

Reef Friendly Landscape Management Plans for Resort Properties in Kā`anapali, Maui

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Preface

The health of the coral reef affects not only Hawai`i's natural resources, but also the experience of tourists that visit our world class beaches and resorts, which in turn can impact Hawai`i's tourism industry. The West Maui Ridge to Reef Initiative (www.westmauir2r.com) was launched in 2012 to focus upon addressing the causes of land based pollution that are believed to be deteriorating our marine systems. As one of several partners in the initiative, the State Department of Land and Natural Resources (DLNR) Division of Aquatic Resources (DAR) has funded a project to collaborate with the Ka`anapali Operators Association (KOA) to develop seven landscape management plans. These management plans address a resorts' need for aesthetically pleasing grounds while implementing best practices that minimize the use of pesticides, fertilizers, and irrigation water.

This project is a true partnership of private and public agencies working together to protect the coral reef, which is vital to our tourism, economy, and Island way of life. The development of the Reef Friendly Landscape Management Plan is the first step for private resorts, public agencies, and all interested parties to collaborate and work toward a common goal of protecting the coral reef. It has involved a series of meetings, site visits, soil sampling, and continual correspondence with participating resorts' maintenance personnel to record and evaluate the existing landscape practices within the Ka`anapali resort community. The Reef Friendly Landscape Management Plan is a product of collective knowledge of field personnel, landscape professionals, chemical distributors, and participating resorts. It is intended to serve as a guideline and best management practices for participating resorts to adopt into their reef friendly landscape maintenance operations.

Many people were involved in preparation of this landscape management plan, and this project would not have been possible without the willingness of the participating resorts, maintenance personnel, various government agencies and interested parties that worked together toward the common goal of protecting Hawai`i's coral reef.

Acknowledgement

Participating Hotels: Hyatt Regency Maui Resort & Spa, Kaanapali Operations Association Inc., Kaanapali Villas, Marriott's Maui Ocean Club, Westin Kaanapali Ocean Resort and Villas/SGS Hawaii, Inc. The Westin Maui Resort & Spa, and Whalers Village

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Reef Friendly Landscape Management Plan Hyatt Regency Maui Resort & Spa

Chapter 1: Background

1.1 Why Reef Friendly Landscape Management Plan?

A typical resort landscape consists of expansive lawn areas, dramatic water features, shade trees, palms and exotic ornamental plants. All of which are maintained through conventional landscape maintenance practices such as the use of automatic irrigation systems, power tools and chemically based fertilizers and pesticides. Routine mowing, pruning, and blowing requires frequent irrigation and fertilization, which can cause nutrient leaching, water runoff, soil erosion, and lead to degradation of coral communities.

Additional coral community degradation can also occur through the addition of pollutants such as: chemical runoff which includes oil and gas from power equipment and irrigation runoff from improper or over watering. A major sources of pollution from landscape operations are plant debris and excess nutrients from fertilizer that has been applied to lawn and garden areas. Although a precise impact of this fertilizer on shoreline properties and contamination of the water is difficult to quantify, the artificially increased nutrient load due to leaching and runoff of fertilizer inadvertently impacts the health of the coral. Excessive and/or improper application of fertilizer, whether organic or synthetic, can be costly and contribute to negative impacts on the coral reef such as: explosive growth of algae which can cause disruptive changes to the coral ecosystem and ultimately kill fish and the coral community.

The health of the coral reef affects not only Hawaii's natural resources, but also the experience of tourists visiting our world class beaches and resorts which in turn can negatively impact Hawaii's tourism industry. The West Maui Ridge to Reef Initiative (www.westmauir2r.com) was launched in 2012 to focus upon addressing causes of land based pollution that are currently believed to be deteriorating our marine systems. As one of several partners in the initiative, the State Department of Land and Natural Resources (DLNR) Division of Aquatic Resources (DAR) has funded a project to collaborate with the Kā'anapali Operators Association (KOA) to develop seven landscape management plans. These management plans address the resorts need for aesthetically pleasing grounds while implementing best practices that minimize the use of pesticides, fertilizers, and irrigation water.

In order to reduce landscape related harmful nutrients leaching into the ocean and help protect the near shore environments along the Kā'anapali Coast, the purpose of the Reef Friendly Management Plan is to achieve a balance between a beautiful aesthetically pleasing resort landscape and chemical inputs to the ground. The Reef Friendly Landscape Management Plans are a natural systems/ecological based approach to landscape maintenance that will maintain healthy and beautiful landscapes while helping to reduce stress to Kā'anapali Coral Reef Communities.

The goal of Reef Friendly Landscape Management Plan is to show that healthy and beautiful landscapes can coexist with healthy and diverse coral community in Kā'anapali by integrating the following practices:

- Reduce chemical inputs to coastal waters
- Reduce waste
- Reduce water & energy consumption
- Reduce runoff/erosion (retain topsoil)
- Improve soil environment to reduce fertilizing
- Create sustainable/harmonious landscapes
- Protect wildlife habitats
- Increase native plants and diversity
- Use integrated pest management to minimize chemical use

1.2 Existing Landscape Context of the Hyatt Regency Maui Resort & Spa

The 40 acre Hyatt Regency Maui Resort and Spa is located on 200 Nohea Kai Drive in Kā'anapali Beach Resort (**Appendix A**).



(Google Aerial View of the Property)



(Major Water Feature + Pool located Makai of the Building)

As with the other ocean front properties a meandering walkway (Kā'anapali Beach Walk) runs through the makai side of the resorts. The walkway is paved with flag stone and lined with Coconut palms. Both sides of the walkway have well maintained lawns. Naupaka hedges and Bougainvillea plants are used to separate the lawn areas from beach sands. The walkway is located along the low area, and the lawn and Naupaka hedge function as a berm. Water runoff is collected and drains into drain inlets that are connected to dry wells, and placed strategically along the walkway.



(Beach Walk)



(Drain Inlet)



(Good Example of Using Appropriate Vegetative Buffer
Implemented at the Hyatt Regency Maui Resort & Spa)

The landscape at the Mauka side of the walkway is comprised of lawns, water features, and lush tropical flower beds, filled with plants such as: Lauae Fern, Ti, Spider plants, Heliconia, Philodendron, Duranta, various palms, and many trees.



(Typical Landscape)

An open drainage stream runs along the south boundary of the site, which drains the water from Hahakea and Wahikuli Gulches and other surrounding properties. The underground drainage channel runs in between Napali and Atrium Towers and is connected to the lagoons at the golf course.



(Drainage Stream runs along south boundary)



(Lagoon at Golf Course)

1.3 Current Landscape Practice

Unlike typical resort landscape management, the Hyatt Regency Maui Resort and Spa implements a “zero” emission landscape maintenance operation which utilizes electrical and battery operated equipment, It should also be noted that the Hyatt Regency Maui Resort and Spa has already made significant steps toward a “Reef Friendly” landscape by limiting use of chemicals to only when it is needed and utilizing R-1 water for irrigation.

The following is a summary of chemical use activities for the landscape maintenance at Hyatt Regency Maui Resort and Spa:

- 1.3.1 Fertilizers:** Best 24-3-10 lawn fertilizer is typically applied via broadcasting quarterly or as needed. Osmokote 14-14-14 slow release fertilizer is typically used for foliage plants in garden beds as needed.
- 1.3.2 Herbicide:** Roundup Pro is typically sprayed to eliminate weed species in the parking lot.
- 1.3.3 Insecticide:** Talster (Pyrethroid insecticide) is used as needed to control insect pests such as aphids, mealy bugs and whiteflies. Talstar is a broad-spectrum Pyrethroid insecticide which is organically derived; however, it is not natural.
- 1.3.4 Pesticide:** Safari (Neonicotinoids pesticide) is a systemic insecticide applied to trees as a drench to control white flies, thrip and mites applied as needed.

1.4 Soil Analysis

According to USA National Cooperative Soil Survey, the makai half of the property is on Jaucas Sand, and the mauka half on Kealia Silt Loam. Jaucas soils are found in very deep, excessively drained, very rapidly permeable soils on vegetated beach areas along the sea coast. It is moderately alkaline and moderately saline throughout the profile.

As part of RFLMP three (3) representative soil samples (HY1, HY2, & HY3) were obtained from the property. The soil analysis provides information on soil pH, Macronutrients (Phosphorous, Potassium, Magnesium, and Calcium), Soil Salinity, Nitrogen, and Micronutrients (boron, copper, iron, manganese, and zinc) levels in the soils and provide recommendations for the correct quantities and types of nutrients that may need to be applied.

The HY1 soil sample was obtained from the lawn area in front of Moana Athletic Club, located on the mauka side of the meandering walkway, while HY2 was obtained from the groundcover planting area near the entry lobby on the upper side of the property and HY3 was obtained from a lawn area near the makai side of meandering walkway along the property line. The soil report and analysis is attached to this document, however in general, the Soil pH appears to be very high (alkaline) in all three samples and at the HY1 location, phosphorus appears to be extremely high and at the HY2 location, Iron appears to be high.



Soil Sample Locations

High phosphorus in the grass area mauka of the coastal walkway may be related to lawn fertilizer and grass clippings as phosphorus tends to remain in the soils longer than other nutrients. If soils high in phosphorus are carried into the ocean with surface water, it could cause explosive algae development in the ocean therefore it is suggested that fertilizers, plant debris, and grass clippings should be contained in planting areas and kept clear of drain inlets and waterways.

1.5 Current Landscape Equipment

Currently the Hyatt Regency Maui Resort and Spa utilizes landscape equipments that are battery or electric power operated, including handheld blower and a straight-shaft trimmer.

Electric Equipment that Hyatt currently uses are listed below:

Weed Eater: STIHL FSA 85 Battery-powered Straight-shaft Trimmer

Blower: STIHL BGA 85 Battery-powered Handheld Blower

Chapter 2: Proposed Reef Friendly Landscape Management Plan Practices

2.1 Chemical Control and Nutrient Management

The most critical element of Reef Friendly Landscape Management is to reduce chemical inputs into the coral environment and therefore the use of fertilizers and other landscape chemicals such as herbicides and pesticides should be kept to a minimum.

