UFC 3-210-05FA, dated 16 January 2004; NAVFAC P-904/Army TM 5-830-1; and NAVFAC P-905/Army TM 5-830-4/AFM 88-17, Chapter 4

FOREWORD

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

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

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

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

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

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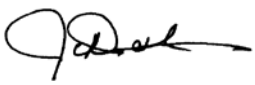

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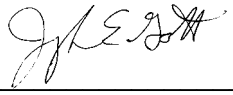

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UNIFIED FACILITIES CRITERIA (UFC)
NEW DOCUMENT SUMMARY SHEET

Document: UFC 3-201-02, *Landscape Architecture*
Superseding: Various DoD manuals

Description:

This UFC – through succinct reference to industry and government standards, codes and reference works – makes possible the replacement and/or consolidation of numerous criteria documents. To date, this UFC supersedes the following criteria documents on the subject matter.

- NAVFAC P-904/Army TM 5-830-1 *Planting Design*
- NAVFAC P-905/Army TM 5-830-4/AFM 88-17, Chap. 4, *Planting and Establishment of Trees, Shrubs, Ground Covers and Vines*
- UFC 3-210-05FA, *Design: Landscape Design and Planting Criteria*

Reason for Document: To comply with defense standardization laws and unification requirements of MILSTD 3007. This unification effort will result in the more effective use of DoD funds, in two ways: first, by significantly improving DoD projects and facilities, through a more efficient **application** of facilities criteria; and second, through more efficient **maintenance** of facilities criteria.

Impact: This UFC will have a pronounced positive impact on the functionality, sustainability, maintenance, appearance, and life cycle cost of DoD projects. Overall impact to design and construction costs will be minimal.

Non Unified Issues: none

CONTENTS

CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE

The purpose of this UFC is to provide technical requirements and design guidance in the discipline field of landscape architecture associated with site improvements and site design for Department of Defense (DoD) projects.

1-2 APPLICABILITY

This UFC is applicable to all DoD projects with ***site improvements*** regardless of the method of execution or the funding source. This includes *sustainment, restoration and modernization* as well as new construction. The term ***site improvements*** refers to all site modification that will result in permanent, on or above-ground, paving, features, or landforms. Representative types of site modification are indicated in the section on *Pre-Design and Design Services*. The term ***site improvements*** does not refer to either: enclosed buildings, in themselves; or, airfield pavements. For a more comprehensive presentation of potential site improvement issues and treatments see Appendix B *Best Practices in Landscape Architecture*.

1-3 GENERAL REQUIREMENTS

Design of all site improvement features shall be accomplished by an experienced registered professional. As a minimum, all construction projects with site improvement costs over $250,000 shall have a landscaping plan and supporting details signed by a registered professional in the state of the project location. For states without licensure requirements, the designer shall be licensed in an adjacent state or jurisdiction. This requirement is consistent with that of the Federal Acquisition Regulations (FAR) and the majority of state departments of professional regulation, which require signature by a licensed professional in their field of study and expertise. In most cases this will be a registered Landscape Architect. More stringent professional requirements and certifications may be required in the individual design and construction contracts.

1-3.1 Experience

The designer shall have a minimum of three years experience in the design and management of projects similar in scope and complexity to the current project. In addition, the designer shall have experience in sustainable development and low impact design as it relates to site improvements and features.

1-3.2 Design Services

The designer shall facilitate the integration of the current project with the existing context, focusing on such specifics as safety, security, sustainability,

accessibility, circulation, function, cost effectiveness, aesthetics, and compatibility with surrounding land use.

1-3.2.1 Pre-Design and Design Services

The following key components of planning and design shall be addressed (examples are provided below, in parenthesis):

- Programming (development and clarification of project scope based on customer needs and expectations)
- Site Analysis (visual and functional analysis, natural landscape analysis, historical and cultural landscape elements, landscape development zoning, existing site plan, project limits)
- Site Planning (preliminary development of spatial-functional relationships based on programming and site analysis)
- Preservation and Maintenance of Existing Resources (plant material, historical, cultural, and natural resources)
- Grading and Drainage (erosion and sedimentation control, low impact development)
- Circulation Systems (roads, streetscapes, parking areas, recreational trails, bikeways and walkways)
- Common Areas (plazas and courtyards, parade grounds, recreational areas, pedestrian and vehicular gates/entrances, playgrounds and tot lots, monuments, memorials, static displays)
- Planting Design (plant selection and location, low maintenance, regionally native species, xeriscape, remediation and reclamation, green roofs, interior planting)
- Forestry (trees, brush and fire management, urban forestry management)
- Irrigation Design (minimizing water requirements, plant establishment and survival, water budgeting and hydrozoning, water sources)
- Site Furnishings (exterior lighting, seating, shelters, trash and ash receptacles, fences and walls, bicycle racks, grates, bollards, planters, water features)

- Signage Systems (interpretive, informational, identification, wayfinding)
- Site Security (comprehensive planning, facility site design, site security details)
- Construction Documents (plans, details, specifications, cost estimating)

1-3.2.2 **Post-Design Services**

As contracted, the designer shall address the following key components of post-design (examples are provided below, in parenthesis):

- Field Consultation During Construction (inspection, quality control, shop drawing and submittal review)
- Landscape Establishment, Maintenance and Management (comprehensive landscape maintenance, landscape maintenance tasks and methods, landscape management plan development)

1-4 CRITICAL DESIGN REQUIREMENTS

The designer shall address the following critical design issues: (Requirements for the following critical issues can be found in the documents listed in paragraph 1-5.)

- Security (Antiterrorism/Force Protection)
- Accessibility
- Sustainable Development (Economical, Environmental, Low-Impact Development)
- Planting and Irrigation Establishment Period
    - Typical time period: 1 year warranty and maintenance
    - Periodic inspections: Establishment start, completion, and once per quarter (minimum)

1-4.1 Sustainable Development

Projects must comply with Executive Order 13423, Strengthening Federal Environment, Energy, and Transportation Management, dated 24 January 2007. EO 13423 requires compliance with the Memorandum of Understanding (MOU) on Federal Leadership in High Performance and Sustainable Buildings. The

Guiding Principles of the MOU align with the US Green Building Council Leadership in Energy and Environmental Design (LEED) green building rating system. The following LEED-New Construction credits that landscape architecture could impact should be included in the design to comply EO 13423: SS 6.1, SS 6.2, WE 1.1, WE 3.1, EA 1, MR 2.1,MR 4.1, MR 6, MR 7 and EQ 4.

Projects must comply with P.L. 110-140 (H.R.6) Energy Independence and Security Act 2007 (EISA 2007). Section 438 provides storm water runoff requirements for federal projects.

Navy and Marine Corps projects must consider Low Impact Development strategies to comply with the storm water management requirements in the Assistant Secretary of the Navy (Installations & Environment) Memorandum: Department of the Navy Low Impact Development (LID) Policy for Storm water Management dated 16 November 2007.

1-5 STANDARDS & CODES

The following standards and codes contain additional site and Landscape Architectural requirements. Under each category, additional project-specific requirements may be applicable and will be provided as appropriate.

1-5.1 Industry

- AASHTO (American Association of State Highway Transportation Officials*, Guide for the Development of Bicycle Facilities*) (http://www.transportation.org/.)
- *USPC* (U.S. Consumer Product Safety Commission) *Handbook for Public Playground Safety* (http://www.cpsc.gov/cpscpub/pubs/325.pdf.)
- ANSI Z60.1, *American Standard for Nursery Stock*, (http://www.anla.org/applications/Documents/Docs/ANLAStandard2004.pdf.)

1-5.2 Government

- ADAAG (*Americans with Disabilities Act Accessibility Guidelines*) (http://www.access-board.gov/adaag/html/adaag.htm)
- ADA and ABA Accessibility Guidelines (http://www.access-board.gov/ada%2Daba/)
- *Endangered Species Act of 1973*, U.S. Fish and Wildlife Service, (http://www.fws.gov/endangered/esa.html)

- *Energy Policy Act of 2005* (http://www.fedcenter.gov/_kd/Items/actions.cfm?action=Show&item_id=2969&destination=ShowI)

- Executive Order 13112, *Invasive Species* (http://www.archives.gov/federal-register/executive-orders/1999.html)

- Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management (http://www.wbdg.org/ccb/FED/FMEO/eo13423.pdf)

- *Energy Independence and Security Act of 2007* – P.L. 110-140 (H.R.6)

- *Federal Clean Water Act of 1977*, Environmental Protection Agency (EPA), (http://www.epa.gov/region5/water/cwa.htm)

- *Uniform Federal Accessibility Standards* (UFAS) (http://www.access-board.gov/ufas/ufas-html/ufas.htm)

- *Federal Leadership in High Performance and Sustainable Buildings* Memorandum of Understanding (http://www.eh.doe.gov/oepa/guidance/p2/hpsb_mou.pdf)

1-5.3 **Department of Defense**

- UFC 1-200-01, *General Building Requirements* (http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4)

- UFC 1-300-09N, *Design Procedures* (http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4)

- UFC 3-120-01, *Air Force Sign Standard* (http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4)

- UFC 3-210-02, *POV Site Circulation and Parking* (http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4)

- UFC 3-210-10, *Low Impact Development* (http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4)

- UFC 3-250-03, *Standard Practice Manual for Flexible Pavements* (http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4)

- UFC 3-250-04, *Standard Practice for Concrete Pavements* (http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4)
- UFC 3-260-01, *Airfield and Heliport Planning and Design* (http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4)
- UFC 3-420-01, *Plumbing Systems* (http://www.wbdg.org/ccb/browse_inactive.php?o=29&c=4)
- UFC 3-440-02N, *Water Conservation Operation and Maintenance* (http://www.wbdg.org/ccb/browse_inactive.php?o=29&c=4)
- UFC 3-701-XX (series), *DoD Facilities Pricing Guide*, (where XX indicates the fiscal year), (http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4)
- UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings* (http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4)
- UFC 4-020-01, *DoD Security Engineering Facilities Planning Manual* (http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4)
- UFC 4-022-01, Security Engineering: *Entry Control Facilities/Access Control Points* (http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4)
- UFC 4-022-02 Selection and Application of Vehicle Barriers (http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4)
- UFC 4-022-03 Security Engineering: Fences, Gates, and Guard Facilities (under development at time of publication)
- UFC 4-030-01, Sustainable Development (http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4)

1-5.3.1 Service-Specific

1-5.3.1.1 Army

- *Access Control Points Standard Definitive Design* (https://pdc.usace.army.mil/library/.).
- EM 1110-2-301, *Guidelines for Landscape Planting and Vegetation Management at Floodwalls, Levees, and Embankment Dams.* (http://www.usace.army.mil/usace-docs/eng-manuals/em1110-2-301/toc.htm.)

1-5.3.1.2 **Air Force**

- Facility and Landscape Design Guides (http://www.afcee.brooks.af.mil/dc/products/dcproducts.asp.)
- AFI 32-7062, *Air Force Comprehensive Planning,* (http://www.e-publishing.af.mil.)
- AFI 32-7064, *Integrated Natural Resources Management*, (http://www.e-publishing.af.mil.)
- *Model Pesticide Reduction Plan*, (http://www.afcesa.af.mil/ces/cesm/pest/cesm_pestmgt.asp.)

1-5.3.1.3 **Navy/Marines**

- OPNAVINST 5530.14D, *Navy Physical Security and Law Enforcement Manual,* (http://doni.daps.dla.mil/default.aspx)

1-5.3.2 **Local and Installation-Specific**

Contact the appropriate entity for access to the following standards.

- State Historic Preservation Office (SHPO) - check with the SHPO, or similar entity, for local policies and guidelines, if aspects of the project may have historical significance.
- Natural Resources Management Plan - check for installation policy or guidelines for natural resource management.
- Cultural Resources Management Plan - check for installation policy or guidelines for cultural resource management.
- Installation Appearance Plans (IAP) – check for installation policy or guidelines for Landscape Architecture.
- Base Exterior Architecture Plans (BEAP) - check for installation policy or guidelines for Landscape Architecture.
- Installation Design Guide - check for installation policy or guidelines for installation design.

APPENDIX A REFERENCES

A-1 **NOT USED**.

Due to the nature of this UFC, Appendix A is not used.

APPENDIX B BEST PRACTICES

B-1 LANDSCAPE ARCHITECTURE

This Appendix is a supplemental reference, and is not required policy.

B-1.1 Role of the Landscape Architect

The landscape architect coordinates and oversees the design and stewardship of natural and built environments on DoD sites. The landscape architect takes a leadership role in the following aspects of the site design process:

- Analysis: Coordinate site assessment and documentation.
- Site Design: Establish use areas and locate building footprints, as well as address the remaining listed items in order to establish a physical plan for the entire site area.
- Design of Circulation Systems: Coordinate interdisciplinary collaboration for the planning and design of vehicular, bicycle, service vehicle, and pedestrian circulation systems.
- Common Area Design: Work with user groups to establish the best and safest possible use of recreational land, ceremonial areas, and other open space systems such as greenways, corridors, and neighborhood linkages.
- Planting Design: Conceptualize planting patterns, forms, types, and heights within clear zones and throughout entire installations at various scales.
- Forestry: Work with a forester to determine preservation areas and future tree planting requirements.
- Site Furnishings: Design site furnishings that respond to users and are appropriate to the architectural and natural surroundings.
- Security: Develop creative solutions to address security requirements within a landscape while meeting or exceeding user expectations.
- Implementation, Maintenance, and Management: Document and oversee the implementation process. Establish a one-year review period to ensure planting quality and to review maintenance contracts.

B-1.2 Documentation

This UFC is a guide for the preparation of documents to promote consistent quality of landscape architectural design and implementation on DoD installations. For organizational purposes, this documentation is grouped into three main categories.

For more information on design procedures and the necessary documentation for **Navy** projects, refer to \1\UFC 1-300-09N, *Design Procedures*./1/

B-1.2.1 Planning Documentation

Planning documents describe actions that affect the entire installation and ensure a consistent approach to all site designs throughout the installation. Typical planning documentation includes the following:

- Base Map of the project;
- Land Use Plan (including natural constraints and program elements;
- Base Comprehensive Plan;
- Land Development Plan;
- Capital Improvements Plan;
- Visual Analysis and Theme Development;
- Approved Plant List;
- Approved Materials List;
- Approved Site Furnishings List;
- Specifications (see Unified Facilities Guide Specifications;) and
- Details.

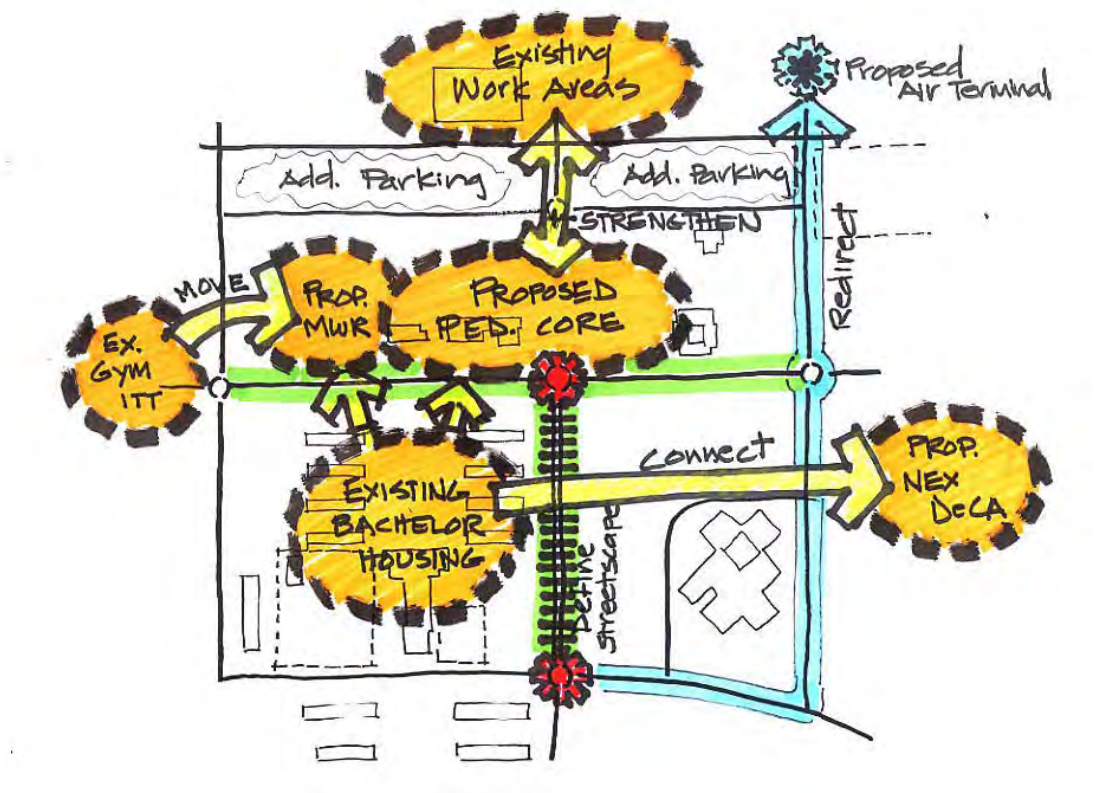
B-1.2.2 Site Design Documentation

Each site design project requires a combination of documents to communicate the landscape architect's design intent to the construction and maintenance contractors. Typical site design documentation includes:

- Site Analysis Documents (including natural, visual, cultural, and historical elements)
- Concept Design
- Site Plan

- Implementation/Installation Documents (including Demolition Plan, Grading Plan, Drainage Plan, Planting Plan, Irrigation Plan, Details, and Specifications according to the UFGS)

Figure B-1.1 Example Diagram to Illustrate Land Use Relationships



B-1.2.3 Land Management Plan

A land management plan describes long-term or continued actions to ensure proper maintenance and management of the installation. Without proper maintenance and management, landscape elements will have a shorter lifespan. A land management plan is tailored to the specific requirements of the installation, and may include the following documents:

- Grounds Maintenance Plan
- Maintenance schedules (includes plant, hardscape, site furnishing, and water feature requirements)
- Urban Forestry Management Plan
- Brush Management Plan

- Erosion Management Plan

B-1.3 Planning Process

The planning process may include land use plans, area development plans, and erosion control plans, and existing conditions survey.

B-1.3.1 Land Use Plan

A land use plan highlights the type of activities that occur in different parts of an installation. Land use impacts site development in the following ways:

- Functional relationship to existing facilities;
- Proximity to user and customer;
- Scope of requirement and expansion potential;
- Noise, environmental impact, safety, and security needs;
- Existing infrastructure capacity; and
- Required site preparation.

B-1.3.2 Area Development Plan

Area development planning blends existing conditions and future facility requirements. Some of the factors that the landscape architect will evaluate in this phase include:

- Architectural theme of surrounding buildings;
- Pedestrian and vehicular needs, volumes, destinations, and access;
- Future facility requirements;
- Conceptual parking configuration; and
- Street realignments and closures.

