

UNIFIED FACILITIES CRITERIA (UFC)

LANDSCAPE ARCHITECTURE



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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

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

Change No.	Date	Location

This UFC supersedes UFC 3-201-02 Change 1, dated November 2009.

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 most 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 Civil Engineer Center (AFCEC) 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 may be sent to the respective DoD working group by submitting a Criteria Change Request (CCR) via the Internet site 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://www.wbdg.org/ffc/dod>.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

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UNIFIED FACILITIES CRITERIA (UFC) REVISION SUMMARY SHEET

Document: UFC 3-201-02, *Landscape Architecture*, unifies the landscape architectural criteria for DoD.

Superseding: UFC 3-201-02, 23 February 2009, including change 1 November 2009

Description: This document assimilates and applies current policies, technology, and environmental planning critical to the long-term success of DoD facilities and projects. The integration of government and industry codes, practices, materials, and reference works ensure the contemporary relevance of the UFC Landscape Architecture document.

Reasons for Document:

- Improve the quality-of-life at DoD facilities through informed, user-centric input to planning, design, construction, and maintenance projects.
- Encourage innovation and alternatives to planning, design, construction, and maintenance projects across the DoD.
- Integrate the DoD commitment to sustainable practices and Low Impact Development (LID).

Impact:

The following direct impacts will result from revision of this UFC:

- Design and construction initial cost benefit
- Energy and water efficiency
- Life-cycle cost reduction
- Facility functionality, safety, and security

Unification Issues:

For **Army** projects, comply with the Assistant Secretary of the Army Installations, Energy and Environment (ASA IE&E) Water Use Memorandums:

- ASA IE&E Memorandum, January 13, 2017, "Energy and Water Goal Attainment Responsibility Policy," which sets policy and assigns responsibilities to achieve federal water use goals.
- ASA IE&E Memorandum, January 17, 2017, "Sustainable Design and Development Policy," Update 5, 3-b Outdoor Water Use.

For **Navy and Marine Corps** projects, comply with UFC 4-750-02N, which includes design requirements for a variety of outdoor sports and recreational facilities.

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

This UFC establishes minimum landscape architectural requirements and best practices to promote consistent landscape architectural quality for DoD facilities worldwide. Where other criteria, statutory or regulatory requirements are referenced, comply with the more stringent requirement.

1-2 APPLICABILITY.

This UFC applies to all DoD agencies and contractors involved in landscape architectural design and implementation of projects with site improvements for permanent DoD facilities worldwide. Use the information in this document for the site analysis, development of plans, specifications, calculations, and deliverables.

1-3 PROFESSIONAL REQUIREMENTS.

Design of all site improvement features must be accomplished by a licensed professional. All DoD military construction (MILCON) projects with site improvement costs over \$250,000, must include a landscape plan with supporting details and specifications prepared by a registered professional (Architect, Engineer, or Landscape Architect) as required by the Federal Acquisition Regulations (FAR) (Subpart 2.1). Additional professional requirements and/or certifications may be required based upon specific project needs as defined in the project Request for Proposal (RFP).

1-4 GENERAL BUILDING REQUIREMENTS.

UFC 1-200-01, *DOD Building Code* provides applicability of model building codes and government-unique criteria for design disciplines and building systems, as well as accessibility, antiterrorism, safety, security, high performance and sustainability requirements.

1-5 CYBERSECURITY.

All control systems (including systems separate from an energy management control system) must be planned, designed, acquired, executed, and maintained in accordance with UFC 4-010-06, and as required by Individual Service Implementation Policy.

1-6 BEST PRACTICES.

Appendix A identifies background information, lessons learned, and proven best practices for landscape architectural design services. The information is considered guidance and not criteria, and is not intended to address all possible design solutions.

1-7 GLOSSARY.

Appendix B contains a list of acronyms, abbreviations, and definitions.

1-8 REFERENCES.

Appendix C contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of the referenced publication applies.

CANCELLED

CHAPTER 2 LANDSCAPE ARCHITECTURAL SITE CRITERIA

2-1 INTRODUCTION.

The following requirements address specific landscape architectural design practices, site elements, and materials. These requirements have been compiled from DoD policy and industry standards.

2-2 LANDSCAPE ARCHITECTURAL SITE DESIGN.

The focus of DoD landscape architecture is to support the users' mission. Landscape architecture combines ecology, hydrology, engineering, planning, and functional design to create successful DoD facilities that achieve the following goals:

- Protect the health, safety, and welfare of all users.
- Elevate Installation functionality and appearance to enhance the quality of life.
- Establish a sense of place and unique identity.
- Preserve cultural and historic landscapes.
- Provide spaces considering 'human factors'.
- Achieve environmentally sustainable development and operations.
- Protect natural communities of plants and wildlife.
- Meet DoD requirements for outdoor water use and management.
- Utilize operation and maintenance plans to ensure successful long-term viability of landscapes.

Effective integration of the landscape architectural discipline into DoD projects requires early involvement, including participation in DD1391 development and project programming, pre-design, and schematic design development.

2-3 WATER USE MANAGEMENT.

2-3.1 General.

Prepare a water management plan that identifies the minimal amount of water required to sustain the project landscape. Develop a plan for how the water can be most efficiently delivered. Include application of reuse water (also called reclaimed or recycled water), when available in conformance with applicable installation and local water reuse policies and guidelines.

2-3.2 Potable Water Reduction.

It is the Department of Defense's policy that DoD Components reduce or eliminate the use of potable/domestic water for purposes of landscape maintenance, consistent with existing legal and contractual obligations. Use water-efficient irrigation strategies that comply with UFC 1-200-02 for required DoD reduction in combined indoor and outdoor potable water use. Refer to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 189.1 Table 6.3.3A for sub-metering requirements for landscape areas that exceed 25,000 square feet (2,322.57 m²).

For water use management criteria, comply with the “Water Use for Landscape Architecture on Department of Defense Installations/Sites” (March 10, 2017) memorandum from the Office of Assistant Secretary of Defense for Energy, Installations, and Environment (OASD EI&E). Ornamental water features and irrigation systems must comply with this policy.

For Army projects: comply with the Assistant Secretary of the Army Installations, Energy and Environment (ASA IE&E) Water Use Memorandums:

- ASA IE&E Memorandum, January 13, 2017, “Energy and Water Goal Attainment Responsibility Policy,” which sets policy and assigns responsibilities to achieve federal water use goals.
- ASA IE&E Memorandum, January 17, 2017, “Sustainable Design and Development Policy,” Update 5, 3-b Outdoor Water Use.

For Navy projects: comply with the “Guidance for Xeriscaping on CNIC Installations (11010, 04 April 2017) memorandums from the Commander, Navy Installations Command.

2-4 CONSERVATION AND RESOURCE PROTECTION.

2-4.1 Natural Resources.

Coordinate with the Installation Environmental (EV) staff to obtain the project NEPA documentation, as applicable, for project specific requirements. Comply with seasonal limitations for site impacts specific to the threatened and endangered species present on site, including all clearing, site disturbance, and tree mitigation requirements.

2-4.2 Cultural Resources.

Discuss the project with the Installation Cultural Resources Manager (CRM) prior to design initiation, to ensure compliance with federal laws and DoD policies for cultural resources, including Section 106 of National Historic Preservation Act (NHPA) and DoD Instructions 4715.16, 4710.02, and 4710.03, or equivalent Host Nation agreements, as applicable. Coordinate with the CRM to identify relevant documentation from the site assessment concerning cultural resources located on or adjacent to the project site. Obtain any additional information necessary to complete the Section 106 consultation process, including the Integrated Cultural Resource Management Plan. Coordinate with the Installation CRM to identify existing cultural resources or tribal consultation agreement documents, such as a Programmatic Agreement, Tribal Consultation Protocol, Comprehensive Agreement, or Memorandum of Agreement. Consult with the CRM to gather appropriate cultural resources information for the project site for purposes of Section 106 compliance, including CRs listed in or eligible for inclusion in the National Register of Historic Places. Engage the CRM to consult with federally recognized tribes and Native Hawaiian Organizations (NHO) with historical or cultural affiliations with Installation lands as required by DoDI 4710.02 and DoDI 4710.03. Include activities that may impact cultural resources of traditional religious and/or cultural importance to the tribe or NHO, including sacred sites, or other resources to which tribes may retain treaty rights.

Coordinate with the CRM, tribes, NHO, Tribal Historic Preservation Officers, and State Historic Preservation Officers to avoid and minimize effects to the cultural resources. If an adverse effect cannot be avoided, partner with the CRM and external stakeholders to develop a memorandum of agreement to mitigate adverse effects. Collaborate with Installation CRM on methods to reduce water use and remove invasive species from historic landscapes. Consider potential impacts of plantings and furnishings to historic properties.

2-4.3 Viewsheds.

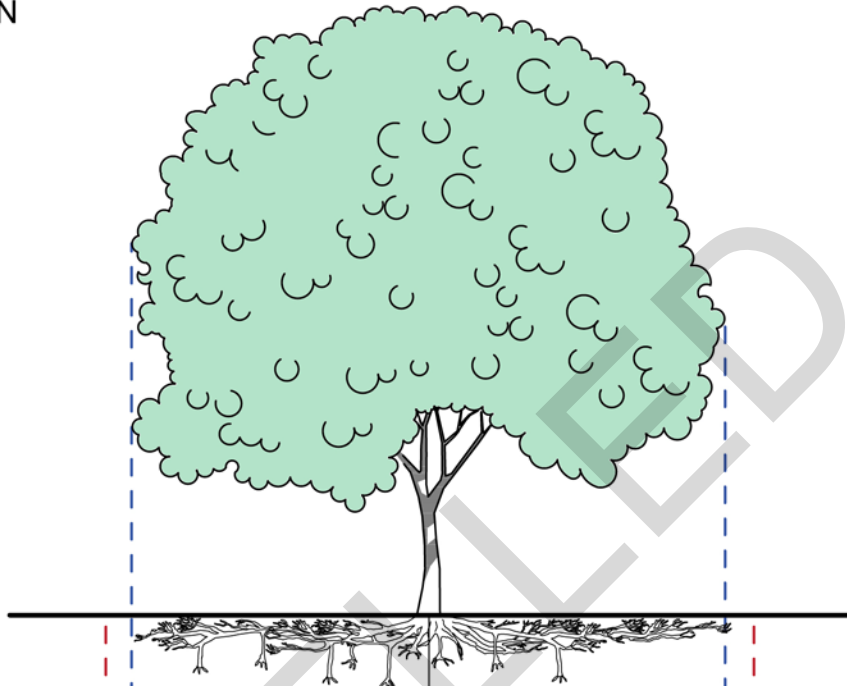
Preserve significant viewsheds as a part of initial project planning and design. Identify significant or historic viewsheds in the project RFP. Historic viewsheds and their features are those that are listed in, or eligible for, inclusion in the National Register of Historic Places. Implement screening elements as appropriate to minimize and mitigate impacts to significant and historic viewsheds. Work with the Installation CRM to consider impacts to historic viewsheds and their historical features, as a part of the Section 106 and tribal consultation responsibilities listed in 2-4.2 Cultural Resources.

2-4.4 Tree Preservation Plan.

Prepare a Tree Preservation Plan to identify existing vegetation to be preserved. Coordinate the Tree Preservation Plan with the Civil Engineer and include it as part of the Erosion and Sediment Control Plan. Calculate the tree critical root zone (CRZ) using a 1.5-foot (0.45 m) protection radius for each 1 inch (3 cm) of tree diameter measured at breast height (DBH).

Figure 2-1 Critical Root Zone Diagram

ELEVATION

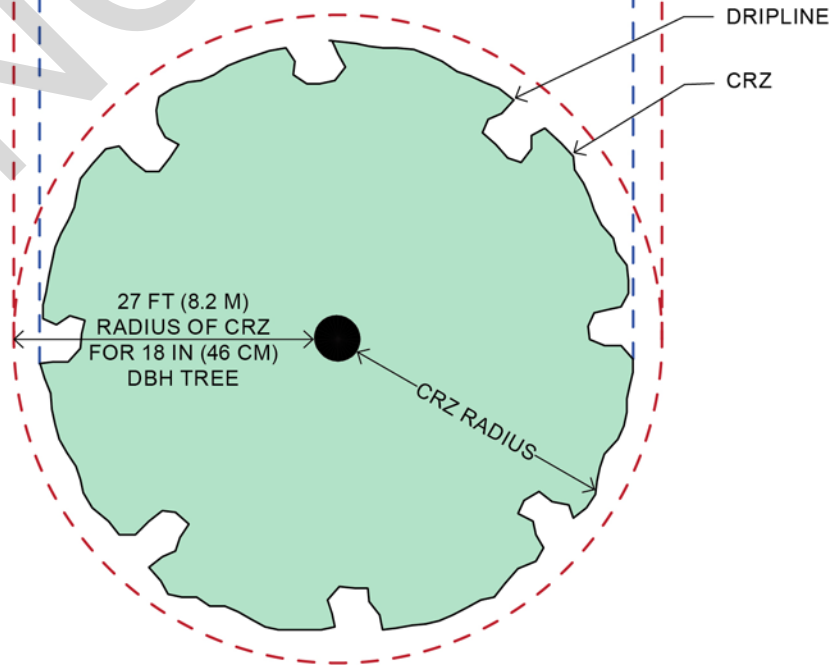


27 FT (8.2 M)
RADIUS OF CRZ
FOR 18 IN (46 CM)
DBH TREE

DRIPLINE (VARIES)

LIMITS OF CRZ
1.5 FT (46 CM) RADIUS OF CRZ
PER 1.0 IN (2.5 CM) DBH

PLAN



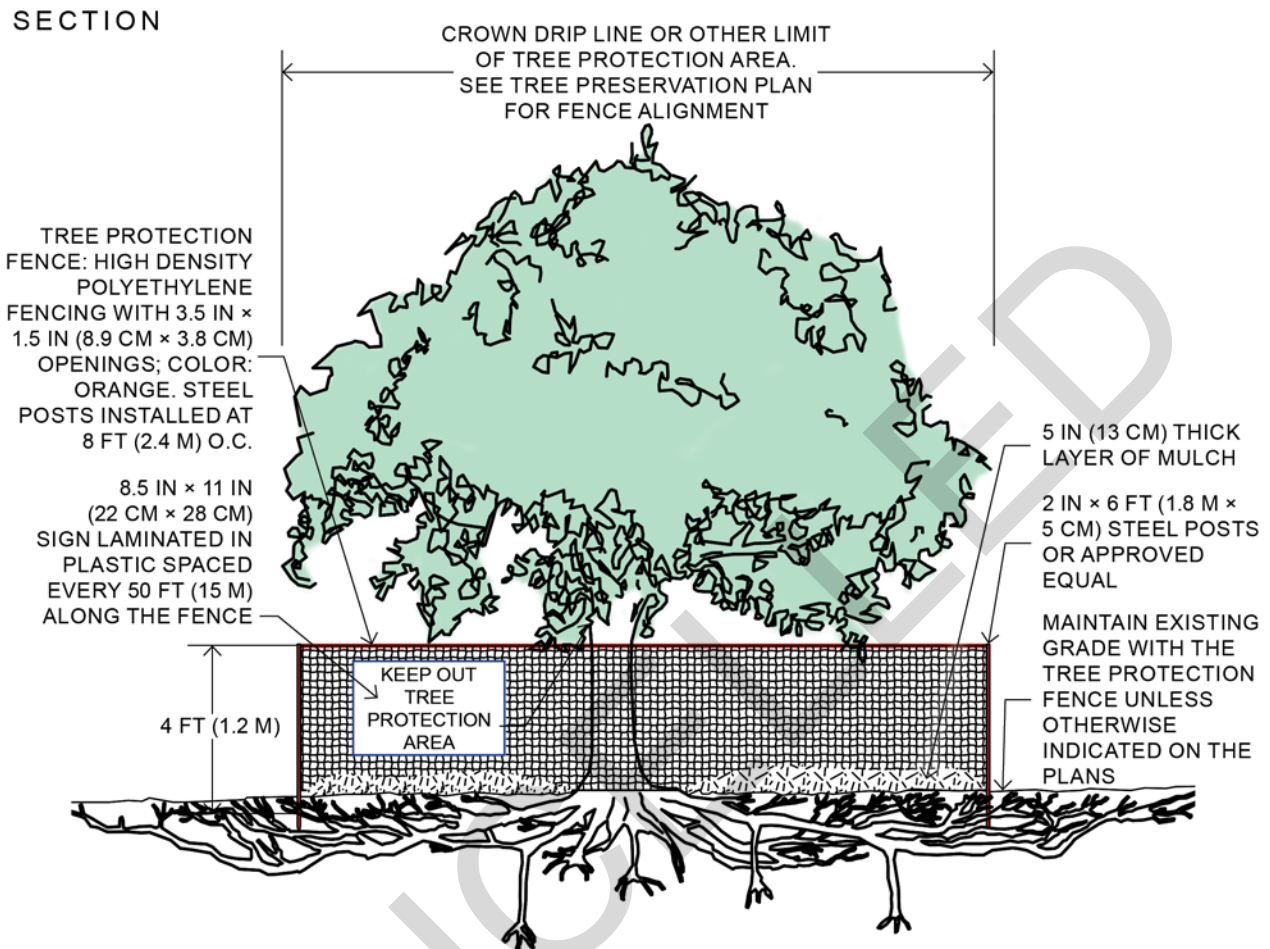
27 FT (8.2 M)
RADIUS OF CRZ
FOR 18 IN (46 CM)
DBH TREE

CRZ RADIUS

DRIPLINE

CRZ

Figure 2-2 Sample Tree Protection Detail¹



2-5 CIRCULATION AND ACCESSIBILITY.