Here are proposed measures to reduce chemical inputs while preserving desirable appearance.

2.1.1 Plant Selection: Soil test results indicated high pH and alkaline soils found in the area, so it is recommended to use plants that thrive in such soils instead of trying to lower soil pH. Many of the Native Hawaiian plants that tolerate drought conditions, high pH and high soil salinity would do well in these locations.

2.1.2 Slow Release Fertilizer: Slow release, organic fertilizers are preferred and should be covered with mulch or worked into the soil to prevent being washed away by rain or irrigation systems to walkways, drain inlets or the ocean.

Since the soil report for the HY1 location indicates high phosphorus, it is recommended that a low phosphorus fertilizer should be used on lawn areas. An organic base fertilizer such as Sustane 18-1-8 with 12 to 16 week release rates should be used as an alternative.

2.1.3 Foliar applied nutrients: Liquid Hawaiian Horticultural Mix is recommended as it is a complete micronutrient which includes both magnesium and sulfur. When plant nutrients are applied to the foliage of the plant, smaller quantities of the fertilizer is required than when applying to the soil. From RFLM standpoint, it is also a desirable method to apply nutrients since leaching will also be reduced when applied directly to the foliage of the plant. From a resort operations and aesthetic improvement standpoint, foliar application has merit as it generally helps plants absorb nutrients more rapidly than when applied to the soil and quickly correcting plant nutrient deficiencies, which in turn improves their appearance. It is important to avoid excessive application to prevent foliar applied nutrients from washed away by rain or irrigation systems.

2.1.4 Organic Mulch: Cover mulch should be placed in all planter beds and replenished biannually at minimum. It should not however, be used or stored near a drain inlet, on pavement, or close to any open water body to ensure it does not get carried into ocean waters.

Benefits of organic mulch include:

- Improves soil structure once it has decomposed
- Reduces soil compaction
- Supports soil microbial life
- Suppresses weeds
- filters out pollutants
- Reduces water consumption, fertilizer, and pesticide
- Supports healthier plants

On top of having mulch, it is a good practice to leave plant debris on site to decompose as long as it is not unsightly.

2.1.5 Non-Chemical Zone: To further prevent additional chemicals from leaching into the water, any fertilizers (except foliar applied nutrients), herbicides, pesticides, or permanent spray irrigation system should not be used on sand dunes, within 30 feet of a certified shoreline, or within 10 feet of a stream bank.

2.2 Lawn Management

This property has a vast amount of lawn areas and being able to effectively maintain these lawn areas is the key to a RFLMP. Maintenance practices such as mowing and blowing tend to shift plant debris from landscaped areas to nearby water bodies which can add pollution and nutrients to the water. Additionally, this practice removes all plant debris from planting areas reducing soil nutrients and health as well as depriving beneficial insects and micro-organisms of food and habitats.

It is suggested that lawn be limited to areas that serve a specific purpose such as; seating, gathering, and play areas, and should be noted that the Hyatt Regency Maui Resort & Spa has limited the amount of lawn area on their property by implementing synthetic turf.

2.2.1 Grass Type: Preferred lawn grass in the area would be Seashore paspalum, and the use of rock salt would be preferred over chemicals to treat weeds in this lawn type.

2.2.2 Mowing: Grass should be cut between 2 to 3" inches to help retain the moisture in grass and reduce runoff. Use a mulching mower to leave the grass clippings on the turf areas to decompose and re-release their nutrients back into the soil. Leaving the clippings on the lawn after mowing saves time, money and reduces greenhouse gases that result from hauling them to the landfill.

2.2.3 Fertilizer: If a fertilizer application is required, slow release fertilizer or foliar applications are recommended and organic slow release nitrogen and phosphorus-free lawn fertilizers such as Sustane 18-1-8+Fe or something similar should be used. As an alternative to fertilizer, periodically (at least twice a year) topdressing lawn areas with finely screened compost (max. 1/4 inches) can help to improve the health of the soil and grass.

2.2.4 Herbicide: To prevent leaching, no Herbicides are to be used in lawn areas within 30' from the shoreline or open water body.

2.2.5 Border: Lawn grass should be kept away from areas that have surface water runoff to reduce the runoff of fertilizer and grass clippings. The existing Naupaka hedge that separates the grass from the sand beach should be maintained, but if there is not adequate room for Naupaka hedge, smaller plants such as Pohinahina could be used. Where feasible, it is recommended to convert lawn grass areas to sand dunes or native Hawaiian planting beds to reduce water consumption and chemical requirements. Reestablishing Hawaiian and Polynesian plants in the landscape will invite more native wildlife which will make the outdoor space "living & sustainable" and help to create a Hawaiian sense of place. Ensuring the proper selection of plant material will reduce maintenance, use of equipment, chemical outputs, pollution, and water consumption.

2.3 Soil Management

In order to reduce chemical input and maintain plant health, it is critical to start with good soil. Reducing pesticide usage helps to build healthy soil environments as many pesticides are toxic to microbes and other soil dwelling creatures such as earthworms, and can reduce the diversity of soil life.

2.3.1 Existing Soils: It is not practical, financially or environmentally sound to replace existing soil or to artificially supplement the soil with synthetic fertilizers. Feeding soils with natural compost and/or compost tea can help to create a healthy soil food web, which aids nutrient availability for the plants, resists pests and diseases and protects water quality. Also, keeping plant debris such as; plant trimmings and grass clippings, in planter beds can provide a cost effective way to manage to nurture soil organisms and recycle organic matter while reducing waste and runoff.

Maintain a minimum of 2 to 4 inches of mulch in all planter beds.

Incorporating compost into the existing soil will not only improve the soils sulfur and iron deficiencies but also the soil structure and drainage ability As well as amending the soil with compost, a cover mulch should be placed in all planter beds and replenished as needed, as mulch cover can help to preserve soil moisture, support soil microbial life, suppress weeds, filter out pollutants as well as create a way to cover plant debris in an aesthetically pleasing manner.

2.3.2 New Grounds: If recreating or restoring lawn or garden areas, tilling to a minimum of 4-inches of compost into the top 6–8 inches of soil is recommended to help improve the structure of the soil. The addition of materials such as mulch, volcanic cinders, crushed coral, or sand (calcium carbonate) should also be incorporated in all garden beds to help improve soil porosity and drainage.

2.4 Green Infrastructure

Green infrastructure, including swales and rain gardens, helps to divert excess water run-off from roofs and impervious surfaces. These sustainable landscape elements capture the "First Flush", which is the first inch of rainfall after a dry spell, which has been proven to carry the most pollutants to our waterways and ocean.

They also help to reduce fresh water runoff from a landscape, protect the ocean and other nearby waterways, and help to replenish groundwater aquifers.

The existing drain inlets on this site are typically located in lawn areas adjacent to the walkways. It is recommended to convert the grass area that surrounds the drain inlets to a wetland garden planted with native Hawaiian plants. These native gardens will mimic the natural environment and function as green infrastructure to help manage water runoff. This enhanced planting along the beach walk will not only add aesthetics but also provide an educational opportunity for visitors to learn about the sustainable approach that the hotel is taking to protect the nearby coral environments.



(Potential Areas for Raingardens)

2.5 Integrated Pest Management

The use of pesticide should be avoided or used as a last resort, as it not only causes environmental pollution but also kills beneficial microbes that natural occur in healthy soils. Integrated Pest Management (IPM) is a sustainable approach to managing pests such as insects, plant diseases, and weeds by eliminating or reducing the use of potentially harmful pesticides. IPM is an environmentally friendly program that combines biological, cultural, physical and chemical tools to help manage pests to an acceptable level, but not necessarily fully eliminate them.

IPM is based upon three strategic steps:

- 2.5.1 Prevention:** The key is to establish a healthy environment in which plants have the strength to resist disease and insect infestations and to out-compete weeds, and the least toxic pesticides are used only when necessary. Referring to

previous sections of this Reef Friendly Management document, nutrient management, lawn management and soil management are all critical elements of IPM and aside from the measures indicated in the previous sections, the following actions should also be taken:

- Choose the right plant material for each environment
- Choose plant material that attracts beneficial insects.
- Plant all plant material at the correct depth and provide adequate spacing.
- Remove noxious weeds before they go to seed.
- Clean equipment thoroughly after each use.

2.5.2 Monitoring: Each landscape is living and complex and specific levels of different species of organisms are necessary for keeping it healthy. Regular monitoring of the site including: the condition of the plant material, population increase/decrease of pests, and population increase/decrease of beneficial organisms is critical in understanding the landscape and what the primary root of problem is. Elements such as: pests, incorrect plant selection, poor soil drainage or nutrient deficiency can all play a large part in a pest infestation.

2.5.3 Control: The purpose of control in IPM is to keep pests at acceptable levels thereby reducing the need for pesticides and in return pollutants are kept out of watershed. After routine monitoring, if it is determined that pests are causing an unacceptable level of damage, the following control measures may be taken before the use of pesticide is considered:

- **Cultural and Physical Control:** Some pests are associated with certain plants. Infested parts or entire plants may need to be removed by hand as soon as possible and replaced with appropriate native plants to create diversity in landscape. Apply water to spray off pests like aphids. Apply 2-inch layer of coarse mulch between and under shrubs and groundcovers to improve soil structure and control weeds.
- **Cultural and Physical Control:** Creating a monoculture through planting few plants species in a small area can cause an influx of pests and disease. Adding different and more pest resistant species will break up this monoculture and minimize infestations.
- **Biological Control:** In natural environments many organisms in the landscape are considered to be beneficial as they feed on pests and therefore minimize the necessity for pesticide. Some beneficial insects include hover flies, lacewings, lady beetles, predatory mites, bees and certain wasps. Small scale biological control can be implemented by creating a favorable environment with a variety of plant material that attracts predators/parasites, introducing beneficial microbes, and by using less harmful pesticides which could potentially kill beneficial insects. **Appendix D** prepared by the College of Tropical Agriculture and Human resources (CTAHR), University of Hawaii, Manoa, provides a list of preferred beneficial insects. Healthy soils contain billions of beneficial organisms and using compost tea introduces large and diverse populations of microbes that can help to suppress some leaf and root diseases.

