

Final Guam Landscaping Guidelines

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NAVFAC PACIFIC

258 Makalapa Drive, Suite 100

Pearl Harbor, HI 96860-3134

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Guam Landscaping Guidelines

1.0 Purpose and Scope

The purpose of this manual is to promote the Navy's beneficial landscaping practices and to provide sufficient information on Guam's unique environment and flora to aid in the development of successful landscape plans that adhere to all policies, laws, regulations, and Executive Orders.

Landscaping in Guam presents some challenges unique to tropical climates. This manual provides landscaping design guidelines specific to appropriate plant selection and establishment. The approved native and non-native plant list contained herein (Appendix A) supersedes the landscaping plant lists found in the COMNAVMAR Marianas Regional Architectural & Construction Standards (MRACS) or COMNAVMAR Installation Appearance Plan (IAP) and will be used for all Navy Projects. Please refer to the applicable base design standards (Marine Corps Base IAP and COMNAVMAR IAP) for landscape architecture guidelines and for proven construction systems that work in this challenging environment which is subject to a salty atmosphere, high wind velocity, and strong seismic forces.

References

- Executive Order 13112 Invasive Species
- Executive Order 13423 Strengthening Federal Environmental, Energy, and Transportation Management
- Executive Order 13514 Federal Leadership in Environmental, Energy, and Economic Performance
- Endangered Species Act of 1973
- National Invasive Species Act of 1996
- Section 106 of the National Historic Preservation Act
- 7 CFR 300-399 Regulated Pest List
- 7 CFR 2.22, 2.80, 371.3 Noxious Weed
- 7 USC 7701 Plant Protection Act
- 7 USC 1551 Federal Seed Act
- OPNAV Instruction 5090.1 C, Chapter 24 Natural Resource Management
- ASTM E 2590-08 Standard Guide for Conducting Hazard Analysis-Critical Control Point (HACCP) Evaluations
- UFC 4-010-31 Minimum Anti-terrorism Standards for Buildings

2.0 Introduction

Landscaping practices should benefit the environment and generate long-term cost savings. In accordance with the OPNAV 5090.1C, Navy installations shall support the goals of EO 13423 and promote the President's April 26, 1994 Memorandum on Environmentally Beneficial Landscaping. It is Navy's policy to:

- **Use regionally native plants for landscaping,**

- Design, use and promote construction practices that minimize adverse effects on natural habitat,
- Prevent pollution by reducing fertilizer and pesticide use, integrated pest management practices, recycling green waste (composting) and minimizing runoff,
- Implement efficient water practices,
- Prevent the introduction of invasive species.

The use of native plants not only protects our natural heritage and provides wildlife habitat, but can also reduce fertilizer, pesticide, and irrigation demands and their associated costs. By prioritizing the use of native plants in our landscaping designs we can reduce the risk of spreading invasive plants or introducing pathogens that have devastated native flora and fauna in the past.

The intent of this plan is not to suggest plants that are unavailable; but rather to increase the use of suitable native plants, and to encourage a collaborative effort amongst the Navy, the University of Guam, the Guam Department of Agriculture and private landscape industry to propagate and incorporate native species into our landscapes. This will require significant planning and lead time because many native plants are not currently available through traditional landscaping suppliers on Guam. As a result of these constraints and Guam's unique environmental conditions the following are landscaping guidelines for Navy landscaping projects on Guam:

- **At least 50% native species should be used for all landscaping projects (native species must be grown on Guam with all cutting/seed stock having originated on Guam)**
- When existing landscape plants need to be replaced, at least 50% of the plants should be native plants.
- Clumping several individual plants together should be used whenever possible to increase survival rate of plants during a typhoon.
- For best results, it is recommended to plant during the wet season and allow time for plants to become established before dry season begins.

Plants are readily available in the tropics and sub-tropics, making it relatively easy to establish many species of ornamental trees and shrubs. Accordingly, it is important to choose the appropriate species to be planted and their placement wisely to avoid overplanting. A professional, such as a licensed Landscape Architect or certified Horticulturalist, should be consulted during development of landscape plans and specifications. Appendix A contains illustrations and information on recommended approved native plants and approved non-native (non-invasive) plants that are appropriate for landscaping Navy properties on Guam.

To aid in the prevention of accidental introductions of non-native species or invasive species, contractors will be required to develop a Hazard Analysis and Critical Control Point (HACCP) Plan which will identify risks and potential pathways for invasive species

and will outline procedures for controlling and removing risks identified. This plan will be approved by the installation's Natural Resource Manager or Biological Monitor.

3.0 Guam's Environmental Conditions

3.1 Typhoons

Guam is situated in one of the most typhoon prone corridors in the world. According to the data collected by the U.S. Navy Joint Typhoon Warning Center, the probability of a tropical storm or typhoon passing within 180 nautical miles of Guam is one every seven years, although a higher frequency has been noted in recent years with storms recorded in 1990, 1992, 1997, 2002 (two storms), 2004 and 2007. Wind tolerant plants can be used to break, guide, deflect or filter the wind and thereby alter its effects. Typhoon resistant plants generally incur less damage and may recover faster following a storm event.

Many native species are wind tolerant and typhoon resistant as they have adapted to the local environment. Other species are extremely brittle and may break when exposed to high winds or due to shallow root systems, may topple when they have grown to a large size. Refer to the Appendix A for information on typhoon resistant and wind tolerant species.

3.2 Soils

Guam soils can generally be grouped into two broad categories: clay (volcanic origin) soils and limestone soils.

(a) Clay Soils. This large category contains the clay soils and the silty clay soils, developed from basalt and other volcanic rocks. In wet areas, these soils are highly leached and are usually strongly acidic. These soils are low in all three major plant food elements (N-P-K), and are also low in calcium. Grasses will usually grow fairly well on clay soils. Clay soils need calcium both as a plant food and also to neutralize acidity. Lacking a better source of calcium, fine coral sand may be applied at the rate of 2 to 4 tons per acre, or as determined by a soil test. Do not use salt laden sand taken directly from beach areas.