2-5.1 General.

Employ a well-integrated circulation system with a network hierarchy that strengthens connectivity, reduces conflicts, and enhances the visual quality of the installation. Connect significant elements, destinations, and features. Promote design of streetscapes that balance vehicular traffic, pedestrian access, and safety of all users. Define goals with the end-user during conceptual design. Establish a comprehensive circulation network, hierarchy of uses, and times of day to optimize use.

Utilize UFC 3-201-01 for circulation requirements, including standards for street widths, sight lines, parking layouts, drop-off zones, and special areas.

¹ Adapted from Urban Tree Foundation, "Planting Details and Specifications," 2014, http://www.urbantree.org/details_specs.shtml.

2-5.2 Pedestrian Circulation.

Coordinate pedestrian circulation with the Transportation Component Plan for Installation Development Plans (IDP) and Area Development Plans (ADP).

Figure 2-3 Pedestrian Circulation²



2-5.3 Bicycle Facilities.

Utilize the American Association of State and Highway Transportation Officials (AASHTO) Guide for the Development of Bicycle Facilities for bicycle circulation design and multi-use trails.

2-6 PLANTING DESIGN.

2-6.1 Sustainable and Resilient Planting Design.

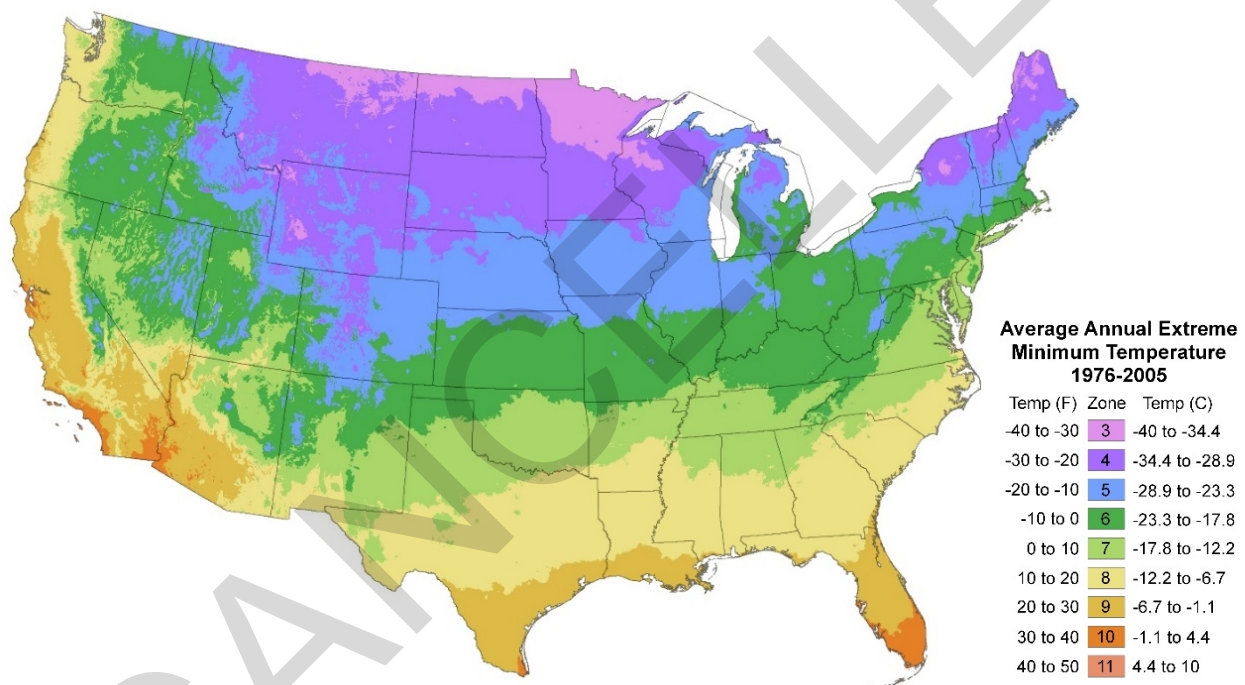
Design for water conservation and minimize maintenance requirements on all new and retrofitted landscape projects. Assess existing irrigated plant and turf areas for opportunities to reduce or eliminate existing irrigation systems. Use vegetation that does not require irrigation beyond the plant establishment period. Specify and install trees to provide shade for paving, vehicles, and pedestrians. Use only non-invasive vegetation; see Chapter 2-6.6 for requirements.

² Image: CallisonRTKL, <https://www.callisonrtkl.com/>

Design plantings for climate resiliency and natural hazards:

- Select plant species and cultivars that can tolerate shifts in U.S. Department of Agriculture (USDA) plant hardiness zones. Recent shifts are reflected in the 2012 update to the USDA Plant Hardiness Zone Map (Figure 2-4). Future changes are projected. See Figure 2-5 for a composite model of future changes projected through 2040.
- Specify plant species and cultivars, based on regional conditions, that will be resilient to extreme weather events.
- Specify plant materials to withstand flooding and saltwater intrusion from storm surge where those events are anticipated risks.
- Specify plant materials with high tolerance for wind strength along coastal areas.

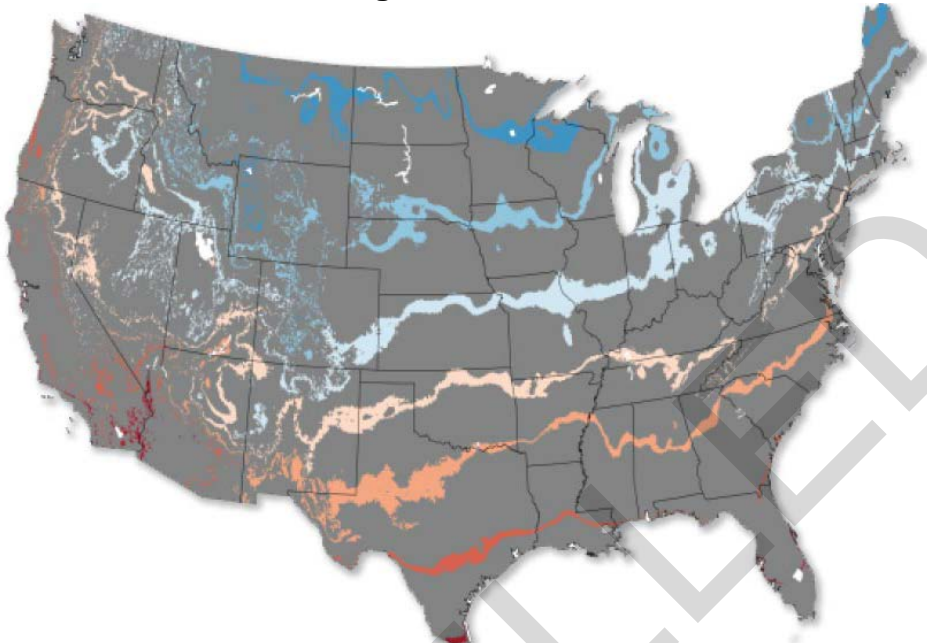
Figure 2-4 USDA Plant Hardiness Zone Map (2012)³



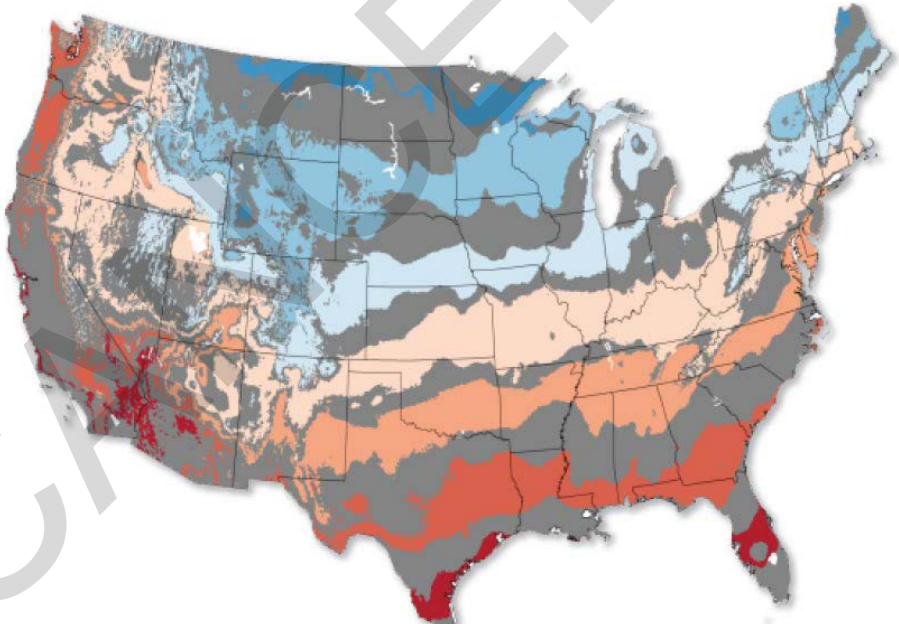
³ USDA, "Map Downloads," 20 June 2018, <http://planthardiness.ars.usda.gov/PHZMWeb/Downloads.aspx>

Figure 2-5 Shifts in Plant Hardiness Zones as of 2010⁴

Zone Changes in Past 10 Years



Zone Changes in Next 30 Years



Average Annual Extreme Minimum Temperature by Climate-Related Planting Zone

■ No Change in Zone	■ Zone 5 (-19 to -10 °F) (-28 to -23 °C)	■ Zone 7 (1 to 10 °F) (-17 to -12 °C)	■ Zone 9 (21 to 30 °F) (-6.1 to -1.1 °C)
■ Zone 4 (-29 to -20 °F) (-34 to -29 °C)	■ Zone 6 (-9 to 0 °F) (-23 to -18 °C)	■ Zone 8 (11 to 20 °F) (-12 to -6.7 °C)	■ Zone 10 (31 to 40 °F) (-0.56 to 4.4 °C)

⁴ National Oceanic and Atmospheric Administration, "Shifts in Plant Hardiness Zones," *Climate Change Impacts in the United States: The Third National Climate Assessment*, U.S. Global Change Research Program, 6 May 2013, <https://nca2014.globalchange.gov/report/appendices/climate-science-supplement/graphics/shifts-plant-hardiness-zones>.

2-6.2 Security and Anti-Terrorism.

Coordinate planting design with security and antiterrorism requirements for unobstructed spaces and clear zones per UFC 4-010-01. Explore creative Landscape Architectural solutions to meet force protection and site security requirements through strategic site planning and circulation design.

Eliminate any opportunity for concealment of objects in the unobstructed space that are larger than a 6-inch (15.24 cm) diameter sphere. Specify and install a minimum tree size of 3-inch (8 cm) caliper or 36-inch (91 cm) box at installation for all trees located within unobstructed spaces. At installation, limb all branches within the unobstructed space to meet antiterrorism requirements. Retain a minimum 2/3 height of branches and 1/3 height of clear trunk. Verify the use of multi-trunked trees within the unobstructed space with Antiterrorism/Force Protection Subject Matter Expert.

Eliminate any opportunity for concealment of objects in clear zones. Specify only low shrubs and ground covers within the clear zone. Trees are not permitted.

2-6.3 Foreign Object Debris and Bird/Wildlife Aircraft Strike Hazard.

Foreign Object Debris (FOD) compliance is critical for selection and placement of plant materials, aggregates, and mulches. Select materials to mitigate site-specific foreign object debris concerns.

The Wildlife Hazard Assessment identifies areas of an airfield that are attractive to wildlife and provides recommendations to remove or modify the features. Adhere to species selection requirements for all plantings within identified Bird Aircraft Strike Hazard (BASH) areas. Consider Installation-specific issues. Do not specify plants that create habitat or food sources for avian species that would attract them to the BASH zone.

2-6.4 Plant Selection.

Design planting plans that define space, reinforce circulation systems, frame views, screen site elements, and provide scale, form, line, mass, texture and color. Apply the following requirements when selecting plant materials:

- Comply with all Installation requirements, including the Installation design guidance documents (IDGD), Integrated Natural Resources Management Plan (INRMP), and project specific Scope of Work (SoW).
- Follow requirements of Mariachero's *American Standard for Nursery Stock*-American National Standards Institute (ANSI) Z60.1.
- Use healthy, disease and pest-free plant materials.
- Select plants with low-maintenance characteristics, disease resistance, and drought tolerance, where appropriate.
- Satisfy sight distance requirements as defined by the AHJ for all streetscape plant materials.

- Provide a plant schedule with each required submittal. Include plant key, quantity, botanical name, common name, minimum installed size (height/spread), container, spacing, and remarks as appropriate. Organize the plants by type (deciduous trees, evergreen trees, and so forth). See Figure 2-6 for plant schedule format.

Figure 2-6 Plant Material Schedule – Typical Format

PLANT MATERIAL SCHEDULE								
SYMBOL	BOTANICAL NAME	COMMON NAME	MINIMUM CONTAINER SIZE OR CALIPER	MINIMUM HEIGHT	MINIMUM SPREAD	QUANTITY	REMARKS	DETAIL
TREES								
XX 'X' OR XXX XXX 'X'	ALL UPPER-CASE LATIN	ALL UPPER CASE COMMON	X' – X2'	X' – X2'	X' – X2'			XX/LPXXX
SHRUBS								
XX 'X' OR XXX XXX 'X'								
XX 'X' OR XXX XXX 'X'								
GROUND COVERS								
XX 'X' OR XXX XXX 'X'								
SEED								
XX 'X' OR XXX XXX 'X'								

2-6.5 Native and Regionally Adapted Plants.

Use hardy native and regionally adapted plant materials. Select plant species based on current science-based information and Installation-specific institutional knowledge and practice. Install plants that are appropriate for site conditions, climate, and design intent. Additional standards for projects located in arid and semi-arid conditions may be required.

2-6.6 Invasive Species.

Do not use plants deemed invasive by the USDA, noxious weed control boards, state and local agencies, or other AHJ. The USDA National Invasive Species Information Center (NISIC) website is a central repository for relevant information. Use extreme care when using non-native species or creating conditions that will attract such species.

Detect, monitor, and eradicate populations of invasive species using Integrated Pest Management (IPM) techniques on Installations whenever feasible. Comply with DoDI 4150.07 and guidance in the Installation's INRMP.

2-6.7 Tree Replacement.

Meet INRMP requirements for the replacement of existing trees. Follow requirements for all trees removed on a project site. Determine the size of the replacement tree from the SoW and IDGD.

2-6.8 Trees.

DoD is committed to establishing a significant tree canopy on base Installations. Each project will be unique in the ability to include significant tree canopy requirements. Tree canopy requirements for projects located in arid and semi-arid conditions may be adjusted. The recommended planting requirement provides trees at a minimum rate of one tree per 1,000 square feet (92.9 m²) of landscape area and identifies off site areas for designated alternative planting. Identify reductions and/or additions to the number of required trees in the Supplementary Instructions to Offerors. Confirm the planting rate with the Government Landscape Architect.