The Westin Maui Resort & Spa currently controls insects such as mealy bug, white fly, scale, aphids, and caterpillars, by implementing plants that attract natural enemies of those pests into the landscape, such as Lacewings, Lady Beetles, Hover flies, Predatory mites, and Parasitic wasps as well as birds and spiders, the need for chemical pesticides would be diminished.

Images of Natural Predators:



Lacewings



Lady Beetles



Predatory Mites



Pteromalid Wasps



Ichneumonid Wasps



Braconid Wasps

- Chemical Control: If infestations of pests or disease cannot be brought to an acceptable level through the use of cultural or biological control, IPM allows for chemical control as a last resort. If chemical application is necessary, only naturally occurring pesticides such as soaps and oils are to be used for control purposes only and not preventative purposes. All directions must be followed explicitly and pesticides must be kept out of gutters, storm drains, and off sidewalks, driveways and other hard surfaces. Disposal of leftover product should abide to EPA and state regulations.

<http://www.epa.gov/pesticides/regulating/disposal.htm>

2.6 Landscape Maintenance Equipment

Gas operated lawn mowers, chain saws and blowers create noise pollution and emit significant amounts of environmental pollutants. Currently Hyatt Regency Maui Resort and Spa is not using any landscape equipment that is battery or electric power operated. RFLMP recommends using electric landscape equipment as it will help to reduce noise level and the resort's carbon

footprint. Also, advantages of electric mowers would be reduced operating cost by saving on gas and reduced maintenance by eliminating needs for oil changes, new spark plugs and replacing air filters. STHL product line provides a wide range of battery operated and fuel efficient equipment.

2.7 Cost Consideration

The main objective of Reef Friendly Landscape Management Plan is to reduce chemical inputs to our landscape. Reduced chemical usage will help minimize costs related to materials, equipment, and labor. It will also reduce health risks and liability for operating personnel as well as visitors/residents while helping to protect the environment.

2.7.1 Fertilizer Use: Reducing fertilizer application will prevent excessive and unusually fast plant growth that weakens the plant and in turn increases maintenance and generates excess plant debris. Reducing fertilizer usage will reduce waste disposal and require less maintenance which will lead to lower costs. One way to reduce fertilizer usage is to leave grass clippings on the grass areas after mowing, which will help to provide nutrients and water back to the soil. The addition of organic mulch in garden beds will also reduce the need for fertilizer application by supplying the nutrients necessary for healthy plant growth and improve the soil condition.

2.7.2 Pesticide Use: Minimizing pesticides not only reduces water pollution but also helps support soil life, which cycles nutrients and promotes resistance to plant disease. In the long run minimizing pesticide saves landscape maintenance cost by creating a healthy environment for plants.

2.7.3 Organic Mulch: Organic materials, including compost and chipped landscape debris, supply the soil and plants with nutrients over time, which reduces the need for fertilizer. Further savings can be achieved by on-site composting which helps to keep valuable nutrients and organic matter in the garden and reduces pollution associated with transporting waste as well as disposal costs.

Organic mulch and compost tea provide a possibility for multiple savings via; water conservation, enhanced plant health/growth, reduced weed growth, disease suppression, reduced need for trimming and maintenance around plants and an aesthetically pleasing landscape appearance. By adding these natural products into a landscape maintenance program, it will help to reduce the landscape maintenance that is required.

2.7.4 Landscape Equipment: Landscape equipment is typically chosen for efficiency and ease of use. However, reducing fossil fuel consumption is one of the most important cost savings for landscape maintenance and for protecting the environment. Where possible, hand powered or electric equipments should be used.

At first, manual labor may reduce the efficiency; however, long term, it can cut costs while protecting the health of your staff, enhancing visitor experience, and improving local air and water quality. Lower operating costs from manual and electric equipment can often recover higher initial purchase costs of new equipment, and more importantly, the contribution to a healthier environment and enhanced visitor experience will benefit the resort and increase pride of the landscape maintenance staff.

Chapter 3: R-1 Water Irrigation System Transition

3.1 R-1 Water Background

From Reef Friendly Landscape Management Stand, the use of reclaimed water is preferred for landscape irrigation. The purpose of this chapter is to encourage the transition to R-1 Water Irrigation System. Kā'anapali Operations Association, Inc. (KOA) currently uses R-1 water from the golf course and has reduced the use of chemical fertilizers on grass areas due to high rate of nitrogen content in R-1 water. Please also refer to "A Guide for West Maui's Resorts and Condominium Properties" prepared by Coral Reef Alliance, which provides a comprehensive review and extensive resources on the use of recycled water. The CORAL document can be found at: http://www.coral.org/files/pdf/recycled_water_for_reefs_v1.pdf

Maui County Ordinance 2525 mandates use of reclaimed water for irrigation where R-1 water is available. "Available reclaimed water service" is defined as "existence of a reclaimed water distribution main contiguous to or within one hundred feet of any consumer's property line." Where there is an available reclaimed water service, the existing irrigation systems are required to be switched to the reclaimed water system within one year of service availability. Cost of retrofitting the existing irrigation system will be credited by the County at a discounted rate of the reclaimed water rates services. This discounted rate (one-half (1/2) of the reclaimed rates) is to continue until the cost to retrofit has been recovered by the resort. Other charges to be applied for connecting to the R-1 water will include the initial installation charge and a connection fee based on peak daily usage

3.2 R-1 Water Permit Requirements

3.2.1 Department of Health (DOH):

The first step to be able to utilize reclaimed water usage in the State of Hawai'i is to apply for Department of Health (DOH) approval. Approval is based on the "Guidelines for the Treatment and Use of Recycled Water", prepared by the Hawai'i State DOH Wastewater Branch, dated May 15, 2002. The DOH permit requirements include the following items:

- Basis of Design Report
- Engineering Report
- Construction Plans
- Cross-Connection Approval
- Construction Inspection

Upon the approval of DOH, design and engineering reports may be waived for smaller reuse projects such as dust control or landscape and irrigation areas less than five acres.

3.2.2 County of Maui

The County of Maui application requires a basis of design report, engineering report, connection fee, Maui County application form (RW-1), an overall map as well as plans and specifications to determine an expected reclaimed water load and meter size.

3.3 Irrigation System Requirements

The State of Hawai'i Department of Health (DOH) "Guidelines for the Treatment and Use of Recycled Water" provides technical guidelines and requirements for designing and installing a reclaimed water irrigation system. The following is a summary of what is required to convert a potable water irrigation system to R-1 reclaimed water irrigation system:

3.3.1 Procedure for converting the existing system to reclaimed water system

The first step would be to evaluate if the existing system can be converted to reclaimed use or if it would need to be replaced with a new system. Locating and testing existing irrigation lines to see if those lines can be converted to reclaimed water use per the Maui County Department of Water Supply (DWS) Standards is required. If the actual locations cannot be verified, it is recommended to install new system as per the DOH and DWS standards.

In order to install a reclaimed water irrigation system, the following requirements are to be met:

- Basket Strainer at the meter
- Irrigation Controller (color coded with label indicating "Recycled Water")
- Irrigation pipes with an identification tape with white or black printing on a purple field (color index 77742 violet #16, Pantone 512 or equal), having the words "CAUTION: RECYCLED WATER - DO NOT DRINK."
- Hose bib not allowed
- Horizontal, and vertical clearances between potable water and other utilities
- Minimum easement or right-of way widths, and minimum cover and requirements for recycled water
- All above ground existing and new facilities to be color coded purple
- Reclaimed water signs
- Inspection & Monitoring

Based on recent a study for R-1 water irrigation system and soils, it is indicated that a salt and sodium content in the soil tends to become higher in dry months from May to September and lower in rainy season. This seasonal trend indicates that the winter rains leach out salt and sodium from the soil. Before converting the existing system to reclaimed water, it is recommended to evaluate the existing plant materials to see how increased salt and sodium content would affect them.

Recycled water irrigation can be cost effective as it costs less than potable water and is exempt from sewer fees. In addition, since recycled water contains more nutrients than potable water, the need for fertilizer is expected to decrease.

Chapter 4: Reef Friendly Operation & Maintenance Checklist

In order to implement a successful Reef Friendly Landscape Management Plan, it is critical that all the resort communities work together. It is especially important that the hotel General Managers and management staff support and encourage landscape maintenance personnel to take an active role in implementing “reef friendly” practices in their daily operations. The checklist below provides a set of Reef Friendly Landscape Operation and Maintenance techniques and strategies to aid participating resorts within the Ka`anapali Beach Resort community that re-validates their good practices and helps to identify areas for potential improvement.

Nutrient Management

- Fertilize ornamental planting beds with organic slow release fertilizer and/or foliar application (Liquid Hawaiian Horticultural Mix). Slow release fertilizer should be covered with mulch or worked into the soil to prevent it from being washed away.
- Do not apply synthetic fertilizers
- No fertilizer on lawn.
- Remove plant debris (fallen leaves, branches, flowers, etc.) from grass, pavement, drain inlet, and along stream bank and shoreline.

Lawn Management

- Mow grass with electric or hand pushed mower.
- Use Mulching Mower to leave grass clippings in lawn areas.
- Mow grass taller (Seashore Paspalum 2 - 3” Tall, Bermuda 1 – 2” Tall)
- Leave Grass Clippings in lawn areas away from drain inlet and pavement.
- No herbicide used in lawn areas.
- Apply salts (instead of herbicides) to control weeds in lawn areas.
- Manually pull weeds once a week or as needed.