(b) Limestone Soils. The other group of soils includes those developed from coral, coral sand, or limestone. These soils are usually sandy and somewhat alkaline. They are low in all three major food elements; nitrogen, phosphorus, and potassium but have a surplus of calcium. Grasses usually grow well if fertilized only with N-P-K. Trees and shrubs require N-P-K and may also require the addition of micro nutrient elements such as iron, zinc, copper, and perhaps others. A deficiency in these micro-elements generally causes leaves to turn pale green or yellow. This is called a "chlorotic" condition.

Most Pacific island areas are geologically so young that very little topsoil has been formed, and in many instances, that small amount has been lost due to soil erosion or prior development. If topsoil is to be brought in to a site for landscaping, contractors will

be required to provide a soil analysis of the material that they intend to deliver to the site, including a list of recommended rates of application. As topsoil becomes less readily available, soil analyses have become more important as a means to determine which amendments are necessary to provide a viable growing medium for plants. Most agricultural colleges are equipped to make such soil analyses (ex. University of Guam, Soil and Plant Testing Laboratory, College of Agriculture & Life Science Building, University of Guam Campus). Soil analyses can also be obtained from independent laboratories and sometimes from bulk fertilizer suppliers.

Weed seed content in imported topsoil should be a maximum of 0.5 percent. Soils should not be excessively acidic or alkaline, nor contain toxic substances which might be harmful to plant growth. It shall be a mixture of subsoil and cobbles and should be fertile and friable. The use of properly composted and mulched green waste material to supplement imported topsoil is highly encouraged, where feasible. Contract specifications may include additional information regarding the reuse of green waste on site or proper disposal off site.

3.3 Rainfall and Water Conservation

To meet the water demands of the human population on Northern and Central Guam, groundwater from the Northern Guam Lens Aquifer is pumped to the surface from numerous deep wells drilled on the limestone plateau. Bearing in mind that water is a precious commodity on Guam, irrigation should be temporary and limited to the establishment of landscape plants.

The amount of water provided to a newly-planted area is the single most important factor in determining the rate of plant establishment and growth. For the best results, it is recommended that planting take place during the wet season. The wet season typically starts in mid-June and can last into December with slight annual variation. It is recommended to complete planting between the months of July through September, so plants are well established before the dry season commences in December or January. The dry season usually spans between the months of December through May. It has been observed that plant species which are planted at the beginning of November typically do not survive unless they are regularly watered.

*For best results plant
between July and
September during the wet
season*

4.0 Landscape Design Guidelines

4.1 Preservation of Existing Vegetation

It is important to identify, early on in the planning or design process, whether the site of any proposed landscape project is historically or culturally significant. If so, it may require special consideration or be subject to various preservation regulations. Section

106 of the National Historic Preservation Act, requires federal agencies to consider the effects of actions on historic properties, including “cultural landscapes.” Cultural landscapes are typically designed historic landscapes, historic vernacular landscapes, historic sites, or ethnographic landscapes.

Careful planning prior to undertaking work can help prevent irrevocable damage to a cultural landscape. Consult with the installation Cultural Resource Manager and refer to the Integrated Cultural Resource Management Plan (ICRMP) for assistance in identifying, documenting, evaluating, and preserving cultural landscapes to the extent required.

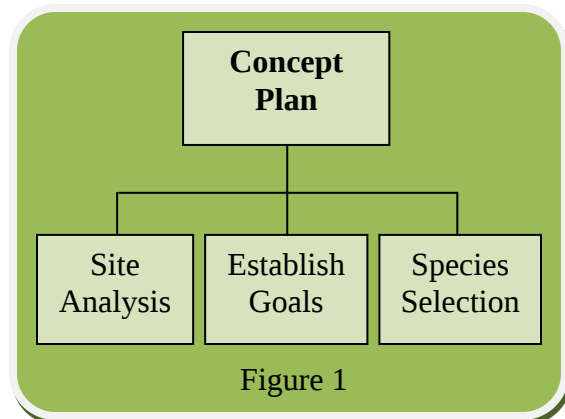
During the planning process, effort should be made to preserve existing landscape features to the maximum extent possible, particularly when the vegetation is native or mature. If it is not possible to preserve mature native trees, note there may be specific requirements for handling and processing of valuable tree species for cultural use.

4.2 Landscape Planning

All landscaping projects will require the development and approval of a landscaping plan. Carefully consider maintenance, typhoon resistance, and watering (drought tolerant plants) needs when developing a landscape plan for Guam.

4.2.1 Concept Plan and Site Analysis

The first step in landscape planning is to obtain a drawing or map of the area to be landscaped and its immediate environs. It should display the boundaries of the property as well as any buildings, paving, walls, fences, and utility lines located on it and immediately adjacent to it. For military property, utility drawings are generally available and are best suited for this purpose. The next step is to record and analyze existing site conditions to assess the environmental setting, opportunities and constraints as they relate to the overall planning and landscape design.



4.2.2 Establish Goals

It is important to establish and clearly define the exact goals of the project early in the planning process. These goals can be depicted on a schematic drawing called the Concept Plan (Figure 1). The site map and site analysis provide an accurate guide for where plants may be used to fulfill identified needs and how much space is available to accomplish the goals of the project.

4.2.3 Species Selection

The next step is to prepare a list of plants that might be used to accomplish the desired goals. Appendix A contains illustrations and information on recommended and approved native plants and approved non-native (non-invasive) plants that are appropriate for landscaping Navy properties on Guam. If there are plants not on this list that landscape planners would like to consider for landscaping, they must not have a PIER rating of 6 or above and must be approved by the installation Natural Resource Manager.

Unlike commercial developments where private homeowners may remove or replace vegetation as each sees fit, plantings on government property are seldom removed. This makes it especially important to have a Concept Plan which is developed by a qualified landscaping architect and that the plan is reviewed and approved by the installation Natural Resources Manager to ensure that appropriate species are chosen.

The species selected should be those that will not only accomplish the desired goals, but will physically fit within the area to be landscaped, not only at the time of planting but during the entire projected life of the adjacent structures. When landscaping an area with existing buildings, subtract the age of the buildings from 30 years and adjust the projected growth of the trees.

A common and expensive mistake is to plant large, rapidly growing species too close together or too close to buildings and utilities. Refer to the Guam Installation Appearance Plan for size and spacing requirements.