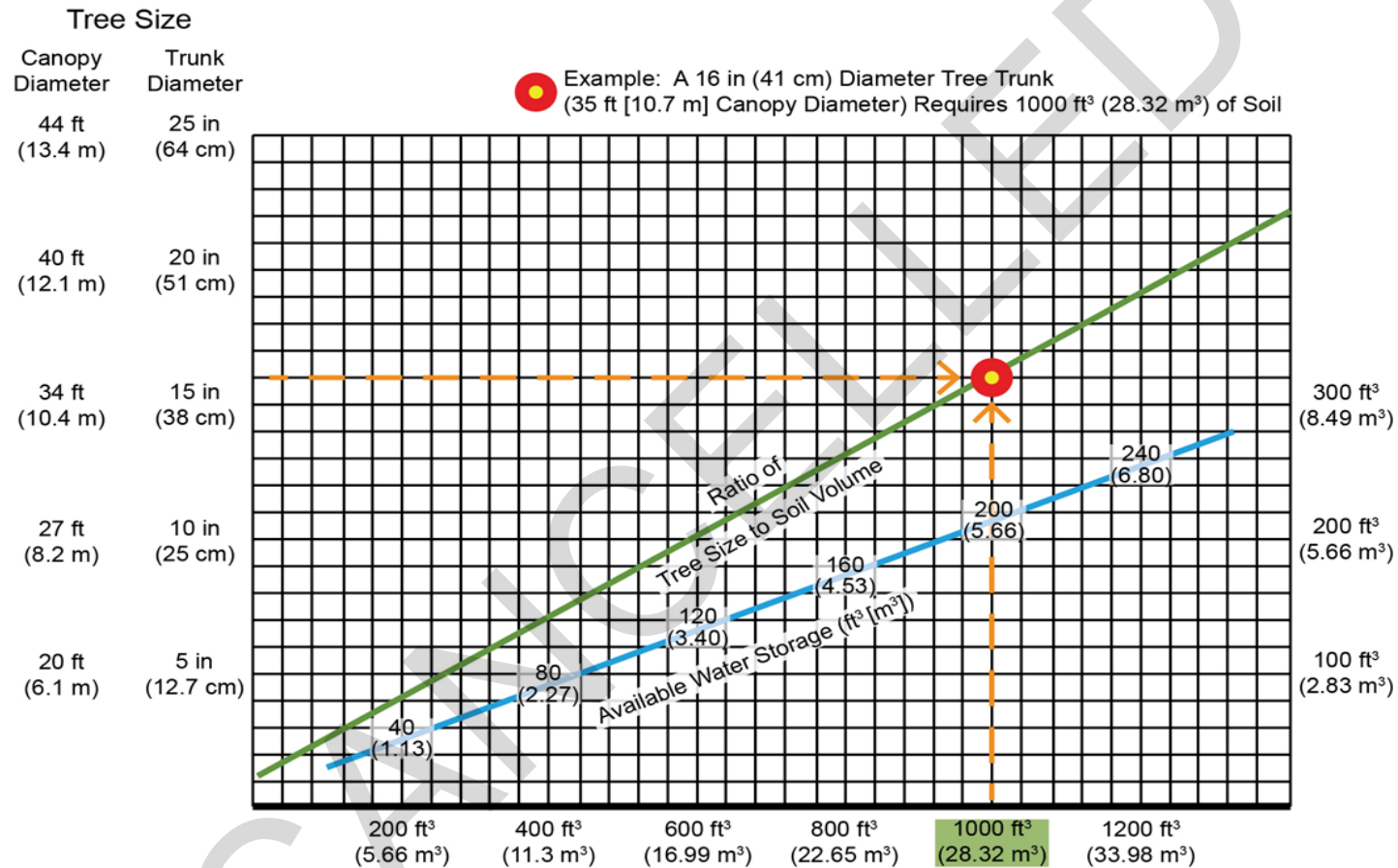
Evaluate placement and species selection to avoid overplanting the site. Ensure that the size and form of trees conforms to ANSI Z60.1 and the Installation INRMP. Refer to Chapter 2-6.2 for size requirements within standoff distances. Size new trees by type as follows:

- Shade Trees:
 - Type 1 and 2: Trees must meet or exceed 3 inches (7.6 cm) caliper and 14 feet (4.2 m) in height at installation.
 - Type 3 and 4: Trees must meet or exceed 2 inches (5 cm) caliper at installation.
- Evergreens:
 - Type 3, 4, 5 and 6: Trees must meet or exceed 6 feet (1.8 m) in height at installation.
- Multi-stem Trees: Trees must meet or exceed 6 feet (1.8 m) in height at installation.
- Palm Trees: Trees must meet or exceed 12 feet (3.6 m) in height at installation.

2-6.8.1 Tree Planting.

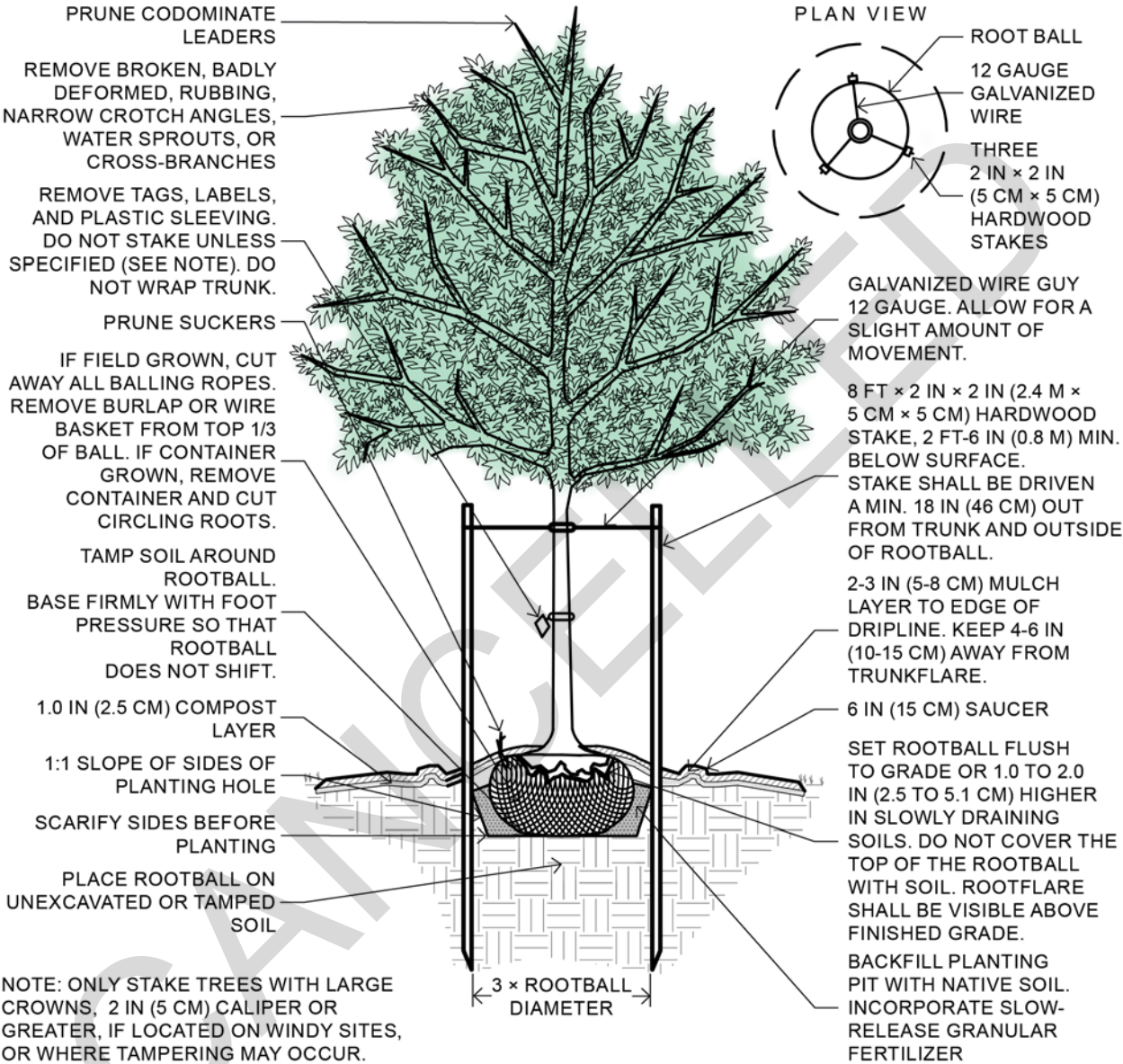
To ensure adequate soil volume and quality for trees located within plazas, sidewalks, or other paved areas, specify adequate non-paved planting area and/or other measures, such as suspended pavements. To facilitate root development and proper drainage, restore overly compacted sub-grade soils to an acceptable compaction level prior to planting. The required soil volume is based on ultimate tree canopy or trunk diameter; see Figure 2-7 for recommended soil volumes. See Figure 2-8 for an example of a standard tree planting detail.

Figure 2-7 Soil Volume Needed to Grow Large Urban Trees¹



¹ Adapted from "Timely Tree Tips—Minimum Soil Volume," 10 June 2016, <https://dnrtreelink.wordpress.com/2016/06/10/timely-tree-tips-minimum-soil-volume/>. Originally from James Urban, *Up by Roots: Health Soil and Trees in the Built Environment*, 2008, International Society of Arboriculture Books, Champaign, IL.

Figure 2-8 Example Tree Planting Detail (Deciduous Tree)



2-6.9 Shrubs.

Specify shrubs to meet or exceed the size of a #3 container at installation, except for those within clear zone. Ensure the size, form, and species selected conform to ANSI Z60.1 and the Installation INRMP. The Government Landscape Architect has final approval authority on selected plant material. Species deemed unsuitable for planting will not be allowed.

2-6.10 Ground Covers, Perennials, Ornamental Grasses, Vines, and Annuals.

Specify ground covers, herbaceous perennials, ornamental grasses, and vines to meet or exceed size of a #1 container at installation, except for those within standoff distances. Refer to Chapter 2-6.2 for size requirements within standoff distances. Provide plants in a healthy, disease and pest free condition. Ensure the size, form, and species selected conform to ANSI Z60.1 and the Installation INRMP. The Government Landscape Architect has final approval authority on selected plant material. Species deemed unsuitable for planting will not be allowed.

2-6.11 Utilities.

Coordinate with other disciplines to design a centrally located utility corridor to minimize conflicts between plants and utilities. Balance site and landscape requirements with location of underground utilities.

Place trees so that the mature canopy will meet or exceed an offset of 10 feet (3.3 m), in any direction, from permanent structures such as buildings, light poles, signs, hydrants, backflow devices, overhead utilities. For transmission lines, towers, and poles, ensure a mature canopy clearance of a minimum of 25 feet (7.6 m).

Place trees a minimum of 10 feet (3.3) from underground utilities to minimize conflicts, or provide a root barrier system to mitigate tree conflicts with underground utilities.

2-6.12 Parking Areas.

Around parking area perimeters, provide trees at a minimum of one tree per every five perimeter parking spaces. Within the parking area, provide trees at a minimum of one tree per every 10 non-perimeter parking spaces, using 50% large trees and 50% small trees. Provide a minimum of one tree in each end island. The Government Landscape Architect may set different standards for projects located in arid and semi-arid conditions.

2-6.13 Lawns and Grasses.

Use certified seed, sod, and sprigs of good quality and established identity verified by an official certification agency. Provide certification prior to installation. Select seed, sprigs, and sod that include mixes that require no potable irrigation post-establishment and are low-maintenance. Selection of regional seed mixes is preferred. Refer to Installation INRMP and other applicable guidance. The Government Landscape Architect may set exceptions and/or different standards for projects located in arid and semi-arid climates.

2-6.14 Pollinator Habitat.

Comply with the Office of the State Department Memorandum for “Department of Defense (DoD) Policy to Use Pollinator-Friendly Management Prescriptions” and the DoDI 4715.03 Integrated Natural Resources Management Plan (INRMP)

Implementation Manual. Implement sustainable goals in coordination with the Installation. Develop corridors for pollinators and connectivity of corridors Installation-wide.

Design planting plans to establish, enhance and restore year-round pollinator habitats. Select plant materials and maintenance strategies to ensure a variety of habitat and native nectar and pollen sources. Select plant materials and design strategies that support pollinators. Install native trees, shrubs, and flowering species that produce nectar and pollen.

Figure 2-9 Pollinator-Friendly Planting



2-6.15 Stormwater Management Areas.

Comply with UFC 3-210-01. Within stormwater management areas, specify and install quantities and species of plants in accordance with state and local regulations or other AHJ.

Ensure appropriate plant selection for each stormwater feature type and expected inundation levels and durations. Observe all antiterrorism requirements within the unobstructed space or clear zone during plant selection and placement.

2-6.16 Vegetative Roofs.

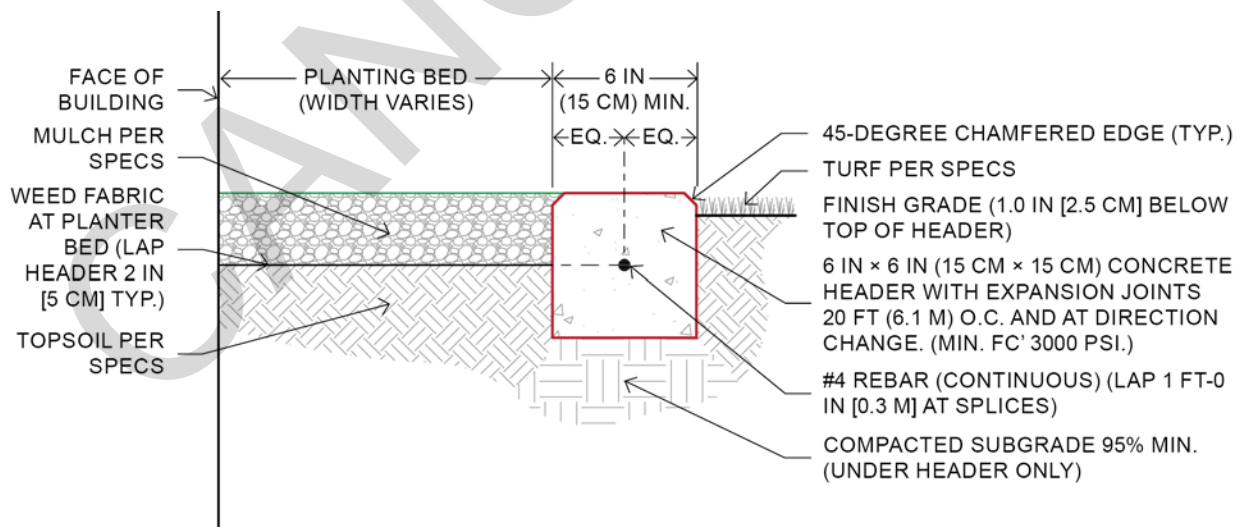
Include the Landscape Architect with all vegetative roof designs, including plant and media selection.

Use plant materials that are appropriate for selected media depth and type. Use herbicides, insecticides, and fungicides currently registered by the United States Environmental Protection Agency (EPA) or approved for such use by the appropriate agency of the host country. Select non-repellant termiticides for maximum effectiveness and duration after application. Select a termiticide that is suitable for the soil and climatic conditions at the project site and apply at the highest labeled rate. Apply herbicides, insecticides, and fungicides by a commercially certified pesticide applicator in the jurisdiction where the work is to be performed as required by Department of Defense Instruction (DODI) 4150.07. Use temporary irrigation during establishment, unless permanent irrigation is planned. Only non-potable water may be used for permanent irrigation. Coordinate with Installation-specific contract services to identify regular O&M needs.

2-6.17 Landscape Edging.

Separate turf areas from planting beds or mulched areas with landscape edging. Specify concrete or metal edging materials. Utilize aluminum, weathering steel (CorTen), or galvanized steel if specifying metal edging materials. Provide stake type and spacing for metal edging per manufacturer's recommendations. Plastic edging is prohibited.