B-1.3.3 Erosion Control Plan

The potential for erosion on the site should be addressed early in the planning and design process to correct existing problems and prevent further erosion from occurring. The results of the plan are often shown on the grading and drainage plans for proposed construction projects.

B-1.3.4 Existing Conditions Survey

Evaluate topography, drainage patterns and structures, soil types, the extent and type of vegetative cover, impermeable surfaces, vehicular and pedestrian circulation patterns, and above- and below-grade drainage structures. Record climatic information, including norms and extremes in temperature, precipitation and wind, to help define both expected and unusual conditions that may affect design decisions.

In developing the existing conditions survey, consider governmental regulations that may affect design actions. These include the *Federal Clean Water Act*, which regulates the discharge of material into waters of the United States, and the *Endangered Species Act*, which regulates actions that may have an impact on rare plants and animals. Projects or actions that may require permits or approvals under these and other acts entail coordination with various Federal agencies, including the U.S. Army Corps of Engineers, the Environmental Protection Agency, and the U.S. Fish and Wildlife Service. The State Historic Preservation Office regulates cultural resources including historic buildings, districts, and archeological sites. Also consider state or local laws that may affect planning and design.

B-1.4 Site Design Process

Synthesize planning and analysis with project requirements during the design process. The result will be a solution that improves the functionality, image, and quality of life for the users. The main components of the design process are:

- Project Programming: During this first stage of the process, summarize requirements, priorities, and user needs.

- Site Analysis: Evaluation factors at this stage include views, existing conditions, vehicular and pedestrian circulation, plant types, noise, and security requirements.

- Concept Design: The concept design illustrates the overall design intent to be discussed with and approved by the client prior to moving forward with more detailed designs.

- Site Plan: Site planning factors include topography, existing vegetation, existing nearby structures, existing natural features, entrances/service areas, orientation, walkways, parking details, lighting, drainage, pedestrian and vehicular circulation, building setback from street, and security elements.

- Theory: Design theory, along with comprehensive site analysis, is key to successful landscape design. Apply the following design principles: proportion, scale, unity, harmony, line, emphasis, contrast, variety, repetition, form, texture and color. The choice of materials also contributes to the quality of landscape design. Landscape materials typically include: plants, inert materials, landforms, site amenities, and water features.

Figure B-1.2 Example Concept Drawing

B-1.4.1 Design Guidelines

Basic principles of quality landscape architecture apply to all projects. The following general guidelines are typically employed:

- Use hardy, regionally native and drought-tolerant plant materials when possible.
- Create design solutions that minimize adverse impacts on the natural habitat.
- Prevent pollution by reducing fertilizer and pesticide requirements and by using integrated pest management techniques, recycle green waste, and minimize runoff.
- Preserve and enhance existing natural landforms and vegetation.
- Maximize low-maintenance landscapes.
- Maximize the use of water-efficient plant material.
- Install water-efficient irrigation systems.
- Ensure site and planting plans promote energy conservation.
- Screen undesirable views and land uses.

- Use mass plantings, berms, groups of trees, and architecturally compatible fencing as screens and buffers.
- Create attractive entries.
- Reduce building mass by creative, security-sensitive foundation plantings.
- Use thornless and non-toxic plant material near children's play areas.
- Use site amenities that are durable, well constructed, and resistant to vandalism.
- Design irrigation systems to minimize damage to key components, including sprinkler heads, controllers, and backflow preventers.

Figure B-1.3 Example Site Plan of a Common Area and Pedestrian Circulation

Figure B-1.4 Example Grading Plan

B-1.5 Implementation and Installation Process

Communicate design intent to the contractors responsible for installing and maintaining the designed landscape. Typical construction documents include:

- Demolition Plan;
- Grading Plan;
- Planting Plan;
- Irrigation Plan;
- Landscape Details;
- Specifications - refer to UFGS Specifications;
- Cost Estimate;
- Planting Plan;

- Establishment Period Contract;
- Construction Management Plan; and
- Maintenance Plan

B-2 SITE DESIGN

B-2.1 Role of the Landscape Architect

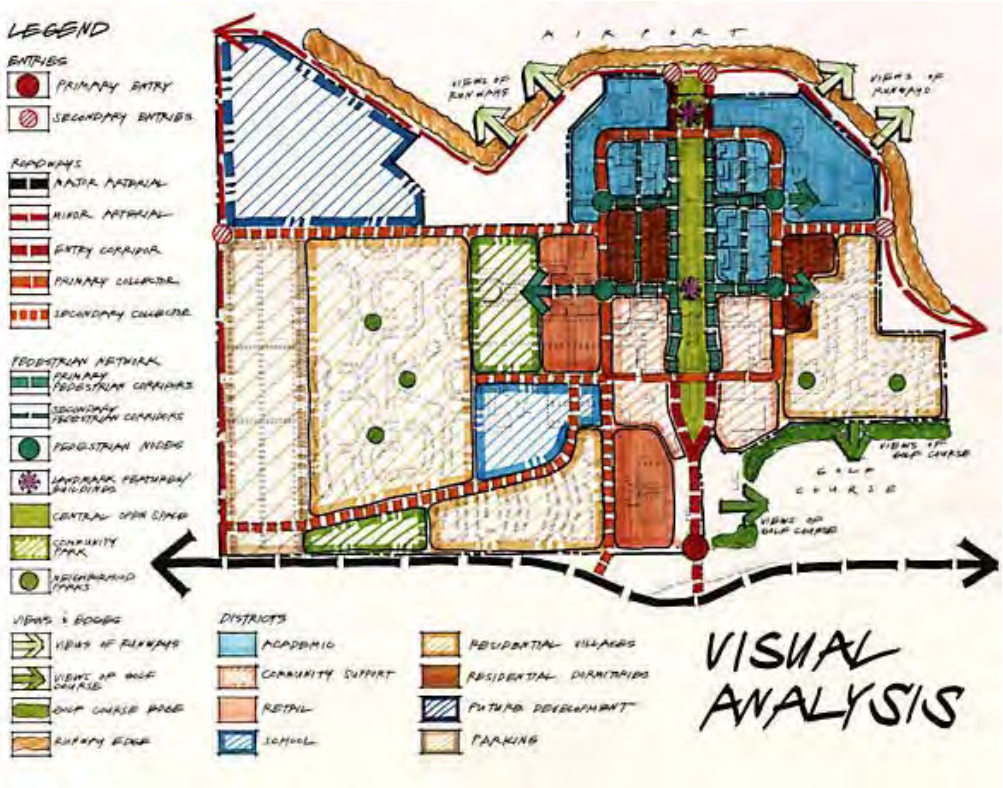
Coordinate, oversee, and conduct the site design process, which includes the following responsibilities:

- Provide a detailed site analysis that includes a thorough assessment of visual, natural, cultural, and historical resources.
- Study design opportunities and constraints that will contribute to the resulting form of the site plan.
- Respond to functional and user requirements with maximum efficiency by the placement and relationship of buildings and circulation networks.
- Conserve natural resources.
- Establish a safe and secure site through creative landscape architectural design solutions.
- Enhance the quality of life by designing a pedestrian-friendly environment.
- Allow for future expansion of surrounding facilities.
- Incorporate sustainable design solutions that are economically and environmentally beneficial for the long-term.
- Use natural amenities in designating recreational areas.
- Provide guidance on identifying and reinforcing an appropriate image through visual design, including enhancement of visual structure, hierarchy, and quality.

B-2.2 Visual Analysis

A site's visual environment consists of visible land, water, vegetation, facilities, architectural compatibility, landscape development, and treatment of natural areas. In addition to expressing mission and function, the character, quality, and relationships of physical features contribute to the comprehension and perception of the visual environment.

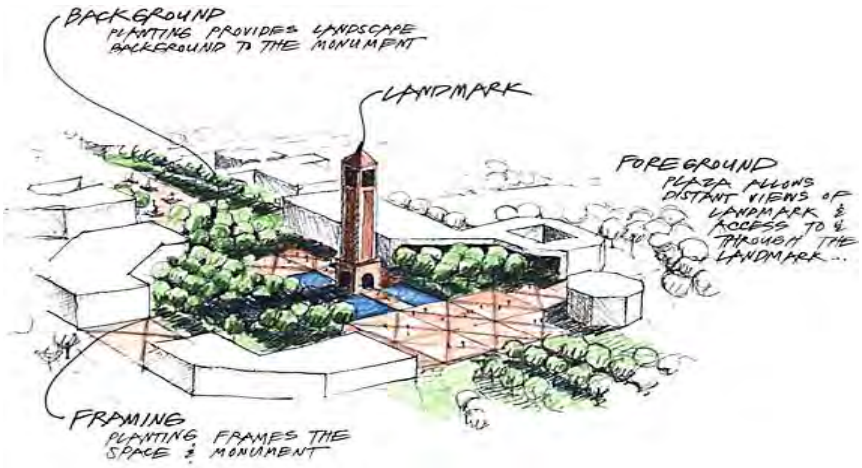
Figure B-2.1 Example of a Comprehensive Summary of the Results of a Visual Analysis



B-2.2.1 Visual Quality

Achieving, enhancing, and maintaining a high level of visual quality strengthens DoD institutions. The visual and physical environments where people work and live have significant effects on their attitudes and quality of life. Provide a framework for accomplishing improvements and enhancements to the visual environment.

Figure B-2.2 Example of How Landmarks Orient Users in the Landscape



B-2.2.2 Factors Affecting the Visual Environment

Land, water, vegetation, buildings, and other physical features shape installations. Our perception of the visual environment is influenced by the following elements:

- Natural Influences: Natural factors that may affect the character of an installation include landform, the presence and characteristics of vegetation, water, and climate.
- Land Use and Facility Siting: The way that land is used, and the relationship of those uses affects overall form, visual and spatial character of a site.
- Circulation Characteristics: The arrangement of vehicular, pedestrian, and bicycle movement corridors plays a significant role in how people perceive an area.
- Urban Design and Development Form: Density, the expression of building form, height, massing, and scale, gives character and form to the space.
- Architectural Style, Building Materials, and Colors: The consistent application and use of building style, materials, and colors, in combination with the principles of building form, mass, and scale.
- Open Space Development: Definition of spaces, buffers uses, softens large expanses of paving, reinforces vehicular and/or pedestrian corridors and enhances the settings of buildings.
- Site Furnishings: Provides an opportunity to create visual design continuity and compatibility.
- Hardscape and Paving Materials: Provides an opportunity to create consistency and continuity on the ground plane and denotes areas of special function.
- Historical and Cultural Features: Can form the basis of a visual theme or image for the installation.
- Dominant Features and Views: Provides opportunities for the formulation of a theme or image.

B-2.2.3 Visual Analysis Summary

Prepare a graphical summary analysis with annotations. Use photographs and/or sketches that illustrate the nature of the findings to support the summary analysis. Develop supporting narratives to document the characteristics, quality and condition of the analyzed components.

B-2.2.3.1 Visual Analysis Requirements

A visual analysis summary includes the following:

- Priority Problem Areas and Opportunities;
- Visual Improvement Recommendations;
- Image and Theme; and
- Priority Projects Development.

B-2.2.3.2 Analysis Elements

Include the following elements in a visual analysis summary:

- Entrances;
- Corridors;
- Vehicular Hierarchy;
- Pedestrian and Bikeway Corridors;
- Edges;
- Visual Districts;
- Activity Nodes;
- Vehicular Nodes;
- Pedestrian Plazas and Open Spaces; and
- Landmarks.

B-2.3 Natural Landscape Analysis

The natural landscape consists of elements and processes inherent in a site. The natural landscape can provide constraints and opportunities for the design process. Manipulate the natural landscape to create places; however, first analyze the site's natural landscape in order to design a sustainable site that maximizes environmental benefits.

B-2.3.1 Natural Landscape Elements

Analyze the potential impacts of the following natural elements prior to design:

- Topography: The natural terrain is a major determinant of the layout and form of the installation and specific site. Maintaining the natural topography of the

installation helps to prevent erosion. Existing landforms on a site can be natural or constructed landforms. Use both natural and constructed in conjunction with each other, including berms, swales, and terraces.

- Wetlands: Wetlands provide a resource for storing stormwater, recharging groundwater, and wildlife. All wetlands on federal lands must be identified and protected throughout the site design and construction processes.

- Vegetation: Existing vegetation on an installation, especially trees, is an asset, and analyzing the type, amount, and condition of the vegetation is an important step to understanding the site. Design the installation or site to protect and preserve existing native vegetation to reduce maintenance and enhance sustainability. Examine sites to determine both individual species and plant associations.

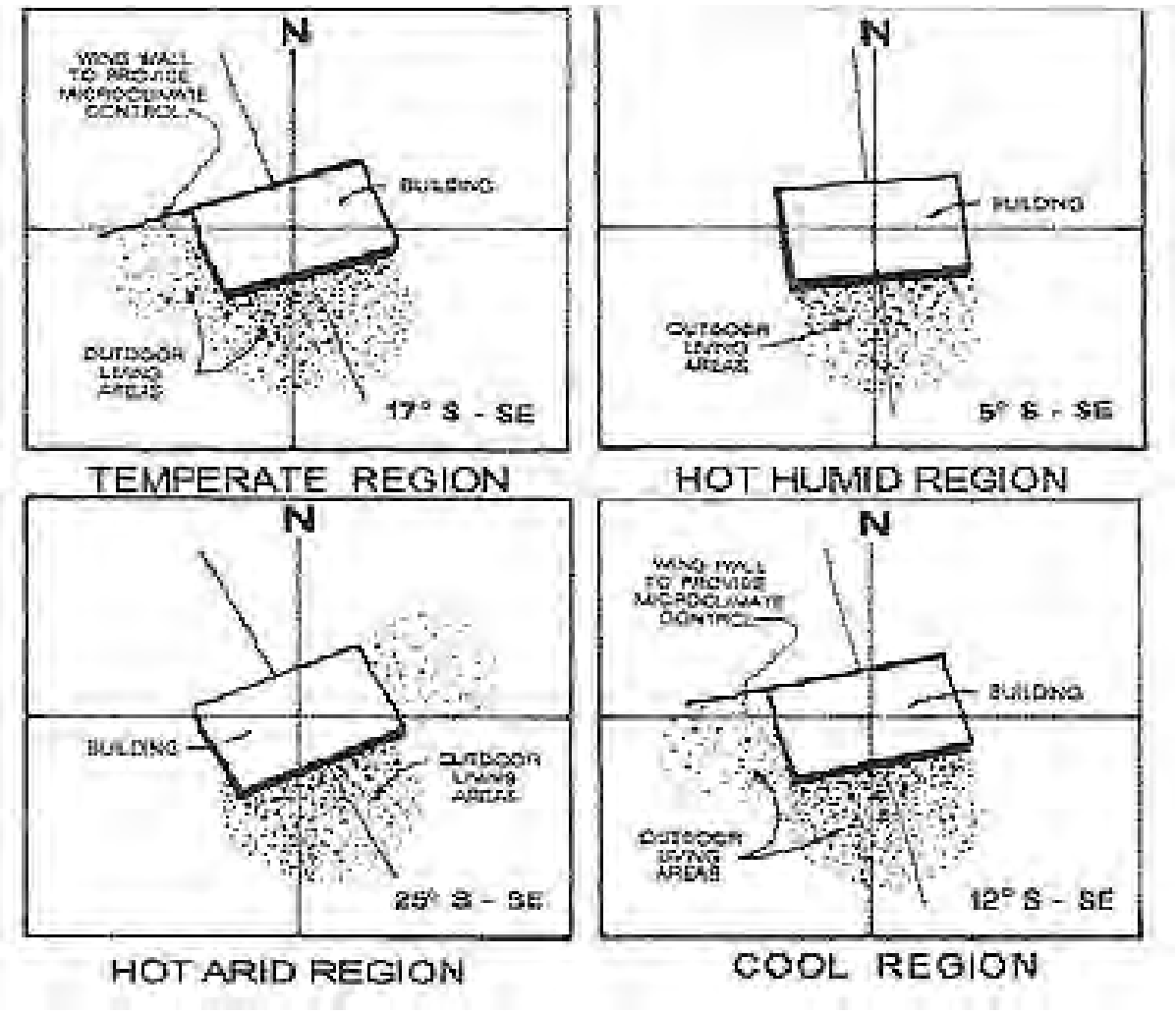
Figure B-2.3 Shrubs, Trees, and Berms Used to Screen a Parking Area

- Prevailing Winds: Whether to encourage winds to cool outdoor spaces in a hot, humid climate or to decrease winds to prevent erosion, understanding the prevailing winds is an important aspect of natural conditions. Interaction of winds with other natural elements will impact design decisions. Because they are most effective when placed perpendicular to the direction of the wind, use windbreaks only where the direction of erosive-force winds is predictable.

- Climate: Climatic considerations are important to human comfort and energy efficiency. Individual installations should maintain design guidelines that respond to local climatic conditions. Evaluate the site-specific microclimates by

determining how the general weather conditions are influenced by such site elements as topography, vegetation, water bodies, and built elements, including buildings, airfields, and parking lots. The principal climatic variables are radiant energy, temperature, air movement, and humidity.

Figure B-2.4 Building Orientation



B-2.3.2 **Natural Landscape Processes**

Erosion and drainage are both natural processes that occur on a site. Developing a site can increase the rate of these processes; however, there are design choices that can mitigate the impact.

B-2.3.2.1 **Erosion**

Erosion is influenced by a number of factors, such as soil type, vegetation, and topography; it can be accelerated by various activities that occur on an installation. While there are many

aspects of erosion that can be controlled during initial site design and planning, a long-term management plan is best.

Conduct and maintain an existing conditions survey for the entire installation, but prepare a similar and more detailed survey for proposed construction projects, identifying site-specific factors that may affect erosion and influence project design. The existing conditions survey provides the physical data upon which to base an analysis of erosion potential. Such conditions include topography, drainage patterns, soil types, the extent and kind of vegetative cover, impermeable surfaces, and above- and below-grade drainage structures.

B-2.3.2.1.1 **Erosion Process**

The soil erosion process involves the dislodging, transport, and deposition of soil particles. These forces are at work whether erosion occurs on a large flat surface, a slope, or in a drainage way or other waterway. Factors that influence soil erosion include soil characteristics, vegetative cover, slope, water, and wind.

B-2.3.2.1.2 **Erosion Control Planning Process**

In order to achieve effective erosion control, follow a logical and comprehensive planning process. This process should include an analysis of potential existing conditions survey, an erosion survey, and an erosion control plan. While the results of this process are shown on grading and drainage plans for proposed construction projects, it should also be applied to an analysis of erosion potential throughout the installation to determine *corrective* actions for existing problems and *preventive* measures for potentially erosive conditions.