Soil Management

- Install 4" min. layer of mulch over all planter beds and under trees. Replenish at least biannually to maintain at least 3" cover.
- Keep mulch away from drain inlet, pavement, or any open water body.
- Topdress lawn areas and planter beds with composted soils and/or apply compost tea biannually

Green Infrastructure

- Install Raingarden(s) near a drain inlet and/or outdoor shower to capture the runoff before going into a storm drain or the open water body.
- Install Bioswale to filter runoff before going into storm drain or the open water body

Integrated Pest Management

- Monitor landscape for pests weekly.
- Identify desirable insects (Lacewings, Lady Beetles, Pteromalid Wasps, Ichneumonid Wasps, and Braconid Wasps).
- Apply soap and oil to control insects (aphids, mealybugs, psyllids and spider mites) if beneficial insects are not present.
- Use foliar application insecticide as a last resort.
- Apply high pressure water jet to remove insects from plants (spider mites, aphids, small caterpillars, etc.).
- Remove/Replace infested plants with new plants rather than trying to use chemical to control insects.
- Apply and maintain 3-4" layers of mulch in planter beds.

Landscape Maintenance Equipment

- Reduce or Eliminate use of gas-powered landscape maintenance equipments. Use electric and manual equipments as much as practicable.
- Clean equipment thoroughly after each use.

General Landscape Improvements and Maintenance.

- Designate a compost recycling bin locations and start creating own compost.
- Create vegetated buffer along makai side of the property with native Hawaiian plants such as Naupaka and Pohinahina.
- Establish no chemical, no irrigation zone for the areas within 30' from the certified shoreline and 10' from stream banks and other open water bodies.
- Prepare irrigation as-built plan (showing all irrigation controllers, weather station, all valves per controller, types of sprinklers (pop-up spray, impact, rotor, or drip).
- Check irrigation coverage and correct overspray to paved areas or buildings biannually.
- Check irrigation systems for leaks weekly.
- Make plans for transition to R-1 Water Irrigation System

Reef Friendly Landscape Management Plan

The Marriot Maui Ocean Club

Chapter 1: Background

1.1 Why Reef Friendly Landscape Management Plan?

A typical resort landscape consists of expansive lawn areas, dramatic water features, shade trees, palms and exotic ornamental plants. All of which are maintained through conventional landscape maintenance practices such as the use of automatic irrigation systems, power tools and chemically based fertilizers and pesticides. Routine mowing, pruning, and blowing requires frequent irrigation and fertilization, which can cause nutrient leaching, water runoff, soil erosion, and lead to degradation of coral communities.

Additional coral community degradation can also occur through the addition of pollutants such as: chemical runoff which includes oil and gas from power equipment and irrigation runoff from improper or over watering. A major sources of pollution from landscape operations are plant debris and excess nutrients from fertilizer that has been applied to lawn and garden areas. Although a precise impact of this fertilizer on shoreline properties and contamination of the water is difficult to quantify, the artificially increased nutrient load due to leaching and runoff of fertilizer inadvertently impact the health of the coral. Excessive and/or improper application of fertilizer, whether organic or synthetic, can be costly and contribute to negative impacts on the coral reef such as: explosive growth of algae which can cause disruptive changes to the coral ecosystem and ultimately kill fish and the coral community.

The health of the coral reef affects not only Hawaii's natural resources, but also the experience of tourists visiting our world class beaches and resorts which in turn can negatively impact Hawaii's tourism industry. The West Maui Ridge to Reef Initiative (www.westmauir2r.com) was launched in 2012 to focus upon addressing causes of land based pollution that are currently believed to be deteriorating our marine systems. As one of several partners in the initiative, the State Department of Land and Natural Resources (DLNR) Division of Aquatic Resources (DAR) has funded a project to collaborate with the Kā'anapali Operators Association (KOA) to develop seven landscape management plans. These management plans address the resorts need for aesthetically pleasing grounds while implementing best practices that minimize the use of pesticides, fertilizers, and irrigation water.

In order to reduce landscape related harmful nutrients leaching into the ocean and help protect the near shore environments along the Kā'anapali Coast, the purpose of the Reef Friendly Management Plan is to achieve a balance between a beautiful aesthetically pleasing resort landscape and chemical inputs to the ground. The Reef Friendly Landscape Management Plans are a natural systems/ecological based approach to landscape maintenance that will maintain healthy and beautiful landscapes while helping to reduce stress to Kā'anapali Coral Reef Communities.

The goal of Reef Friendly Landscape Management Plan is to show that healthy and beautiful landscapes can coexist with healthy and diverse coral community in Kā'anapali by integrating the following practices:

- Reduce chemical inputs to coastal waters
- Reduce waste
- Reduce water & energy consumption
- Reduce runoff/erosion (retain topsoil)
- Improve soil environment to reduce fertilizing
- Create sustainable/harmonious landscapes
- Protect wildlife habitats
- Increase native plants and diversity
- Use integrated pest management to minimize chemical use

1.2 Existing Landscape Context of the Marriot Maui Ocean Club

The 16 acre Marriot Maui Ocean Club is located on 100 Nohea Kai Drive in Kā'anapali Beach Resort (**Attachment A**). The makai side of the property features expansive lawn areas, extensive water features and swimming pools as well as lush tropical landscapes.



(Google Aerial View of the Property)



(Expansive Lawn Areas on the Property)

As with other ocean front properties, a meandering walkway (Kā'anapali Beach Walk) runs through makai side of this resort. The walkway is paved with concrete and lined with Coconut palms located in the open lawn areas that are used for seating and relaxing. Located at corners, pathway intersections and entry points along the meandering walkway are accent garden beds planted with flowering tropical plants including: Ti, Spider Plant, Heliconia, Plumbago, Ginger, Lauae, Plumeria, Hibiscus, Gardenia, Bromeliad, Ginger, Croton and Dwarf Date Palm. Plant material such as Kamani, Seagrape, Coconut Palms, and Naupaka are located on the makai side of the walkways.



(Tropical Landscape by Pool)



(Meandering Walkway)



(Typical Landscape Makai Side)



(Typical Landscape by Building)

1.3 Current Landscape Practice

The Marriot Maui Ocean Club has twelve (12) maintenance personnel. The existing irrigation system is operated by four (4) Rainbird ESP-SAT controllers and utilizes the County potable water source. The point of connection and backflow prevention unit for makai side irrigation system also supplies the water for pools and a public shower.

It should be noted that the Marriot Maui Ocean Club already takes significant steps toward a “Reef Friendly” landscape management program by limiting herbicide use, using salt to control weeds in lawn areas, and incorporating wood mulch in all planters and making their own compost.

The following is a summary of chemical use activities for landscape maintenance at the Marriot Maui Ocean Club:

- 1.3.1 Fertilizers:** Best Turf Supreme fertilizer and various synthetic shrub fertilizers are applied biannually.
- 1.3.2 Herbicide:** Roundup Pro is typically sprayed to eliminate weed species such as Hilo grass and crabgrass in lawn areas. Salt is used to kill weeds on seashore paspalum grass, and although not often, Ronstar pre-emergent herbicide is also used as needed.
- 1.3.3 Insecticide:** Talstar is used when needed to control mosquitoes and caterpillars in lawn areas. Pointer is used twice a year for ornamental plants and trees to help control Aphids, Scale, Beetles, Mealybug, and Whitefly.
- 1.3.4 Compost:** The Marriot Ocean Club utilizes their own compost as well as Maui EKO compost. 2 yards of a sand/compost blend is applied biannually to all planting beds.



(Example of Using Cinder and Wood Mulch in a garden bed at the Marriot Maui Ocean Club)

1.4 Soil Analysis

According to USA National Cooperative Soil Survey, the makai half of the property is on Jaucas Sand, and the mauka half on Kealia Silt Loam. Jaucas soils are found in very deep, excessively drained, very rapidly permeable soils on vegetated beach areas along the sea coast. It is moderately alkaline and moderately saline throughout the profile. Makai of the property line is beach sand.

As part of RFLMP three (3) representative soil samples (MOC1, MOC2, & MOC3) were obtained from the property. The soil analysis provides information on soil pH, Macronutrients (Phosphorous, Potassium, Magnesium, and Calcium), Soil Salinity, Nitrogen, and Micronutrients (boron, copper, iron, manganese, and zinc) levels in the soils and provide recommendations for the correct quantities and types of nutrients that may need to be applied.

Soil sample MOC1 was obtained from the south corner of property by Lahaina Villas, MOC2 was obtained from the lawn area mauka of the beachwalk and MOC3 was from a garden bed containing groundcover and Hibiscus. The soil report and analysis are attached to this document, however in general, both Potassium and Magnesium appear to be very low and the soil pH appears to be very high (alkaline) in all three samples, especially in soil sample MOC3. MOC 1 shows very high levels of sodium and extremely low levels of iron, sulfur, zinc and Manganese, while MOC2 shows low levels of sulfur, zinc and manganese along with high levels of sodium.

The soils report indicates low sulfur content. Sulfur is an essential element in the life processes of all living things as it is an important part of the proteins that are needed to sustain life in all biological organisms including microorganisms and plants. Organic matter is a major source of sulfur in landscape and therefore regular application of organic amendments such as compost in the planting areas is recommended.



Soil Sample Locations

1.5 Landscape Equipment

Currently the Marriot Maui Ocean Club is not using any landscape equipments that are battery or electric power operated.

Chapter 2: Proposed Reef Friendly Landscape Management Plan Practices

2.1 Chemical Control and Nutrient Management

The most critical element of Reef Friendly Landscape Management is to reduce chemical inputs into the coral environment and therefore the use of fertilizers and other landscape chemicals such as herbicides and pesticides should be kept to a minimum.

Here are proposed measures to reduce chemical inputs while preserving desirable appearance.

2.1.1 Plant Selection: Soil test results indicated high pH and alkaline soils found in the area, so it is recommended to use plants that thrive in such soils instead of trying to lower soil pH. Many of the Native Hawaiian plants that tolerate drought conditions, high pH and high soil salinity would do well in these locations.