4.2.3.1 Scientific Names

Scientific names have a very important purpose in landscaping. They identify exactly which plant is being discussed. They are part of the “specifications” for a plant.

The first word in the scientific name is the genus; it begins with a capital letter. A genus is a taxonomic category ranking below a family and above a species and generally consists of a group of species exhibiting similar characteristics. The second word is the species; it begins with a lower cased letter. It identifies the exact plant within a group (Genus). If, instead of a species name, the letter sp. or spp. are used, that means either the species is unknown, or that all species within the genus are included. Please note, avoid this practice as much as possible, so an undesirable species within the same genus is not selected over a desirable one (i.e., *Ficus* spp.).

Unlike common names, which may vary with locality, the use of the scientific name immediately identifies the plant in any and all locations. In addition, the same plant may have several common names even in the same location; or several completely different plants may have the same common name. The use of the scientific name helps to eliminate any confusion.

4.2.3.2 Native Plant Species

A native plant is one that grows in the same habitat in which it originated. They were brought to a single location without the help of man, such as by wind, wave and/or birds. The primary design requirement is to select the appropriate native plants in conditions similar to where it would naturally be found.

To ensure that plants in their wild habitat are protected and perpetuated, not injured or depleted, native plants should be acquired from nurseries, growers and landscape contractors that are familiar with the laws and ethics associated with the cultivation of native plants.

There is a growing awareness by the general public, regional landscape industries (designers, growers, contractors), and all levels of government that native plants are not only beautiful and practical, but also beneficial to the environment. Utilizing native plants in a landscaping design has many advantages. By prioritizing the use of native plants in our landscaping designs we can lower the risk of propagating invasive plants. In addition, native plants often require less water (except during establishment), chemical pesticides, fertilizers and overall maintenance. They are also an important part of a region's biological and cultural heritage. The desired use of native plants in landscapes encourages cultivation. Furthermore, native plants often provide shelter and food for native wildlife.

The Guam natives in this Guide include those that are readily used and available (such as *Cordia subcordata* and *Calophyllum inophyllum*), as well as natives that have strong potential for ornamental use, but are not yet commercially propagated and grown in significant numbers. The intent is not to suggest plants that are not available; but rather to increase the awareness of suitable natives for landscapes, and to encourage a collaborative effort amongst the DoD, the University of Guam, Guam Department of Agriculture, and the private landscape industry to bring these plants into cultivation.

All native plants selected must be grown on Guam using seed or cuttings collected from indigenous tree species located on Guam. Non-native plant seed should be sourced from Guam and grown on Guam to the maximum extent possible. Avoid importing non-native plants from off-island to the maximum extent practical.

4.2.3.3 Invasive Plant Species

An "invasive species" is defined as a species that is non-native (or alien) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112).

Over time, disturbances from fire, agriculture and urbanization have created ideal conditions for the establishment of alien species within native communities on Guam. Once established the alien plants may smother and displace native species ultimately preventing their reestablishment.

The Navy has the opportunity, through responsible landscaping to help prevent further introductions of invasive plant species. Table 1 identifies invasive plants that pose a serious threat to the Guam's native environment and are restricted from use in Navy landscapes. If there are plants not included in Appendix A that are being considered for landscaping, they must not have a Pacific Islands Ecosystems at Risk (PIER) rating of 6 or above and must be approved by the installation Natural Resource Manager.

4.2.3.4 Restricted Plant Species

Certain species, especially large fruiting trees, cause maintenance problems due to excessive debris, and may become an "attractive nuisance," as people attempt to pick the fruits. Others have growth habits, such as aggressive root systems, that generally make them difficult to maintain. Such species should not be used in "improved" areas.

One restrictive species that deserves special mention is the Coconut palm. Although it is commonly associated with a tropical setting, it is probably the least desirable species of palm to use for Navy landscaping for a number of different reasons. They are costly to maintain because they produce approximately 100 coconuts and about a dozen fronds per year. If they are not trimmed at least once a year (and preferably every six months) by professional tree trimmers there is the danger of injury from falling coconuts. Furthermore, Coconut palms are known to harbor rodents like rats and are the host plant for the Coconut Rhino Beetles (CRB), an invasive insect that has been introduced to Guam.

Table 1. Plant species that are restricted from use in Navy landscapings.

Restricted Plant List*		
Scientific Name	Common Name(s)	Reason for Restriction
<i>Artocarpus altilis</i>	Breadfruit (Ulu)	Fruit
<i>Bambusa spp.</i>	Bamboo	Aggressive
<i>Brassaia actinophylla</i>	Octopus Tree	Invasive
<i>Carica papaya</i>	Papaya**	Fruit
<i>Chrysophyllum oliviforme</i>	Satin Leaf, Satinwood	Invasive
<i>Citharexylum spinosum</i>	Fiddlewood	Invasive
<i>Cocos nucifera</i>	Coconut Palm	Fruit/host plant for CRB
<i>Dendrocalamus spp.</i>	Bamboo	Aggressive
<i>Eucalyptus globulus</i>	Blue Gum	Invasive
<i>Ficus macrophylla</i>	Moreton Bay Fig	Invasive
<i>Ficus microcarpa (retusa)</i>	Chinese Banyan	Invasive, aggressive
<i>Grevillea robusta</i>	Silky Oak	Invasive
<i>Hedychium coronarium</i>	White Ginger	Invasive
<i>Hedychium flavescens</i>	Yellow Ginger	Invasive
<i>Hedychium gardnerianum</i>	Kahili Ginger	Invasive
<i>Mangifera indica</i>	Mango	Fruit
<i>Melaleuca quinquenervia</i>	Paperbark	Invasive
<i>Musa spp.</i>	Banana**	Fruit; Aggressive
<i>Nerium oleander</i>	Oleander	Poisonous