B-2.3.2.1.2 **Vegetative Soil Stabilization Measures**

Vegetative stabilization measures employ plant material to protect soil exposed to the erosive forces of water and wind. Vegetation above the surface reduces the impact of precipitation, provides direct protection of the soil from wind, intercepts and slows runoff, and removes water from the soil through evapotranspiration. Below the surface, vegetation helps to bind the soil and increase the infiltration of runoff. Areas that will benefit from vegetative soil stabilization include:

- Slopes;
- Channels;
- Large flat areas;
- Areas susceptible to wind erosion;
- Seeding areas; and
- Planting pre-grown stock planting areas.

B-2.3.2.1.3 **Structural Soil Stabilization Measures**

Structural soil stabilization measures involve the physical control of a potentially unstable condition. This includes the modification of site grades and the use of structural elements to retain or provide structure for soil. Structural soil stabilization measures include:

- Slope reduction and compaction;
- Retaining walls; and
- Soil covering.

B-2.3.2.2 **Drainage**

Drainage incorporates all the natural drainage corridors, floodplains and waterways located on the site. Included in these waterways are wetlands, which require special protection under the Federal Clean Water Act. Increasing or decreasing the amount of water flowing into the waterways can dramatically affect natural ecosystems. Initial goals for site development should, at minimum:

- Preserve and maintain natural drainage areas and floodplains.
- Limit development in floodplains to open spaces and recreation uses.
- Preserve wetlands, rivers, lakes, streams, or other waterways, and incorporate them into the design layout.
- Maintain stormwater infiltration to recharge the groundwater system.

Figure B-2.5 Example of Environmentally Sensitive Site Design

B-2.3.2.2.1 **Stormwater Systems Design**

Stormwater systems move runoff from circulation areas, and can help clean contaminants picked up from parking areas, roofs, and the air. Stormwater systems are most efficient when considered early in the site design process. Create a sensitive stormwater system with the following benefits:

- Water conservation;
- Groundwater recharge;
- Erosion control;
- Sedimentation control;
- Contaminant control; and
- Wildlife habitat preservation.

Design surface and subsurface drainage systems to control the amount of sediment leaving the site. Use these systems in combination to slow water and divert it from exposed soils or other vulnerable areas.

B-2.3.2.2.2 **Runoff from Impermeable Surfaces**

Streets, paved parking lots, roofs, and other impermeable surfaces allow no infiltration of runoff and provide little resistance to flow. Runoff draining from these surfaces can be highly concentrated and move at a velocity greater than runoff flowing over an unpaved surface. Soils must be protected from this erosive force, particularly at the edges of impermeable surfaces and soils. Figure B-2.6 shows a bioswale for runoff from a parking lot.

At airfields, the accumulation of runoff from runway, apron, and taxiway pavements can be considerable, see \1\UFC 3-260-01, *Airfield and Heliport Planning and Design*./1/

Figure B-2.6 Bioswale with Native Planting

B-2.3.2.2.3 **Detention**

On-site detention of runoff protects adjacent property from erosion, and prevents sediment from discharging off site. Detaining runoff allows suspended soil particles to be filtered or settle out before the runoff is released. After sediment has been trapped, runoff can be released from the basin at controlled rates to reduce the erosion potential. Figure B-2.7 shows a detention pond incorporated as a design element.

Airfield planning guidance permits water bodies, including retention and detention ponds, within runway clear zones and accident potential zones. See \1\UFC 3-260-01/1/ for more information.

Figure B-2.7 Example of a Retention Basin Functioning as a Design Element

B-2.3.2.2.4 **Sustainable Stormwater Management**

Several techniques and technologies allow for a wide variety of stormwater management systems. The techniques described below can be integrated in a comprehensive system to make a site more sustainable. Many of the techniques listed have accepted quantifiable results and are gaining popularity and acceptance with local regulators.

- Permeable paving;
- Paving;
- Rain gardens;
- Gardens;
- Bioswales;
- Wet ponds;
- Ponds;
- Constructed wetlands;
- Wetlands;
- Bioretention; and
- Green Roofs (see figure B-2.8 for example.)

Figure B-2.8 Beginnings of a Green Roof

Refer to the most recent LEED point system for specific goals to help towards certification. A minimum site design should aim to achieve the following:

- Limit runoff rate and quantity;
- Control erosion during construction and for the life of the site;
- Select sites away from sensitive areas, including wetlands;
- Reduce site disturbance during construction;

- Protect or increase open space on existing heavily -developed sites;
- Treat stormwater to eliminate contaminants, such as suspended solids and phosphorous; and
- Grade the site to increase water efficiency for planting areas.

B-2.4 Historical and Cultural Landscape Elements

Historic sites and structures can be community and cultural focal points. Historic resources include buildings, sites, objects, structures, and districts. A site may be in an area significant for its historic or archaeological importance or for its cultural importance. Structures or sites listed on, or eligible for, the National Register of Historic Places may pose development constraints.

B-2.5 Site Plan

After a thorough analysis, a site plan refines the preferred spatial relationships and accommodates the program into a hardline plan for the site. It provides accurate location, dimensions and elevations for facilities and site improvements. This concept plan can identify potential conflicts and problems, preventing costly changes later in the process. The site plan provides sufficient detail to serve as the basis for construction documents for the project. The concept site plan does not resolve all the site problems, but indicates, at a minimum, how they will be addressed and their costs.

B-2.5.1 Landscape Development Zoning Plan

Landscape development zoning defines the level of landscape treatment a particular area or facility should receive. It is the basis for budgeting for future landscape development. The landscape development zoning plan graphically depicts these zones to assist installation landscape programming, design, construction, and maintenance.

There are three zones of landscape development: primary, secondary, and tertiary. Landscape development zones are created through analysis of facilities and surrounding areas. Determine the intensity of landscape development by looking at the areas in terms of visual and historical significance, visitor frequency, proximity to major circulation routes, and other criteria specific to the installation.

B-2.5.1.1 Primary Zone

The primary zone is an area that is highly significant to the perceived visual quality and image of the installation. Facilities listed below commonly occur in the primary development zone. These facilities warrant additional funds for landscape design, construction, and maintenance.

- Main gate(s);

- Command and Headquarters buildings;
- Primary administration offices;
- Community Center;
- Main roadways;
- Visitor Center;
- Significant static displays and parade grounds;
- Billeting office;
- Distinguished Visitor quarters;
- Hospital;
- Airfield entrance to Base Operations;
- Clubs;
- Base Operations facility;
- Military Family Housing areas (MFH); and
- Golf clubhouse and course.

B-2.5.1.2 **Secondary Zone**

The secondary zone contains most of the remaining developed areas of an installation. Many facilities in this area are important in the daily lives of the installation's community, but extensive landscape development is not essential due to lower visibility and maintenance budget requirements.

This zone is a transition between what is generally a highly developed primary zone and the functionally and simply developed tertiary zone. Consistent and proper project programming and design become paramount as the secondary zone can be significant in creating a positive visual image for the installation.

- Base Civil Engineering facility;
- Fitness Center;
- Family Support Center;
- Squadron Operations facilities;

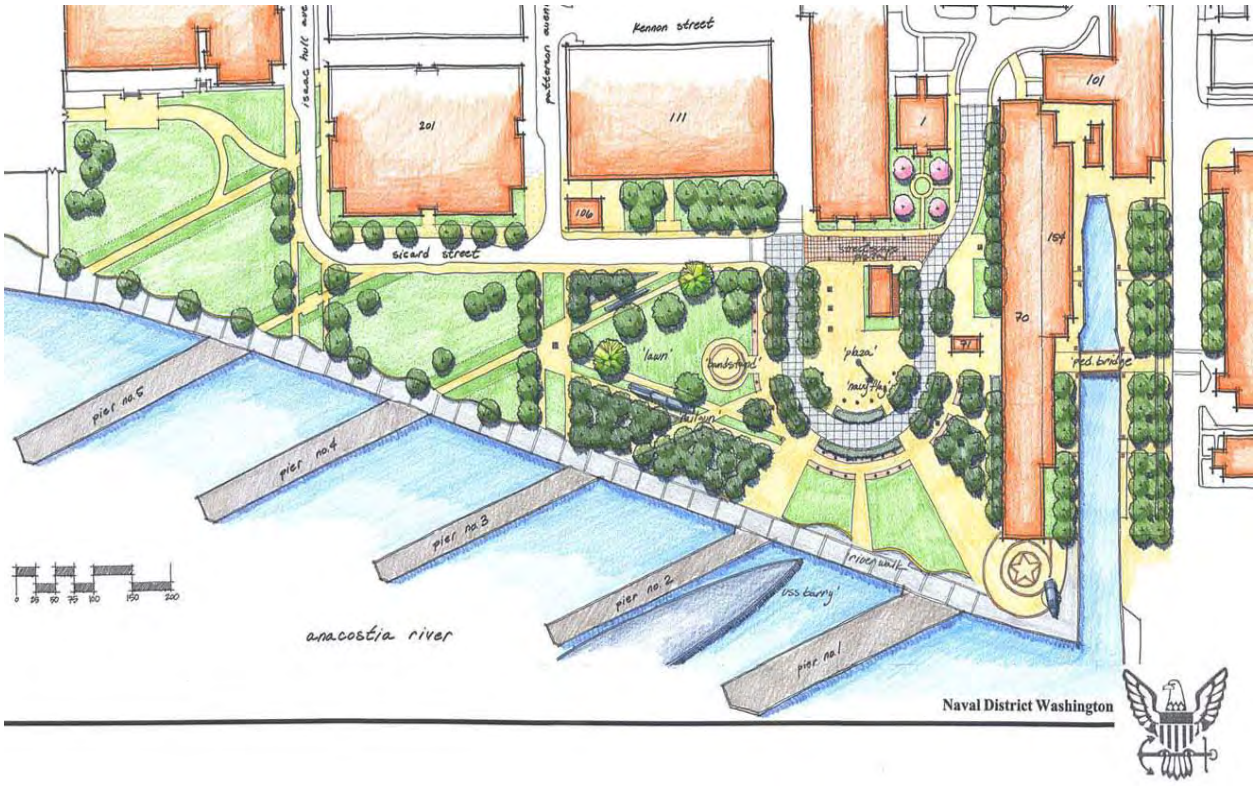
- Credit Unions and banks;
- Bowling Center;
- Fam Camp;
- Convenience stores;
- Undeveloped areas or open space in MFH; and
- Moderate public visibility areas of perimeter fence.

B-2.5.1.3 **Tertiary Zone**

The tertiary zone encompasses those areas that will require little to no long-term landscape development. Many of these areas are adjacent to the flightline, in or near clear zones, or serve as buffer areas around the installation. Most of the areas should be left natural. Maintenance requirements in the tertiary zone are minimal, typically consisting of rough mowing or managing of grassy areas. Wooded areas require even less maintenance.

- POL tank farm;
- Munitions storage facilities;
- Operations side of runway facilities;
- Civil engineer storage and shop areas;
- Forested areas outside of cantonment area;
- Service roads;
- Water treatment facilities;
- Test cells;
- Limited public visibility areas of perimeter fence; and
- Security areas.

Figure B-2.9 Example of Site Plan for a Park



B-2.5.2 Site Plan Elements

Figure B-2.1811 shows an example of a site plan. The level of detail may vary with the size of the site; however, the site plan should address the following principle considerations. Many of these topics are discussed in greater detail in other sections of this UFC.

B-2.5.2.1 Construction Lines

This plan locates critical construction lines (e.g. setbacks, easements, or building spacing). Many of these regulations are dictated by security or force protection standards; review the most current standards, and keep abreast of changes.

B-2.5.2.2 Buildings

This plan precisely defines the location of the building footprints, identifies all entrances, including fire exits, and refines the outdoor space between facilities.

B-2.5.2.3 Vehicular Circulation and Parking

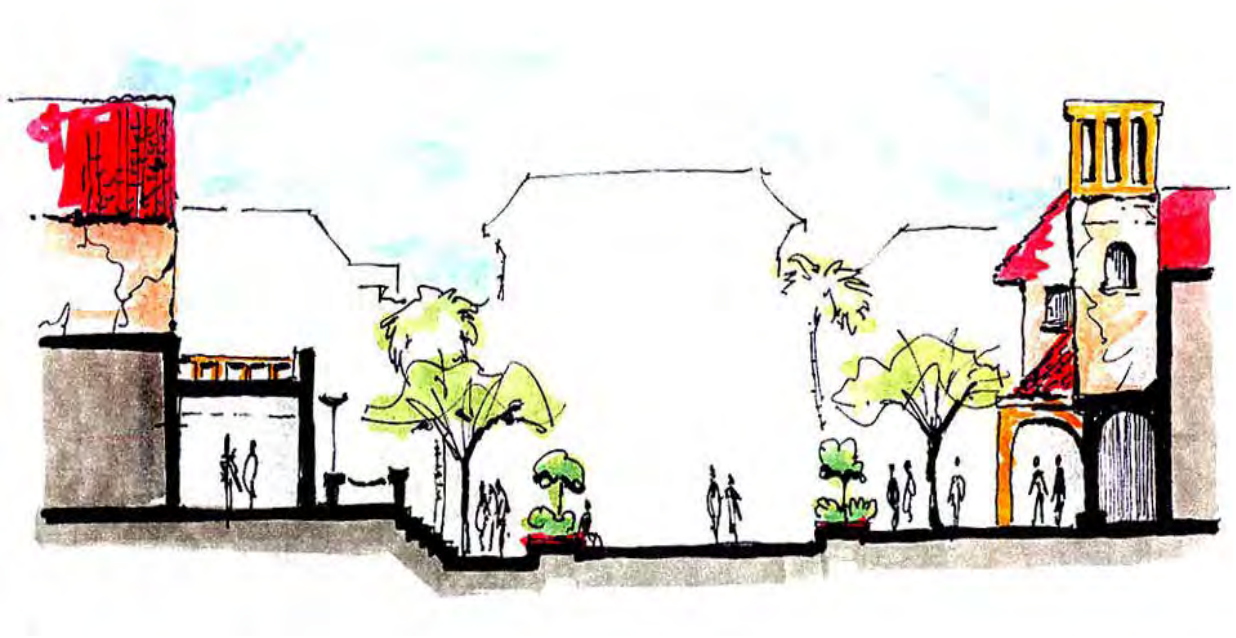
This plan defines access, service, and emergency drives. It defines parking areas, including delineated parking spaces, barrier-free spaces, proper count, and islands and medians. Indicate turning radii throughout the site, including sufficient turnaround room for service and

emergency vehicles. Locate and properly delineate elements such as gates, drop-off areas, and dumpster pads.

B-2.5.2.4 Pedestrian Circulation

This plan refines pedestrian circulation to assure clear, convenient, and safe flow of pedestrian movement both within the site and connecting to adjacent sites. Assure barrier-free accessibility between buildings and from barrier-free parking spaces to at least one building entrance, including the location of any necessary ramps. Identify means of using topography and plant material to help direct pedestrian flow.

Figure B-2.10 Example of Spatial Relationships of a Site Design



B-2.5.2.5 Grading and Drainage

This plan establishes an overall grading concept for the site, showing proposed contours and critical elevations. Locate and provide critical elevations for structures, including retaining walls and steps, needed to facilitate grading conditions. Define and locate proposed stormwater management areas on site. Determine the need for and location of retention or detention ponds. Indicate methods of controlling erosion or sediment.

B-2.5.2.6 Energy Conservation

This plan responds to climatic conditions.

B-2.5.2.7 Utilities

This plan defines the locations of utility lines, and identifies access points from the supply lines and entry points into buildings. Ensure that utility lines are not located under proposed paved areas to facilitate line maintenance and repair.

B-2.5.2.8 **Lighting**

The site plan develops a preliminary lighting coverage scheme and identifies areas requiring higher lighting levels or special lighting. See \1\UFC 3-520-01/1/ for more information on lighting.

B-2.5.2.9 **Physical Security**

This plan indicates proposed security measures to comply with force protection standards.

B-2.5.2.10 **Landscape Plantings**

This plan refines the planting scheme by broadly describing the types of vegetative massing and lawn areas.

B-2.5.2.11 **Outdoor Spaces and Site Amenities**

This plan refines the design for outdoor areas and gives preliminary consideration to the location of site features.

B-3 CIRCULATION SYSTEMS

This chapter provides information regarding vehicular circulation, parking, bikeways, and walkways. While each of these systems has distinct guidelines for design, coordinate the location and interaction of these systems. Streets and sidewalks are important landscape elements because they connect centers of activities.

B-3.1 Role of the Landscape Architect

The circulation plan for each project should incorporate the following:

- Encourage circulation patterns that reduce the need for automobile use.
- Design a pedestrian system that is logically connected from start to finish, meets Americans with Disabilities Act Accessibility Guidelines (ADAAG) and other width regulations, and is separated from vehicular traffic.
- Design principals and elements, including scale, street trees, material selections, and site furnishings, to delineate and clarify wayfinding.
- Sustainable design solutions for parking areas, such as bioswales and permeable surfaces.

B-3.2 Streetscapes

The roadway system on DoD installations not only provides the primary means of circulation, but is also the major vantage point from which the installation is viewed and comprehended. The streetscape environment consists of the roadways and the visual corridors through which they pass. Elements within these visual corridors include landscape planting, signs, light fixtures, site furnishings, walkways and bikeways, utilities, and the roads themselves. A well-planned streetscape system reinforces the vehicular circulation system hierarchy, reduces potential safety conflicts, and enhances the visual image of the installation.

According to \1\UFC 3-210-02/1/, *POV Site Circulation and Parking*, a multi-disciplinary team of design professionals is responsible for developing a streetscape system. This team must include, and is often led by, a landscape architect. See \1\UFC 3-210-02/1/ for detailed requirements of turning radii, street widths, sight lines, parking layout and geometry, and special areas including drop-off zones. Once a system is designed, a streetscape may be implemented as a standalone project or as part of various projects throughout the installation.

Figure B-3.1 Example of a Streetscape with Pedestrian Elements

B-3.2.1 Streetscape System Design Process

In order to successfully integrate the diverse elements of the streetscape, the streetscape design process should be logical and comprehensive, and should include an existing conditions survey, a corridor identification analysis, and a streetscape corridor plan.

Use a streetscape hierarchy to effectively clarify circulation, and apply it consistently throughout an installation. Elements to be included in each corridor type include vegetation, lighting, site furnishings, and crosswalks.

B-3.2.2 Streetscape Elements

Address the following elements in the streetscape design process:

- Medians;
- Pedestrian buffer;
- Force protection;

- Entrances;
- Streetscape image;
- Streetscape planting;
- Furnishings;
- Signs and signals; and
- Paving materials.

B-3.3 Parking Areas

Parking areas that are concurrently designed and developed with facilities are more efficient and less costly than stand-alone parking projects. Determine parking requirements and assess opportunities to reduce the size of parking area lots and other means.