2.1.2 Slow Release Fertilizer: Slow release, organic fertilizers are preferred and should be covered with mulch or worked into the soil to prevent being washed away by rain or irrigation systems to walkways, drain inlets or the ocean.

Since the soil report for the HY1 location indicates high phosphorus, it is recommended that a low phosphorus fertilizer should be used on lawn areas. An organic base fertilizer such as Sustane 18-1-8 with 12 to 16 week release rates should be used as an alternative.

2.1.3 Foliar applied nutrients: Liquid Hawaiian Horticultural Mix is recommended as it is a complete micronutrient which includes both magnesium and sulfur. When plant nutrients are applied to the foliage of the plant, smaller quantities of the fertilizer is required than when applying to the soil. From RFLM standpoint, it is also a desirable method to apply nutrients since leaching will also be reduced when applied directly to the foliage of the plant. From a resort operations and aesthetic improvement standpoint, foliar application has merit as it generally helps plants absorb nutrients more rapidly than when applied to the soil and quickly correcting plant nutrient deficiencies, which in turn improves their appearance. It is important to avoid excessive application to prevent foliar applied nutrients from washed away by rain or irrigation systems.

2.1.4 Organic Mulch: Cover mulch should be placed in all planter beds and replenished biannually at minimum. It should not however, be used or stored near a drain inlet, on pavement, or close to any open water body to ensure it does not get carried into ocean waters.

Benefits of organic mulch include:

- Improves soil structure once it has decomposed
- Reduces soil compaction
- Supports soil microbial life
- Suppresses weeds
- Filters out pollutants
- Reduces water consumption, fertilizer, and pesticide
- Supports healthier plants

On top of having mulch, it is a good practice to leave plant debris on site to decompose as long as it is not unsightly.

2.1.5 Non-Chemical Zone: To further prevent additional chemicals from leaching into the water, any fertilizers (except foliar applied nutrients), herbicides, pesticides, or permanent spray irrigation system should not be used on sand dunes, within 30 feet of a certified shoreline, or within 10 feet of a stream bank.

2.2 Lawn Management

The Westin Maui Resort and Spa has limited amount of lawn areas as the majority of the outdoor environment is covered with water features, pools and hardscape, however, effectively maintaining lawn areas is the key to a RFLMP. Maintenance practices such as mowing and blowing tend to shift plant debris from landscaped areas to nearby water bodies which can add pollution and nutrients to the water. Additionally, this practice removes all plant debris from planting areas reducing soil nutrients and health as well as depriving beneficial insects and micro-organisms of food and habitats.

It is suggested that lawn be limited to areas that serve a specific purpose such as; seating, gathering, and play areas.

2.2.1 Grass Type: Preferred lawn grass in the area would be Seashore paspalum, and the use of rock salt would be preferred over chemicals to treat weeds in this lawn type.

2.2.2 Mowing: Grass should be cut between 2 to 3” inches to help retain the moisture in grass and reduce runoff. Use a mulching mower to leave the grass clippings on the turf areas to decompose and re-release their nutrients back into the soil. Leaving the clippings on the lawn after mowing saves time, money and reduces greenhouse gases that result from hauling them to the landfill.

2.2.3 Fertilizer: If a fertilizer application is required, slow release fertilizer or foliar applications are recommended and organic slow release nitrogen and phosphorus-free lawn fertilizers such as Sustane 18-1-8+Fe or something similar should be used. As an alternative to fertilizer, periodically (at least twice a year) topdressing lawn areas with finely screened compost (max. 1/4 inches) can help to improve the health of the soil and grass.

2.2.4 Herbicide: To prevent leaching, no Herbicides are to be used in lawn areas within 30' from the shoreline or open water body.

2.2.5 Border: Lawn grass should be kept away from areas that have surface water runoff to reduce the runoff of fertilizer and grass clippings. The existing Naupaka hedge that separates the grass from the sand beach should be maintained, but if there is not adequate room for Naupaka hedge, smaller plants such as Pohinahina could be used. Where feasible, it is recommended to convert lawn grass areas to sand dunes or native Hawaiian planting beds to reduce water consumption and chemical requirements. Reestablishing Hawaiian and Polynesian plants in the landscape will invite more native wildlife which will make the outdoor space "living & sustainable" and help to create a Hawaiian sense of place. Ensuring the proper selection of plant material will reduce maintenance, use of equipment, chemical outputs, pollution, and water consumption.

2.3 Soil Management

In order to reduce chemical input and maintain plant health, it is critical to start with good soil. Reducing pesticide usage helps to build healthy soil environments as many pesticides are toxic to microbes and other soil dwelling creatures such as earthworms, and can reduce the diversity of soil life.

2.3.1 Existing Soils: It is not practical, financially or environmentally sound to replace existing soil or to artificially supplement the soil with synthetic fertilizers. Feeding soils with natural compost and/or compost tea can help to create a healthy soil food web, which aids nutrient availability for the plants, resists pests and diseases and protects water quality. Also, keeping plant debris such as; plant trimmings and grass clippings, in planter beds can provide a cost effective way to manage to nurture soil organisms and recycle organic matter while reducing waste and runoff.

Maintain a minimum of 2 to 4 inches of mulch in all planter beds.

Incorporating compost into the existing soil will not only improve the soils sulfur and iron deficiencies but also the soil structure and drainage ability As well as amending the soil with compost, a cover mulch should be placed in all planter beds and replenished as needed, as mulch cover can help to preserve soil moisture, support soil microbial life, suppress weeds, filter out pollutants as well as create a way to cover plant debris in an aesthetically pleasing manner.

2.3.2 New Grounds: If recreating or restoring lawn or garden areas, tilling to a minimum of 4-inches of compost into the top 6–8 inches of soil is recommended to help improve the structure of the soil. The addition of materials such as mulch, volcanic cinders, crushed coral, or sand (calcium carbonate) should also be incorporated in all garden beds to help improve soil porosity and drainage.

2.4 Green Infrastructure

Green infrastructure, including swales and rain gardens, helps to divert excess water run-off from roofs and impervious surfaces. These sustainable landscape elements capture the "First Flush", which is the first inch of rainfall after a dry spell, which has been proven to carry the most pollutants to our waterways and ocean. They also help to reduce fresh water runoff from a landscape, protect the ocean and other nearby waterways, and help to replenish groundwater aquifers.

The existing drain inlets on this site are typically located in lawn areas adjacent to the walkways. It is recommended to convert the grass area that surrounds the drain inlets to a wetland garden planted with native Hawaiian plants. These native gardens will mimic the natural environment and function as green infrastructure to help manage water runoff. This enhanced planting along the beach walk will not only add aesthetics but also provide an educational opportunity for visitors to learn about the sustainable approach that the hotel is taking to protect the nearby coral environments.

2.5 Integrated Pest Management

The use of pesticide should be avoided or used as a last resort, as it not only causes environmental pollution but also kills beneficial microbes that natural occur in healthy soils. Integrated Pest Management (IPM) is a sustainable approach to managing pests such as insects, plant diseases, and weeds by eliminating or reducing the use of potentially harmful pesticides. IPM is an environmentally friendly program that combines biological, cultural, physical and chemical tools to help manage pests to an acceptable level, but not necessarily fully eliminate them.

IPM is based upon three strategic steps:

2.5.1 Prevention: The key is to establish a healthy environment in which plants have the strength to resist disease and insect infestations and to out-compete weeds, and the least toxic pesticides are used only when necessary. Referring to previous sections of this Reef Friendly Management document, nutrient management, lawn management and soil management are all critical elements of IPM and aside from the measures indicated in the previous sections, the following actions should also be taken:

- Choose the right plant material for each environment.
- Choose plant material that attracts beneficial insects.
- Plant all plant material at the correct depth and provide adequate spacing.
- Remove noxious weeds before they go to seed.
- Clean equipment thoroughly after each use.

2.5.2 Monitoring: Each landscape is living and complex and specific levels of different species of organisms are necessary for keeping it healthy. Regular monitoring of the site including: the condition of the plant material, population increase/decrease of pests, and population increase/decrease of beneficial organisms is critical in understanding the landscape and what the primary root of problem is. Elements such as: pests, incorrect plant selection, poor soil drainage or nutrient deficiency can all play a large part in a pest infestation.

2.5.3 Control: The purpose of control in IPM is to keep pests at acceptable levels thereby reducing the need for pesticides and in return pollutants are kept out of watershed. After routine monitoring, if it is determined that pests are causing an unacceptable level of damage, the following control measures may be taken before the use of pesticide is considered:

- Cultural and Physical Control: Some pests are associated with certain plants. Infested parts or entire plants may need to be removed by hand as soon as possible and replaced with appropriate native plants to create diversity in landscape. Apply water to spray off pests like aphids. Apply 2-inch layer of coarse mulch between and under shrubs and groundcovers to improve soil structure and control weeds.
- Cultural and Physical Control: Creating a monoculture through planting few plants species in a small area can cause an influx of pests and disease. Adding different and more pest resistant species will break up this monoculture and minimize infestations.
- Biological Control: In natural environments many organisms in the landscape are considered to be beneficial as they feed on pests and therefore minimize the necessity for pesticide. Some beneficial insects include hover flies, lacewings, lady beetles, predatory mites, bees and certain wasps. Small scale biological control can be implemented by creating a favorable environment with a variety of plant material that attracts predators/parasites, introducing beneficial microbes, and by using less harmful pesticides which could potentially kill beneficial insects. **Appendix D** prepared by the College of Tropical Agriculture and Human resources (CTAHR), University of Hawaii, Manoa, provides a list of preferred beneficial insects. Healthy soils contain billions of beneficial organisms and using compost tea introduces large and diverse populations of microbes that can help to suppress some leaf and root diseases.