<i>Paraserianthes falcata</i>	Albezia	Invasive
<i>Persea Americana</i>	Avocado	Fruit
<i>Phyllostachys spp.</i>	Bamboo	Aggressive
<i>Prosopis pallida</i>	Kiawe	Invasive
<i>Psidium cattleianum</i>	Strawberry Guava	Invasive
<i>Psidium guajava</i>	Guava	Fruit
<i>Roselia spp</i>	Firecracker	Invasive
<i>Schinus terebinthifolius</i>	Christmas Berry	Invasive
<i>Spathodea campanulata</i>	African Tulip Tree	Invasive
<i>Sphaeropteris cooperi</i>	Australian Tree Fern	Invasive
<i>Heterospatha elata</i>	Sagisi Palm	Invasive
<i>Veitchia merrillii</i>	Chinese betel nut	Invasive
Shrubs		
<i>Ligustrum lucidum</i>	Oriental Privet	Invasive
<i>Ligustrum sinense</i>	Chinese Privet	Invasive
Groundcover		
<i>Asystasia gangetica</i>	Asystasia	Invasive
<i>Lonicera japonica</i>	Honeysuckle	Invasive
<i>Passiflora suberosa</i>	Passion Fruit	Fruit; Invasive
<i>Sphagneticola trilobata</i>	Wedelia	Invasive
<i>Thunbergia grandiflora</i>	Bengal Trumpet	Invasive
<i>Tradescantia spathacea</i>	Oyster plant/Moses in the bullrushes	Invasive
<i>Thunbergia</i>	Laurel Leaved Thunbergia	Invasive

* Note: This list is subject to change as new information becomes available

** In certain circumstances some fruit trees can be considered in well maintained community gardens.

4.2.4. Completing the Plan

After considering the goals of the plan; the size, minimum spacing, and growth habits of the plants; the maintenance requirements of each species; and the special considerations according to the planned use of the area; the planting plan should be prepared on a concept map that shows buildings, paving and utilities.

Items to include on each sheet of the landscaping plans:

- Number each planting location, beginning with the number 1.
- Where possible, show the actual distance from the closest building or any suitable reference point.
- At each planting location, show an alphabetical symbol designating the species to be planted. For alphabetical symbols use the first two letters of the genus and the first two letters of the species in the scientific name. For example, *Scaevola sericea* = SCSE
- Draw trees to scale according to their projected crown spread at age 30 years for new construction. For landscaping around existing buildings, subtract the age of the structures from 30 years and reduce the size of the crown spread accordingly, since the trees will not grow for a full 30 years before the building is due to be demolished or renovated.

- Summarize the species shown on each sheet in a list giving the total number of each species, alphabetical symbol, scientific name, common name, height and spread of the plants to be used, and spacing where applicable.

4.2.5 Xeriscaping

Within the past 15 years, the public's perception of water as an abundant and easily renewable resource has changed dramatically to an understanding that water is a finite and expensive commodity. This change of perception has taken place as increased population demands and droughts have taken their toll on regional water supplies, particularly island environments.

Additionally, Executive Order on Environmentally and Economically Beneficial Practices on Federal Landscaped Grounds (April 26, 1994) directs Federal agencies to employ landscaping practices that conserve water. One response to increased concern for methods of conserving water has been the idea of "Xeriscape," a philosophy of design aimed at water conservation through effective and appropriate landscaping. Xeriscaping, which refers to landscaping in ways that reduce or eliminate the need for supplemental irrigation. Xeriscape design is based on seven basic practices of good horticulture:

- a. Planning and good design
- b. Soil improvement
- c. Use of mulch
- d. Limited lawn areas (saves energy due to little or no lawn mowing)
- e. Lower water consumption
- f. Efficient irrigation
- g. Good maintenance

Xeric plants are those that tolerate dry soil conditions. Xeriscape design approaches landscaping with an eye toward using water efficiency. Note: xeriscape designs don't always require xeric plants.

4.2.6 Special Considerations

4.2.6.1 Antiterrorism/Force Protection

The Department of Defense has established planning, design and construction criteria to minimize vulnerabilities from terrorist attacks. The criteria, effective 1 October 2003, are entitled "Unified Facilities Criteria (UFC), DOD Minimum Anti-Terrorism Standards for Buildings, UFC 4-010-31 July 2002". Based on the type of use and occupancy of a given building, AT / FP criteria dictate setback distances, types and sizes of plant materials that may be permitted around it. These criteria must be reviewed and applied early in the landscape design process.

4.2.4.3 Erosion Control

Since there is little existing topsoil on most sites, it is desirable that contractors use mulch and composted green-waste from the site for landscaping, thereby reducing the amount of imported soil brought onto the site.

The combined use of groundcovers, shrubs, and trees generally provides the most functional and most aesthetic erosion control. The shallow fibrous roots of grass and groundcover spread throughout the surface and tend to hold soil in place while improving its permeability. Trees and shrubs provide multiple layers of protection such as from raindrop impact and wind.

If hydroseeding is to be used, the hydroseed mixture must not contain any seeds that are listed as noxious or prohibited. Use seeds that are native or are on the approved non-native list included in Appendix A. All policies, procedures, regulations for erosion control must be followed during construction and landscaping processes.

4.2.4.4 Noise/Wind Buffers

Dense foliage is of some use in absorbing and deadening noise. In locations such as family housing areas located near main traffic arteries vegetation may prove beneficial in reducing traffic noise. Two examples of good wind/noise buffer trees include; the showy, flowering species such as Alexandrian Laurel (*Callophyllum inophyllum*) and Fish-kill Tree (*Barringtonia asiatica*). Refer to Appendix A for additional species that can be considered for use as noise/wind buffers.

To be most effective, noise buffers should be planted as close to the source of the noise as possible. Plants, trees and shrubs used in combination provide the greatest amount of sound absorption and deflection. In addition, vegetation can be used in combination with solid walls, fences or similar noise abatement.

4.2.4.4 Playgrounds, Parks, and Housing Areas

Plants with thorns or toxic (if ingested) plant parts should NOT be used in areas subject to young children, such as playgrounds and housing areas.

4.3 Plant Installation

In the area to be landscaped, the proposed planting locations should be marked with a stake showing the location number and the species symbol. Prior to actual planting, the location of each stake should be inspected and approved, or minor adjustments made simply by moving the stake.