Figure B-3.2 Example of Incorporating Pedestrian Circulation into Planting Design

B-3.3.1 Design Considerations

Refer to \1\UFC 3-210-02/1/ for details relating to required geometry and sizes of parking areas. Parking lots should be easy to use and safe for both vehicles and pedestrians, while mitigating adverse stormwater impacts stemming from the increase of impervious surfaces. Other considerations for parking lot design include:

- Siting;
- Orientation;
- Geometry;
- User walking distance;
- Islands;
- Maintenance;
- Stormwater runoff; and
- Lighting and safety.

Figure B-3.3 Example of Adequate Walkways in Parking Lots

B-3.3.2 Reducing Heat Island Effects

Heat islands are created when heat from the sun is absorbed by dark, non-reflective surfaces, particularly roofs and parking lots, and radiated back into surrounding areas. The resulting ambient temperatures in areas with significant impervious surfaces are artificially elevated by

10 degrees or more, increasing cooling equipment and operational costs in surrounding buildings. Good landscape design can mitigate heat island effects by providing trees, which cool the environment through shade and transpiration, and by using light-colored materials that reflect heat.

Figure B-3.4 Example of Sustainable Parking Lot

The U.S. Green Building Council's (USGB) Leadership in Energy and Environmental Design (LEED) suggests that providing shade and using appropriate materials significantly reduces heat island effects in parking lots. To effectively reduce such effects and increase energy savings, materials used in parking lots should be highly reflective over the life of the product. Specify highly reflective materials for non-vehicular areas including walkways and plazas.

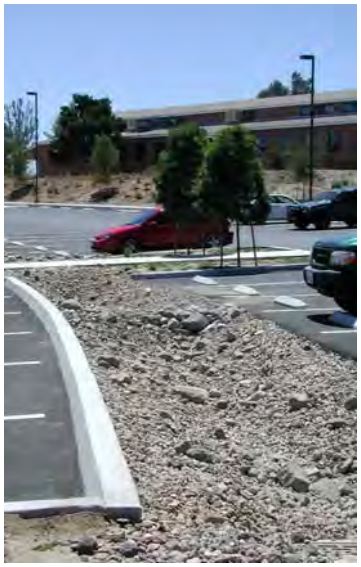
There are new coating and integral colorants that can be used in parking surfaces to improve solar reflectivity. If such products cannot be used, consider an open paving system that increases perviousness by at least 50%, reducing the amount of low reflective material and increasing infiltration of stormwater. Open grid paving systems cannot withstand high-traffic areas; however, they are ideal for overflow parking areas. Shade trees can significantly decrease heat island effects by lowering the ambient temperature. Design strategies and landscaping schemes should reduce solar heat absorption of exterior materials.

Figure B-3.5 Example of Parking Lot with a Permeable Parking Surface and Bioswales

B-3.3.3 Controlling Runoff

Parking areas typically create large amounts of runoff, taxing stormwater management systems. Techniques that help mitigate the runoff include bioretention, bioswales and strategically placed detention areas.

Figure B-3.6 Example of Drainage Solution in Parking Lot



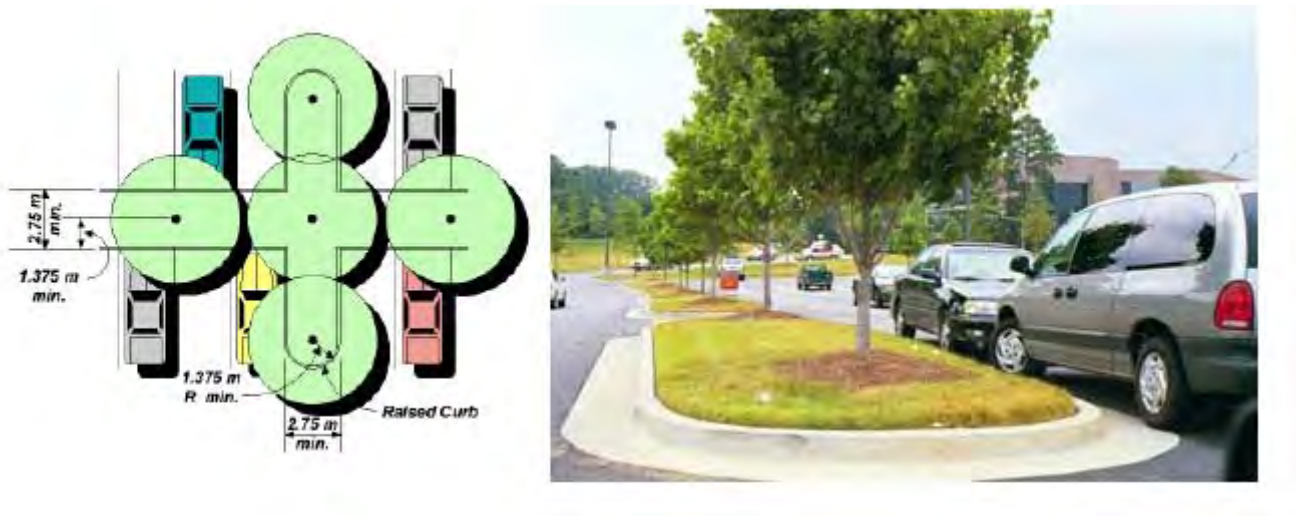
Reducing the size of parking lots is ultimately the best way to minimize negative effects of impervious surfaces. Scrutinize the parking requirements; parking lots may not need to be

designed for peak use. Overflow parking areas constructed of pervious materials may meet the occasional peak demand, reducing stormwater runoff and increasing on-site infiltration.

B-3.3.4 Horticultural Requirements

Parking areas are not normally conducive to healthy plant growth. Reflected sunlight, heat, and exhaust fumes pose challenges to plants. Non-porous pavement eliminates essential water exchange between plant roots and the atmosphere. For healthy plant growth, it is important to protect vital plant components (- roots, trunks, and leaves) - by providing adequate space for root growth and protecting the roots from cars.

Figure B-3.7 Examples of Adequate Planting Areas in Parking Island



B-3.3.5 Tree Selection Criteria

Trees are the most effective means of improving the aesthetics of parking areas. Some species are more appropriate than others for parking lots. Select trees with the following characteristics:

- Provide medium-to-dense shade in summer;
- Have normal lifespans over 60 years;
- Thrive in a typical urban environment;
- Demonstrate tolerance to salt and de-icing compounds where applicable - examples of tolerant trees are red oak, white oak, and red cedar;
- Require little pruning and are structurally sound; and
- Resist insects and diseases.

B-3.4 Bikeway and Walkway Planning Process

The automobile has become the primary means of transportation between the home, workplace, and community and commercial areas. Alternative circulation systems, including walkways for pedestrians and bikeways for bicyclists, can help reduce problems related to automobile travel, including traffic congestion, the consumption of resources, air pollution, parking area requirements, and potential safety conflicts. Adequate pedestrian and bicycle networks provide convenient, efficient, and aesthetically pleasing pathways and create opportunities for healthy activity. The objectives for walkway and bikeway networks include:

- Connect continuous pathways to community path systems where possible;
- Provide accessible pathways to all users, including challenged persons;
- Reduce safety conflicts between pedestrians, bicyclists, and automobiles;
- Provide amenities for the pedestrians and bicyclists; and
- Provide design consistency throughout the pedestrian and bicycle networks.

B-3.4.1 Planning Process

In order to create successful pedestrian and bicycle networks, develop an existing conditions survey, an origin-destination study, an adequacy analysis, and a network plan.

B-3.4.2 LEED Credits

LEED gives credits for encouraging alternative transportation, including public transit, bicycles, and alternative-fuel vehicles. In order to receive credit for alternative transportation using bicycles, the project must include adequate, secure bicycle storage and changing/shower facilities.

B-3.4.3 Fitness Trails

Military personnel must maintain a good level of physical fitness. Outdoor trails provide an alternative to indoor fitness centers. Lighting can extend the use of the trail into evening or early morning hours. Furnishings provide additional amenities along the trail. Coordinate fitness trails with other circulation systems for safety and usability.

B-3.4.4 Bikeways

Plan and design bikeways according to classifications that define the level of separation from roadways and walkways. Ideally, bikeways should be separate from both walkways and roads. When designing a bike path, key considerations include:

- Pavement widths;

- Bikeway clearances;
- Paving materials;
- Gradients and curvature;
- Stopping distances;
- Street crossings; and
- Signage.

B-3.4.5 Walkway Network Hierarchy

Based upon projected levels and types of use, design a hierarchical pedestrian circulation system that organizes walkways into a logical network according to each segment's function and reinforces the function through the width, treatment, amenities, and location of each segment.

Figure B-3.8 Example of Pathway Hierarchy

B-3.4.6 Troop Movement Walkways

Troop movement walkways are specific to military installations. Include special design considerations if the installation will have troops that regularly move from one location to another. Troops move four abreast, and a minimum of 10 ft (3 m) of unobstructed width should be provided.

Figure B-3.9 Troop Movement Walkway

B-3.4.7 Walkway Location

Locate walkways in response to the levels and patterns of user demand. Walkways should provide direct routes between destinations; however, walkways may instead provide physical and visual continuity where the pedestrian network may be otherwise discontinuous.

B-3.4.8 Crosswalks

Locate and clearly designate crosswalks to encourage pedestrians to use safe street crossings. Include crosswalks in all street intersections where there is pedestrian traffic. The design of crosswalks should follow these guidelines:

- Mark crosswalks with clearly visible painted stripes or by street paving that is consistent with the walkway paving material.
- Crosswalks should be the width of the adjacent walkway, but a minimum of 6 ft (1.8 m) wide.
- Provide curb-cut ramps for wheelchair access at each crossing. Apply a textured finish or raised devices to the ramp to indicate the vehicle roadway.
- Maintain sight lines to give both pedestrians and drivers an unobstructed view.

- Where a walkway and bikeway intersect, provide pavement markings to warn both pedestrians and bicyclists of the others' presence.

B-3.4.9 Steps and Ramps

Minimize the use of steps and ramps along walkways because they are more difficult to negotiate or, for some users, impassable. Gradients of 3 percent or less are preferred along walkways, and any walkway that exceeds a 4.2 percent gradient should be designated as a ramp. Follow the requirements of the Americans with Disabilities Act Accessibility Guidelines (ADAAG), and Uniform Federal Accessibility Standards (UFAS).

B-4 COMMON AREAS

Common areas include plazas, courtyards, parade grounds, recreational areas, landscape architecture at main gates, building entrances, playgrounds, and monuments. Design of common areas is similar to site design and the planning of circulation systems.

B-4.1 Role of the Landscape Architect

Coordinate and oversee the common area design process, which includes the following responsibilities:

- Provide a detailed analysis that includes a thorough assessment of visual, natural, cultural, and historical resources.
- Study design opportunities and constraints that will contribute to the resulting form of the common area.
- Design common areas to incorporate the overall circulation system and contextual surroundings.
- Select permeable surface materials for common areas unless an impermeable surface is a user requirement.

B-4.2 Plazas and Courtyards

The design process of a plaza or courtyard follows the same principles established in the site design and circulation systems described in the previous chapters.

B-4.2.1 Analysis

Conduct a visual analysis of the site and adjacent areas. Identify any buildings or structures that frame the space, and understand the scale relationships between these structures and the proposed open space. Other important analyses include context, views into and out of the site, destination points, circulation, topography, color, line, mass, and void.

Plazas and courtyards are typically proposed in urban environments, but natural resources play a significant role in the design process. Hydrologic systems and vegetative cover can affect a courtyard's resulting form. Both the locations of existing vegetation and the drainage requirements of a plaza or courtyard site may result in constraints on proposed utility locations and other structures that affect the proposed form and organization of the courtyard or plaza. Other natural variables include climate and topography.

The public benefits from interpretive elements of cultural and historic resources. Many DoD installation landscapes provide this opportunity, and all future plaza and courtyard installations should be assessed for such value.

Figure B-4.1 Illustration of a Courtyard

B-4.2.2 Programmatic Considerations

Most plazas and courtyards need space for group gathering and events. In these instances, it is appropriate to allow approximately 4 ft^2 (0.36 m^2) to approximately 12 ft^2 (1.1 m^2) per person. Different size requirements result in different spaces, including an intimate space or a larger, more open space that allows fluid circulation.

B-4.2.3 Materials

Types of impermeable surface materials that can be used in plazas and courtyards include, but are not limited to, unit pavers, concrete, and special paving. Asphalt is typical for vehicular applications and ball courts. Communicate with local paving suppliers and vendors for the availability of paving options.

B-4.3 Parade Grounds

Parade grounds are traditionally manicured lawns. Parade grounds provide sober, formal spaces for military ceremonies, formation drills, parade and review functions, and honor ceremonies. Like plazas and courtyards, the size and shape of a parade ground is determined by its use. Perform a needs assessment of programmatic uses during the planning or renovation process.

The size of a parade field is typically one acre per 125 persons. Surfaces are turf where feasible, and must be stabilized where climate and other conditions dictate. A reviewing stand may be planned with a capacity based on 5 -percent of the total officer strength.

Figure B-4.2 Example of Parade Ground

B-4.4 Recreational Areas

Recreational areas discussed in this chapter refer to fitness trails, sports fields, picnic areas, and golf courses. Dependent upon region and programmatic use, surfaces can range from compacted dirt to wild flowers. Other possible surfaces are mulched trails, planting zones of trees and shrubs, and even recycled rubber tires. Design recreational areas according to the predominant use intent.

B-4.5 Entrances

Entrances, as discussed in this chapter, refer to both main gates and building entrances. As key indicators of image and importance, design entrances in collaboration with a multi-disciplinary team. Involve security personnel in entrance design to ensure that security requirements are met.

B-4.6 Playgrounds

The design of playgrounds involves understanding the needs of the users, assessing the constraints and opportunities of the site, and addressing security issues with an interdisciplinary team approach. Landscape architects have traditionally designed playgrounds and are able to incorporate environmental education, sports, recreation, and low-maintenance surface and planting materials into designs. \1\UFC 3-210-04/1/*, Children's Outdoor Play Area*, details the required elements for playground design. UFC 4-740-14, *Design, Child Development Centers* provides information regarding outdoor landscaping for child development centers.

Figure B-4.3 Playground with Safe Low-Maintenance Surfaces

B-4.7 Monuments

Monuments identify places, memorialize individuals, and commemorate events and missions that are significant to the history of a DoD installation. Monuments can be as simple as a memorial plaque attached to a building, or they can be statues or sculptures, historic military equipment, or other freestanding commemorative displays. With proper planning and design, monuments will fulfill their intended function as aesthetic and cultural objects, and contribute to the visual quality and identity of a DoD installation.

Monuments increase awareness of an installation's history and strengthen its image and identity by:

- Preserving historically or culturally significant objects or features;
- Commemorating places, events, individuals, and missions that are significant to the history and identity of the installation or the region; and
- Contributing to the visual quality of the installation.

Figure B-4.4 Static Display Included as Part of the Overall Site Design

B-4.8 Surface Materials

The benefits of impermeable surfaces are discussed below. When applicable, specify local materials for quality, timeliness in delivery, and local access for repairs. In addition, LEED encourages the use of local materials.

B-4.8.1 Impermeable Surfaces

Specify impermeable surfaces for common areas that must accommodate vehicular traffic and equipment such as bicycles, wheelchairs, strollers, roller blades, skate boards, and maintenance vehicles. A few of the many other common area uses that require an impermeable surface are ball courts, outdoor cafes, and swimming areas. Impermeable surfaces should only be used program requirements since they often increase stormwater runoff, increase light reflection, and can be more labor-intensive to construct and maintain than many permeable surfaces.

B-4.8.2 Permeable Surfaces

From an environmental, construction, and maintenance standpoint, permeable surfaces are preferred for common areas where possible. Permeable surfaces allow water to infiltrate through the ground's surface and recharge underground aquifers. They also result in less retention of heat than large masses of impermeable or hard surface paving.

Some permeable surfaces are more environmentally responsible and cost-effective than others. For example, turf grass typically requires irrigation, chemical treatments, and high levels of maintenance. Conversely, areas planted with low-maintenance local vegetation, including groundcovers, varieties of grasses, as well as combinations of trees and understory plantings, may not. Refer to the installation plant list for low-maintenance, drought-resistant planting options in the project's region.

B-5 PLANTING DESIGN

This chapter provides guidelines for the planting design process to produce functional, attractive, and sustainable landscapes.

B-5.1 Role of the Landscape Architect

The planting design process includes the following:

- A detailed analysis that includes a thorough assessment of existing vegetation, wildlife, sun-shade studies, soil types, climate, and user needs.
- Use of planting design, material, and maintenance procedures that are sustainable, manageable, and affordable.
- Planting plans that define space through mass, form, scale, line, pattern, texture, color, framework and variety.
- The selection of plants to ensure that they are indigenous or otherwise appropriate to the site.

B-5.2 Planting Design Goals

Planting plans should promote energy conservation, direct circulation, and minimize maintenance and irrigation requirements. The following sections highlight key goals for planting design on a DoD installation.

B-5.2.1 Sustainability

A sustainable planting design may initially cost more to install, but it can ultimately result in a more viable and attractive landscape. Strive to design using the latest sustainable techniques. Some of the benefits of sustainable designs include:

Requires less maintenance;

Maximizes installation operational efficiency;

Contributes to the overall visual quality of the installation;

Increases the quality of life on the installation; and

Increases erosion control.

B-5.2.2 Compatibility

The installation should promote a simple, low- maintenance planting style. To ensure consistency in planting design solutions, all landscape architects, design agents, and tenants should comply with the installation landscape development plan.

B-5.2.3 Maintenance

Landscape maintenance becomes the key issue considering dwindling budgets and personnel. Strategically select and locate plant material to minimize maintenance requirements.

Figure B-5.1 Dry Stream Bed Adjacent to an Outdoor Storage Lot

Figure B-5.2 Example of Planting Design Reducing Effects of Solar Glare and Reflection

B-5.2.4 Grading and Drainage

Consider the effects of heavy rainfall, drainage patterns, downspouts or roof drains, and potential ponding areas in the final planting design. Choose and locate plants and inert material to make drainage and grading elements more functional and attractive. In drier climates, grading and drainage should direct runoff to landscaped areas to minimize irrigation requirements.

Many projects may require retention or detention facilities to impound or delay storm water runoff, potentially creating special planting design situations. Opportunities for creative planting that alleviate extensive use of stormwater infrastructure include:

- Rain gardens;
- Bioswales;
- Wet ponds;
- Constructed wetlands;
- Bioretention areas; and
- Green Roofs.

B-5.2.5 Site Security

Planting design plays an integral role in the site security design. Choose plants to either open lines of sight or block views or movement of people. In sensitive areas, planting design must closely coordinate with security. See \1\UFC 4-010-01/1/*, DoD Minimum Antiterrorism Standards for Buildings*, for specific guidance. Installation should determine a list of low-growing plants that require minimum maintenance.