The Marriot Maui Ocean Club currently controls insects such as mealy bug, white fly, scale, aphids, and caterpillars, by implementing plants that attract natural enemies of those pests into the landscape, such as Lacewings, Lady Beetles, Hover flies, Predatory mites, and Parasitic wasps as well as birds and spiders, the need for chemical pesticides would be diminished.

Images of Natural Predators:



Lacewings



Lady Beetles



Predatory Mites



Pteromalid Wasps



Ichneumonid Wasps



Braconid Wasps

- Chemical Control: If infestations of pests or disease cannot be brought to an acceptable level through the use of cultural or biological control, IPM allows for chemical control as a last resort. If chemical application is necessary, only naturally occurring pesticides such as soaps and oils are to be used for control purposes only and not preventative purposes. All directions must be followed explicitly and pesticides must be kept out of gutters, storm drains, and off sidewalks, driveways and other hard surfaces. Disposal of leftover product should abide to EPA and state regulations.

<http://www.epa.gov/pesticides/regulating/disposal.htm>

2.6 Landscape Maintenance Equipment

Gas operated lawn mowers, chain saws and blowers create noise pollution and emit significant amounts of environmental pollutants. Currently the Marriot Maui Ocean Club is not using any landscape equipment that is battery or electric power operated. RFLMP recommends using electric landscape equipment as it will help to reduce noise level and the resort's carbon footprint. Also, advantages of electric mowers would be reduced operating cost by saving on gas and reduced maintenance by eliminating needs for oil changes, new spark plugs and replacing air filters. STHL product line provides a wide range of battery operated and fuel efficient equipments.

2.7 Cost Consideration

The main objective of Reef Friendly Landscape Management Plan is to reduce chemical inputs to our landscape. Reduced chemical usage will help minimize costs related to materials, equipment, and labor. It will also reduce health risks and liability for operating personnel as well as visitors/residents while helping to protect the environment.

2.7.1 Fertilizer Use: Reducing fertilizer application will prevent excessive and unusually fast plant growth that weakens the plant and in turn increases maintenance and generates excess plant debris. Reducing fertilizer usage will reduce waste disposal and require less maintenance which will lead to lower costs. One way to reduce fertilizer usage is to leave grass clippings on the grass areas after mowing, which will help to provide nutrients and water back to the soil. The addition of organic mulch in garden beds will also reduce the need for fertilizer application by supplying the nutrients necessary for healthy plant growth and improve the soil condition.

2.7.2 Pesticide Use: Minimizing pesticides not only reduces water pollution but also helps support soil life, which cycles nutrients and promotes resistance to plant disease. In the long run minimizing pesticide saves landscape maintenance cost by creating a healthy environment for plants.

2.7.3 Organic Mulch: Organic materials, including compost and chipped landscape debris, supply the soil and plants with nutrients over time, which reduces the need for fertilizer. Further savings can be achieved by on-site composting which helps to keep valuable nutrients and organic matter in the garden and reduces pollution associated with transporting waste as well as disposal costs.

Organic mulch and compost tea provide a possibility for multiple savings via; water conservation, enhanced plant health/growth, reduced weed growth, disease suppression, reduced need for trimming and maintenance around plants and an aesthetically pleasing landscape appearance. By adding these natural products into a landscape maintenance program, it will help to reduce the landscape maintenance that is required.

2.7.4 Landscape Equipment: Landscape equipment is typically chosen for efficiency and ease of use. However, reducing fossil fuel consumption is one of the most important cost savings for landscape maintenance and for protecting the environment. Where possible, hand powered or electric equipments should be used.

At first, manual labor may reduce the efficiency; however, long term, it can cut costs while protecting the health of your staff, enhancing visitor experience, and improving local air and water quality. Lower operating costs from manual and electric equipment can often recover higher initial purchase costs of new equipment, and more importantly, the contribution to a healthier environment and enhanced visitor experience will benefit the resort and increase pride of the landscape maintenance staff.

Chapter 3: R-1 Water Irrigation System Transition

3.1 R-1 Water Background

From Reef Friendly Landscape Management Stand, the use of reclaimed water is preferred for landscape irrigation. The purpose of this chapter is to encourage the transition to R-1 Water Irrigation System. Kā'anapali Operations Association, Inc. (KOA) currently uses R-1 water from the golf course and has reduced the use of chemical fertilizers on grass areas due to high rate of nitrogen content in R-1 water. Please also refer to "A Guide for West Maui's Resorts and Condominium Properties" prepared by Coral Reef Alliance, which provides a comprehensive review and extensive resources on the use of recycled water. The CORAL document can be found at: http://www.coral.org/files/pdf/recycled_water_for_reefs_v1.pdf

Maui County Ordinance 2525 mandates use of reclaimed water for irrigation where R-1 water is available. "Available reclaimed water service" is defined as "existence of a reclaimed water distribution main contiguous to or within one hundred feet of any consumer's property line." Where there is an available reclaimed water service, the existing irrigation systems are required to be switched to the reclaimed water system within one year of service availability. Cost of retrofitting the existing irrigation system will be credited by the County at a discounted rate of the reclaimed water rates services. This discounted rate (one-half (1/2) of the reclaimed rates) is to continue until the cost to retrofit has been recovered by the resort. Other charges to be applied for connecting to the R-1 water will include the initial installation charge and a connection fee based on peak daily usage

3.2 R-1 Water Permit Requirements

3.2.1 Department of Health (DOH):

The first step to be able to utilize a reclaimed water use in the State of Hawaii is to apply for Department of Health (DOH) approval. Approval is based on the "Guidelines for the Treatment and Use of Recycled Water", prepared by the Hawaii State DOH Wastewater Branch, dated May 15, 2002. The DOH permit requirements include the following items:

- Basis of Design Report
- Engineering Report
- Construction Plans
- Cross-Connection Approval
- Construction Inspection

Upon the approval of DOH, design and engineering reports may be waived for smaller reuse projects such as dust control or landscape and irrigation areas less than five acres.

3.2.2 County of Maui

County of Maui application requires a basis of design report, engineering report, connection fee, Maui County application form (RW-1), an overall map as well as plans and specifications to determine an expected reclaimed water load and meter size.

3.3 Irrigation System Requirements

The State of Hawaii Department of Health (DOH) "Guidelines for the Treatment and Use of Recycled Water" provides technical guidelines and requirements for designing and installing a reclaimed water irrigation system. The following is a summary of what is required to convert a potable water irrigation system to R-1 reclaimed water irrigation system:

3.3.1 Procedure for converting the existing system to reclaimed water system

The first step would be to evaluate if the existing system can be converted to reclaimed use or if it would need to be replaced with a new system. Locating and testing existing irrigation lines to see if those lines can be converted to reclaimed water use per the Maui County Department of Water Supply (DWS) Standards is required. If the actual locations cannot be verified, it is recommended to install new system as per the DOH and DWS standards.

In order to install a reclaimed water irrigation system, the following requirements are to be met:

- Basket Strainer at the meter
- Irrigation Controller (color coded with label indicating "Recycled Water")
- Irrigation pipes with an identification tape with white or black printing on a purple field (color index 77742 violet #16, Pantone 512 or equal), having the words "CAUTION: RECYCLED WATER - DO NOT DRINK."
- Hose bib not allowed
- Horizontal, and vertical clearances between potable water and other utilities
- Minimum easement or right-of way widths, and minimum cover and requirements for recycled water
- All above ground existing and new facilities to be color coded purple
- Reclaimed water signs
- Inspection & Monitoring

Based on recent a study for R-1 water irrigation system and soils, it is indicated that a salt and sodium content in the soils tends to become higher in dry months from May to September and lowers in rainy season. This seasonal trend indicates that the winter rains leach out salt and sodium from the soils. Before converting the existing system to reclaimed water, it is recommended to evaluate the existing plant materials to see how increased salt and sodium content would affect them.

Recycled water irrigation can be cost effective as it costs less than potable water and is exempt from sewer fees. In addition, since recycled water contains more nutrients than potable water, the need for fertilizer is expected to decrease.

Chapter 4: Reef Friendly Operation & Maintenance Checklist

In order to implement a successful Reef Friendly Landscape Management Plan, it is critical that all the resort communities work together. It is especially important that the hotel General Managers and management staff support and encourage landscape maintenance personnel to take an active role in implementing “reef friendly” practices in their daily operations. The checklist below provides a set of Reef Friendly Landscape Operation and Maintenance techniques and strategies to aid participating resorts within the Ka`anapali Beach Resort community that re-validates their good practices and helps to identify areas for potential improvement.

Nutrient Management

- Fertilize ornamental planting beds with organic slow release fertilizer and/or foliar application (Liquid Hawaiian Horticultural Mix). Fertilizer should be covered with mulch or worked into the soil to prevent it from being washed away.
- Do not apply synthetic fertilizers
- No fertilizer on lawn.
- Remove plant debris (fallen leaves, branches, flowers, etc.) from grass, pavement, drain inlet, and along stream bank and shoreline.

Lawn Management

- Mow grass with electric or hand pushed mower.
- Use Mulching Mower to leave grass clippings in lawn areas.
- Mow grass Taller (Seashore Paspalum 2 - 3” Tall, Bermuda 1 – 2” Tall)
- Leave Grass Clippings in lawn areas away from drain inlet and pavement.
- No herbicide used in lawn areas.
- Apply salts (instead of herbicides) to control weeds in lawn areas.
- Manually pull weeds once a week or as needed.