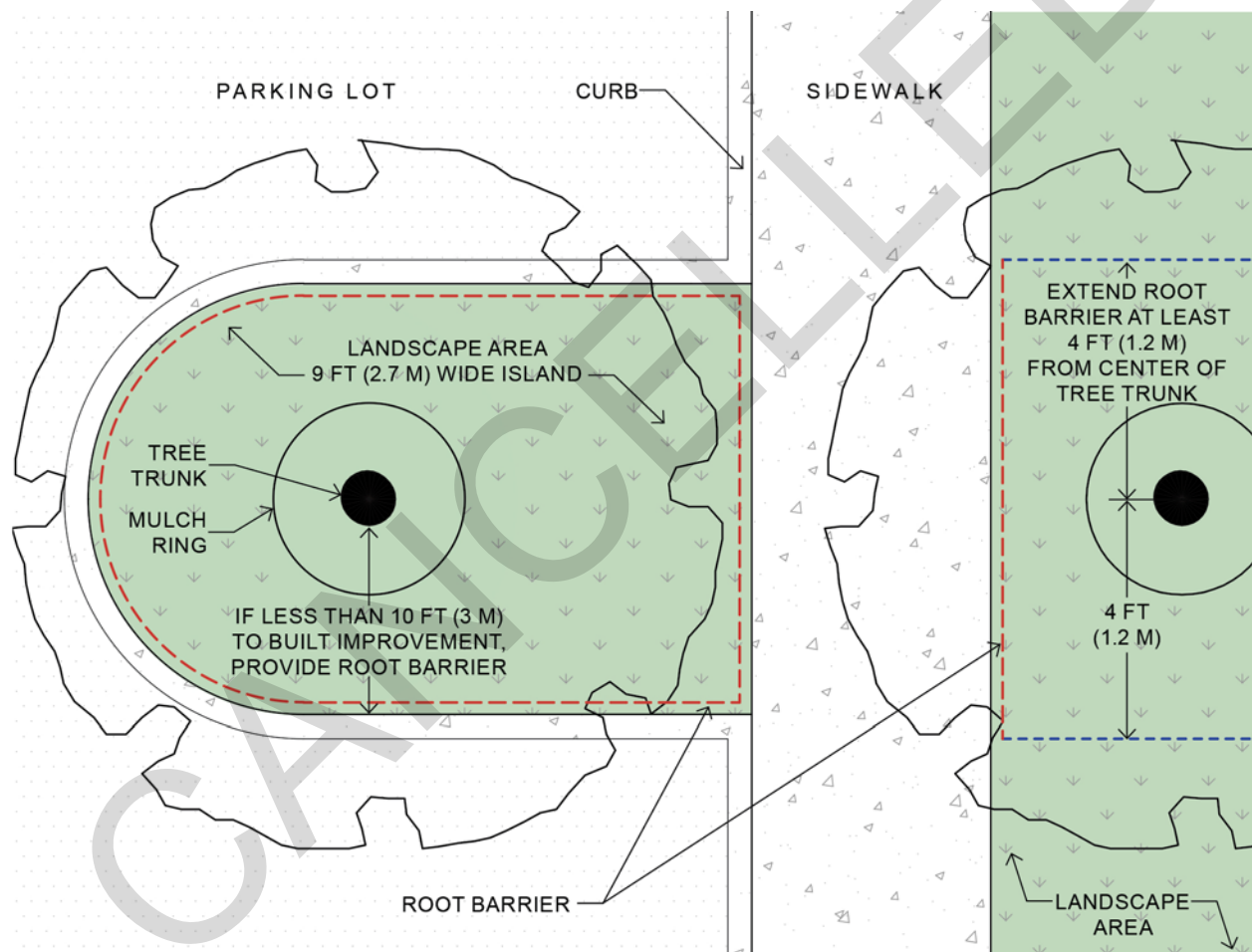
Figure 2-10 Concrete Header Mow Edge



2-6.18 Root Barrier.

Install linear tree root barriers along the edge of the built improvement where trees are planted within 10 feet (3 m) of hardscape, paving, structures, or utilities that could be compromised by root systems. Install root barrier parallel to the structure or utility to allow for the maximum amount of contiguous root zone. Extend the root barrier parallel to the site improvement at least 4 feet (1.2 m) from the center of the tree trunk in either direction as shown in Figure 2-11.

Figure 2-11 Example Root Barrier



2-7 IRRIGATION.

Design irrigation to promote optimum health, growth, color, and appearance of plant materials. Abide by the regulations of all local, state, federal, and international water agencies and authorities.

The irrigation designer manages the design and coordination of new irrigation systems with supporting plans, details, specifications, irrigation equipment (including smart

controllers), schedule, and calculations. Use the following document for DoD irrigation criteria:

- UFC 3-420-01 Plumbing Systems

2-8 WALLS AND FENCES.

Comply with UFC 3-201-01, UFC 3-301-01, and UFC 4-022-03. Design walls and fences to correspond with the material palette for the Installation or facility, and correspond with the overall design concept of the site and building.

2-9 SITE LIGHTING.

For exterior lighting criteria, refer to UFC 3-530-01. Select fixtures and criteria to conform to IDGD unless otherwise stated within the project Program of Requirements (PoR) or RFP. Coordinate with the Electrical Engineer for overall lighting design, integrated pole placement, and selection of fixtures. Coordinate tree and light fixture placement to avoid conflicts that will obstruct lighting and prevent tree placement where required. Include the Landscape Architect in the design of appropriately scaled site lighting that reflects a sequence of arrival for the user, inclusive of vehicular circulation and parking, as well as pedestrian circulation, including plazas and entries.

2-10 EXTERIOR WAYFINDING AND SIGNAGE.

For exterior wayfinding and signage, comply with UFC 3-120-01.

2-11 SITE FURNISHINGS.

Provide site furnishings per the IDGD.

Comply with UFC 4-022-02 for site furnishings, including bollards and planters, intended to provide crash resistance and other security measures. Comply with UFC 4-010-01 to ensure site furnishings and elements will not conceal a threat.

2-11.1 Shelters.

Outdoor shelters include bus shelters, pavilions, gazebos, canopies, shade structures, pergolas, arbors, and other open-air facilities. Structures may consist of pre-fabricated shelters, shade structure products, or site-built shelters. Coordinate with the structural engineer on the design of footings, foundations, and other structural elements. Coordinate with the electrical engineer on the design of lighting and other electrical components.

Design shelters to match or coordinate with the material palette for the Installation or facility and correspond with the overall design concept. Scale shelters appropriately in relation to adjacent buildings. Provide plantings and other landscape features to integrate shelters into the site and enhance their visual appeal.

2-11.2 Flagpoles.

Locate flagpoles on paved surfaces that allow for routine and ceremonial access. Identify and design to avoid conflicts with trees, overhead utilities, adjacent banners, and other vertical elements. Space flagpoles so that flags do not touch when fully extended. At a minimum, specify flagpoles to meet National Association of Architectural Metal Manufacturers (NAAMM) FP1001-07 and all regional wind velocity standards for sustained wind and wind gusts.

2-11.3 Dumpster Enclosures (Trash and Recycling).

Design dumpster enclosure components and service requirements to comply with the IDGD, and to be compatible with the facility's architecture and materials. Use masonry materials for construction of enclosure unless alternate screening materials such as fencing or vegetated barriers are allowed. Construct enclosures to screen all contents from public view. Provide doors unless otherwise stated in the IDGD. Provide an evergreen screen, which at maturity is a minimum of 6 feet (1.8 m) high, to buffer walled enclosures, where applicable.

2-12 COMMON AREAS, RECREATIONAL FACILITIES, AND PLAYGROUNDS.

2-12.1 General.

Common areas may include campus entrances, main gates, building entrances, drop-off zones, plazas, courtyards, parade grounds, parks, playgrounds, recreational areas, monuments, and memorials. Ensure the area is adequately sized to accommodate the program requirements. See specific IDGD for programming and design requirements.

2-12.2 Recreational Facilities.

See the 4-700 Series UFC for requirements pertaining to specific recreational facilities. For outdoor gathering areas at military recreation centers, comply with UFC 4-740-16. Comply with requirements for recreational facilities in the U.S. Access Board's *Architectural Barriers Act (ABA) Standards*, "Chapter 10: Recreational Facilities" and ASTM F1951, "Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment".

Comply with UFC 4-750-02N for **Navy and Marine Corps** outdoor sports and recreational facilities.

2-12.3 Playgrounds.

Conform to the requirements in all relevant Housing and Community Facilities UFC (Series 4-700) and Facilities Criteria (FC) (Series 4-700) for playground designs. Comply with requirements for play areas in the U.S. Access Board's *Guide on Play Areas*. Ensure that playground equipment is age-appropriate. Equipment is typically designed for areas designated as tot lots (ages 2 to 5) and play lots (ages 5 to 12). Install signage to indicate age-appropriateness. For equipment layout, account for both

the full zone of use (fall zone) for each piece of play equipment, which requires protective surfacing, and any non-encroachment zone for the equipment as specified for the equipment by the manufacturer. Comply with ASTM F1487, "Standard Consumer Safety Performance Specification for Playground Equipment for Public Use".

Comply with UFC 4-740-14 and FC 4-740-14N requirements for child development centers.

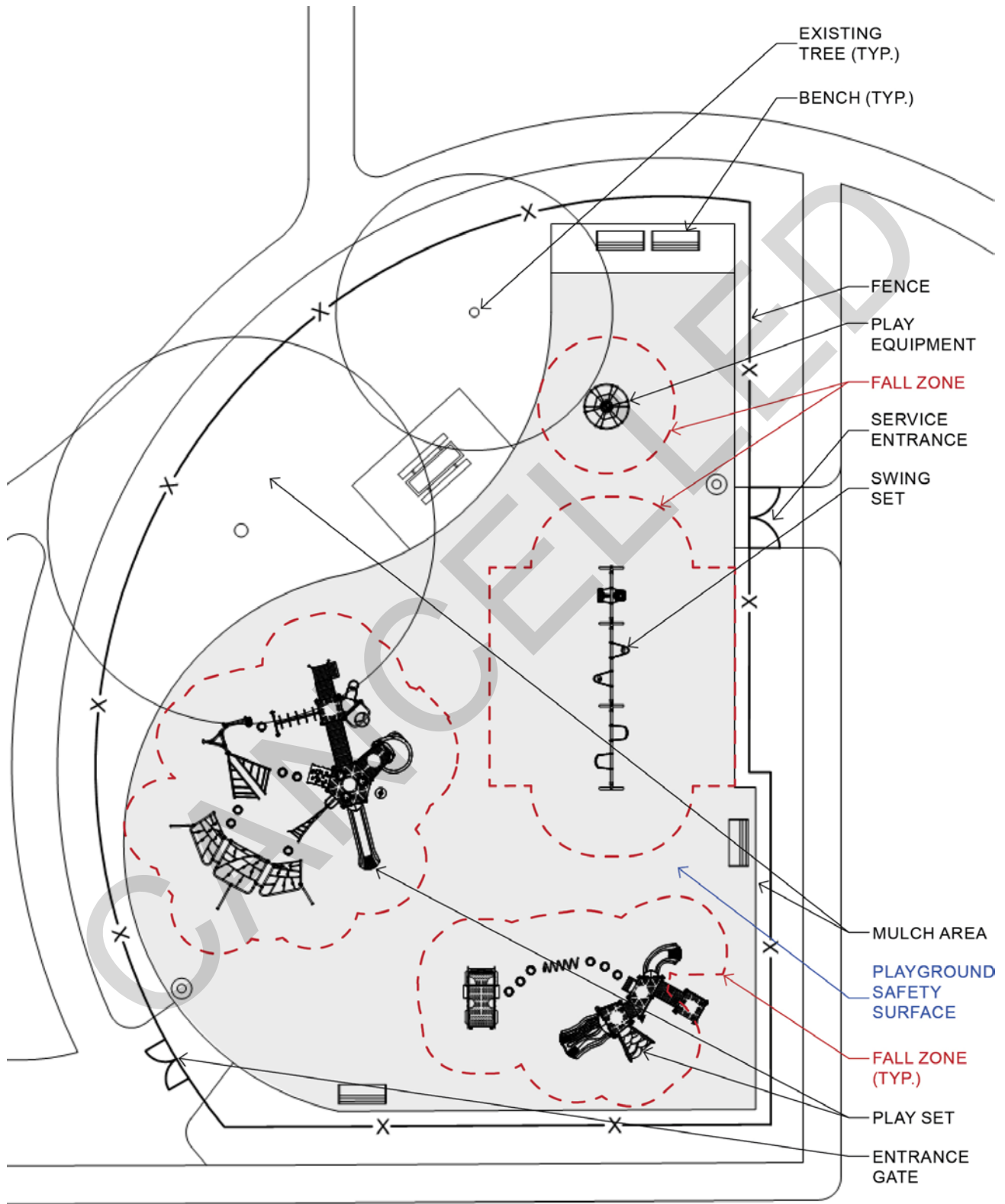
2-12.3.1 Playground Protective Surfacing.

Use a playground safety surface under play equipment, such that the surface covers the extent-of-use zones and extends at least 6 feet (1.8 m) out from all equipment. Materials at risk for compaction, flammability, and wind dispersion, or that are ingestible, are prohibited. The use of chromated copper arsenate (CCA) treated lumber is prohibited. Manage CCA-treated lumber at existing sites to prevent arsenic migration. Comply with ASTM F1292, "Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment".

2-12.3.2 Planting Design at Playgrounds.

Identify and remove existing poisonous plants and plants that have thorns or other hazardous physical characteristics. Do not specify or install poisonous or hazardous plants near playgrounds. Refer to a comprehensive, commercially available field guide for complete lists of poisonous plants. Consult local cooperative extension services, regional poison control centers, or other relevant agencies for specific guidelines.

Figure 2-12 Playground Equipment Layout Plan with Fall Zones



2-12.4 Pool and Aquatic Complexes.

Comply with UFC 4-750-07 for pool and aquatic complexes.

Recreation pools and splash pads are often free form in shape, responding to the site layout and design aesthetic. Direct water away from the pool coping to the drainage system around the pool deck perimeter. Provide fence enclosures that meet minimum height, gap, and material requirements for public pools. Landscape architectural construction documents may include: pool layout, hardscape, grading, lighting, planting, and materials selection.

2-12.5 Smoking Areas.

Comply with provisions for environmental tobacco smoke control in UFC 1-200-02. See Chapter A-24.4 for best practices.

CANCELLED

CHAPTER 3 LANDSCAPE ARCHITECTURAL PROJECT DOCUMENTATION

3-1 GENERAL.

Prepare landscape architectural design submittals and requirements in accordance with the following criteria. Landscape architectural project documentation is key to the successful execution of work. This body of work includes deliverables from project inception through project completion.

Submit required documentation as defined in the project contract and based upon component-specific guidance.

3-2 PRE-DESIGN SUBMITTALS.

3-2.1 Concept Design Workshop/Charrette.

The DoR must participate in the Concept Design Workshop/Charrette and contribute to the development of the conceptual site plan and charrette report as they relate to landscape architecture.

3-2.2 Site Inventory and Analysis.

The goal of Site Inventory and Analysis is to gather site-specific information, identify applicable requirements and regulations, and establish opportunities and constraints. Conduct a Site Inventory and Analysis narrative during Concept Design Workshops and charrettes. Include deliverables in the charrette report and into the BoD documentation. Collect the following components in the site inventory:

- Existing Conditions:
 - Environmental Checklist and NEPA Documentation
 - Visual Resources: including but not limited to photographs, existing maps, and video recordings
 - Site context
 - Climate and microclimate(s)
 - Solar aspect and wind conditions
 - Topography
 - Hydrology
 - Delineated wetlands
 - Floodplain boundaries and storm surge projections
 - Existing waterbodies
 - Man-made BMPs and stormwater structures and outfalls
 - Groundwater wells (production wells and monitoring wells)
 - Geology and soils
 - Horticultural soils analysis, including but not limited to pH, soil organic matter, and macro- and micronutrients
 - Ecosystems
 - Wildlife corridors
 - Threatened and endangered species
 - Vegetation

- Tree inventory
- Existing vegetation inventory
- Identified preservation and protection areas
- USDA Plant Hardiness Zone, or overseas equivalent
- Ecoregion, using EPA or U.S. Forest Service (USFS) designations, or overseas equivalent
- Invasive plants
- Hazardous trees
- Existing vegetation corridors and connectivity
- Existing utilities
- Sanitary sewer lines and pumping stations
- Industrial activities and structures (e.g., hazardous waste, hazardous material storage facilities, fuel storage facilities, landfills, etc.)
- Access and circulation patterns, including existing and proposed walks, trails, and pathways
- Views (internal and external)
- Odors
- Noise
- Cultural Resources
 - Historic structures, objects, landscape elements, and viewsheds
 - Traditional cultural properties, Native American sacred sites, and archaeological resources that have the potential to be disturbed during construction and ground disturbance
 - Heritage or significant trees
 - Cultural landscapes that are listed in or eligible for listing in the National Register Historic Places (NRHP)
- Cultural landscapes as identified by the appropriate federal agency in consultation with state and Native American stakeholders, as appropriate
- Criteria compliance
- IDGD and local, state, federal, and international regulations
- Buffers and setbacks
- Security and antiterrorism

Perform site analysis to weigh the program of requirements against the constraints and opportunities present on the project site. Consider all existing planning documents such as the IDP and ADP.