B-5.2.6 Functional Uses of Plants

Besides adding seasonal variety and beauty, use planting design to achieve the following functions.

- Energy conservation/temperature modification;
- Wind control;
- Noise abatement;
- Security;
- Glare control;

- Surface erosion control;
- Wildlife habitat; and
- Wetlands.

Figure B-5.3 Example of Low-Growing, Native Plants

Figure B-5.4 Example of Planting to Diffract and Break-Up Sound Waves

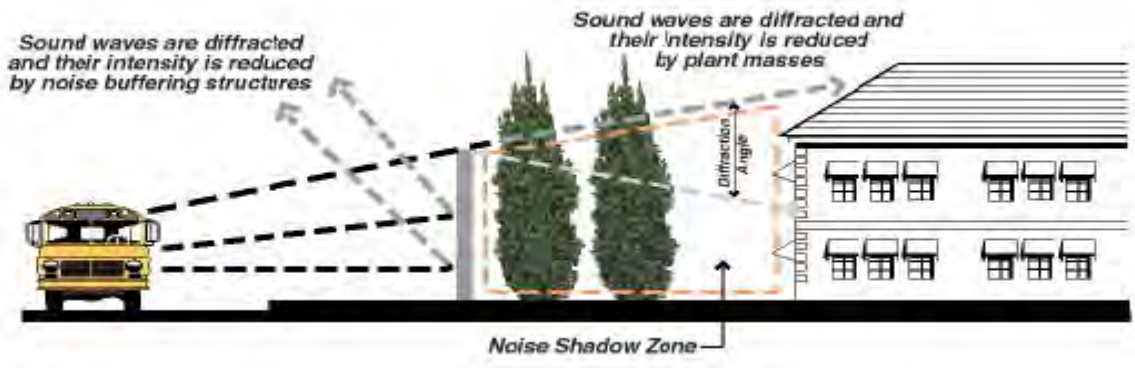
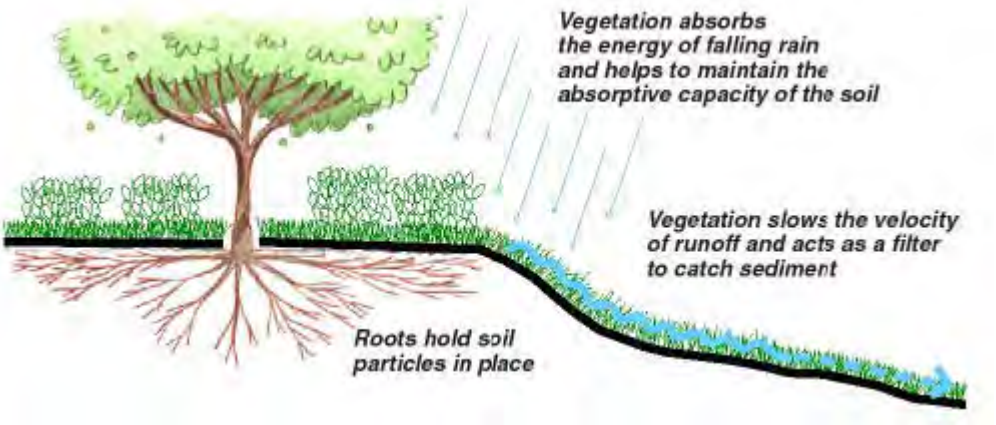


Figure B-5.5 Example of Planting to Prevent Erosion



B-5.2.7 Visual Effect

Use planting design to create the following visual effects through planting design:

- Streetscape wayfinding;
- Architectural softening;
- Visual barriers to physical movement;
- Screen undesirable elements;
- Accent key places or elements; and
- Parking area buffers.

Figure B-5.6 Example of Consistent Identity of Streets

(Formal [Left] and Informal [Right])

Figure B-5.7 Example of Trees Used as Architectural Elements to Frame Building Entry

Figure B-5.8 Example of Visual Barrier with Plants

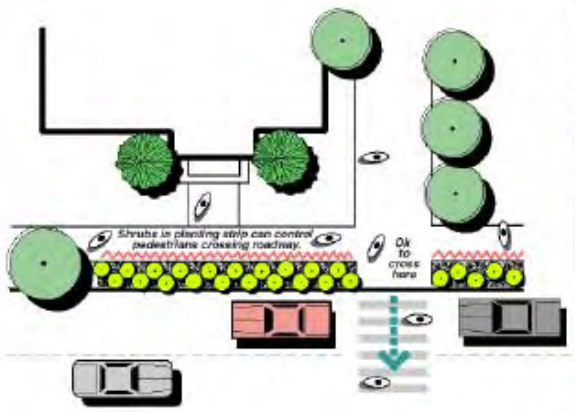


Figure B-5.9 Shrubs and Trees Buffer Pedestrian Walkways and Vehicular Traffic

Figure B-5.10 Trees Screen a Parking Structure

Figure B-5.11 Example of Parking Lot Screened by Native Planting Design

B-5.3 Design Process

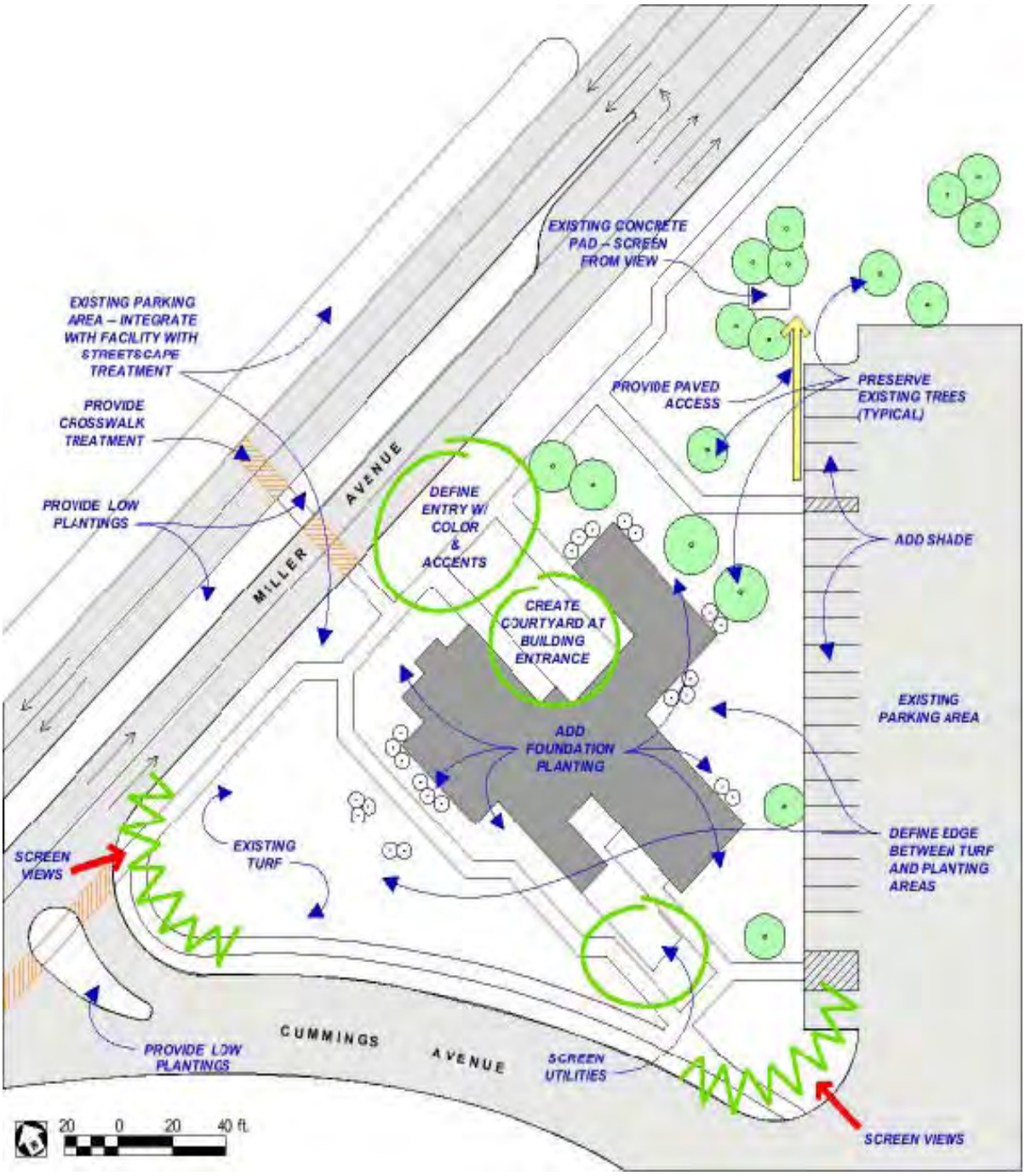
The planting design process closely parallels all successful problem-solving methods, and consists of three basic steps: analysis, concept, and implementation. Each of these steps has a graphic component. Before beginning a planting design, finish the site plan, including major site elements such as parking areas, screen walls, and sidewalks, and complete the following tasks:

- Determine existing vegetation to be saved;
- Determine major grading requirements; and
- Locate both proposed and existing utilities.

B-5.3.1 Analysis

Identify the functional areas, which will greatly assist in plant material location and selection later in the planting design process. See Figure B-5.12 for an example planting design analysis.

Figure B-5.12 Example of Planting Design Analysis

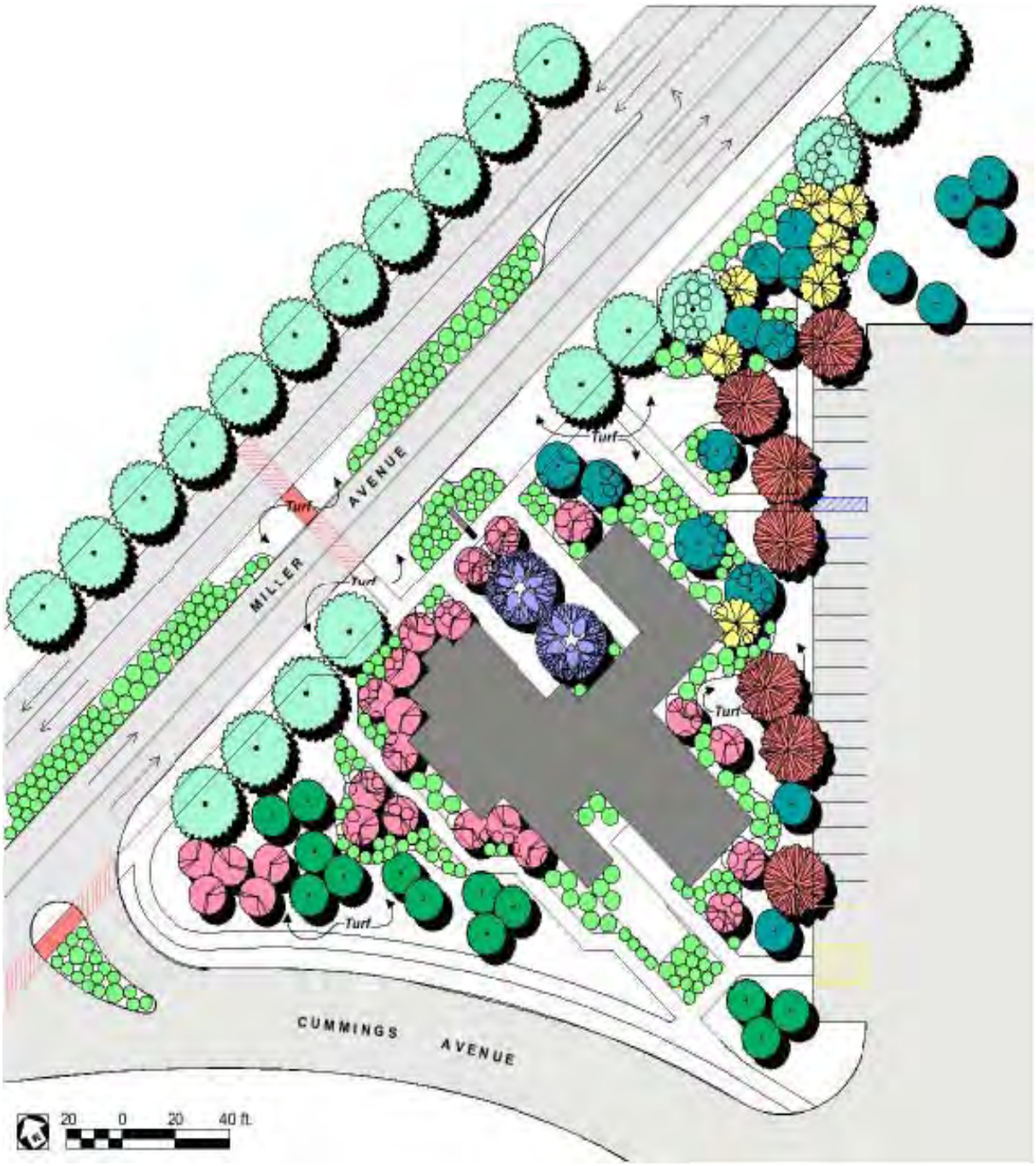


B-5.3.2 **Concept**

Rather than making specific plant choices, think in terms of general plant size and character. Use concept plans to discuss design concepts and plant choices with commanders, nursery

personnel, customers, facility users, or other landscape professionals. See figure B-5.13 for an example of a concept planting plan.

Figure B-5.13 Example of a Concept Planting Plan

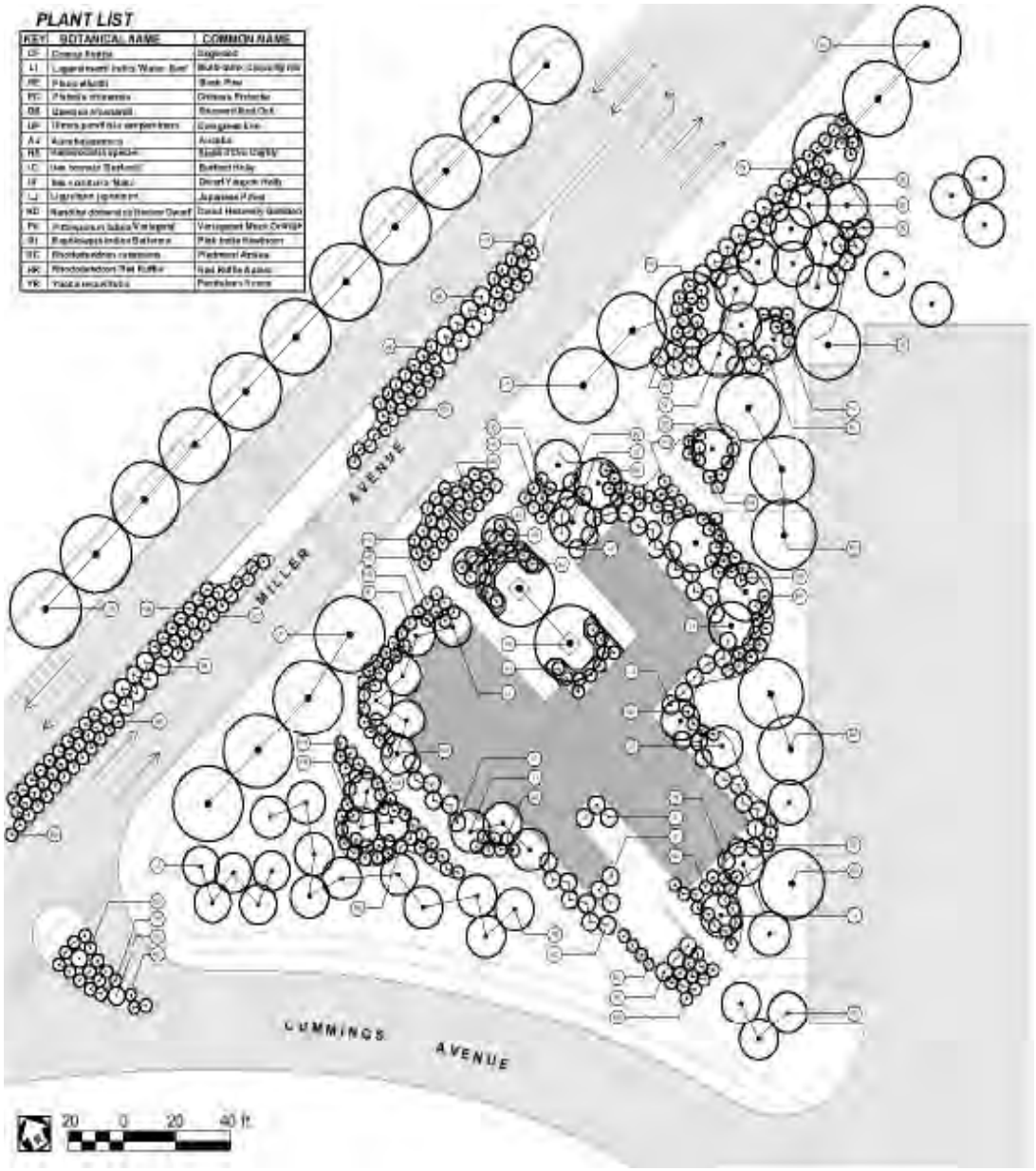


B-5.3.3 **Implementation**

Communicate construction elements of the final design on the planting plan. Consider the following elements during the implementation phase of the planting design process:

- Location;
- Identification;
- Quantity; and
- Clarification.

Figure B-5.14 Example of Planting Plan Specifying Number and Location of Plants in a Design



B-5.4 Selecting and Locating Plants

In order to create low-maintenance and attractive landscapes, select and use plants that grow together in native plant communities in the region.

B-5.4.1 Plant Types

A good planting design includes plants at several different scales. Combining plants of several types - including trees, shrubs, groundcovers, grasses, vines, perennials, and annuals - adds richness to the site. In an exemplary and sustainable planting design, each plant contributes to the intended overall effect.