Soil Management

- Install 4" min. layer of mulch over all planter beds and under trees. Replenish at least biannually to maintain at least 3" cover.
- Keep mulch away from drain inlet, pavement, or any open water body.
- Topdress lawn areas and planter beds with composted soils and/or apply compost tea biannually

Green Infrastructure

- Install Raingarden(s) near a drain inlet and/or outdoor shower to capture the runoff before going into a storm drain or the open water body.
- Install Bioswale to filter runoff before going into storm drain or the open water body

Integrated Pest Management

- Monitor landscape for pests weekly.
- Identify desirable insects (Lacewings, Lady Beetles, Pteromalid Wasps, Ichneumonid Wasps, and Braconid Wasps).
- Apply soap and oil to control insects (aphids, mealybugs, psyllids and spider mites) if beneficial insects are not present.
- Use foliar application insecticide as a last resort.
- Apply high pressure water jet to remove insects from plants (spider mites, aphids, small caterpillars, etc.).
- Remove/Replace infested plants with new plants rather than trying to use chemical to control insects.
- Apply and maintain 3-4" layers of mulch in planter beds.

Landscape Maintenance Equipment

- Reduce or Eliminate use of gas-powered landscape maintenance equipments. Use electric and manual equipments as much as practicable.
- Clean equipments after each use.

General Landscape Improvements and Maintenance.

- Designate a compost recycling bin locations and start creating own compost.
- Create vegetated buffer along makai side of the property with native Hawaiian plants such as Naupaka and Pohinahina.
- Establish no chemical, no irrigation zone for the areas within 30' from the certified shoreline and 10' from stream banks and other open water bodies.
- Prepare irrigation as-built plan (showing all irrigation controllers, weather station, all valves per controller, types of sprinklers (pop-up spray, impact, rotor, or drip).
- Check irrigation coverage and correct overspray to paved areas or buildings biannually.
- Check irrigation systems for leaks weekly.
- Make plans for transition to R-1 Water Irrigation System

Reef Friendly Landscape Management Plan

Maui Ka`anapali Villas

Chapter 1: Background

1.1 Why Reef Friendly Landscape Management Plan?

A typical resort landscape consists of expansive lawn areas, dramatic water features, shade trees, palms and exotic ornamental plants. All of which are maintained through conventional landscape maintenance practices such as the use of automatic irrigation systems, power tools and chemically based fertilizers and pesticides. Routine mowing, pruning, and blowing requires frequent irrigation and fertilization, which can cause nutrient leaching, water runoff, soil erosion, and lead to degradation of coral communities.

Additional coral community degradation can also occur through the addition of pollutants such as: chemical runoff which includes oil and gas from power equipment and irrigation runoff from improper or over watering. A major sources of pollution from landscape operations are plant debris and excess nutrients from fertilizer that has been applied to lawn and garden areas. Although a precise impact of this fertilizer on shoreline properties and contamination of the water is difficult to quantify, the artificially increased nutrient load due to leaching and runoff of fertilizer inadvertently impacts the health of the coral. Excessive and/or improper application of fertilizer, whether organic or synthetic, can be costly and contribute to negative impacts on the coral reef such as: explosive growth of algae which can cause disruptive changes to the coral ecosystem and ultimately kill fish and the coral community.

The health of the coral reef affects not only Hawaii's natural resources, but also the experience of tourists visiting our world class beaches and resorts which in turn can negatively impact Hawaii's tourism industry. The West Maui Ridge to Reef Initiative (www.westmauir2r.com) was launched in 2012 to focus upon addressing causes of land based pollution that are currently believed to be deteriorating our marine systems. As one of several partners in the initiative, the State Department of Land and Natural Resources (DLNR) Division of Aquatic Resources (DAR) has funded a project to collaborate with the Kā'anapali Operators Association (KOA) to develop seven landscape management plans. These management plans address the resorts need for aesthetically pleasing grounds while implementing best practices that minimize the use of pesticides, fertilizers, and irrigation water.

In order to reduce landscape related harmful nutrients leaching into the ocean and help protect the near shore environments along the Kā'anapali Coast, the purpose of the Reef Friendly Management Plan is to achieve a balance between a beautiful, aesthetically pleasing resort landscape and chemical inputs to the ground. The Reef Friendly Landscape Management Plans are a natural systems/ecological based approach to landscape maintenance that will maintain healthy and beautiful landscapes while helping to reduce stress to Kā'anapali Coral Reef Communities.

The goal of Reef Friendly Landscape Management Plan is to show that healthy and beautiful landscapes can coexist with healthy and diverse coral community in Kā'anapali by integrating the following practices:

- Reduce chemical inputs to coastal waters
- Reduce waste
- Reduce water & energy consumption
- Reduce runoff/erosion (retain topsoil)
- Improve soil environment to reduce fertilizing
- Create sustainable/harmonious landscapes
- Protect wildlife habitats
- Increase native plants and diversity
- Use integrated pest management to minimize chemical use

1.2 Existing Landscape Context of the Maui Kā'anapali Villas

The 11 acre Maui Kā'anapali Villas is located on 45 Kai Ala Drive in Kā'anapali Beach Resort (**Appendix A**). It contains five (5) groups of buildings, Pools, Beach Service, Castaway Café, and a baseyard.



(Google Aerial View of the Property)



(Large lawn areas and Mature Trees)

The existing five building cluster is connected by a concrete walkway and Asphalt/Concrete paved driveways and parking areas. The landscape is comprised of lawns and lush tropical landscape plants such as: Areca palms, Ti, Spider plants, and various palms. The majority of the properties' landscape is covered with lawn and several mature large canopy trees. Landscape improvements consisting of tropical shrubs and groundcovers surround buildings and recreational areas while thick layers of Naupaka hedge border the property and separate it from the beach sand.



(A Good Example of Utilizing Native Plants as a Vegetative Buffer, this was implemented at the Maui Kā'anapali Villas)



(Landscape at the main entry lobby)

1.3 Landscape Practice

The Maui Kā'anapali Villas' property is maintained by seven (7) maintenance personnel. The existing irrigation system is connected to the County potable water source and the irrigation control system is comprised of a permanent control system and battery operated valves.

It should be noted that the Maui Kā'anapali Villas already takes significant steps toward creating a "Reef Friendly" landscape by using organic insecticide, keep strict record of amount and timing of herbicide application, and limit use of landscape chemicals to only when it is needed.

The following is a summary of chemical use activities for landscape maintenance at the Maui Kā'anapali Villas (**Appendix B**):

1.3.1 Fertilizers: Miracle Grow 30-5-10 and 18-6-8 are used as needed.

1.3.2 Herbicide: Roundup Pro is typically sprayed to eliminate weed species such as Hilo grass and crabgrass in lawn and in Wedelia plantings to help prevent grass from intruding into garden beds. Fusilade II is used as needed and Finale is used under Coconut Palm and Plumeria trees to help control weeds. If needed, Certainty and Monument are spot sprayed to control nutgrass and other weed species.

1.3.3 Pesticide: Neem oil is used as needed to control mites, white fly, scale, beetles, and aphids.

1.3.4 Fungicide: Eagle fungicide is used as needed to control dollar spots and brown patches on occur in the lawn areas.

1.4 Soil Analysis

According to USA National Cooperative Soil Survey, the majority of the property is on Ewa Silty Clay Loam. Ewa Silty Clay Loam is typically found in coastal plains and is well drained, has slow to medium runoff and moderate permeability.

As part of RFLMP two (2) representative soil samples (Mar1 & Mar2) were taken within the property. The soil analysis provides information on soil pH, Macronutrients (Phosphorous, Potassium, Magnesium, and Calcium), Soil Salinity, Nitrogen, and Micronutrients (boron, copper, iron, manganese, and zinc) levels in the soils and provide recommendations for the correct quantities and types of nutrients that may need to be applied.

Mar1 was obtained from the grass area that is adjacent to the outdoor shower just outside of seat wall and Mar2 was obtained from the Naupaka hedge area on the makai side of the Castaway Cafe. In both samples, the pH appears to be very high (alkaline) while Potassium and Iron are quite low. The Mar1 soil sample indicates that Sodium levels are high while Magnesium and Sulfur levels appear to be low. Plants that can tolerate high sodium should be selected for these areas and an application of Phosphorous is recommended to help neutralize the soil pH.

The soils report indicated low sulfur content. Sulfur is an essential element in the life processes of all living things as it is an important part of the proteins that are needed to sustain life in all biological organisms including microorganisms and plants. Organic matter is a major source of sulfur in landscape and therefore regular application of organic amendments such as compost in the planting areas is recommended.



Soil Sample Locations

1.5 Landscape Equipment

Currently the Maui Kā'anapali Villas is not using any landscape equipment that is battery or electric power operated.

Chapter 2: Proposed Reef Friendly Landscape Management Plan Practices

2.1 Chemical Control and Nutrient Management

The most critical element of Reef Friendly Landscape Management is to reduce chemical inputs to the coral environments. The use of fertilizers and other landscape chemicals such as herbicides and pesticides should be kept minimal.

Here are proposed measures to reduce chemical inputs while preserving desirable appearance.

2.1.1 Plant Selection: Soil test results indicated high PH and alkaline soils found in the area, so it is recommended to use plants that thrive in such soils instead of trying to lower soil pH. Many of the Native Hawaiian plants that tolerate drought conditions, high pH and high soil salinity would do well in these locations.

2.1.2 Slow Release Fertilizer: Slow release, oorganic fertilizers are preferred and should be covered with mulch or worked into the soil to prevent being washed away by rain or irrigation systems to walkways, drain inlets or the ocean.

It is recommended a low phosphorus fertilizer be used on lawn areas. An organic base fertilizer such as Sustane 18-1-8 with 12 to 16 week release rates can be used.

2.1.3 Foliar applied nutrients: Liquid Hawaiian Horticultural Mix is recommended as it is a complete micronutrient which includes both magnesium and sulfur. When plant nutrients are applied to the foliage of the plant, smaller quantities of the fertilizer is required than when applying to the soil. From RFLM standpoint, it is also a desirable method to apply nutrients since leaching will also be reduced when applied directly to the foliage of the plant. From a resort operations and aesthetic improvement standpoint, foliar application has merit as it generally helps plants absorb nutrients more rapidly than when applied to the soil and quickly correcting plant nutrient deficiencies, which in turn improves their appearance. It is important to avoid excessive application to prevent foliar applied nutrients from washed away by rain or irrigation systems.