Figure 3-1 Examples of Site Analysis Plans
Grading and Drainage

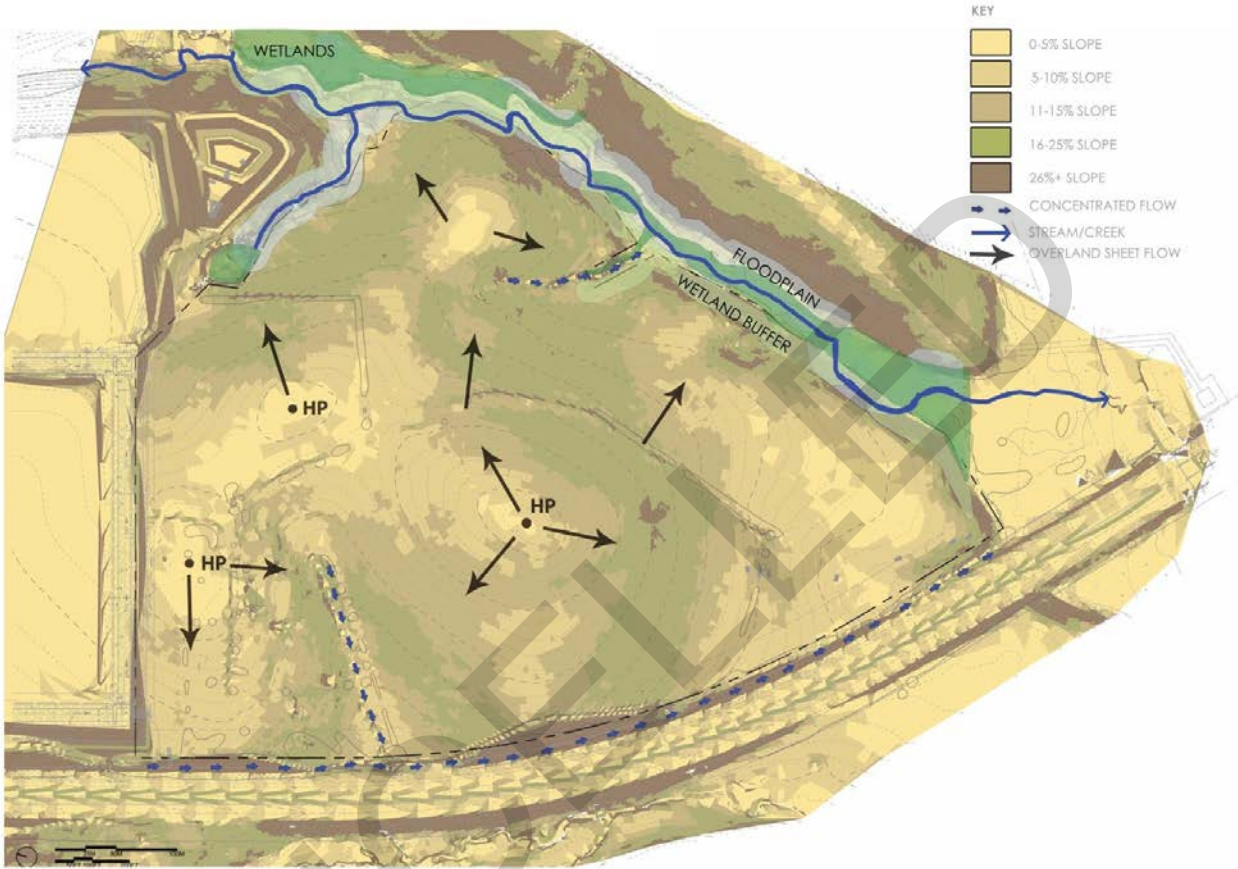


Figure 3-1 (Cont'd) Examples of Site Analysis Plans
Land Use, Viewsheds, and Solar Aspect



3-2.3 Basis of Design.

The Basis of Design is a narrative presentation of facts, sufficiently complete, to demonstrate that the project concept is fully understood, and that subsequent design details, and their ultimate presentation in the final drawings and specifications, will be based on sound decisions. Update and submit the BoD at each submittal. Address all requirements presented with the PoR in the BoD narrative, including:

- Project SoW
- Site compliance with Installation Planning Standards (IPS)
- Synopsis
 - Site inventory
 - Site analysis
 - Design approach
 - Resiliency and sustainability
 - Antiterrorism standards
 - Proposed circulation and accessibility plan
 - Stormwater design and planting

- Planting design
- Site Furnishings
- Hardscape
- Site lighting
- Irrigation: temporary or non-potable permanent
- Reference documents
- Third Party Certification (TPC) – requirements where applicable
- Maintenance plan
- IPM plan

3-3 DESIGN SERVICES.

3-3.1 General.

Address the following key components in the design documents from landscape establishment through landscape warranty periods:

- Field consultation during construction including site observations, shop drawings, and submittal review.

3-4 POST-DESIGN SERVICES.

3-4.1 General.

Address the following key components during construction from landscape establishment through landscape warranty periods:

- Field consultation during construction including site observations, shop drawings, and submittal review.
- Landscape establishment, maintenance, and management through the warranty period.

3-4.2 Construction.

Review the construction package, site conditions, criteria, schedule, procedures, and coordination with related work. Address specific landscape architecture and site-related items at the pre-construction meeting:

- Tree Mitigation
- Environmental Issues
- Endangered Species
- Other critical project specific issues

3-4.3 As-Built and Record Drawings.

Require record drawings for planting, hardscape, site lighting, and irrigation at project completion as part of the entire construction document package. As-builts and record drawings are not required for planting unless there are overall field changes in plant material types or location.

3-4.4 Landscape Establishment and Landscape Warranty Periods.

Specify the landscape establishment period and landscape warranty period for a minimum of 365 days after the date of final acceptance to run concurrently. Provide temporary potable or non-potable water or permanent non-potable water irrigation systems to improve plant establishment and viability.

At the end of the warranty period, plant materials must have a minimum 95% survival rate. Require replacement of all unacceptable material. If the overall survival rate is less than 95%, the contractor is responsible for another full warranty period of 365 days for the replacement plants.

3-4.5 Site observations and Project Acceptance.

Perform site observations as required. Determine final turf acceptance based on a satisfactory stand of turf. Acceptable turf area is defined as 95% coverage of the specified turf species at the end of the landscape establishment period with no bare turf areas larger than 6 inches by 6 inches (15 cm by 15 cm). Bare meadow or prairie mix(es) areas greater than 12 inches by 12 inches (30 cm by 30 cm) are not acceptable.

Replace dead plant material during the next approved planting season. Replace plants in their entirety with more than 20% dead material. Require another 365 day warranty period from the date of installation for replacement plant material. Test the irrigation system at final acceptance and at the end of the establishment period. Extend plant establishment and warranty periods for work that does not meet contract requirements. Conduct a final site observation at least 10 days prior to the expiration of the warranty period.

3-4.6 Operations & Maintenance (O&M).

After the establishment and warranty period, the DoD is responsible for coordination and completion of maintenance tasks by the Installation-specific grounds or resource management authority.

Perform tree care by an International Society of Arboriculture Certified Arborist in compliance with Tree Care Industry Association standards. Perform pesticide applications using a commercial-grade licensed or certified professional.

APPENDIX A BEST PRACTICES

A-1 GENERAL.

The Best Practices Appendix is considered guidance and not criteria. Its main purpose is to communicate proven facility solutions, systems, and lessons learned, but may not be the only solution to meet the requirement or design issue.

This Appendix identifies background information and practices for accomplishing certain landscape architectural site design services.

A-2 RESILIENCE.

Resilience and adaptation are essential considerations for Installation planning and design. Assess all potential site risks and design projects to minimize the long-term vulnerability of the site and optimize the opportunity for recovery. Consult databased methodologies that project models for future conditions.

For Army projects: Apply the Army's "Prepare-Absorb-Recover-Adapt" (PARA) framework to resilience planning at the project level. Consult the Screening Level Vulnerability Assessment (SLVA) available for each Installation. The Screening Level Vulnerability Assessment provides qualitative data to identify the need for more in-depth studies and data collection.

A-2.1 Hazard Response.

Hazards pose direct threats to Installations and DoD operations. For each project, inventory potential hazards. Develop and implement design strategies that serve as appropriate response measures to these hazards. This includes the conservation, restoration, and creation of natural infrastructure assets, such as wetlands that mitigate flooding and storm surge. In selecting response measures, prioritize the Installation's critical built infrastructure, including energy, fuel, water supply, and utility services.

A-2.2 Climate Resilience.

Consider the following potential climate change effects:

- Shifts in USDA plant hardiness zone designation
- Stresses on specific species
- Changes in disease and pest vector distribution
- Changes in regional precipitation patterns

Coastal erosion, flooding, storm surge, and sea level rise pose risks to DoD Installations. Address solutions to these through strategic land use planning, modifications and design interventions. Consider natural and nature-based adaptation approaches, including preserving and restoring natural coastal ecosystem defenses, vegetated dunes, living shorelines, and living breakwaters. Alteration and plant installation in and around natural landscape features may require environmental permitting.

A-3 SUSTAINABILITY.

Aspects of sustainability are covered in UFC 1-200-02, UFC 3-201-01, and UFC 3-210-10. For sustainable site development, see best practices in UFC 1-200-02.

A-3.1 Energy Conservation Planning.

Minimize building energy use for heating, ventilation, and air conditioning using vegetation to shade facades and shield the building from winds. Minimize outdoor energy consumption for lighting and other site amenities.

A-3.2 Materials.

Address material selection from the basis of embodied energy and life cycle costs. Practice waste reduction and diversion and consult the integrated solid waste management (ISWM) plan at the Installation level. Employ the use of:

- Salvaged, reclaimed, or refurbished materials. Verify that salvage, such as brick, is appropriate for outdoor use.
- Locally and regionally sourced materials.
- Materials with recycled content.
- Non-toxic materials, including the use of low-emitting and non-emitting materials.
- Raw materials that have been extracted responsibly or products that contain such raw materials.
- Sustainably grown and harvested trees and other plant material.

A-3.3 Site Commissioning and Landscape Performance.

Site commissioning is used to verify the performance of a built work by evaluating sustainability metrics and cost-effectiveness and ensuring greater longevity for the project. Site and building commissioning processes can be combined to form a total commissioning process. The nature of living systems within the landscape requires that the site commissioning processes include on-going post-occupancy evaluation. Incorporate site commissioning into landscape maintenance and management plans.

A-4 REMEDIATION AND RECLAMATION.

Engage an interdisciplinary team for projects that require bioremediation, including phytoremediation, to address the complexities of rehabilitating a brownfield site. Identify the benefits of bioremediation as applied to the identified project site. Select the appropriate methodology for mitigation based on specific site contaminants.

Adhere to EPA guidance and other AHJ guidance pertaining to soil and groundwater remediation.

A-5 SECURITY AND ANTI-TERRORISM.

Utilize design principles defined in Crime Prevention Through Environmental Design (CPTED) to minimize safety and security risks. Design and construct projects to meet

security and anti-terrorism criteria as required in the project BoD and RFP including stand-off distances, planting restrictions, and visibility.

A-6 CIRCULATION AND ACCESSIBILITY.

A-6.1 Streetscape System.

Collaborate with the design team to create streetscapes that enable safe access for all users, including pedestrians, bicyclists, motorists, and transit riders of all ages and abilities. Integrated streetscapes will improve user health by facilitating and encouraging walking and biking. Refer to Smart Growth America's National Complete Streets Coalition program for complete streets design goals and standards.

Collaborate with the design team to:

- Encourage circulation patterns that reduce the need for automobile use.
- Develop a hierarchy of streets, walkways, and trails based on adjacent land use, demand, and peak travel times.
- Plan corridors utilizing the IDGD for standard design requirements.
- Minimize impacts on natural and cultural resources, including stormwater runoff, heat island effect, and visual impact.
- Delineate and clarify circulation systems to facilitate wayfinding, using elements such as signage, special pavements, lighting, furnishings, trees, and other plantings.

A-6.2 Sustainable Streetscape Design.

Sustainable streetscapes function as a part of the greater ecosystem employing technologies that manage stormwater runoff and reduce carbon footprint. Sustainable streets create benefits relating to movement, ecology, and community that together support a broad sustainability agenda embracing the environment and economy. Implementing sustainable streets will create more livable communities.

Landscape verges are an effective treatment between sidewalks and streets that create a buffer from moving vehicles. Verge width is a key factor in pedestrian-friendly design. The greater the separation between vehicular and pedestrian circulation, the safer and more pleasant the pedestrian experience. Installation standoff requirements often create opportunities to establish verge widths that exceed ten feet. Verges adapt for stormwater infiltration and shade tree planting. A minimum verge width of 4 feet (1.2 m) is recommended for small street tree installations and 6 feet (1.8 m) is recommended for large street tree installations. Rain gardens offer a greener solution to detaining and treating street runoff and easily integrate into streetscape design. Filtered runoff is then fed back into the drainage system or allowed to infiltrate and recharge the water table. Structured stormwater planters effectively infiltrate and filter large amounts of runoff using special media, adaptive plantings, and underdrains.

A-6.3 Drop-offs.

Consider dedicated passenger drop-off zones for high-use facilities. Design of covered drop-offs should reflect safety and security best practices. Separate passenger drop-off circulation from service vehicular circulation. Drop-off circulation should be one-way traffic with a counter-clockwise movement. Place seating adjacent to drop-off.

A-6.4 Transit.

The integration of complete street design and public transportation is critical in improving the efficiency of circulation on DoD Installations and projects by reducing the dependence on automobiles. Incorporate these principles within project designs where feasible:

- Parking. Adapt and design streets that accommodate transit vehicles.
- Establish direct pedestrian access routes to transit stops.
- Include transit shelters for new stops and stations that protect from rain, sun, and wind.

A-6.5

Utilize proven design components to mitigate stormwater, reduce ambient temperature, and ensure safety for all users. Include the following design features where feasible:

- Introduce stormwater treatment trains, pervious parking, dark-sky compliant lighting, and shade within parking lots.
- Consider collection and reuse of parking lot runoff for landscape watering.
- Design pedestrian circulation through parking lots to minimize conflicts.
- Strategically place shade trees to mitigate heat island effect.
- Designate snow storage areas that will not adversely affect plant health.
- Utilize appropriate specialty paving materials that meet accessible design standards.
- Coordinate placement of cameras and trees to create and maintain unobstructed sight lines for security cameras.
- Include step outs and convenience strips along pedestrian corridors to increase pedestrian safety and protect plant materials.

A-6.6 Trails and Troop Movement.

Utilize the *ABA Standards*, “Chapter 10: Recreational Facilities.” for trail design, accessibility standards, technical requirements, surface, slope, tread width, and other standards.

Troop movement walkways are specific to military Installations. Include special design considerations for troops that regularly move from one location to another. Design routes with a minimum unobstructed width of 10 feet (3.0 m) to accommodate four individuals abreast, or as directed by the IDGD.

A-7 PLANTING DESIGN.

Each Installation should promote a simple, drought tolerant, and low-maintenance

planting style. To ensure consistency in planting design, utilize detailed plant lists specifically developed for each Installation. Plant lists should be dominated by durable, long-lived species.

To ensure plant diversity, do not plant monocultures of the same species or cultivar. Select plants to meet a site-wide goal of no more than:

- 10% of the same plant species
- 20% of the same genus
- 30% of the same family

Table A-1 Example of Plant Diversity Calculation

Botanical name	Common Name	Quantity	Percent of Total
Species			
<i>Amelanchier x grandiflora</i> 'Autumn Brilliance'	Apple serviceberry	6	5.61
<i>Betula nigra</i> 'Heritage'	River birch	10	9.34
<i>Carpinus betulus</i> 'Fastigiata'	Pyramidal European hornbeam	10	9.34
<i>Cercis canadensis</i>	Eastern redbud	6	5.61
<i>Chionanthus virginicus</i>	White fringe tree	7	6.54
<i>Ilex x attenuata</i> 'Fosteri'	Foster's holly	10	9.34
<i>Ilex opaca</i>	American holly	8	7.48
<i>Juniperus virginiana</i>	Eastern red cedar	9	8.41
<i>Magnolia virginiana</i>	Sweet bay	3	2.80
<i>Myrica cerifera</i>	Southern wax myrtle	10	9.34
<i>Nyssa sylvatica</i> 'Wildfire'	Black gum	3	2.80
<i>Pinus taeda</i>	Loblolly pine	8	7.48
<i>Pinus virginiana</i>	Virginia pine	6	5.61
<i>Quercus bicolor</i>	Swamp white oak	4	3.74
<i>Quercus phellos</i>	Willow oak	5	4.67
<i>Quercus virginiana</i> 'Burkii'	Live oak	2	1.87
TOTAL		107	100
Genus			
<i>Amelanchier</i>		6	5.61
<i>Betula</i>		10	9.34
<i>Carpinus</i>		10	9.34
<i>Cercis</i>		6	5.61
<i>Chionanthus</i>		7	6.54
<i>Ilex</i>		18	16.82
<i>Juniperus</i>		9	8.41
<i>Magnolia</i>		3	2.80
<i>Myrica</i>		10	9.34
<i>Nyssa</i>		3	2.80
<i>Pinus</i>		14	13.08
<i>Quercus</i>		11	10.28
TOTAL		107	100
Family			
Aquifoliaceae		18	16.82
Betulaceae		20	18.69
Cornaceae		3	2.80
Cupressaceae		9	8.41
Fabaceae		6	5.61
Fagaceae		11	10.28
Magnoliaceae		3	2.80
Myricaceae		10	9.34
Oleaceae		7	6.54
Pinaceae		14	13.08
Rosaceae		6	5.61
TOTAL		107	100

A-7.1 Sustainable and Resilient Planting Design.