Figure B-5.15 Example of Groundcover in Area Difficult to Mow

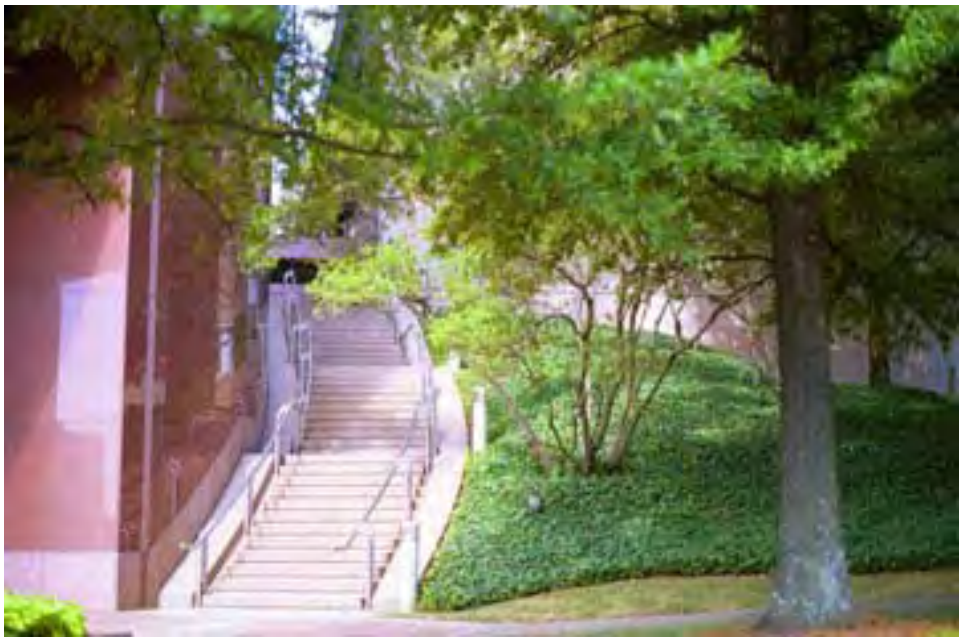


Figure B-5.16 Example of Perennials and Annuals used to Accent a Pedestrian Path.

Figure B-5.17 Example of Ornamental Grass Used as an Accent

B-5.4.2 Plant Communities

Selecting plants from the same natural community reinforces the regional landscape character while offering the following benefits:

- Naturally compatible soil and nutrient needs reduce significant requirements for planting pit preparation and amendments.
- Complementary visual image provides cohesiveness and unity to eventual planting design composition.
- Comparable water needs reduce requirements for expensive irrigation systems.

An experienced, conscientious landscape architect is knowledgeable about species composition, plant distribution patterns, natural order, and diversity of the commonly occurring plant communities. Identify plants native to the installation's region in the installation plant list.

B-5.4.3 Installation Plant List

The installation plant list documents trees, shrubs, annuals, perennials, turfgrasses, and groundcovers to be used in landscape design projects. The installation plant list should be part of the installation design guidelines. The plant list is the backbone of installation planting design and helps to unify the image of the installation. The installation plant list provides a palette of desirable plant material that possesses the following characteristics:

- Hardy and relatively pest-free;
- Regionally native or indigenous;
- Minimal maintenance and irrigation; and

- Readily available.

B-5.4.3.1 Plant List Information

The installation plant list should include the following information for each plant:

- Genus, species, and cultivar (if necessary);
- Common name;
- Evergreen/deciduous;
- Mature height and width;
- Planting size;
- Exposure (sun/shade tolerance); and
- Irrigation requirements.

B-5.4.3.2 Use Categories

Plant material selected for the installation plant list should be categorized according to the following uses:

- Foundation;
- Barrier;
- Screen;
- Accent;
- Wetlands; and
- Wildlife.

B-5.4.3.3 Invasive Plants

The installation plant list should also contain a section for plants that **must not** be specified. Invasive plants are non-native species that spread quickly. These non-native species are difficult to control and can infest both designed and natural areas.

B-5.5 Xeriscape

Xeriscape is the theory and practice of planting that conserves water and energy through creative and adaptive landscape design. Xeriscape landscapes are attractive solutions that

save money, water, and maintenance. Xeriscape uses native, naturally-occurring plant material in the landscape design to convey a sense of regional context while embracing sustainable landscape design and preservation of native and endangered species.

B-5.5.1 Xeriscape Design Techniques and Maintenance

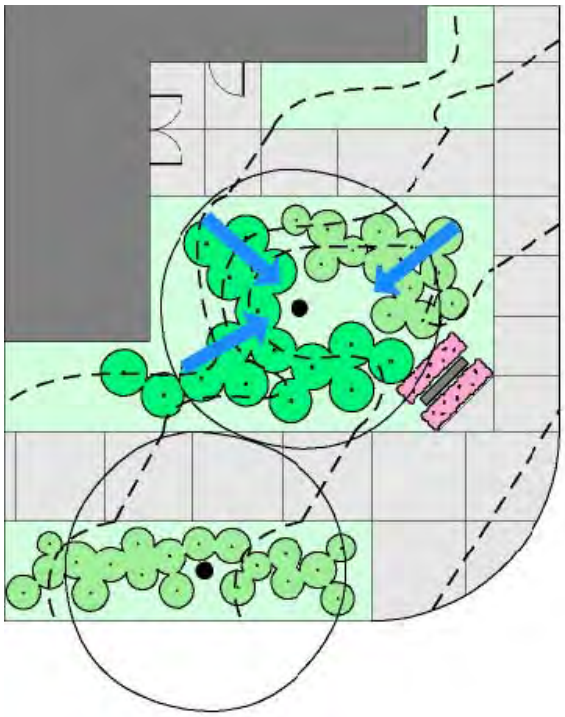
Reduce the amount of outdoor water use through appropriate techniques and proper maintenance specification.

- Select turf varieties that require minimal additional irrigation, or alternate with plant materials that require less water.
- Design larger turf areas in shallow depressions to passively collect rainwater.
- Use innovative rainwater harvesting techniques including berming and sensitive site grading for collecting, concentrating, and storing water for use by plants.
- Select water-efficient plants. Installations should populate their plant lists with native plants that have demonstrated long-term landscape value through hardiness, availability, and minimal maintenance and water requirements.
- Use pine needles, bark, or other inert organic mulches to reduce water needs and weed growth while providing surface erosion control and soil improvement through slow decomposition.
- Practice proper maintenance, including raising the mower height and pruning appropriately to reduce evapotranspiration.
- Irrigate efficiently by watering slowly, deeply, and infrequently.

Figure B-5.18 Example Xeriscape Planting Design

Figure B-5.19 Example of Combination Mulch and Groundcovers

Figure B-5.20 Example of Water Harvesting Plan



B-5.5.2 Xeriscape Guidelines

Follow these principles to ensure functional and attractive xeriscape plants.

- Contact local landscape architects, nursery personnel, and county extension agents to obtain specific xeriscape information.
- Regularly update the installation plant list to include newly available water-efficient material.
- Replace missing or broken sprinkler heads or emitters immediately.
- Adjust irrigation controller programs according to temperature and seasonal changes.
- Regularly inspect emitter flow and flush distribution tubing, and clean filters on drip systems.
- Consider replacing turf areas with groundcovers or inert materials.
- Mulch plants wherever possible.

- Integrate well-timed applications of fertilizers, pesticides, and herbicides to the maintenance program of xeriscape plantings.

- Conduct regular xeriscape seminars to increase the understanding and appreciation of water-conserving practices among military family housing residents and facility managers and custodians.

B-5.6 Remediation and Reclamation

Several sites across the country are the by-products of DoD operations activities which have had long-term, harmful impacts on the land. Various types of personnel training, munitions and ordnance production and testing, and other types of research and development, produce toxic wastes that have resulted in significant contamination of soil, groundwater, and air. The contamination threatens ecosystems and poses potential health risks to adjacent human communities. Remediation is a possible solution to the negative effects of contamination, and multiple organizations within DoD are actively engaged in studying and using remediation technologies to address these issues.

For sites that require consideration of bioremediation and phytoremediation techniques, engage an interdisciplinary team that is actively engaged in studying and using remediation technologies.

B-5.6.1 Sites

Many types of sites, including the following, are potential candidates for remediation.

- Former defense sites;

- Training ranges;

- Small arms ranges;

- Bombing and aerial gunnery ranges; and

- Underground test area project and offsites.

B-5.6.2 Contamination

Remediation is a solution to the following types of contamination and disruption:

- Deforestation;

- Unexploded ordnance;

- Lead;

- Explosive compounds;

- Heavy metals;
- Polyaromatic hydrocarbons; and
- Petroleum and oil lubricants.

B-5.6.3 Technologies

Consider the following remediation technologies:

- Revegetation;
- Terrestrial phytoremediation;
- Wetland phytoremediation;
- Removal and off-site decontamination of soil;
- Incineration;
- Air sparging and bioventing;
- Soil washing;
- Acid leaching; and
- Slurry reactor.

B-5.6.4 Case Studies

To learn more about the use of remediation on DoD installations, look at the following demonstration projects:

- Milan Army Ammunition Plant (MAAP) in Tennessee;
- Small Arms Range Remediation at Fort Polk, Louisiana; and
- Iowa Army Ammunition Plant in Middleton, Iowa.

B-5.7 Interior Planting

Indoor plants were once considered to play only an aesthetic role as a "nice-looking green mass." Plants can control traffic flow, screen views, and reduce glare. They can enliven any indoor setting and be environmentally beneficial by filtering and purifying the air.

B-5.7.1 Design

Base interior designs upon sound design principles and an understanding of the unique indoor environment. The design should consider all of the following:

- Benefits (aesthetic, engineering uses, environmental);
- Light (intensity, plant response, sources);
- Temperature;
- Atmosphere (air movement, relative humidity, air pollutants); and
- Maintenance level.

Figure B-5.21 Examples of Indoor Plants Defining a Large Space

B-5.7.2 **Planters**

Planters can be either permanent fixtures or moveable containers. The selection and design requires careful consideration and planning. It is important to consider the practical and aesthetic qualities of the choices when selecting planters for interior use. These qualities include:

- Plant needs;
- Aesthetics;
- Cost and availability;
- Strength and durability;
- Weight;
- Drainage; and

- Material.

Figure B-5.22 Examples of Permanent and Moveable Containers

B-5.7.3 Maintenance

Maintenance is the key to successful interior planting design. Poor maintenance makes even the best design and installation a failed interior landscape. To ensure long-term success of the interior landscape, the landscape architect should be involved when writing the maintenance contract.

B-5.7.4 Interior Planting Principles

Sound interior planting design principles and appropriate maintenance techniques minimize environmental impacts while maximizing long-term value and efficiency. The following are principles for efficient and attractive interior planting designs.

- Consult local extension agents and nurseries on the suitability and availability of interior plant material.
- Comply with installation interior landscape development and design policies.
- Always factor all facility, site, user, and environmental considerations into the final design.
- To ensure interior plant beauty and viability, establish a watering and fertilizing schedule and keep plants free of dust, pests, and disease.
- Ensure trimming and maintenance tools are routinely disinfected with alcohol or bleach.
- Ensure indoor environmental conditions are maintained appropriately to maintain plant viability.
- Remove any standing water from planter saucers.

B-6 FORESTRY

Trees, whether naturally occurring or planted, are a valuable asset on every DoD installation. This chapter outlines the importance of an urban forestry program. Forested areas improve air quality, reduce energy costs, preserve wildlife habitat, and contribute to water and soil conservation in a built environment.

B-6.1 Role of the Landscape Architect

Coordination and oversight of the urban forestry design process includes:

- Promotion of urban forestry practices as a required aspect of site planning, design, and construction.
- Conservation of existing and native trees in built areas through environmentally sensitive and creative site planning and design.
- Oversight of the establishment of a tree inventory.
- Oversight of the writing of a maintenance plan and the development of management tools for urban forestry.

B-6.2 Trees

Trees are an important resource that not only provide texture, color, and beauty to an installation's surroundings, but also modify the local environment and give an installation a specific character and identity. Trees should be properly managed, including selection, planting, and maintenance.

Figure B-6.1 Example of Trees Used to Soften Architecture

B-6.2.1 Energy Conservation

Place trees strategically to maximize energy savings. The shade and canopy cover from trees alter surrounding micro-environments and reduce energy costs by reducing cooling demand. During winter months, trees alter wind flow and drifting snow by blocking or redirecting winds, passively reducing winter heating costs.

B-6.2.2 Natural Resources

A forestry program is useful to locate, improve, and preserve the habitat of wildlife species.

B-6.2.3 Environmental Influence

Trees reduce air pollution by serving as natural air cleaners, removing carbon dioxide from the air and releasing oxygen. Trees intercept rainfall to help control erosion. The root systems of trees help stabilize the soil and slow rainfall runoff by absorbing water before it enters a storm drainage system. Trees return overall benefits and value to the installation beyond the time and money invested in them for planting, protection, and maintenance.

Figure B-6.2 Examples of Trees Used to Shade Roadways and Parking Areas

B-6.3 Urban Forestry Management Plan

Identifying, quantifying, and understanding an installation's tree population is crucial to determining a comprehensive, long-term approach to its well being. Trees will generally live longer and gradually require less intensive care with scheduled maintenance.

B-6.3.1 Management Categories

Trees on an installation fall into four management categories. Each of these categories will have different management or maintenance requirements.

B-6.3.1.1 Native Forests

Native forests found in undeveloped areas should be managed as part of the commercial forestry program.

B-6.3.1.2 Native Trees in Developed Areas

Native trees located in and around developed areas should be inventoried and become part of the urban forest database, which should receive regularly scheduled maintenance and care.

B-6.3.1.3 Installed

Every tree planted as seedlings, transplants, or nursery stock should be included in the urban forestry inventory and receive scheduled maintenance and care.

B-6.3.1.4 **Airfield**

See \1\UFC 3-260-01/1/, *Airfield and Heliport Planning and Design*. Proper planning and management should ensure safe aircraft operations while eliminating the need to remove maturing trees.

B-6.3.2 **Tree Inventory**

A tree inventory can yield valuable information for the landscape architect, community planner, natural resources planner, and grounds maintenance manager. Below are a few of the uses for the tree inventory:

- Indicate locations of tree resources that should be protected and integrated into the building siting process.
- Provide location, species, and size of existing trees to inform of existing conditions for site analysis and planting design.
- Provide an information database for the installation's urban forestry management plan.

Information about protecting and managing trees should be incorporated into a computer aided drafting program (CAD) database or geographical information system (GIS) which can be customized to create an integrated management strategy to effectively maintain the installation's valuable tree resources. The following information is typically gathered during a tree inventory:

- Botanical and common names;
- Size (height, canopy spread, trunk diameter at breast-height);
- Approximate age and life expectancy;
- Condition;
- Replacement value;
- Maintenance needs;
- Tree location reference points;
- Hazard potential; and
- Tree box or planting strip condition.

B-6.3.3 Analysis

Use tree condition data to develop cost-effective pruning and removal schedules, personnel or labor needs, and material requirements. The following areas contribute to a viable maintenance program:

- Species diversification;
- Approximate age and life expectancy; and
- Removal and pruning requirements.

Table B-6.1 Sample Table of Species Population Distribution

(No genus and species should account for more than 10 percent of the total tree population.)

Genus Species	Common Name	#	%
Acer ginnala	Amur Maple	686	17.3
Acer rubrum	Red Maple	208	5.2
Betula nigra	River Birch	534	13.4
Cedrus deodara	Deodar Cedar	294	7.4
All others	Miscellaneous	-	56.7

Table B-6.2 Sample Table Shows Annotation of Age Data

(The ideal age distribution of a species in the urban forest is 20 percent young, 60 percent mature, and 20 percent over-mature.)

DBH Range	Number of Trees	Percentage of Trees
Young (<15 cm)	2,260	56.8
Mature (>15 to 61 cm)	1,499	37.7
Overmature (>61 cm)	215	5.5

B-6.3.4 Implementation

Properly collected and analyzed data provides the urban forest manager or landscape architect with information to formulate replacement schedules, maintenance policies, and budgets. A comprehensive tree inventory facilitates the following urban forestry tasks:

- Maintenance scheduling;
- Planting recommendations; and
- Database management.

B-6.4 Planning Actions

Healthy trees increase in value with age while providing both tangible and intangible benefits. Urban forest resources should be protected and preserved. New trees should be added to the inventory as a legacy of DoD stewardship and concern. Installation leadership can make a contribution to the future by implementing a comprehensive and progressive Urban Forestry Management Plan.

Below are recommended actions to initiate and execute a comprehensive Installation Urban Forestry Management Plan:

- Develop an installation tree inventory to identify and assess the extent, condition, and needs of the urban forest.
- Use a computer to effectively and efficiently manage and update tree database information.
- Integrate the tree inventory with installation planning and design functions.
- Enlist the education and experience of a certified arborist.
- Follow tree care specifications.
- Consult with landscape architects in developing tree planting designs.

B-7 IRRIGATION DESIGN

Limited water and energy resources place great importance on the need for irrigation efficiency and sustainable design practices. Irrigation design is closely tied to the entire site design, especially planting design. Consider the impacts of irrigation at the beginning of the design process.

B-7.1 Role of the Landscape Architect

Coordination and oversight of the irrigation system design process includes:

- Consideration of the unique characteristics of the soil, climate, topography, quantity and quality of water and specific plant material when determining a preliminary irrigation strategy.
- Providing irrigation system designers and vendors with the information necessary to understand the irrigation resources, requirements, and sustainable design opportunities of a project.
- Promotion of water conservation efficiency to irrigation designers.
- Guidance of the overall planning and design concept of irrigation systems.

B-7.2 Irrigation Importance

Irrigation systems are an important part of establishing and maintaining a landscape. Planting on a DoD installation is a large investment, and without proper maintenance it will not survive. If the irrigation system is not properly designed, however, it can be a large financial and water drain on an installation. Design an irrigation system to efficiently conserve water while delivering required resources to the landscape.

B-7.2.1 Water-Efficient Landscapes

The LEED program gives credit for water-efficient landscapes. The intent is to limit or eliminate the use of potable water for landscape irrigation. Obtaining this goal creates economic and water efficiencies for installations. This chapter outlines techniques to create planting designs that require less irrigation.

B-7.2.2 Efficient Systems

High-efficiency irrigation systems deliver up to 95 percent of the water supplied versus conventional irrigation systems that are as little as 60 percent efficient. Research into the latest technology should save water and money.

B-7.2.3 Technical Guides

For technical information related to irrigation, see \1\UFC 3-420-01/1/*, Plumbing Systems,* Unified Facilities Guide Specifications (UFGS) \1\32 84 23/1/, *Underground Sprinkler Systems*, and UFGS 32 84 24, *Irrigation Sprinkler Systems*. The information in this chapter discusses broad concepts relating to site design to efficiently use irrigation systems.

B-7.3 Minimizing Water Requirements

Design a comprehensive landscape plan to minimize water requirements. The following techniques should be used in coordination or alone, depending on the site.