4.3.1 Planting Pits

Holes for planting trees and shrubs should generally be dug to a width twice the diameter of the container, and only slightly deeper than the root-ball height. The top of the root-ball should be even with the final grade, or slightly above. Deeper planting pits are not recommended as they cause excessive setting.

Landscaping contract specifications should specify a container size and minimum height and spread for each species to be planted. Terms such as “seedlings,” “15 gallon can,” and “large trees,” although commonly use in the nursery business, are vague and should not be used; instead, specify plant height, crown width, or trunk diameter depending upon the species. The tree should optimally form in a vertical position relative to the trunk of the tree; therefore, the roots must not be pot bound or J-shaped. The size of trees will also depend upon the species, so a blanket tree specification will not work in a mixed planting.

4.3.2 Staking and Guying

To prevent newly planted trees and shrubs from moving, which can cause damage to new root growth; or toppling, which destroys the new root growth and is potentially hazardous (in the case of large trees), staking and guying should be used to hold the plants in place. This is the best done with at least three stakes and guys. This will also minimize deformities caused by exposure to prevailing winds and can be used to correct slight deformities in the shape of a young tree or shrub by applying tension at the proper points. (Wait until the plant is well rooted in its new location.) In all cases, guy wires should be flagged as a safety measure, and the trees or shrubs should be protected from direct contact with the guy wires by a piece of garden hose or surgical tubing.

5.0 Fertilization

Determining the type and amount of fertilizer to use will depend on the type of soil at the location (or imported), type of plant(s) to be grown, and the type of fertilizer available. As mentioned previously, type of soil can be determined by laboratory soil analysis (see Section 3.2). Fertilize all trees, shrubs, groundcovers as recommended by the local agricultural extension services.

Areas that have been fertilized should be well watered immediately thereafter and very lightly each day for a few days following fertilization. In areas where it is impossible to water fertilizing should be timed to take advantage of the rainy seasons. For very young, or recently transplanted trees and shrubs wait a few weeks before fertilizing, otherwise the shock may kill them. Grass may be fertilized immediately upon planting.

6.0 Maintenance

Landscaping contract specifications will indicate maintenance requirements following plant installation. Long term maintenance will be included in maintenance contract specifications.

For More Information on Guam's Native Plants and Urban Landscaping in Tropical Environments Visit:

- Overstory the Agroforestry eJournal: <http://www.agroforestry.net/overstory/overstory87.html>
- Official Guam Forestry website: <http://www.guamforestry.org>
- Plant Threats to Pacific Ecosystems: http://www.hear.org/Pier/how_to_use_PIER.htm
- National Tropical Botanical Garden: <http://www.ntbg.org/plants>

7.0 References

Books and Publications

Birrnbbaum, Charles A. (1994) Preservation Brief 36: Protecting Cultural Landscapes: Planning, Treatment and Management of Historic Landscapes. U.S. Department of the Interior, National Park Service Cultural Resources, Washington D.C.

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COMNAVMMAR Installation Appearance Plan (current version), Landscape Chapter.

Department of the Navy, Pacific Division, Naval Facilities Engineering Command. (July 2003) Tropical Landscaping and Plant Selection Guide for Hawaii, Guam, the Pacific Islands.

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Raulerson, L & Rinehart, A. (1991) Trees and Shrubs of the Northern Mariana Islands. Coastal Resource Management Office of the Governor, Commonwealth of the Northern Mariana Islands.

Vogt, Scott R. and Laura L. Williams. (2004) Common Flora and Fauna of the Mariana Islands. Laura L. Williams and Scott R. Vogt, Northern Mariana Islands.

Warren, Wagner, L., Herbst, Derral, R. and Sohmer, S.H. (1999) Manual of the Flowering Plants of Hawaii Revised Edition Volume 1.

Organizations and Web Sites

GUAM FORESTRY

www.guamforestry.org

Navy Research Laboratory Monterey (NRLM 2007). Typhoons Havens Handbook for the Western Pacific and Indian Oceans. NRL/PU/7543-96-0025.

<http://www.nrlmry.navy.mil>

PLANT THREATS TO PACIFIC ECOSYSTEMS

http://www.hear.org/Pier/how_to_use_PIER.htm

SOUTH PACIFIC REGIONAL ENVIRONMENT PROGRAMME (SPREP)

www.sidsnet.org/topic/Invasive.htm

UNIVERSITY OF FLORIDA, Environmental Horticulture.

<http://hort.ufl.edu/>

UNIVERSITY OF GUAM, College of Agriculture and Life Sciences.

www.sidsnet.org/pacific/sprep

U.S. AIR FORCE, Landscape Design Guide

www.afcee.brooks.af.mil/ldg/siteoutline.html

U.S. DEPARTMENT OF AGRICULTURE, Animal and Plant Health Inspection Service, “Federal Noxious Weed List”

www.aphis.usda.gov

Personal Communication

Eric Cook, Plant Propagation Specialist, Ecology of Bird Loss Project (Guam & CNMI), University of Washington.

John H. Lawrence, Assistant Director Field Operations Office, US Department of Agriculture, Natural Resource Conservation Service.

Robert J. Falvey, Director of U.S. Navy Joint Typhoon Warning Center.