Employ ecological design principles to restore natural communities, improve the health of ecosystems, and to support wildlife. Design plantings for climate resiliency and natural hazards by:

- Transforming hardened shorelines into living shorelines while mitigating coastal erosion and flooding, creating wildlife habitat, and improving water quality.
- Identifying opportunities for managing natural plant communities using strategies that restore ecological processes, such as controlled burning or prescribed fires that mimics the effects and benefits of wildfires.
- Layering plantings that emulate natural communities, reduce the need for watering, and are self-supporting once established.

A-7.2 Native and Regionally Adapted Plants.

Design the landscape to achieve an Installation-wide target of 80% native plant species.

Design with plant communities that mimic natural ecosystems. These designed plant communities should include native species that form associations in their natural habitat. Also, incorporate non-native, adapted species that perform similar ecological functions and niches to native counterparts.

A-7.3 Landscape Areas.

If there is inadequate space on the project site to meet the landscape area or tree planting requirements, identify auxiliary location for installation of trees. Coordinate with the landscape architect, the Installation forestry manager, arborist, natural resources group, or other designated point of contact. Refer to IDGD and project specific SoW for additional guidance. The Government Landscape Architect may set alternate standards for projects located in arid or semi-arid conditions.

Install large street trees 40 feet on center. Maximize continuous root zone to the greatest extent possible. Design parking lot landscaping to meet the following recommended requirements:

- Select trees that have a normal life span of greater than 40 years.
- Limb branches a minimum of 5 feet (1.5 m) above grade to avoid vehicular and pedestrian conflict. Maintain a balance of 2/3 foliage and 1/3 trunk.
- Strive for a minimum 10% of interior greenspace for privately owned vehicle (POV) parking lots.
- Strive for a minimum 10% of interior greenspace for non-POV parking lots where possible. If user requirements for non-POV lots do not warrant interior tree planting, consider planting trees elsewhere on-site or Installation.
- Provide 30 square feet (25 m²) of landscape area per parking space.

- Design a 9-foot (2.7 m) minimum width interior landscape area, exclusive of curbing, for all small trees.
- Design a 15-foot (4.6 m) minimum width interior landscape area, exclusive of curbing, for all large trees.
- Design a 10-foot (3.0 m) minimum width interior landscape area, exclusive of curbing, for linear landscape islands running perpendicular to the parking stalls.
- A 15-foot (4.6) wide landscape area is preferred in areas utilizing LID strategies.
- End islands should aim to have two trees where space allows.
- Install required trees within 5 feet (1.5 m) to 10 feet (3.0 m) outside the parking lot perimeter if room within islands is not available.
- Coordinate with DoD or the designated point of contact, for parking lot requirements in climates that are non-conducive to tree planting within parking lots.

A-7.4 Wildlife Borders.

Wildlife edge plantings are composed of native vegetation that include a mixture of woody and herbaceous plant materials, including grasses, that attract and sustain wildlife. The inclusion of wildlife borders establishes habitat and food sources. Wildlife borders, with a width of at least 30 feet (9.1 m), should be located at the edges of woodlands, fields, and drainage areas. The establishment of interconnected wildlife corridors is encouraged. Wildlife corridors should reinforce the Green Infrastructure plans of the Installation-specific IDP and ADP, the INRMP, and other IDGD.

Comply with BASH guidance if located within the zone for active runways. Once established, maintain borders by removing invasive species and large trees and shrubs as they begin to shade out low-growing plants.

Figure A-1 Wildlife Border



A-7.5 Integrated Pest Management.

IPM provides an effective and environmentally sensitive approach to pest control through a focus on prevention and the use of pesticides only as needed. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. Multiple approaches are combined to establish an IPM plan that is site specific and incorporates situational needs. A four-tiered implementation approach should be applied:

1. Identify pests and monitor weekly progress
2. Set action thresholds to focus the size, scope, and intensity of the plan
3. Prevent infestation by removing conditions that attract pests
4. Control by employing mitigation options if action thresholds are exceeded

Comply with Installation-specific guidance when preparing IPM plans.

A-7.6 Fire-resistant Landscaping.

Employ strategies to reduce the risks posed by fire, including wildland fire, to structures, facilities, and infrastructure:

- Remove fuel sources and use fire-resistant materials, such as plants and mulch with low resin content, around structures.
- Create permanent firebreaks that are least 10 feet (3.0 m) wide, using hardscape or appropriate vegetation.
- Select plants that are low growing, fire-resistant, have high-moisture content and low sap or resin content.

- Perform regular maintenance such as pruning and removing deadwood.

Refer to guidance from the National Fire Protection Association (NFPA), including the “NFPA 1144 Standard for Reducing Structure Ignition Hazards from Wildland Fire” and recommendations for “Firewise Landscaping” in the NFPA’s *Safer from the Start: A Guide to Firewise-Friendly Developments*.

A-7.7 Xeriscaping.

Practice conservation through the implementation of the seven horticultural principles of xeriscaping. Xeriscaping will provide attractive solutions that save water and reduce maintenance requirements. Provide plantings that cover at least 60% of a planting area (planting bed) with shrubs and ground cover so that masses form within five years. The remaining area may be mulched. Follow Installation-specific guidelines for mulch requirements. Limit large areas of rock to minimize the creation of heat sinks.

Minimize lawn areas. Avoid unnecessary or unusable, small areas of lawn that cannot be irrigated effectively and efficiently. Reduce maintenance by maintaining lawn at a height that will shade out weeds. Use native or regionally adapted plant materials.

A-7.7.1 Xeriscaping Maintenance.

Perform yearly soil tests and apply soil amendments as recommended. Xeriscaping techniques may reduce, but do not eliminate the need for, weed control, pruning, mowing, fertilizing, and annual mulch replenishment.

A-7.8 Lawns and Grasses.

Limiting turf grass areas will reduce water required for establishment. Minimize turf areas in arid climates, except where required for active or passive recreation.

Avoid a monoculture lawn. Use seed, sod, or sprig mixes that combine multiple varieties of native and adaptive species, require less water, and grow to a maximum height of 6 inches (15 cm). A maintenance guide and schedule should be written for the specific species to be installed.

A-7.9 Meadows and Native Prairies.

Meadows and native prairies are designed to replicate natural ecosystems. The installation of meadows and native prairie restorations will reduce maintenance, fertilizer, and water use, and will create a more varied landscape. Educate maintenance staff about the unique attributes and requirements of a meadow or prairie installation. The establishment period is typically three years, at which point the meadow will begin to look full and diverse.

Create a manicured edge adjacent to pedestrian areas to allow for a clean transition to the taller meadow areas. Mow manicured edge to a maximum height of 6 inches (15

cm). Include educational signage for meadow areas in high use traffic areas to educate users and maintenance staff. Refer to section A-21 Exterior Wayfinding and Signage.

A-7.9.1 Meadow and Native Prairie Maintenance.

Meadows and native prairies require different maintenance practices than traditional lawns. Mowing is performed one to two times per year, as opposed to weekly. Specialty mowing equipment capable of raising mowing deck to 6 inches (15 cm) will be required. Native prairies can be managed through controlled burns, where appropriate, to minimize invasive plants and to rejuvenate growth of desirable species.

The active management of invasive plant materials is critical to the success and diversity of the meadow or prairie. A maintenance guide and schedule should be written for the specific species to be installed.

A-8 EXISTING VEGETATION.

Existing vegetation on Installations, especially trees, is an asset and analyzing the type, amount and condition of the vegetation is an important step in understanding the site. Design the project to preserve existing vegetation, including pollinator or host food-source plants. Examine and document sites to determine individual species and plant associations.

A-8.1 Tree Inventory.

If required, tree inventories must be performed by a licensed landscape architect or an International Society of Arboriculture (ISA) Certified Arborist ®.

For wooded areas, survey the edge of the tree line and inventory the density and species of trees. The tree inventory should identify and record any tree over 6 inches (15 cm) DBH. Trees with 24 inches (61 cm) DBH or greater are defined as a significant, heritage, champion, or specimen tree. Note these trees on the survey where present. Gather the following information during the tree inventory:

- Botanical and common names
- Size (height, canopy spread, trunk DBH)
- Approximate age and life expectancy
- Condition
- Replacement value
- Maintenance needs
- Tree location reference points
- Hazard potential

A-9 TIMBERING.

Coordinate all timbering activity with the Installation forestry manager, landscape architect, arborist, natural resources group, or other designated point of contact. Comply with applicable regulations for each jurisdiction.

A-10 REFORESTATION.

Coordinate reforestation with the Installation forestry manager, landscape architect, arborist, natural resources group, or other designated point of contact. Specify a minimum of five species of trees to avoid the installation of a monoculture. Plant species as a diverse mix across the landscape, not in rows or blocks of single species. Install a 10-foot (3.0 m) to 15-foot (4.6 m) wide wildlife border at the edge of all reforestation areas. If there are no established state, local, or Installation reforestation criteria, then plant seedlings at a minimum rate of 625 trees per acre (0.4 hectare). Include the implementation of a wildlife border where space allows. A final walkthrough and inspection are recommended prior to acceptance. A one-year warranty is recommended. Require 90% viability of seedlings at final acceptance.

A-11 FORESTRY MANAGEMENT PLAN.

Identifying, quantifying and understanding an Installation's tree population is crucial to devising a comprehensive, long-term approach to its viability. Trees that receive scheduled maintenance will generally live longer.

Tree management categories include the following:

- Native Forests: If found in undeveloped areas, native forests should be managed as part of a commercial forestry program.
- Native Trees in developed areas: Inventory and add to the forest database, which should receive regularly scheduled maintenance and care.
- Installed Trees: Include all trees planted as seedlings, transplants, or nursery stock in the forestry inventory, which should receive regularly scheduled maintenance and care.

A-12 GREEN WALLS.

Green walls include all types of vegetated vertical surfaces. Systems typically include plants growing into supporting structures. Green walls may be freestanding or attached to a structure. Benefits of implementation include the support of the natural cooling processes and improved air quality. Design to adhere to Installation-specific development and design policies. Consider the following in the design of green walls:

- Location and setting-defined: maintenance level, drainage, space constraints, soil bed or growing media, or application type
- User-defined: desired benefits, function, and access
- Environmental-defined: light, temperature, atmosphere, humidity, and watering needs

Identify and address watering needs of the plant materials during the establishment period and beyond. Consider the use of alternative water sources. The installer should submit an irrigation schedule and watering contract.

Figure A-2 Green Wall with Green Screen



A-13 GREEN ROOFS.

Green roofs are typically vegetative plantings installed over an integrated drainage and growing system on a rooftop. Benefits include enhancing visual quality, stormwater mitigation, energy savings, increasing building insulation, and mitigating heat island effect. Green roofs typically have higher initial costs than traditional roofs; however, the costs are offset through reduced energy and stormwater management costs, as well as increased lifespan of the membrane and roofing system.

A-13.1 Extensive and Intensive Green Roofs.

Extensive green roofs have a shallow growing medium, usually less than 6 inches (15 cm), with a lesser roof load, limited plant selection, and minimal maintenance. Extensive green roofs employ more low-growing plant sections. Due to the shallow nature of the system, extensive roofs can be utilized on sloped surfaces up to 30 degrees.

Intensive roofs have a deep growing medium section that will support a diverse range of plants, including trees. Intensive systems have greater loads, and it is critical that the supporting structure can handle the additional weight. A higher level of visual quality is achieved with a wider plant palette. Typically, intensive roofs are physically and visually accessible and are combined with hardscape pedestal systems for access. Intensive roofs require a greater level of maintenance.

A-13.2 Media Selection.

Green roof growing medium is a mixture of porous mineral aggregates and small amounts of organic material. Permeability, porosity, and weight are key considerations. Select the media mix to resist decomposition and compression. The media mix should be able to withstand freeze-thaw cycles that may degrade the material. Media selections should comply with German Landscape Research, Development and Construction Society (FLL) recommendations for extensive and intensive green roofs in *Green Roof Guidelines: Guidelines for the Planning, Construction and Maintenance of Green Roofs*.

A-13.3 Plant Selection.

Plant materials can be installed in a variety of ways, including trays, plugs, containers, and carpets. Select plants with the following considerations:

- Roof type: extensive vs. intensive
- Growth habit
- Climate and micro-climates: wind, temperature, precipitation, freeze/thaw cycles
- Low-maintenance: native, drought tolerant, hardy plants that require limited irrigation and nutritional needs
- Purpose: stormwater management, energy conservation, heat island reduction, aesthetics, or a combination

A-13.4 Green Roof Establishment and Maintenance.

Consider establishment as well as long-term irrigation needs.

Weed seeds have the potential to be deposited onto the roof by birds, insects, and the wind. Weed the green roof aggressively during establishment to remove weeds and to prolong the life of the plants and growing medium. Create a maintenance guide and seasonal schedule for the specific plant species and system to be installed.

Figure A-3 Extensive Green Roof



A-14 EROSION CONTROL.

Erosion is influenced by soil type, vegetation, and topography. Use slope stabilization techniques on all slopes greater than 3:1. Methods include the use of specialty plantings, hydro seeding, geotextiles, and erosion control mats. Lawn areas should not exceed a 3:1 slope.

A-14.1 Vegetative Stabilization of Soils.

Vegetative stabilization measures employ low-maintenance plant materials to protect soil exposed to the erosive forces of water and wind. Vegetation intercepts and slows runoff, offers direct protection of the soil from wind, and removes water from the soil through evapotranspiration. Below the surface, vegetation binds the soil and increases the infiltration of runoff that recharges the water table.

Select plant materials and ground covers that withstand erosion during periods of intensive rainfall. Use grasses, ground covers, and woody plants with root systems to help stabilize soils and reduce surface erosion on slopes and embankments.

A-15 SOILS.

A-15.1 Specialty Soils.

Coordinate specialty soil mixes, such as bioretention media, green roof media and structural soils, with the DoR.

A-15.2 Topsoil.

Spread topsoil across all areas to be seeded, sodded, or planted. Apply topsoil at a depth appropriate to intended plant materials, existing soils, and moisture needs. Under no circumstances should the depth be less than 4 inches (10 cm).

A-15.3 Organic Matter Application.

Apply compost to existing soils with inadequate and low percentages of organic matter. Organic matter keeps soils friable, which is critical for optimal plant growth. Aerate and spread compost at a rate of 1 inch per acre (25 mm per 0.4 hectare), over the target area, to increase the organic matter percentage by approximately 2%. Lighter applications may be applied in subsequent years. Perform soil testing periodically to gauge application efficacy.

A-16 INTERIOR PLANTING.

The installation of plants within a building environment has quantifiable benefits, including the improvement of indoor air quality, environmental cooling, and noise mitigation. Research has shown that workers with a view of plants, either indoor or outdoor, have increased productivity and morale. Adhere to Installation-specific interior landscape development and design policies where applicable. Consider the following in the design of interior planting:

- Location: maintenance level, drainage, space constraints, and application type, including moveable planters, living walls, planting beds, and trellises
- User: desired benefits, location within individual workspaces, and access
- Environmental-defined: light, temperature, atmosphere, humidity, and watering needs

A-16.1 Interior Planting Maintenance.

Maintenance is the key to successful interior planting design. Interior plantings will need an irrigation system, hose bibs, or watering contract. Drip irrigation is recommended. Do not use non-potable water sources for spray irrigation. Consider the use of alternative water sources. The installer should submit an irrigation schedule and watering contract to address watering needs.

A-17 IRRIGATION.

Irrigation systems are an important part of establishing a landscape. Planting is a large investment and without proper establishment, it will not survive. A one-year establishment period is typical; however, some plantings may need up to 3 years for establishment. Design efficient temporary irrigation systems to conserve water while delivering required resources. Consider the unique characteristics of the soil, climate, topography, quantity and quality of water availability, and specific plant materials when determining a temporary irrigation strategy.

High-efficiency irrigation systems, whether permanent or temporary, deliver up to 95

percent of the water supplied versus conventional irrigation systems that are as little as 60 percent efficient. Use smart irrigation controllers that draw on data from sensors, weather forecasts and plant-care databases to determine watering requirements and time of delivery. Drip irrigation will deliver water to shrub beds more efficiently with little water loss due to evaporation or runoff. Replace or upgrade existing irrigation systems as practical to maximize water utilization. Refer to the Irrigation Association's publication *Landscape Irrigation: Best Management Practices*.