B-7.3.1 Plant Material Selection

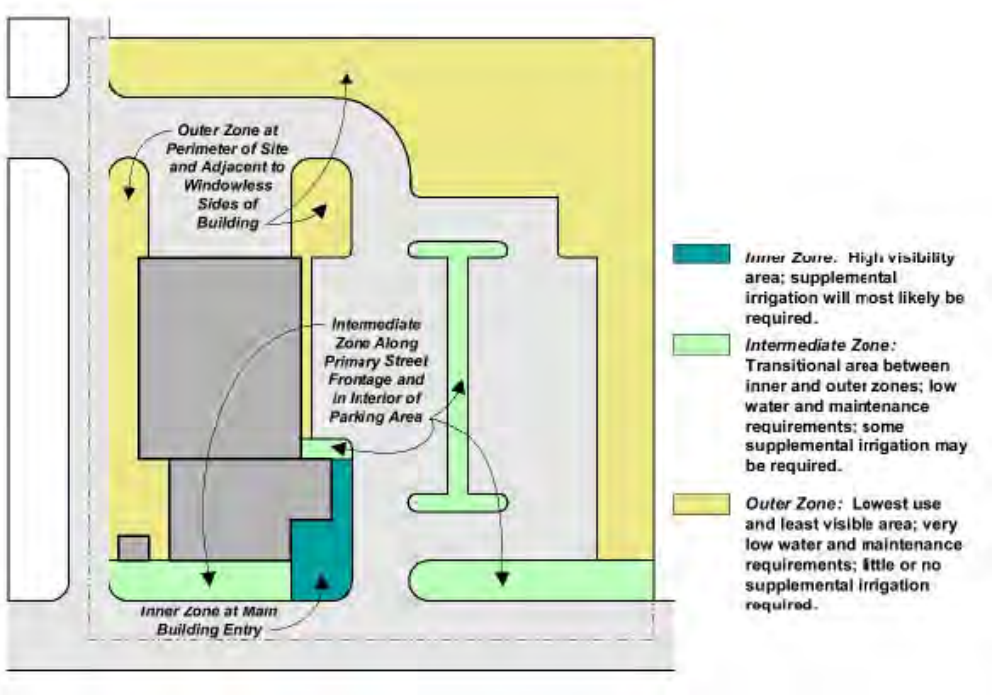
Consider water requirements when choosing plant material in order to reduce water consumption. The following planting practices reduce water requirements:

- Limiting the amount of turf grass will reduce a large amount of water required.
- Grouping plants with similar water requirements allows for greater efficiency in the irrigation system.
- Native plants are more acclimated to the climate and require less irrigation. Choosing plants that grow together in nature, called plant associations, is one way to assure that they will have similar requirements.

B-7.3.2 Water Budgeting

Concentrating plants with similar water-use requirements, or creating hydrozones, simplifies and economizes irrigation system design and maintenance requirements. Hydrozoning a landscape development based on site use patterns, plant material densities, supplemental water requirements, and microclimates is fully embodied in the concept of water budgeting. Three hydrozones are discussed below:

Figure B-7.1 Example of Hydrozoning Concept Plan



- **Inner Zone:** The inner zone of a planting plan is the area which will have high visibility and be significantly important to the facility in terms of appearance, image, and use. Even though the inner zone has a higher water demand than other zones, it can still require less irrigation than a traditional landscape if it is planned appropriately.

- **Intermediate Zone:** Plants in the intermediate zone may require more water than available from natural precipitation. Plant densities are less than in the Inner Zone. Overall, maintenance and water use should be minimal. By taking advantage of runoff from paved areas or roof drains, supplemental irrigation can be reduced.

- **Outer Zone:** The Outer Zone is generally characterized by plants having the lowest water requirements and lowest intensity of human use. Once established, plants in the Outer Zone typically require very little to no irrigation or maintenance, with the exception of weed control and occasional pruning. Choose plant materials especially for their hardiness and extremely low water requirements.

B-7.3.3 Water Schedule

Water requirements will change throughout the year. Update the schedule with each season. Some scheduling systems allow for daily updates based on information gathered at the nearest weather station.

B-7.3.4 Irrigate Efficiently

The methods of daily application of water can greatly influence growth patterns and hardiness of plants. The following three irrigation practices should reduce the overall amount of water used:

- Water Slowly: Never apply water faster than the infiltration rate of the soil. Slow and even irrigation allows for proper soil moisture to be maintained in the root zone, providing for the best growing conditions for plant material while eliminating or minimizing runoff and potential erosion.

- Water Deeply: Irrigate each plant variety long enough for water to reach the root zone.

- Water Infrequently: Deep watering promotes deeper roots, further reducing irrigation requirements.

B-7.3.5 Grading

When applicable, use the slope of the land to direct water to planting areas, reducing the amount of irrigation needed and controlling excessive stormwater runoff.

B-7.4 Water Sources

Irrigation typically uses potable water, although lower quality water is equally effective for irrigating landscapes. Sources of non-potable water include the following:

- Captured rainwater from roof and parking lot runoff;

- Graywater from building systems; and

- Municipal recycled water supply systems.

Figure B-7.2 Example of a Rainwater Collection System

B-7.5 Establishment

After a planting design has been installed, there is a required establishment period. New plantings are in a stressful situation and require additional care, observation, and water to promote growth and vigor. A one-year establishment period is typical; however, some plants, particularly trees, may need longer. After the plants are established, evaluate the irrigation control system and adjust if necessary.

Personnel responsible for maintaining the project after installation should be aware of the watering needs of the plants on-site, as well as the operation of the total irrigation system from the controller to the individual sprinkler heads. Adjustments to the irrigation system should be made in a timely and correct manner. Proper establishment significantly increases the chances that the landscape will provide years of function and beauty.

B-7.6 Maintenance

Immediately following installation of the irrigation system, establish a comprehensive and aggressive maintenance program to ensure lasting results of the irrigation system and landscape. Include the following in an irrigation system maintenance program:

- Adjust the controller program according to seasonal changes;
- Establish a schedule to clean all filters and strainers on the entire system;
- Ensure that controllers are operating correctly by checking them at least weekly;
- Regularly check the connections and fuses and test the rechargeable program back-up battery;

- Verify that spray and rotary head spray patterns are not spraying undesired areas such as driveways or parking lots;

- Test backflow prevention devices at least two times a year to confirm correct operation;

- Educate grounds maintenance personnel to ensure they minimize lawnmower and string trimmer damage to risers and delivery devices;

- During inspection tours of the project site, look carefully for dry or overly wet spots; and adjust components as necessary;

- Establish a schedule to clean all delivery device orifices annually;

- In cold winter areas, establish dates to purge and drain the irrigation system and ensure the components are protected from the effects of freezing; and

- On drip systems, ensure the narrow "spaghetti" tubes with the emitters on the end are protected and those installed in the ground remain covered.

B-7.7 Conclusion

Efficient irrigations systems begin with sustainable landscape design. Educate the client and the contractors about the water-efficient intent of the design. When the design requires extensive irrigation, especially when it must be sustained indefinitely, educate the client regarding the consequences of intense irrigation.

B-8 SITE FURNISHINGS

Landscape architectural involvement in specifying and designing site furnishings will ensure that the intended and agreed-upon design concept and functional requirements of a project site will be met.

B-8.1 Role of the Landscape Architect

Coordination and oversight of the site furnishing design and specification process includes:

- Understanding the project user needs and requirements for site furnishings and the maintenance availabilities of a site.
- Coordinating site furnishings with all aspects of the site plan and installation requirements, including security design requirements.
- Providing recommendations for site furnishings that fit within the local context of a site and are available through accessible vendors.
- Considering the use of sustainable materials in the selection of site furnishings.
- Providing adequate lighting for the safety and security of drivers and pedestrians.

Site furnishing design specifics will be addressed on a per-installation basis through the base installation design guide.

B-8.2 Exterior Lighting

Choose fixtures that are energy-efficient and have low maintenance requirements. A qualified lighting professional should be involved in the selection of equipment and the development of a lighting system design. For **Army** and **Navy** projects, refer to \1\UFC 3-530-01/1/, *Design: Interior and Exterior Lighting and Controls*.

In order to establish nighttime security, orientation, and illumination of features, the planning process for the lighting system should be logical, comprehensive, and include the following documents:

- Existing conditions survey;
- Adequacy analysis; and
- Lighting plan.

B-8.2.1 Exterior Lighting Equipment

Choose light fixtures based on existing architectural standards of the installation and that reflect the installation's architectural character and visually unify the streetscape and other areas. Use of standardized parts and procedures should simplify maintenance and repair of equipment.

B-8.2.1.1 **Lamps**

The type of lamp used in the light fixture determines brightness, color, energy efficiency, life span, and suitability for a specific application.

B-8.2.1.2 **Luminaires**

Based on the use of the area, decide on the distribution pattern of light on a surface. The pattern will be controlled by placing the lamp in a luminaire with the use of an enclosure, reflector, refracting lens, or a combination of these.

B-8.2.1.3 **Poles**

Select light poles according to length, material, finish, and shape based on existing architectural standards and the installation's proposed architectural character. The variety of light poles used on an installation will be limited. Common materials for poles include:

- Concrete poles;
- Aluminum poles;
- Decorative wood poles;
- Painted steel poles; and
- Weathered steel poles.

Table B-8.1 Characteristics and Uses of Different Lamp Types

Lamp Type	Color Rendition	Energy Efficiency (lumens / watt)	Life (hours)	Recommended Uses
Incandescent	renders colors well with emphasis on warmer tones	10–20	750–2,000	pedestrian areas, where natural color rendition is important
Mercury Vapor	green to blue-green; cannot render reds and yellows well	30–65	24,000	residential street lighting and accent lighting for planting material

Metal Halide	white light; renders colors well	75–125	15,000	general area lighting in public areas
High-Pressure Sodium	golden cast	75–130	20,000	primary and secondary roadway and parking lot lighting

B-8.2.1.4 Design Considerations

Consider the design, material, and scale of lighting equipment during the development of a lighting system. Other design considerations include:

- Light fixtures should reflect similar design, materials, and finishes throughout the lighting system to promote continuity and consistency;
- Fixtures should be appropriate in scale and character with the setting;
- Coordinate light fixtures with other site furnishings;
- Light fixture materials, such as poles and luminaire enclosures, should have a matte or dulled finish to prevent glare;
- To reduce negative visual impacts, clutter, and potential conflicts with trees and other elements, locate lines supplying power to light fixtures underground; bury existing overhead lines during new construction or renovation projects when possible; and
- To minimize streetscape clutter, integrate light fixtures with traffic signs, street signs, and traffic control signals.

B-8.2.2 Economy of Operation, Maintenance, and Repair

The type, design, and location of lighting equipment can increase energy efficiency and help minimize the long-term operation, maintenance, and repair associated with the lighting system.

- Minimize the variety of light fixtures used in the lighting system to facilitate maintenance, repair, and ordering and storage of parts.
- Use the highest-efficiency, longest-lived lamp appropriate to a particular application. Limit incandescent lamps to pedestrian areas to improve color and facilitate replacement.
- Coordinate the placement of light fixtures with tree locations to prevent tree canopies from interfering with the proper distribution and level of lighting.

- Choose light fixtures and luminaires that are durable and resistant to vandalism and damage from accidents.

- The placement, height, and design of light fixtures should allow for easy access for replacement of lamps and luminaires.

B-8.2.3 Roadway Lighting Hierarchy

Use street lighting to reinforce the vehicular circulation hierarchy on the installation. To properly reinforce the hierarchy, apply a consistent street lighting concept throughout the installation roadway network. Various types of streets should be illuminated by the level of lighting and by the appearance of the light fixtures.

B-8.2.4 Parking Lots

Provide adequate lighting in all parking lots that will be used at night. Set light fixtures back a minimum of 2 ft (0.6 m) from circulation aisle and parking stalls.

B-8.2.5 Pedestrian Lighting

Design pedestrian lighting to reinforce the hierarchy of the installation walkway network and to extend the use of the nighttime environment by providing lighting to increase safety and security.

B-8.2.6 Safety and Security

Lighting levels allow pedestrians to clearly distinguish the edges of the walkway, changes in direction, intersecting walkways, and any potential obstacles or hazards. Illuminate street crossings, changes in grade, and other potentially hazardous locations at a higher level than other sections of the walkway. Locate light fixtures so they do not impede pedestrian traffic.

B-8.2.7 Illumination of Features

The use of direct or indirect lighting can accentuate features or create a special effect. Installation entry areas, monuments, static displays, architectural landmarks, and other special features may be lighted with floodlights or spotlights, to create the intended effect.

Figure B-8.1 Example of Dramatic Effect of Landscape Lighting

B-8.3 Signs

The signage system is integral to the continuity of the installation. Design a signage system to ensure order and separation of vehicular and pedestrian traffic, while providing clear, concise directions and information. For **Air Force** and **Navy** projects, refer to \1\UFC 3-120-01/1/, *Air Force Sign Standard*.

Figure B-8.2 Sign Types Follow a Logical Order and Sequence from the Roadway Entrances to the Final Building Destinations

Guidelines developed for each installation will promote an integrated, coordinated signage system. The design principles and major sign types recommended for a signage guide are listed below.

- Programming messages (including color, number of messages, message order);
- Materials;
- Typefaces;
- Hierarchy of sign types;
- Site entry identification;
- Vehicular directionals;
- Pedestrian wayfinding;
- Directories;
- Regulatory signs (including traffic control signage); and
- Building identity signs.

B-8.4 Seating

Provide seating at all primary building entrances, drop-off zones, congregation points, and high-activity areas. Place seating at least 3 to 6 ft (1 to 2 m) away from sign post, trash receptacle, or any stationary obstacle, to avoid blocking pedestrian flow. Select benches and seat walls that create a unified system of seating.

B-8.5 Shelters

Locate bus shelters near public areas or gathering spaces to encourage the use of public transit. Locate shelters adjacent to pathways so they will not impede pedestrian circulation. Pave the inside of shelters for wheelchair access and easy access to buses. Provide outdoor seating at the bus shelters.

Locate smoking shelters near buildings with a large employee population. They should be located near secondary entrances in areas which are protected from winter winds and summer sun. They should have low seat walls or benches appropriate for seating. Scale the size of the shelter proportionately with the buildings immediately adjacent to it, as well as the number of users expected.

B-8.6 Trash Receptacles

Strategically place trash receptacles along major walkways, intersections of paths, near building entrances, picnic areas, food services, and congregation points. Since many trash receptacles can conceal packages that may threaten security, consult with security personnel on the selection and placement of receptacles. Refer to \1\UFC 4-010-01/1/.

B-8.7 Fences and Walls

Use walls, fences, and gates to define the interface between the general public and the security perimeter of the base. The perimeter walls or fences will provide adequate security while complementing surrounding architecture, materials and styles of the region. Inside perimeter fence, additional fencing walls will define open spaces, provide privacy or protection, and screen unsightly uses. They should relate in scale and material to surrounding structural features.

B-8.8 Bicycle Racks

Convenient bicycle racks encourage bicycle use as an alternative method of transportation. Integrate bicycle racks into the site plan; they should be readily accessible to high-activity areas, yet not impede vehicular or pedestrian circulation. In addition, site racks in visible locations to decrease the opportunity for theft. Size bike racks according to the number of bikes expected at a single location.

B-8.9 Grates

Specify tree grates to be used when trees are installed in a formal paved area, such as on a primary avenue, an entry area, a plaza, or a courtyard. Grates allow air and water to pass to the root system without impeding foot traffic.

Drainage grates are necessary in courtyards or plaza areas and other non-impermeable paved surfaces. Narrow trench drains should be black cast iron or heavy steel, and should be incorporated into the paving design to create a high-quality environment.

B-8.10 Bollards

Use bollards to control or separate vehicle and pedestrian traffic. In certain circumstances, a removable bollard is recommended for pedestrian areas while also allowing emergency vehicle access.

B-8.11 Planters

Planters should be used in highly visible pedestrian areas, building entries, plazas or courtyards. Planters provide both aesthetic and security functions.

Figure B-8.3 Example of Tree Grate

B-9 SITE SECURITY

Security design must be approached by a multi-disciplinary team. The landscape architect must understand force protection issues in order to offer creative site and planting design solutions that incorporate security requirements. This chapter outlines key issues and discusses basic guidelines that allow a landscape architect to incorporate security features as an integral part of a site plan. Specific requirements and standards are delineated in \1\UFC 4-010-01/1/, *DoD Minimum Antiterrorism Standards for Buildings*. Check the most current version of \1\UFC 4-010-01/1/ as well as any service-specific documentation for authoritative decisions.

Other UFCs applicable to site security are \1\UFC 4-020-01/1/, *DoD Security Engineering Facilities Planning Manual*, \1\UFC 4-022-01/1/, *Security Engineering Entry Control Facilities/Access Control Points*, \1\UFC 4-022-02/1/, *Selection and Application of Vehicle Barriers* and \1\UFC 4-022-03, *Fences, Gates and Guard Facilities* (under development)/1/.

B-9.1 Role of the Landscape Architect

The following responsibilities are included in the coordination and oversight of the security design and force protection process as related to landscape architecture:

- Coordinate with decision-makers and security specialists to determine project force protection requirements;
- Explore creative landscape architectural solutions to meet force protection and site security requirements through the use of strategic site planning, circulation design, and planting plans; and
- Use design solutions that incorporate structural elements into the force protection landscape such as walls, bollards, fencing, hardened street furniture, natural features, and plantings.

B-9.2 Comprehensive Planning

Implementing appropriate force protection measures at the planning stage can preclude the need for costly security enhancements later on. Incorporate force protection measures into the following comprehensive planning areas.

B-9.2.1 Land Use Planning

When preparing land use plans, locate high-risk land uses in the interior of the installation. High-risk land uses contain high concentrations of personnel located in administrative, community, and housing areas. Consolidate high-risk land uses to increase security efficiency and minimize control points. Also assess off-base adjacent land use and zoning plans for potential development that would impact security within the installation.

In most cases, integrating force protection measures at the comprehensive planning level will increase the land area needed for individual facilities due to security stand-off requirements. Accordingly, when preparing future land use plans, take into account the land areas associated with proposed force protection measures in the calculation of land area requirements.

B-9.2.2 Site Selection

When selecting a site for a facility, consider its location relative to the base perimeter, interior roads, and parking lots. In addition, consider that elevated sites generally enhance surveillance of the surrounding area. Adjacent high terrain or structures outside the base boundary, however, allow observation of on-base areas by outsiders. Dense vegetation in proximity to a facility can screen covert activity and must be avoided.

B-9.2.3 Area Development Planning

Facility site design includes the arrangement of the facility footprint, relationship of a building to a specific site, internal circulation, access, parking, landscaping, lighting, and signage. By comparison, area development plans focus on broader site planning, facility siting, and circulation variables.

Provide a separation distance between facilities to minimize collateral damage of a potential attack. Facilities will, however, be sited within view of other occupied facilities. Clustering facilities that are functionally compatible and have similar threat levels reduces the perimeter area to be protected, limits access points, and provides compact security areas. The practical benefits of clustering facilities must be balanced with the survivability benefits of resource dispersal in the event of an attack.

The arrangement of buildings into complexes with strongly delineated boundaries and buildings oriented to enhance surveillance opportunities results in the creation of “defensible space” that can be protected more efficiently than scattered buildings. Eliminate vehicle parking between clusters of high-risk buildings.