APPENDIX A

Approved Landscaping Plant Lists

Landscaping Plant List

Scientific Name Common name Chamorro Name		Description	Usage	Mature Height	Habitat requirements	Comments
Recommended/Approved Native Plant List for Landscaping on DOD Lands on Guam						
<i>Aglaia mariannensis</i> Aglaia Mapunao		Shade tolerant, small to medium attractive tree with flesh-to-salmon colored flowered that inflorescence as they increase in size; produce orange colored fruits in clusters; young branches and new rusty colored leaves.	Good shade tree and an attractive ornamental.	24 feet	Grows well in limestone and volcanic soils; prefers shade.	Not proven in urban landscapes; do not plant in high traffic areas.
<i>Barringtonia asiatica</i> Fish-kill tree Puteng	 	Large tree with spreading canopy; large, showy white flowers; square-sided fruits. <i>Photo courtesy of Dr. James McConnel, University of Guam</i>	Good windbreak; typhoon resistant, high salt and drought tolerance.	25-50 feet	Grows well in a variety of soils; prefers full sun exposure.	Requires maintenance to remove fallen fruits. Culturally important.
<i>Calophyllum inophyllum</i> Alexandrian laurel Dáok		Large tree with broad crown; fragrant and showy white flowers which grow in clusters. Produces round, brown fruits 1-2 inches in size. Glossy dark green leaves.	Excellent shade tree and a commonly planted ornamental. Good windbreak and accent specimen.	50 feet	Grows well in a variety of soils; prefers full sun exposure.	Slow growing, highly resistant to typhoons/wind, high salt and drought tolerance; has aggressive roots. Recommend pruning when young to get desired shape.
<i>Cerbera dilatata</i> Island Plumeria Chiute	 	Small to medium sized tree with showy, white, fragrant flowers at the end of the branches. Leaves are elliptical shaped and glossy dark green in color.	Attractive ornamental for most locations as an accent specimen.	30 feet	Grows well in a variety of soils; adaptable to full sun or partial shade.	May be toxic if ingested, therefore not suitable for planting near playgrounds or parks. Medium wind, drought, and salt tolerance. Resistant to most pests.
<i>Cordia subcordata</i> Cordia Niyoron	 	Small to medium sized tree; clusters of showy, orange flowers occur in few-flowered corymbs that are terminal and lateral on braches. Long shaped fruits are yellowish to brown.	Attractive accent specimen, windbreak, xeriscape. Provides shade in open shores and the flowers can be used for necklaces headbands (leis and mwarmwars).	20 feet	Prefers full sun exposure.	Medium maintenance and fertilization, prune to shape annually. Pest resistant.

<i>Elaeocarpus joga</i> Blue marble tree Yoga		Large, handsome tree with spreading crown and a pagoda-like appearance. Smooth, dark trunk and often buttressed. White feathery flowers and spherical, marble sized, blue fruits. Shiny green leaves are held parallel to ground turn red before falling. Photo courtesy of Dr. James McConnel, University of Guam		45 feet	Grows well in limestone to partial limestone soils; prefers partial to full sun exposure.	Recommend planting in cluster of several individuals due to potential mortality during transplanting. Requires low maintenance and fertilization.
<i>Ficus prolixa</i> Banyan Nunu		Medium to large tree with aerial roots that emerge from the trunk and branches; alternate leaves contain a milky sap; white colored fruit develops in the leaf axils and trunk.	Attractive ornamental for most locations as an accent specimen. Used for medicinal purposes.	30 feet	Grows well in a variety of soils; adaptable to full sun or partial shade.	Culturally important. There are many species of ficus available in nurseries, be sure to chose the appropriate native species.
<i>Guamia mariannae</i> Guamia Paipai		Compact, understory tree of the limestone forest. Solitary, yellowish petals are triangular and thick and there are many stamens; brown when mature fruits and dark green, glossy leaves.	Attractive accent specimen and compact enough in size to be planted in developed areas. Due to difficulty with propagation may be better suited for reforestation efforts at this time.	9-16 feet	Grows well in a variety of soils; prefers full to partial shade.	Medium wind, drought, and salt tolerance. Low maintenance and fertilization. Pests may include mealy bugs.
<i>Hernandia sonora</i> Lantern Tree Nonak		Large tree with silvery gray, smooth or slightly fissured bark and a dense spreading crown; flowers are silvery white and appear in clusters; fruits are black, elliptical nuts.	Excellent shade tree and a commonly planted ornamental. Used for medicinal purposes.	65 feet	Grows well along coastal areas and is occasionally found in limestone soil ; prefers full sun.	Propagated by seeds which should be removed from seed jacket before sowing.
<i>Morinda citrifolia</i> Indian Mulberry Lada		Small tree with a bushy crown that is not widely spreading. White flowers occur yellow white and gelatinous fruit with dark green, glossy leaves.	Attractive accent specimen. Used for medicinal purposes.	13-16 feet	Prefers full sun.	Has a long life span relative to other plant species and a moderate growth rate.
<i>Neisosperma oppositifolia</i> Fagot		Medium sized tree that has pagoda like branching with elliptical shaped, dark green leaves; small, white, fragrant flowers occur in dense clusters at branch tips. Large egg shaped fruits turn yellow when mature.	Excellent all around landscape plant for all locations. Good windbreak; typhoon resistant, high salt and drought tolerance. Used for medicinal purposes.	16-33 feet	Grows well in a variety of soils; adaptable to full sun or partial shade.	Low maintenance and fertilization and no pruning required. Pests may include Scale and Mealy bugs.

<i>Scaevola sericea</i> Half flower Nanaso Lanansa	 	Dense, spreading large shrub with a rounded look; has clusters of small, white flowers at the ends of its branches; medium gray leaves are waxy and fleshy.	An excellent shrub to use in housing areas, perimeters of buildings, along walkways and roadways that require a screen, buffer or hedge for erosion control. High drought and salt tolerance, medium wind tolerance.	4-6 feet	Grows well in a variety of soils. Adaptable to partial sun to full sun.	Pests may include spittle bugs, aphids, mealy bugs and scale
GROUNDCOVER						
<i>Polypodium scolopendria</i>		Fern with wide variation in shape and size, lobed fronds that stand erect, and is an accomplished climber of tree trunks.	Used as an attractive ground cover under or around trees and shrubs. Drought tolerant.		Can grow in a variety of soils, prefers limestone soils.	Low maintenance and low fertilization requirements. Can be easily propagated by its rhizome. Requires advance planning as it is propagated as needed for specific projects.