A-17.1 Plant Associations.

Design a comprehensive landscape plan to minimize water requirements. Consider water requirements when choosing plant material to reduce water consumption. The following planting practices will reduce water needs:

- Limit the amount of turf grass.
- Select plant associations to ensure similar requirements.
- Group plants with similar water requirements.
- Specify native plants that are more acclimated to regional conditions.

A-17.2 Alternative Water Sources.

Research opportunities to update existing irrigation systems, especially on golf courses and driving ranges, in order to reduce the use of potable water by taking advantage of alternative water sources. Alternative water sources, including captured rainwater and gray water, and water conservation systems, including drip irrigation, are being used successfully on DoD projects to reduce demand on potable water sources. Alternative methods include:

- Collection and storage of rainwater in cisterns
- Reuse of chiller condensate
- Retention and detention of runoff in stormwater features

Inspect existing irrigation systems for efficiency and soundness.

A-18 HARDSCAPE.

Hardscape design has essential requirements for drainage, accessibility, health, and safety. Safety considerations include safe lighting levels and slip-resistant surfaces. There are opportunities to design hardscape to reduce stormwater runoff, heat island effect, and life-cycle costs.

General recommendations for hardscape include the following:

- Select paving materials for the local climatic conditions to ensure longevity, functionality, and aesthetics.
- Distinguish between vehicular and pedestrian rated pavers.
- Utilize a raised or flush curb as an edge restraint for asphalt and paver areas.

- Review samples and field-constructed mockups with a minimum area of 8 feet by 8 feet (2.4 m by 2.4 m) of specialty pavements.

A-18.1 Concrete.

Design a scoring plan and details to indicate control and expansion joints. When designing colored concrete applications, for durability, always use a foundation of integral color. Typically applied color (color hardener or dust-on color) may then be used for enhancement purposes where not prohibited by IDGD.

A-18.2 Pervious Pavements.

Pervious or permeable pavements may be part of a strategy to restore a more natural hydrologic system on site. Evaluate these pavements for cost-effectiveness, structural capacity, and maintenance requirements. Follow the manufacturer's recommended installation specifications. General recommended standards include the following:

- Limit the use of pervious surfaces to flat or slightly sloped areas. Terrace slopes greater than 5%.
- Verify that soils have a permeability rate of 1 inch (2.5 cm) per hour or greater.
- Verify a 2 foot (0.6 m) minimum clearance (vertical distance) between the bottom of the pavement system and the seasonal high-water table.
- Ensure that the permeable pavement system is not hydraulically connected to structural foundations.
- Verify that selections for joint filler, void material, and bedding material ensure permeability.
- Use a herringbone pattern or other approved pattern for vehicular surfaces.

Figure A-4 Vehicular-Grade Pervious Pavement Systems¹



A-18.2.1 Pervious Pavement Maintenance.

A major design consideration for pervious pavements is maintenance requirements. Vacuum pervious pavements yearly. Prevent soil and mulch from clogging the stormwater system.

Pervious pavements are susceptible to damage from conventional snow removal practices. Plows with metal blades can damage surfaces. Salt, chemicals, and sand treatments may reduce porosity. Sanding should not be used on pervious surfaces without permission from AHJ. The use of a rotary broom or snow blower is the preferred method for snow removal. Plows with rubber or plastic-edged blades are acceptable. If a metal blade is used, keep the blade 1 inch (3 cm) above the pavement surface.

A-19 HEAT ISLAND EFFECT.

Landscape architectural site design plays a major role in unifying efforts to reduce heat-island effect. Reduction strategies include use of the following:

- Paving materials with a high Solar Reflectivity (R) value or high Solar Reflectance Index (SRI). SRI is a composite measure of solar reflectivity and thermal emissivity. An SRI value of 29 or higher is recommended for site

¹ Image: Cascade Design Collaborative, <http://www.cascadedesigncollab.com/>

materials exposed to sunlight. Solar reflectivity characteristics can be obtained from the material manufacturer.

- Open-grid paver systems with a high SRI value
- Vegetated surfaces or rock mulch with a high R or SRI value in lieu of hardscape
- Tree canopy and structures to shade paved surfaces, buildings and lawns
- Vegetated roofs

Prioritize the retention of existing vegetative cover to shade hardscape, especially dark surfaces. In arid and polar climates, tree canopy is less likely to be used. Parking canopy structures are more common. Consider parking canopy options with vegetative roofs or photovoltaic solar panels.

Figure A-5 Covered Parking: Parking Canopy with Photovoltaic Solar Panels²



A-20 WALLS, FENCES, AND GATES.

Limit the use of chain link fence to temporary, secondary, and utilitarian applications. Select decorative styles for primary entrances, formal contexts, and highly visible perimeters. Scale these elements appropriately in relation to adjacent buildings. Balance security needs with pedestrian access and circulation through common areas and along typical pedestrian routes.

Consider the use of green screens (vining plants growing on fences or trellises) to provide privacy, protection, or visual screening, while creating a softer, more aesthetically appealing barrier.

² Image: Airman 1st Class Cary Smith/U.S. Air Force, "Building resilient infrastructures one panel at a time," 2016 August 12, <https://www.usafe.af.mil/News/Article-Display/Article/916922/building-resilient-infrastructures-one-panel-at-a-time/>

A-21 EXTERIOR WAYFINDING AND SIGNAGE.

Successful wayfinding and signage systems clearly communicate information, making a campus legible and accessible. Signage systems operate on a hierarchy of scale, graphics standards, and strategic placement, and should form a cohesive scheme. Integrate the following components into a comprehensive wayfinding system:

- Maps
- Visual communication including variation in colors, patterns and marking of hardscape
- Visual guidance created by structural elements in the landscape
- Non-visual communication, such as auditory and tactile wayfinding

Signage programs are unique for each Installation. Consult the individual IDGD for wayfinding and signage standards. Minimize the number of signs for directions, identification, and customer service to achieve an efficient, cost-effective, and attractive system. The design of wayfinding features and signage should correspond with the material palette for the Installation or facility. Integrate interior signage standards and wayfinding elements into the overall project design and coordinate with exterior features.

A-22 SITE LIGHTING.

Consult the individual IDGD for site lighting standards. Use multiscale lighting across the site to emphasize circulation corridors and highlight significant site features. Incorporate vehicular, pedestrian, bollard, and accent lighting into the lighting design.

A-22.1 Lighting Coordination and Placement.

Lighting coordination and placement are critical components of a safe and secure site. Coordinate with the electrical engineer and design team to implement the following recommended standards:

- Place lighting to minimize conflicts with trees, utilities and stormwater structures, closed-circuit television (CCTV), and other site elements.
- Locate vehicular lighting along travel ways and within parking areas. In vehicular lighting areas, meet or exceed the minimum industry standard of 1 foot-candle (10 lux) average.
- Set light fixtures back a minimum of 2 feet (0.6 m) from circulation aisles and parking stall curbs.
- Use pedestrian-scale lighting in gathering spaces and along walkways. Install pedestrian lighting at a maximum height of 12 feet (3.7 m), unless IPS guidance directs higher or lower installations.
- Bollards and accent lighting may be used in place of traditional light poles within pedestrian areas. Ensure fixtures do not emit light skyward and meet minimum foot-candle requirements.
- Light all pedestrian areas to a minimum industry standard of 1 foot-candle (10 lux) average, unless otherwise stated in IPS guidance.

- Position light fixtures to avoid light trespass along property lines. Maximum light levels at the property line should not exceed 0.1 foot-candle (1 lux).

A-22.2 Dark Sky and Light Trespass.

Meet dark-sky criteria and ensure all light fixtures have horizontal cut off at 90 degrees. The dark-sky movement encourages the use of full cut-off light fixtures that cast no light upward. Control the direction and spread of light by choosing appropriate light fixtures. Refer to the International Dark-Sky Association (IDA) website for resources on product selection. Select all light fixtures to conform to the Illuminating Engineering Society's (IES) standards for "full cut-off" or "fully shielded" fixtures.

Minimize light trespass from site lighting to reduce sky-glow, increase nighttime visibility, minimize negative effects on nocturnal animals, and improve human health and functioning.

A-22.3 Environmental Considerations.

Poorly designed lighting may adversely affect wildlife populations, including endangered species such as nesting sea turtles and migrating birds and bats. Consult with the Installation natural resources manager to identify any potential conflicts with wildlife and appropriate design modifications.

A-22.4 Energy Efficiency.

Select lighting in accordance with the Installation-specific energy efficiency goals and criteria.

Solid state lighting (SSL), including light-emitting diodes (LED), or improved systems that meet more stringent energy goals must be the first consideration for all exterior applications such as building area, roadway, parking lot, pathway, sidewalk, signage, landscape, and security lighting. Formulate site lighting to minimize energy use while maintaining safe light levels.

A-23 SITE FURNISHINGS.

Select site furnishings to match the IDGD and create a cohesive design palette that is applied consistently across a project, including use of the same materials, colors, and finishes. Affix all site furnishings to a permanent surface. Ground mounting or use of a ground-set foundation is preferred.

Site furnishings, together with active users (as in the case of seating), should not impede the flow of vehicular, bicycle, or pedestrian traffic, except where used as traffic barriers or security features.

A-23.1 Flagpoles.

Use the following recommended design standards for ground-mounted flagpoles:

- Appropriate flagpole size for the flag desired per manufacturer recommendations
- Tapered flagpole
- Foundation tube is ground set in a concrete footing. Roof mounting or use of an outrigger pole are acceptable alternatives if ground-mounting is not possible
- An internal cable halyard assembly
- Finial ball ornamentation
- Lightning kit recommended for the pole specified which supplies the required protection
- Stainless steel or aluminum pole with matching components

Table A-2 Flagpole Size Recommendations³

Flagpole Height	Recommended Flag Dimensions
20 ft (6.1 m)	3-1/2 ft by 6-2/3 ft (1.1 m by 2.0 m)
30 ft (9.1 m)	5 ft by 9-1/2 ft (1.5 m by 2.9 m)
40 ft (12.2 m)	5 ft by 9-1/2 ft (1.5 m by 2.9 m)
50 ft (15.2 m)	8-2/3 ft by 17 ft (2.6 m by 5.2 m)
60 ft (18.3 m)	8-2/3 ft by 17 ft (2.6 m by 5.2 m)

A-23.2 Bike Storage.

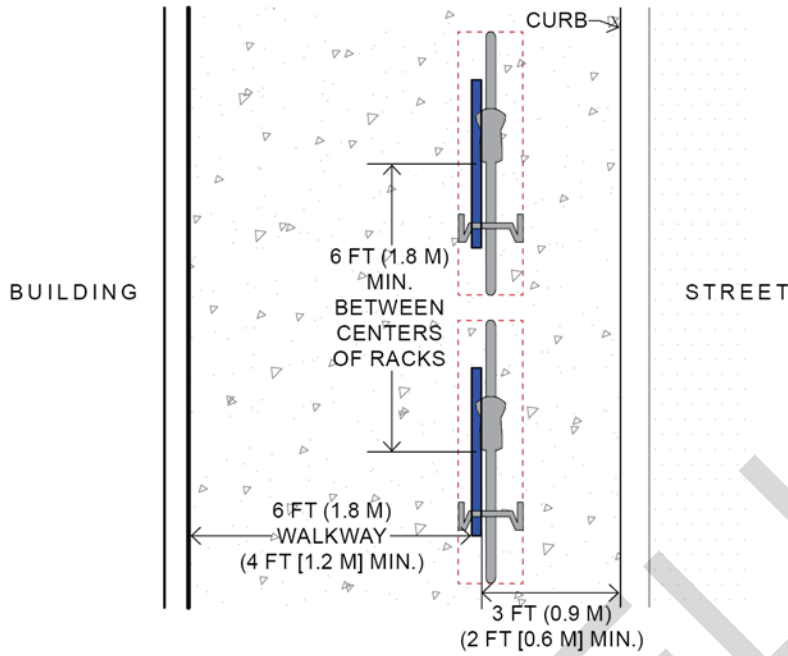
Placement of at least one bicycle storage unit at every facility is recommended, with space to accommodate a minimum of four bicycles with each storage unit. Align bicycle storage with occupancy requirements as stated in the IDGD and other project-specific documents. Install storage units in a secure location near facility entrances. Bike storage can be divided into three types:

- Short-term bike storage consists of outdoor racks; see Figure A-6 for examples of recommended space requirements.
- Long-term storage consisting of a covered facility, including racks under or inside of a shelter.
- Long-term bike lockers.

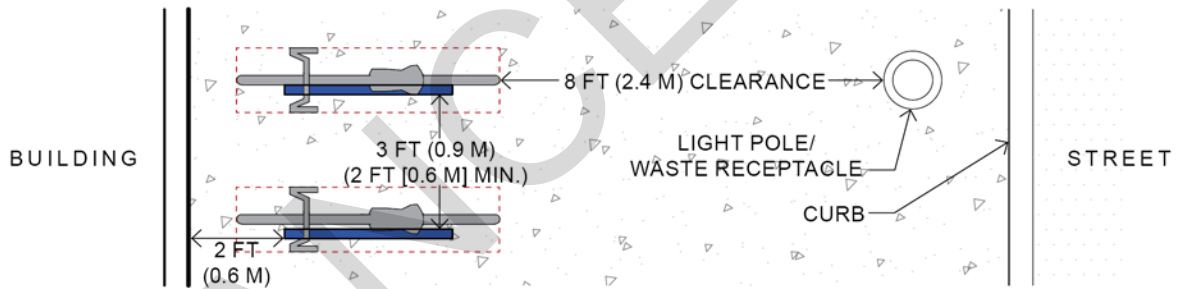
³ General Services Administration. *Facilities Standards for the Public Buildings Service* (PBS-P100), April 2017, https://www.wbdg.org/FFC/GSA/p100_2017.pdf.

Figure A-6 Short-Term Bike Storage: Layout Options

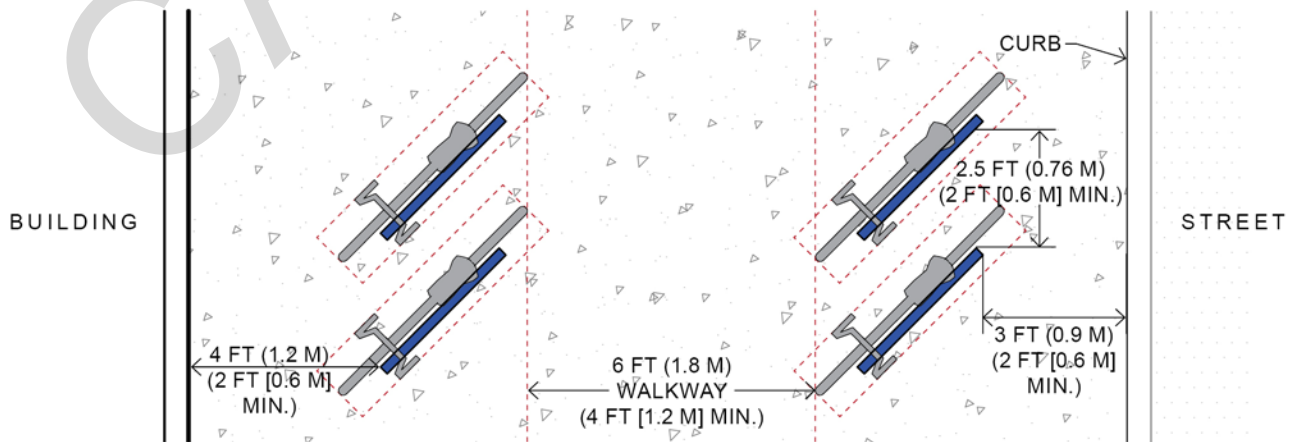
A. Racks parallel to curb



B. Racks perpendicular to curb



C. Racks diagonal to curb – 45 degree angle



A-23.3 Seating.

Select benches that create a unified system of seating. Locate benches and seat walls at primary building entrances, drop-off zones, and gathering spaces such as plazas and courtyards. Design for a minimum of 1 linear foot (0.3 m) of seating per 50 square feet (4.6 m²) of plaza or courtyard space. Ensure that seating options accommodate all user groups. Locate a minimum of one bench along every 1/4 mile (0.40 km) of trail. Consider accessibility requirements when designing seating areas.

To facilitate good pedestrian traffic flow, place benches and other seating:

- A minimum of 3 feet (0.9 m) from the path of travel, such as a sidewalk or trail.
- At least 3 feet (0.9 m) away from sign posts, waste receptacles, or any stationary obstacle.

A-23.4 Outdoor Dining.