B-9.2.4 Vehicular Access and Circulation

A landscape architect will often become involved in the design of vehicular access and circulation. In these instances, refer to \1\UFC 4-022-01/1/. One key element of vehicular design is to avoid straight-line access to high-risk facilities.

B-9.3 Facility Site Design

See \1\UFC 4-020-01/1/. Force protection issues for consideration at the facility site design stage include orientation of buildings and integration of circulations systems, control points, physical barriers, landscape planting, and parking. Conflicts sometimes arise between security site design and conventional site design. For example, open circulation and common spaces, which are desirable for conventional design, are often undesirable for security design. To resolve these and other issues, coordination between design disciplines (e.g., landscape

architecture, planning, architecture, and engineering) is critical in the force protection design process. Designers will balance force protection priorities with the requirements of the Americans with Disabilities Act Accessibility Guidelines (ADAAG), Uniform Federal Accessibility Standards (UFAS), National Fire Protection Codes (NFPA), and all applicable local building codes.

As a site planner, the landscape architect will be involved in locating building footprints and designing comprehensive site designs to include security features. Key security elements are discussed below.

B-9.3.1 Standoff Zones

\1\UFC 4-010-01/1/ sets out the requirements for "standoff zones" that ensure a minimum guaranteed distance between a potential explosion and target structure. Locate facilities as far as possible from points on the site perimeter that are accessible to vehicles. "Standoff zones" can be defined by site elements that function as perimeter barriers to vehicles. Facilities should be located away from other buildings that are not potential targets to minimize damage to them in the event of an explosion.

Figure B-9.1 Example of Clear Zone Planting Design

The ideal stand-off distance is determined by the type and level of threat, the type of construction, and desired level of protection, per \1\UFC 4-010-01/1/. The minimum standoff distances identified in \1\UFC 4-010-01/1/ were developed to provide survivable structures for a wide range of conventionally constructed buildings and expeditionary/temporary structures, ranging from tents and wood-framed buildings to reinforced concrete buildings. For a more detailed discussion of this issue, refer to \1\UFC 4-010-01/1/ and \1\UFC 4-020-01/1/.

B-9.3.2 Orientation of Buildings on a Site

Orient buildings to deny aggressors a clear “line of sight” to the facility from on or off base and to protect the facility from visual surveillance.

B-9.3.3 Relationship of Roads

If possible, choose a site away from main thoroughfares. Locating the facility away from uncontrolled vehicle access and minimizing the number of access roads and entrances into a facility will help to increase safety during times of threat.

B-9.3.4 Landforms and Natural Resources

Avoid siting the facility adjacent to higher surrounding terrain, non-DoD facilities that are unsecured; and vegetation masses, drainage channels, or ditches, ridges or culverts, which can provide concealment. However, carefully designed berms used in conjunction with other physical barriers can be a successful security design. Discuss facility site alternatives with the anti-terrorism/force protection (AT/FP) specialists assigned to the project.

B-9.3.5 Physical Barriers

Barriers are selected and designed based on threat levels per \1\UFC 4-010-01/1/. Some barriers are fixed and obvious (fences and gates), while others are simply visual (e.g., sidewalks far away from buildings, curbs with lawn). Where physical barriers are required, consider using landscape elements and materials to create barriers that are soft and naturalistic rather than obviously engineered. Carefully designed high curbs, low berms, shallow ditches, trees, shrubs and other physical separations can be effective and attractive. Consider bollards for keeping vehicles out of restricted areas.

B-9.3.6 Landscape Planting

Specify landscape planting appropriately to screen and protect the facility without providing hiding places. Proper selection, placement, and maintenance of landscape planting can both screen and provide a greater field of vision. Design landscape planting to permit building occupants to see out but prevents outside monitoring of functions or people inside the building. \1\UFC 4-010-01/1/ provides guidance on size restrictions on masses of groundcover in a clear zone. Carefully choose and place tall deciduous plantings. Potential hiding places can be minimized through strategic placement of landscape materials. Dense, thorn-bearing plant materials can create natural barriers to deter aggressors.

B-9.3.7 Parking

\1\UFC 4-010-01/1/ provides the requirements for parking within the clear zone and the standoff zone of inhabited buildings or portions of buildings. Ensure that parking plans comply with \1\UFC 4-010-01/1/.

B-9.4 Site Security Details

The following are discussions and images of barriers, bollards, planters, and landforms designed and used as security features.

B-9.4.1 Site Furnishings

People need to be protected inside a building without disrupting movement and accessibility of the surrounding streets and sidewalks. Good urban design and effective security at DoD installations requires a well-coordinated, multi-disciplinary effort between landscape architects, architects, engineers, and security experts. Effective security design should meet the following goals:

- Provide a balance between perimeter security and the vitality of streetscapes and common areas with site furnishing design by incorporating long-range planning and exceeds temporary measures, such as the placement of basic concrete barriers;
- Provide security in the context of streetscape enhancement;
- Explore site furnishing design options that do not evoke an uneasy sense of defensiveness and visual monotony; instead provide superior protection as well as the function and beautification of a site;
- Provide structural and visual continuity along streets by creating a coherent strategy for designing a family of site security furnishings that reflect the architecture of an area; and
- Provide perimeter security that does not impede commerce, operational use, pedestrian and vehicular mobility, nor impact the health of existing vegetation.

Figure B-9.2 Example of Low Fencing

If site furnishings are hardened to provide crash resistance and are placed with approved spacing, they can be incorporated as part of the perimeter design. \1\UFC 4-010-01/1/ provides guidance on the types of site furnishings that are prohibited and what types are allowed if properly hardened. Specific types of site furnishings to consider for the purpose of security design are:

- Benches;
- Tree enclosures;
- Trash receptacles;
- Light posts;
- News stands;
- Café carts;
- Café enclosures;
- Vendor carts; and
- Bollards.

B-9.4.2 **Barriers**

Barriers include fences, walls, gates, ditches, berms, and bollards. They typically provide controlled perimeters and limited access to a site. Depending on their specific function, barriers may have a variety of design characteristics. Whenever possible, it is preferable that barriers have similar design characteristics to surrounding architecture to reduce any negative visual impacts. The requirements for various barrier types will be contained in \1\UFC 4-022-02/1/, *Selection and Application of Vehicle Barriers*, and \1\UFC 4-022-03/1/, *Fences, Gates and Guard Facilities (under development)* The landscape architect must be familiar with the requirements set out in these two UFC when involved in site security planning and design.

B-9.4.2.1 **Fencing**

Security fences must meet DoD standards based on facility priority. Prior to beginning the design of any projects that involves fences, check for the availability of \1\UFC 4-022-03/1/.

Limit the use of chain link fence to temporary and secondary uses. Fences serve the purposes listed below:

- Platform for the Intrusion Detection System;
- Pre-detonation screen for some standoff weapons;
- Stop moving vehicles, if they are reinforced to do so;
- Define boundaries and to deter penetration of a secure area; and
- Assist in controlling and screening authorized access to a secure area.

B-9.4.2.2 **Walls**

Walls are an alternative to fencing and provide similar protection. Some types of walls recently used for security are plinth walls, ha-ha walls, and retaining walls. Prior to beginning the design of any projects that involves walls, check for the availability of \1\UFC 4-022-02/1/.

Figure B-9.3 Example of Security Fencing

Figure B-9.4 Example of Proper Plant Selection Softening the appearance of a Wall without Compromising Security

B-9.4.2.3 **Gates**

Gates are also employed in security design, adding not only to the safety of a site but also to the general appearance and landscape quality. Prior to beginning the design of any project that involves gates, check for the availability of UFC 4-022-03.

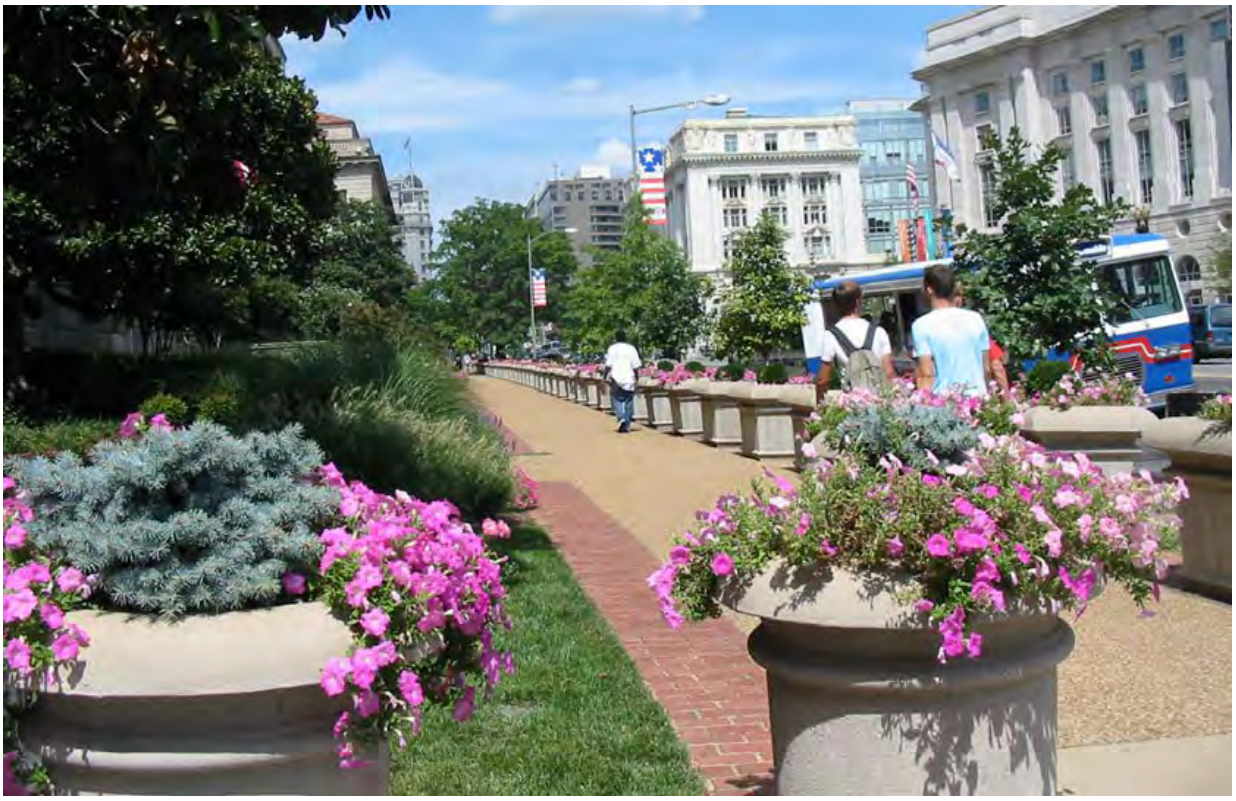
Figure B-9.5 Example of Double Security Gate

Figure B-9.6 Example of Bollards Matching the Existing Architectural Character

B-9.4.2.4 **Planters**

Reinforce moveable planters to secure certain areas. A good planter will have a watering and drainage system. Planters can also be built in place. The addition of plant material, particularly in plazas, will soften the look of a security element while maintaining an adequate level of protection. Prior to beginning the design of any project that involves planters to be used for site security, check for the availability of \1\UFC 4-022-02/1/.

Figure B-9.7 Planters Containing a Mix of Evergreen and Seasonal Plants



B-9.4.2.5 **Natural Features**

Use topography, including berms, ditches, forests, wetlands, and bodies of water, effectively in the landscape to provide protection against vehicular threats. Prior to incorporating natural features into the design of any project for the purpose of vehicular barriers, check for the availability of \1\UFC 4-022-03/1/.

B-9.4.2.5.1 **Berms**

For detailed guidance regarding use of berms as a security feature, refer to \1\UFC 4-020-01/1/.

Figure B-9.8 Berms and Vegetation for Perimeter Control

B-9.4.2.5.2 **Ditches**

Integrate ditches into the landscape and architectural context of a site. Ditches can serve as a design feature and once all requirements are met, can be approached from an environmental and visual standpoint. Prior to incorporating ditches in the design of any project as a security feature, refer to \1\UFC 4-020-01/1/.

B-10 IMPLEMENTATION

Ensure project construction documents convey the necessary information to successfully implement the design. While landscape architects are responsible for designing the project, the landscape contractor is responsible for the actual implementation, installation, and establishment of the design. Following installation, maintenance personnel are responsible for the various landscape elements of the project to maturity. Between the design, implementation, and establishment phases is a need for clear communication. Plan drawings, construction details, and specifications are the tools used to communicate the intent of the design to the contractors.

B-10.1 Role of the Landscape Architect

The following responsibilities are included in the coordination and oversight of the design implementation process:

- Conduct interdisciplinary and user coordination meetings throughout the implementation process.
- Prepare construction documents for use by a landscape contractor. These documents are required to be stamped by a registered landscape architect.
- Design and determine all proposed site structures and materials.
- Design and determine all proposed plant materials and exact locations.

B-10.1.2 Construction Documents Package

In communicating the design intent to the contractors, submit the following documents to contractors:

- Demolition plan;
- Grading plan;
- Planting plan;
- Irrigation plan;
- Details;
- Specifications; and
- Cost estimate.

B-10.2 Construction Details

Details, along with specifications and plans, are the tools used to communicate design intent to the project contractor.

Details should eliminate doubt and confusion on how to bid or construct the project. Metric measurements are now the DoD standard. Installation personnel should compile a landscape architecture detail library based on installation and regional standards, policies, and practices. Use the Tri-Service CADD/GIS Technology Center (https://tsc.wes.army.mil/) as a resource for DoD-approved details. Details can be created for any of the following:

- Site-work;
- Irrigation;
- Site amenities;
- Planting; and
- Inert materials.

B-10.3 Implementation Specifications

Landscape implementation specifications define the type and quality of materials and equipment and specify the required construction standards and methods. In contracted work, specifications are the final word if there are contradictions between the various implementation documents, including drawings and details.

B-10.4 Cost Estimating

Landscape architects, planners, and programmers require accurate cost estimates to ensure scarce project dollars are factored into overall project costs. See \1\UFC 3-701-XX/1/ (where XX indicates the fiscal year) for specific guidance on cost-estimating a site design project.

Approach landscape cost estimating by compiling project costs according to the expected order of construction. The following landscape components occur in the following order:

- Site-work;
- Irrigation;
- Site amenities;
- Planting;
- Inert materials; and
- Establishment.

B-10.5 Conclusion

To ensure the designs are built correctly, convey the user's design needs to the contractors. In the absence of being on-site, conduct coordination meetings, prepare construction documents, communicate design intent for all proposed site structures and materials, and convey location and types of plant materials.

B-11 LANDSCAPE MAINTENANCE AND MANAGEMENT

The regular care of plant material, site furnishings, and other outdoor elements ensure that a site will function and appear as it was designed. Collaboration between maintenance supervisors and landscape architects is the key to establishing and maintaining a site with sustainable goals for the long-term.

B-11.1 Role of the Landscape Architect

The following responsibilities are included in the coordination and oversight of the maintenance and management of a site.

- Collaborate early with the maintenance team to understand and communicate maintenance requirements and limitations.
- Apply planting design decisions to typical maintenance and management practices.
- Enforce a required one-year minimum establishment period on all landscape installation contracts.
- Write or oversee the writing of a landscape management plan for each project.

B-11.2 Comprehensive Landscape Maintenance

Develop a comprehensive plan to direct and control the quality of work. Base this plan on field practices, compliance with DoD directives, and satisfaction of mission requirements.

B-11.2.1 Grounds Maintenance Plan

Develop plans to direct the type and frequency of landscape maintenance tasks needed for specific areas. Maps will delineate the grounds maintenance into levels and a statement of work will describe each task based on an area's maintenance level. When designing specific sites, remember the level of maintenance it will receive. The three levels are designated as follows:

- Improved grounds consist of turf grass areas and planting material which will require intensive maintenance.
- Semi-improved grounds are areas where landscape maintenance is performed primarily for functional or operational purposes. The semi-improved category contains airfield safety zones, rifle ranges, and open spaces in developed areas.
- The unimproved grounds category includes all other grounds on the installation and is made up of undeveloped areas. This level is comprised of forests, wildlife areas, crop, and grazing lands, lakes, ponds, and airfield areas outside the clear

zone. Minimal maintenance will be required. Annual mowing or pruning will be part of the installation's grounds maintenance or management plans. Responsible design and management practices will allow larger proportions of the base to be maintained at the unimproved level.

B-11.2.2 Establishment Period

Every landscape project will have a required establishment period, typically one year, in which the site will require more intensive maintenance. Specific tasks during this time may include irrigation, pruning, and plant replacement. After this period, many landscapes can be designed to require minimal maintenance.

B-11.2.3 Erosion Control Maintenance Procedures

Specify proper maintenance of the following elements to prevent the development of potential erosion problems. Complete specific maintenance projects to prevent problems and correct existing problems, such as:

- Drainage structures;
- Unstable soils;
- Runoff;
- Plant materials; and
- Irrigation systems.

B-11.2.4 Land Management Plan

According to DoD policy, this document must be updated at least every five years. Landscape architects must be consulted in the development of the land management plan to ensure consistent implementation while meeting long-term landscape design, planning, and maintenance objectives.

The land management plan is used as a reference in design and landscape maintenance contracts. It will contain specific information, including the plant and inert material lists, standard landscape construction specifications and details, and soils maps.

B-11.3 Landscape Maintenance Tasks And Methods

Well-defined maintenance guidelines are key to an efficient and effective program. Include the following tasks—common to installation landscape maintenance—in every task list:

- Aeration;
- Fertilization;

- Mowing;
- Mulching;
- Pest and plant disease control;
- Pruning (trees and shrubs);
- Soil amendments;
- Trimming; and
- Weed control.

B-11.4 Landscape Management

Some landscapes on DoD installations require long-term management to protect them from potential problems. Areas such as forests and ranges need to be understood from operational, wildlife, and natural resources perspectives. Federal lands must comply with Federal legislation actions, including the Endangered Species Act. Large areas of forest or agricultural land may provide additional income to the installation. A wide array of land management plans may be compiled for different installations. These plans are most effective when developed by an inter-disciplinary team that includes a landscape architect. Landscape architects have the knowledge and skills needed to understand how different land uses and practices affect the surrounding land and resources.

B-11.5 Plan Development

The emphasis on increasing the quality of life on DoD installations while decreasing funding for maintenance continues to gain momentum. It is important that funding for landscape maintenance is spent constructively and wisely.

As described above, the following are some of the actions necessary to implement an efficient and logical landscape maintenance program:

- Ensure grounds maintenance plan, land management plan, and installation landscape development objectives are coordinated for consistency and long-term compatibility.
- Require project-specific landscape maintenance guidance be provided for all new landscape projects on the installation.
- Request landscape establishment specifications be provided for all new landscape projects on the installation.

- Provide and require landscape maintenance training for all installation grounds personnel.

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