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Landscaping Plant List

Scientific Name Common name Chamorro Name		Description	Usage	Mature Height	Habitat requirements	Comments
Approved Non-native Plant List for Landscaping on DOD Lands on Guam						
<i>Bauhinia blakeana</i> Hong Kong Orchid Tree		Very showy, rounded, spreading canopy composed of large six inch purple, rose, and pink blossoms; large, six to eight-inch-diameter, gray/green leaves.	Recommended for buffer strips around parking lots or for median strip plantings in the highway.	20-40 feet	Grows well in a variety of soils; adaptable to full sun or partial shade.	Good choice for planting in an urban landscape setting because they do not drop long pods as other Orchid-Trees do.
<i>Caesalpinia pulcherrima</i> Dwarf poinciana		Very showy, wide spreading branches, produces orange, red and yellow colored flowers that resemble a Poinciana tree but smaller sized; leaves are bipinnately compound and elliptical in shape.	Attractive ornamental for most locations as an accent specimen.	8-10 feet	Grows well in a variety of soils; adaptable to full sun or partial shade.	Susceptible to breakage either at the crotch due to poor collar formation, or wood itself is weak and tends to break. PIER rating: 5
<i>Chrysalidocarpus lutescans</i> / <i>Chrysalidocarpus lutescens</i> Areca Palm		Clustering palm tree that produces clusters of reedlike stems that carry arching fronds and drooping yellow-gold flowers.	Good accent specimen and for use as a screen or noise/wind buffer.	13-16 feet	Grows especially well in a variety of soils; prefers full sun.	High drought tolerance and medium to high maintenance due to fertilization needs. PIER rating: 2
<i>Clusia rosea</i> Autograph Tree		Attractive ornamental shade tolerant with pink and white flowers solitary, terminal; fruit globuse green capsule with numerous red seeds; leaves simple, opposite, blade obovate, dark green.	An attractive ornamental which is commonly planted as a street, parking lot, or specimen tree.	32 feet	Grows well in a variety of soils; adaptable to full sun or partial shade.	Propogated by seeds; susceptible to root rot and leaf spot. PIER rating: 5

<i>Jatropha integrerrina</i> Jatropha		Evergreen shrub or small tree with a dome like shape, glossy leaves and clusters of star shaped bright scarlet flowers.	An attratrctive accent or in a mixed shrub border.	8-10 feet	Prefers full sun exposure.	Medium maintenance and fertilization, prune to shape annually. Pest resistant.
<i>Livitonia chensis</i> / <i>Livitstona chinensis</i> Chinese Fan Palm		Palm tree whose large bright green fan-shaped leaves are deeply divided into 75 segements that droop downward to give a gracefully fountain-like aspect.	Becoming common to see young Chinese fan palms used in masses as ground cover.	30 feet	Grows well in a variety of soils; prefers full sun exposure.	Palm forms a long tap root and can survive extended periods of drought . PIER rating: 5
<i>Mascarena laggeniculis</i> / <i>Mascarena lagenicaulis</i> Bottle Palm		Named for its bottle shaped grey trunk with ring scars and a green crownshaft at the top; pinnate leaves emerge from its crownshaft. Produces beautiful white flowers that are followed by black berry like fruits.	Recommended as an accent species in housing and other developed areas.	10-20 feet	Grows well in a variety of soils but prefers moist and well drained soil; prefers full sun exposure.	
<i>Phoenix Roebellini</i> Dwarf Date Palm		Slow growing palm with a curved trunk(s) with narrow arching dark green fronds that have a thin layer of white scales.	May be planted both indoor and outdoors.	6-7 feet	Grows well in limestone soils; prefers full sun exposure.	The tree is not drought tolerant, therefore it should be watered regularly.
<i>Plumeria obtusa</i> Singapore plumeria		Evergreen shrub or small tree with low branching dark, shiny leathery, blunt ended leaves; produces very fragrant creamy white flowers with a yellow center.	Common accent species in housing and other developed areas.	15 feet	Grows well in a variety of soils; adaptable to partial shade to full sun exposure.	Flowers are sometimes collected for leis.
<i>Pritchordia pacifica</i> Fiji Fan Palm		Attractive solitary fan palm with leaf blade that is glabrous dull green on both upper and lower surfaces, without any scales or spots underneath; produces a spherical fruit that matures from red to black.	Recommended as an accent species in housing and other developed areas.	32 feet	Grows well in a variety of well-drained soils; prefers full sun exposure.	Slow growing. PIER rating: -4

<i>Pterocarpus indicus</i> Narra		Large tree with broad canopy; long, fragrant pea-shaped flowers are bright yellow to orange-yellow; pod shaped fruit turns dull brown when mature; bright green leaves are arranged alternately on the branchlets.	Good windbreak; typhoon resistant, soil stabilizer, and ornamental.	82-115 feet	Grows well in a variety of soils; prefers full sun exposure.	Has limited potential to invade undisturbed native plant communities. PIER rating: 4
SHRUBS						
Scientific Name Common name Chamorro Name		Description	Usage	Habitat requirements	Comments	
<i>Alpinia purpurata</i> Red Ginger		Plants with showy flowers on long brightly colored red bracts. They look like they are blooming but the true flower is the small white flower that appears on top.	Plant has outstanding ornamental features.	4-6 feet	Grows well in a variety of different soils; prefers partial shade. Requires frequent watering, does not grow well in dry conditions.	Attracts butterflies. PIER rating: 4
<i>Carissa macrocarpa</i> Natal Plum		Dense, closely branched spiny evergreen shrub or small tree; dark green ovate shaped leaves; produce an abundance of sweetly fragrant white starlike flowers.	Is an ideal hedge plant with its dense foliage that makes it a good screen and its fragrant blossoms and edible fruits.	up to 20 feet	Grows well in a sandy well-drained soil; requires full sun exposure.	May be necessary to prune frequently.
<i>Codiaeum variegatum</i> Croton		Shrub which produces beautiful coarse textured leaves in a variety of shapes and colors from ribbon-like strands to long, broad leaves.	Plant has outstanding ornamental features.	12 feet	Grows well in a variety of soils as long as they are well drained; adaptable to full sun or partial shade.	May be toxic if ingested, therefore not suitable for planting near playgrounds or parks.
<i>Cordyline fruticosa</i> Ti plant		Palmlike evergreen shrub with a strong, usually branched trunk; leaves are may be glossy green, reddish purple, or marked with various combinations of purple, red, yellow or white. Fruits are red berries.	In tropical climates, the Ti plant makes an interesting specimen shrub, valued mainly for its magnificent foliage. Leaves can be made into Hawaiian hula skirts.	10 feet	Grows well in a variety of soils as long as they are well drained; prefers partial shade to nearly full sun.	Ti plant is easy to propagate from stem cuttings.