Locate outdoor dining spaces according to the project program requirements and locate on concrete paving that extends at least 3 feet (0.9 m) beyond the edge of seating on all sides. Consider accessibility when designing seating areas.

Include permanent grill stations in picnic areas. Use grills with a minimum 200 square inch (0.12 m²) size grill area, and preferably a stainless-steel lid. Specify whether the grill is gas or charcoal in the RFP.

A-23.5 Grates.

Use tree grates in pedestrian areas where there is a need for additional walkable surface area. Design tree grates no smaller than 5 feet by 5 feet (1.5 m by 1.5 m), and plan to replace or modify grates to accommodate trunks as they grow in diameter. Specify decorative metal grates in pedestrian areas.

Place grates over trench drains and other stormwater conduits that traverse walkways. Dome grates are recommended in yard areas to reduce clogging.

A-23.6 Planters.

Use planters for decorative purposes at building entrances and in pedestrian plazas. Planters may function as security barriers, if they meet the design specifications in UFC 4-022-02. Planters may be used to screen security barriers. Design or select planters to contain the soil volume needed to support the intended planting and include appropriate drainage requirements. Consider the option for a self-watering container with a reservoir system.

A-23.7 Waste Collection and Trash Enclosures.

Designate separate receptacles for trash and recycling. Locate waste receptacles in common areas. Screen trash enclosures with evergreen vegetation.

A-24 COMMON AREAS, RECREATIONAL FACILITIES, AND PLAYGROUNDS.

Design common areas, recreational facilities, and playgrounds using principles and standards for universal or barrier-free design. This includes facilities for both users and spectators. As appropriate, furnish these spaces with shade, benches, bicycle racks, and waste receptacles. Wherever possible, maintain existing natural features, open areas or greenspace that can be used for passive recreational use.

Design recommendations for specific facilities include the following:

- Use main gate and building entrances to elevate the image and importance of the Installation and facility. Coordinate closely between disciplines to balance aesthetics with access and security needs.
- Size plazas and courtyards to allow for 4 to 12 square feet (0.36 to 1.1 m²) per person, depending on the anticipated site programming.
- Design monuments to create the environment needed to properly memorialize and commemorate significant events and people.
- Locate bus shelters near common areas. Specify bus shelters that are universally accessible and provide seating.

A-24.1 Parade Grounds.

Design parade grounds to create the large open space needed for formation drills, parade and review functions, honor ceremonies, and other events. Parade grounds traditionally take the form of manicured lawns. Surface with turf and stabilize as needed. Use water-saving grasses or ground cover such as low-water engineered turf blends or other low-water alternatives where possible and in consideration of local climatic conditions. Size parade grounds at 1 acre (0.4 hectare) per 125 persons, and size reviewing stands to accommodate a capacity of 5% of officer strength at the Installation.

A-24.2 Exercise Equipment.

Incorporate exercise equipment and fitness trails into outdoor recreational areas. Install equipment on a surface recommended by the manufacturer. Select and design fitness stations for universal accessibility.

A-24.3 Playgrounds.

For playground design and safety, refer to the U.S. Consumer Product Safety Commission (CPSC) 325, *Public Playground Safety Handbook*, or equivalent overseas standards. Apply accessibility design guidance in the *ADA Accessibility Guidelines for Play Areas*. Use a Certified Playground Safety Inspector (CPSI) for design of all playground plans.

Fence play areas to mitigate nearby accessible hazards, such as roads, waterbodies, and steep slopes. Fencing should be a minimum of 4 feet (1.2 m) tall. The preferred material is a decorative aluminum fence. Install an 8-foot (2.4 m) wide gate to allow a service vehicle to enter the play area. Concrete curbing is recommended as a border for

the play surface. Place benches in play areas and establish a clear view across the play area. Play areas should have shaded areas in the form of mature tree canopy, shade sails, a shelter or other type of canopy.

A-24.4 Smoking Areas.

Prohibit smoking in common areas frequented by nonsmokers including sidewalks, courtyards, plazas, gathering spaces, main entrances, seating and pavilions. Display clear signage indicating no smoking zone within 50 feet (15.25 m) of all building entrances, windows, other openings or ventilation intake systems. Comply with DODI 1010.10 "Health Promotion and Disease Prevention".

Consider placing shelters with seating and protection from the elements in the designated smoking area to encourage use of identified space. Use stand-alone ash receptacles or ash receptacles mounted on trash cans. Label hot ash receptacles with logos or text indicating their use. Do not wall-mount hot ash receptacles.

A-25 POST-DESIGN SERVICES.

A-25.1 Operations and Maintenance Manual.

Educate maintenance personnel on the goals and implementation of the site maintenance plan. Address the following in the O&M manual, as applicable:

- Seasonal plant care and pruning
- IPM
- Mowing
- Removal of stakes and guys
- Removal of invasive plants
- Fertilization and soil amendments
- Stormwater planting
- Interior plants
- Green roofs
- Irrigation system
- Hardscape: including resealing, pervious paver vacuuming, salting limitations, and repairs
- Structures, including wall maintenance
- Lighting

Identify maintenance requirements pre-acceptance, during the warranty period, and post-establishment. Identify the responsibilities for each party outlined in the project specifications.

Figure A-7 Example Seasonal Maintenance Schedule

Activity	Season			
	Spring	Summer	Fall	Winter
General Maintenance:				
Trash pick-up	Weekly	Weekly	Weekly	Biweekly
Remove all broken or fallen twigs and limbs	Weekly	Weekly	Weekly	Biweekly
Sweep pavement	Weekly	Weekly	Weekly	Biweekly
Mulching:				
All planting beds with double-shredded hardwood (maintain at 3-in. depth) *			Biannually	
Perennials:				
Deadhead spent flowers		Monthly	Monthly	
Cut back tender varieties after frost			Monthly	Monthly
Pruning:				
Remove sucker growth from tree trunks**				Annually
Prune shrubs to maintain optimal height**				Annually
Fertilization:				
Fertilize shrub plantings with granular application	Biannually (Full Rate)		Biannually (Half Rate)	
Fertilize meadow/lawn	Biannually (Full Rate)		Biannually (Half Rate)	
Chemicals:				
Apply pre-emergent				Annually
Apply post-emergent	Monthly	Monthly		
Insect controls as needed	Monthly	Monthly	Monthly	Monthly
General Meadow/Grasses:				
Mow with Bush Hog – Warm/Cool Season Mix #1 and #2 ***				Annually
Mowing – Cool Season Mix #3 and #4	Biweekly (or as needed to maintain desired height)	Biweekly (or as needed to maintain desired height)	Biweekly (or as needed to maintain desired height)	
Reforestation:				
Reposition or replace tree shelters that are tilted or severely damaged	Monthly	Monthly	Monthly	Monthly
Replace dead/decayed trees per warranty agreement	Biannually		Biannually	
Other:				
Leaf removal			Monthly	Monthly
Irrigation start-up	Annually			
Irrigation shut-down			Annually	
Hand water dry or stressed plants – First 1-2 years (establishment period)	Monthly	Monthly	Monthly	Monthly
Remove dead plants/Replace per warranty – First 1-2 years	Monthly	Monthly	Monthly	Monthly
Spray and grub weeds and invasive plants	Monthly	Monthly	Monthly	

* Flexibility with mulch replenishment in either the spring or the fall

** Prior to spring flush

*** Could be done more than once a year as needed

APPENDIX B GLOSSARY

B-1 ACRONYMS AND ABBREVIATIONS.

AASHTO	American Association of State and Highway Transportation Officials
ABA	Architectural Barriers Act
ADP	Area Development Plan
AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
ASA IE&E	Assistant Secretary of the Army Installations, Energy and Environment
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BASH	Bird/Wildlife Aircraft Strike Hazard
BIA	Bilateral Infrastructure Agreement
BoD	Basis of Design
CRM	Cultural Resources Manager
CRZ	Critical Root Zone
DBH	Diameter at Breast Height
DoDI	DoD Instruction
DoR	Designer of Record
EPA	Environmental Protection Agency
FGS	Final Governing Standards
HNFA	Host Nation Funded Construction Agreements
IDGD	Installation Design Guidance Documents
IDP	Installation Development Plan
INRMP	Integrated Natural Resource Management Plan
IPM	Integrated Pest Management
IPS	Installation Planning Standards

LID	Low Impact Development
MILCON	Military Construction
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NHPA	National Historic Preservation Act
NHO	Native Hawaiian Organization
OASD EI&E	Office of Assistant Secretary of Defense for Energy, Installations, and Environment
O&M	Operations and Maintenance
PoR	Program of Requirements
POV	Privately Owned Vehicle
R	Solar Reflectivity
RFP	Request for Proposals
SAES	Statement of Architectural and Engineering Services
SOFA	Status of Forces Agreements
SoW	Scope of Work
SRI	Solar Reflectance Index
UFC	Unified Facilities Criteria
USDA	United States Department of Agriculture
WBDG	Whole Building Design Guide

B-2 DEFINITION OF TERMS.

Authority Having Jurisdiction (AHJ): The component office of responsibility, i.e., U.S. Army, HQ USACE/CECW-CE; U.S. Navy, NAVFACENGCOCOM HQ Code CHE; U.S. Marine Corps, HQMC Code LFF-1; and U.S. Air Force, AFCEC. The enforcement of the codes and standards as they pertain to facility projects can be delegated to the local Components Office's Chief Engineer's Technical Representative at the discretion of the components aforementioned office.

Bioremediation: The treatment of pollutants or waste (as in an oil spill, contaminated groundwater, or an industrial process) by the use of microorganisms (such as bacteria) that break down the undesirable substances.

Bird/Aircraft Strike Hazard (BASH): The conflict between birds, airfields, and flight paths that poses safety issues for the flying environment. Problem species can be drawn away from active airfield areas by managing habitats on or near airfields, including enhancing habitat elsewhere.¹

Building: "A roofed and floored facility enclosed by exterior walls and consisting of one or more levels that is suitable for single or multiple functions and that protects human beings and their properties from direct harsh effects of weather such as rain, wind, sun, etc."²

Certified Seed: "Certification is the process by which a state seed certifying agency gives official recognition to seeds produced of a cultivar or named variety under a limited generation system which ensures genetic purity, identity, and a given minimum level of quality. Progeny of breeder, foundation or registered seed, handled under procedures acceptable to the Department of Agriculture and Forestry to maintain satisfactory genetic purity and identity."³

Charrette: "An intensive creative work session in which a design team focuses on a design problem and arrives at a collaborative solution with stakeholders from the project area. A charrette can be a breakthrough event that helps creates a meaningful master plan or facility design. Properly executed, this technique can produce a master plan or facility design that is more useful, better understood, and more quickly produced than

¹ DoD Natural Resources Program, "DoD Bird Conservation Focus Area: Bird/Animal Aircraft Strike Hazard Bird Conservation on Military Lands," December 2016, file:///S:/310/99999-UFC%20Landscape%20Architecture/Docs/1-Working%20Files/6-Reference%20Documents/Resources/DOD/focusarea-fs_BASH_Dec2016.pdf

² DoDI 4165.14, "Real Property Inventory (RPI) and Forecasting," 17 January 2014, <http://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/416514p.pdf?ver=2017-11-14-112325-230>.

³ USDA, Natural Resources Conservation Service, "Plant Materials Technical Note No. 10: Understanding Seed Certification and Seed Labels," 10 July 2009, https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/lapmctn9030.pdf.

one formed by any other method.”⁴

Complete streets: Complete streets “are designed and operated to enable safe access for all users, including pedestrians, bicyclists, motorists, and transit riders of all ages and abilities.”⁵

Cultural landscape: “Cultural landscapes are geographical areas (including both cultural and natural resources and the wildlife or domestic animals therein), associated with a historic event, activity or person or exhibiting other cultural or aesthetic values. There are primarily four types of cultural landscape: designed landscapes, ethnographic landscapes, historic sites, and vernacular landscapes.”⁶

Cultural resource (CR): Per DoDI 4715.16:

- Historic properties (any prehistoric or historic district, site, building, structure, or object as defined by part 800 of Reference (k) included in, or eligible for inclusion in, the National Register of Historic Places, whether such eligibility has been formally determined), including artifacts, records, and material remains related to such a property or resource.
- Cultural items as defined in Reference (m).
- American Indian, Eskimo, Aleut, or Native Hawaiian sacred sites as defined in Reference (l).
- Archaeological resources as defined in section 470 aa-mm of Reference (x).
- Archaeological artifact collections and associated records as defined in part 79 of Reference (k).⁷

Embodied energy: The total energy required to manufacture or produce a material, transport it to a project site, and install it.

Hardscape: Inorganic or inanimate landscape elements, primarily referring to pavements and other non-vegetative materials used for paths and gathering areas.

Integrated Cultural Resources Management Plan: “A plan that defines the process for the management of cultural resources on DoD Installations.”⁸

⁴ UFC 1-200-02, *High Performance and Sustainable Building Requirements, with Change 2*, 7 June 2018, <https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-1-200-02>.

⁵ Smart Growth America – National Complete Streets Coalition, <https://smartgrowthamerica.org/program/national-complete-streets-coalition/>

⁶ National Park Service, *The Secretary of the Interior’s Standards for the Treatment of Historic Properties and Guidelines for the Treatment of Cultural Landscapes*, 12 July 1995, <https://www.nps.gov/tps/standards/four-treatments/landscape-guidelines/terminology.htm>.

⁷ DoDI 4715.16, “Cultural Resources Management,” 18 September 2008, <http://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/471516p.pdf?ver=2017-11-21-114100-670>.

⁸ DoDI 4715.16, “Cultural Resources Management,” 18 September 2008, <http://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/471516p.pdf?ver=2017-11-21-114100-670>.

Installation Design Guidance Documents (IDGD): Installation-level plans and guidelines including, but not limited to the Installation Master Plan (IMP), Installation Development Plan (IDP), Area Development Plan (ADP), Base Exterior Architectural Plan (BEAP), and Installation Planning Standards (IPS), Air Force's Installation Facilities Standards (IFS), Army's Installation Design Guides (IDG), and Navy's Installation Appearance Plans (IAP).

Landscape area: Pervious area with landscape improvements that is not covered by built improvements and impervious surfaces (including buildings, other structures, or paved surfaces such as including parking areas and walkways).

Large tree: Type 1 and 2 shade trees as classified by the *American Standard for Nursery Stock* (ANSI Z60.1).

Lawn: A managed grass space.

Native plant: A species that is endemic to a geographic or ecological region, or a cultivar of that species.

Landscape establishment period: A period lasting a minimum of 365 days from final acceptance of project, during which plant material is irrigated and observed for viability. The irrigation system, if used is maintained and repaired as needed. This period may be adjusted by the Reviewing Government Landscape Architect. Runs concurrently with *landscape warranty period*.

Landscape warranty period: A period lasting a minimum of 365 days from final acceptance of project, during which plant material must meet 95% survival rate and the irrigation system is in good working order. Runs concurrently with *landscape establishment period*.

Phytoremediation: the treatment of pollutants or waste (as in contaminated soil or groundwater) by the use of green plants that remove, degrade, or stabilize the undesirable substances (such as toxic metals).

Resiliency: The capacity to anticipate, prepare for, respond to, recover from, and adapt to hazards and the risks they pose, including severe weather events and the effects of climate change.

Site commissioning: "Site Commissioning is a systematic process of verifying that systems within the built environment, beyond a building's skin, perform in accordance with design intent and the property owner's operational needs."⁹

Site furnishings: Functional and aesthetic amenities that enhance a site for human comfort.

⁹ General Services Administration, *Site Commissioning White Paper*, July 2017, https://www.gsa.gov/cdnstatic/2017-13-07_SiteCommissioning_AccSingle_WhitePaper.pdf.

Site improvements: All site modification that will result in permanent paving features or landforms. Does not refer to enclosed buildings or airfield pavements.

Small Tree: Type 3 small upright trees and Type 4 small spreading trees as classified by the *American Standard for Nursery Stock* (ANSI Z60.1).

Turf: The upper stratum of soil bound by grass and plant roots into a thick mat.

Viewshed: The natural environment that is visible from one or more viewing points

Xeriscaping: Xeriscaping is landscaping and gardening that reduces or eliminates the need for supplemental water from irrigation. This term was coined by Denver Water in 1981 and is associated with seven design principles elaborated on at utility's website: <https://www.denverwater.org/residential/rebates-and-conservation-tips/remodel-your-yard/xeriscape-plans/xeriscape-principles>.

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

UFC 3-301-01, *Structural Engineering*

UFC 3-420-01, *Plumbing Systems*

UFC 3-530-01, *Interior and Exterior Lighting Systems and Controls*

UFC 4-010-01, *DoD Minimum Anti-Terrorism Standard for Buildings*

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