<i>Dracaena marginata</i> Money Tree		Multiple thin, curving stalks with narrow ribbonlike, green leaves edged in purplish-red. Produces a white flower and a round, fleshy fruit.	The upright, unbranched stems form a delicate, somewhat abstract silhouette, perfect for accent planting.	8-15 feet	Grows well in a variety of soils as long as they are well drained; adaptable to full sun or partial shade.	Long-term health usually not affected by pests.
<i>Gardenia taitensis</i> Tahitian gardenia		Evergreen tropical shrub with glossy dark green leaves that are oppositely arranged along the stem. Produces a fragrant creamy white flower, pinwheel shaped with 5 to 9 lobes.	Used for accent planting. The flower has a sweet fragrance and is used to make leis.	13 feet	Grows well in a variety of soils as long as they are well drained; very drought tolerant (promotes flowering); prefers full sun exposure.	
<i>Heliconia psittacorum</i> Parrot Beak		Exotic plants that abundantly bloom all year long with orange/red bracts that arise from a central point on the stem. The long pointed leaves are shiny green with a red edge.	Used for accent planting as an ornamental shrub.	4 feet	Grows well in rich soils with adequate moisture; adaptable to full sun or partial shade.	Must be watered often. Requires medium to high maintenance.
<i>Philodendron selloum</i> Split leaf philodendron		Large-leaved, three to four foot long tree-like trunk and a spread of 8 to 10 feet. The deeply divided, usually drooping, medium green leaves grow up to three feet long and appear on long, smooth petioles.	When given enough room to spread, Selloum makes a handsome foundation or specimen planting.	3 to 4 foot trunk with a spread of 8 to 10 feet	Grows well in fairly rich, moisture retentive soil; adaptable to full sun or partial shade.	Long-term health is usually not affected by pests.
<i>Pseuderanthemum reticulatum</i> Golden Eldorado		Ornamental evergreen shrub with waxy round leaves in pale green, yellow and white, in varied patterns; small white, purple spotted flowers appear in colorful loose, erect clusters.	Used for accent planting as an ornamental shrub.	6 feet	Grows well in rich, well-watered, well-drained soil; adaptable to full sun or partial shade.	Easily propagated from cuttings.
<i>Ixora coccinea</i> Ixora		Dense multibranched evergreen shrub produces glossy, leathery oblong shaped leaves and scarlet flowers in dense round clusters. It has a rounded form with a spread that may exceed its height.	Used as a hedge and screen, foundation plantings, massed in flowering beds, or grown as a specimen shrub or small tree.	4 to 6 feet	Grows well in low acidic, well drained soil; prefers partial shade.	Feed with a high nitrogen fertilizer and mulch well. Plants placed in full sun will be denser and more compact, and produce more flowers. PIER rating: 4

<i>Strelitzia reginae</i> Bird of Paradise		The uniquely shaped brilliant orange and blue colored flower of this exotic tropical perennial resembles a bird-of-paradise.	Large and showy enough to use as focal points in a landscape design.	5 feet	Grows well in soils rich in acid; plant in full sun for the best looking flowers and plant in shade for the best looking foliage.	Provide liberal amounts of water.
<i>Polyscias fruticosa</i> Panax or Ming Aralia		Perennial evergreen shrub with tripinnate leaves are a dark green color and glossy in texture.	May be planted both indoor and outdoors.	6 feet	Grows well in a variety of soils; adaptable to full sun or partial shade.	It is customary to drop their leaves as they age.
GROUND COVER						
Scientific Name Common name Chamorro Name		Description	Usage	Mature Height and spread	Habitat requirements	Comments
<i>Liriope platyphylla</i> Lily turf, Giant mondo		Evergreen perennial herb. Leaves are grasslike, deep-green, clustered with base; flowers are pale violet in axillary fascicles; fruit berrylike with a black seed.	Used as a ground cover under trees and shrubs and as a mass planting on slopes and banks.	1 foot 1 foot	Grows well in a variety of soils; adaptable to full sun or partial shade.	Rather slow to spread and will require weeding for the first one to two years.
<i>Ophiopogon japonicus</i> / <i>Ophiopogon japonicus</i> Mondo grass		Evergreen perennial with slender, rigid leaves that curl back toward the ground and resemble blades of turf grass. Mondo grass produces small light purple flowers but are of little interest as they are hidden in the dense foliage as are the small blue-black berries that follow.	Mondo grass is useful as a ground cover for shady areas and a path border; the dense mat of roots holds the ground exceedingly well where runoff is a problem.	8 inches 2 inches	Grows well in sandy soil; adaptable to full sun or partial shade.	May be fertilized in the rainy season, but seldom needs encouragement.
GRASS						
Scientific Name Common name Chamorro Name		Description	Usage	Habitat requirements	Comments	
<i>Cynodon dactylon</i> Common Bermuda grass		Dense medium textured.	Commonly used as a home lawn due to its low ease and economy of establishment. Also, a major turf species for sports fields, parks, golf courses and general utility turfs.	Grows well in a variety of soils; prefers full sun exposure.	Drought tolerant, but needs water weekly to remain green.	

<i>Paspalum vaginatum</i> Seashore paspalum		Medium to coarse bladed grass with a dense root system and an aggressive growth habit.	Typically planted beside the ocean because it has a high heat and salt tolerance.	Grows well in soil with a high salt content; prefers full sun exposure.	Spread by rhizomes. Moderate maintenance required. Challenging to mow and recovers slowly from mower damage. PIER rating: 7	
<i>Zoysia japonica</i> Zoysia El Toro		Dense medium textured, highly durable turf. Has a wide blade and produces little thatch.	Used in home lawns, commercial installations and golf courses.	Adaptable to full sun or partial shade.	It spreads by runners. Requires dethatching every two to three years depending on amount of sun shine.	
<i>Zoysia japonica tenuifolia</i> Emerald Zoysia		Finely textured hybrid Zoysia that produces an excessive thatch layer.	Highly recommended for top quality lawns where time and money allow for adequate maintenance.	Adaptable to full sun or partial shade.	Sod is the preferred method of installation because of its slow growth; requires weekly mowing. Disease resistant and traffic tolerant.	

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