2.1.4 Organic Mulch: Cover mulch should be placed in all planter beds and replenished biannually at minimum. It should not however, be used or stored near a drain inlet, on pavement, or close to any open water body to ensure it does not get carried into ocean waters.

Benefits of organic mulch include:

- Improves soil structure once it has decomposed
- Reduces soil compaction
- Supports soil microbial life
- Suppresses weeds
- Filters out pollutants
- Reduces water consumption, fertilizer, and pesticide
- Supports healthier plants

As well as having mulch, it is a good practice to leave plant debris on site as long as it is not unsightly.

2.1.5 Non-Chemical Zone: To further prevent additional chemicals from leaching into the water, any fertilizers (except foliar applied nutrients), herbicides, pesticides, or permanent spray irrigation system should not be used on sand dunes, within 30 feet of a certified shoreline, or within 10 feet of a stream bank.

2.2 Lawn Management

This property has a vast amount of lawn areas and being able to effectively maintain these lawn areas is the key to a RFLMP. Maintenance practices such as mowing and blowing tend to shift plant debris from landscaped areas to nearby water bodies which can add pollution and nutrients to the water. Additionally, this practice removes all plant debris from planting areas reducing soil nutrients and health as well as depriving beneficial insects and micro-organisms of food and habitats.

It is suggested that lawn be limited to areas that serve a specific purpose such as; seating, gathering, and play areas.

2.2.1 Grass Type: Preferred lawn grass in the area would be Seashore paspalum, and the use of rock salt would be preferred over chemicals to treat weeds in this lawn type.

2.2.2 Mowing: Grass should be cut between 2 to 3" inches to keep moisture in grass longer and reduce runoff. Use a mulching mower to leave the grass clippings on the turf areas to decompose and release their nutrients into the soil. Leaving the clippings on the lawn after mowing saves time, money and reduces greenhouse gases that result from hauling them to the landfill.

2.2.3 Fertilizer: If fertilizer application is required, slow release fertilizer or foliar application are recommended. Organic slow release nitrogen and phosphorus-free lawn fertilizers such as Sustane 18-1-8+Fe or something similar should be used if fertilizer application is required. As an alternative to fertilizer, periodically (at least twice a year) topdressing lawn areas with finely screened compost (max. 1/4 inches) can improve the health of the soil and grass.

2.2.4 Herbicide: To prevent leaching, no Herbicides are to be used in lawn areas within 30' from the shoreline or open water body.

2.2.5 Border: Lawn grass should be kept away from areas that have surface water runoff to reduce the runoff of fertilizer and grass clippings. The existing Naupaka hedge that separates the grass from the sand beach should be maintained, but if there is not adequate room for Naupaka hedge, smaller plants such as Pohinahina could be used. Where feasible, it is recommended to convert lawn grass areas to sand dunes or native Hawaiian planting beds to reduce water consumption and chemical requirements. Reestablishing Hawaiian and Polynesian plants in the landscape will invite more native wildlife which will make the outdoor space “living & sustainable” and help to create a Hawaiian sense of place. Ensuring the proper selection of plant material will reduce maintenance, use of equipment, chemical outputs, pollution, and water consumption.

2.3 Soil Management

In order to reduce chemical input and maintain plant health, it is critical to start with good soil. Reducing pesticide usage helps to build healthy soil environments as many pesticides are toxic to microbes and other soil dwelling creatures such as earthworms, and can reduce the diversity of soil life.

2.3.1 Existing Soils: It is not practical, financially or environmentally sound to replace existing soil or to artificially supplement the soil with synthetic fertilizers. Feeding soils with natural compost and/or compost tea can help to create a healthy soil food web, which aids nutrient availability for the plants, resists pests and diseases and protects water quality. Also, keeping plant debris such as; plant trimmings and grass clippings, in planter beds can provide a cost effective way to manage to nurture soil organisms and recycle organic matter while reducing waste and runoff.

Maintain a minimum of 2 to 4 inches of mulch in all planter beds.

Incorporating compost into the existing soil will not only improve the soils sulfur and iron deficiencies but also the soil structure and drainage ability. As well as amending the soil with compost, a cover mulch should be placed in all planter beds and replenished as needed, as mulch cover can help to preserve soil moisture, support soil microbial life, suppress weeds, filter out pollutants as well as create a way to cover plant debris in an aesthetically pleasing manner.

2.3.2 New Grounds: If recreating or restoring lawn or garden areas, tilling to a minimum of 4-inches of compost into the top 6–8 inches of soil is recommended to help improve the structure of the soil. The addition of materials such as mulch, volcanic cinders, crushed coral, or sand (calcium carbonate) should also be incorporated in all garden beds to help improve soil porosity and drainage.

2.4 Green Infrastructure

Green infrastructure, including swales and rain gardens, helps to divert excess water run-off from roofs and impervious surfaces. These sustainable landscape elements capture the "First Flush", which is the first inch of rainfall after a dry spell, which has been proven to carry the most pollutants to our waterways and ocean.

They also help to reduce fresh water runoff from a landscape, protect the ocean and other nearby waterways, and help to replenish groundwater aquifers.

The existing drain inlets on this site are typically located in lawn areas adjacent to the walkways. It is recommended to convert the grass area that surrounds the drain inlets to a wetland garden planted with native Hawaiian plants. These native gardens will mimic the natural environment and function as green infrastructure to help manage water runoff. This enhanced planting along the beach walk will not only add aesthetics but also provide an educational opportunity for visitors to learn about the sustainable approach that the hotel is taking to protect the nearby coral environments.



(Potential Areas for Raingardens)

2.5 Integrated Pest Management

The use of pesticide should be avoided or used as a last resort, as it not only causes environmental pollution but also kills beneficial microbes that naturally occur in healthy soils. Integrated Pest Management (IPM) is a sustainable approach to managing pests such as insects, plant diseases, and weeds by eliminating or reducing the use of potentially harmful pesticides. IPM is an environmentally friendly program that combines biological, cultural, physical and chemical tools to help manage pests to an acceptable level, but not necessarily fully eliminate them.

IPM is based upon three strategic steps:

2.5.1 Prevention: Key is to establish a healthy environment in which plants have the strength to resist disease and insect infestations and to out-compete weeds. The least toxic pesticides are used only when it is required. Referring to previous sections of this Reef Friendly Management document, nutrient management, lawn management and soil management are all critical elements of IPM. Aside from the measures indicated in the previous Sections, the following actions should also be taken:

- Choose the right plant material for each environment to help create more resistant plant material.
- Choose plant material that attracts beneficial insects.
- Plant all plant material at the correct depth and provide adequate spacing.
- Remove noxious weeds before they go to seed.
- Clean equipment thoroughly after each use.

2.5.2 Monitoring: Each landscape is living and complex and specific levels of different species of organisms are necessary for keeping it healthy. Regular monitoring of the site including: the condition of the plant material, population increase/decrease of pests, and population increase/decrease of beneficial organisms is critical in understanding the landscape and what the primarily root of problem is. Elements such as: pests, incorrect plant selection, poor soil drainage or nutrient deficiency can all play a large part in a pest infestation.

2.5.3 Control: The purpose of control in IPM is to keep pests at acceptable levels thereby reducing the need for pesticides and in return pollutants are kept out of watershed. After routine monitoring, if it is determined that pests are causing an unacceptable level of damage, the following control measures can be taken before the use of pesticide is considered.

- **Cultural and Physical Control:** Some pests are associated with certain plants. Infested parts or plants need to be removed by hand as soon as possible. Replace infested plants with appropriate native plants and create diversity in landscape. Apply water to spray off pests like aphids. Apply 2-inch layer of coarse mulch between and under shrubs and groundcovers to improve soil structure and control weeds.
- **Cultural and Physical Control:** Creating a monoculture through planting only a few plants species in a small area can cause an influx of pests and disease. Adding different and more pest resistant species will break up this monoculture and minimize infestations.
- **Biological Control:** In natural environments many organisms in the landscape are considered to be beneficial as they feed on pests and therefore minimize the necessity for pesticide. Some beneficial insects include hover flies, lacewings, lady beetles, predatory mites, bees and certain wasps. Small scale biological control can be implemented by creating a favorable environment with a variety of plant material that attracts predators/parasites, introducing beneficial microbes, and by using less harmful pesticides which could potentially kill beneficial insects. **Appendix D** prepared by the College

of Tropical Agriculture and Human resources (CTAHR), University of Hawaii, Manoa, provides a list of preferred beneficial insects. Healthy soils contain billions of beneficial organisms and using compost tea introduces large and diverse populations of microbes that can help to suppress some leaf and root diseases.

The Maui Kā'anapali Villas currently controls insects such as Hibiscus mites, mealy bug, white fly, scale, aphids, and caterpillars, by implementing plants that attract natural predators of those pests. By attracting Lacewings, Lady Beetles, Hover flies, Predatory mites, and Parasitic wasps as well as some birds and spiders, into the landscape, the need for chemical pesticides would be diminished.

Images of Natural Predators:



Lacewings



Lady Beetles



Predatory Mites



Pteromalid Wasps



Ichneumonid Wasps



Braconid Wasps

- **Chemical Control:** If infestations of pests or disease cannot be brought to an acceptable level through the use of cultural or biological control, IPM allows for chemical control as a last resort. If chemical application is necessary, only naturally occurring pesticides such as soaps and oils are to be used for control purposes only and not preventative purposes. All directions must be followed explicitly and pesticides must be kept out of gutters, storm drains, and off sidewalks, driveways and other hard surfaces. Disposal of leftover product should abide to EPA and state regulations.

<http://www.epa.gov/pesticides/regulating/disposal.htm>

- **Chemical Control:** It should be noted that Maui Kā'anapali Villas already uses Neem Oil as an alternative for pesticide, which is a significant step toward a Reef Friendly landscape Management Program.

2.6 Landscape Maintenance Equipment

Gas operated lawn mowers, chain saws and blowers create noise pollution and emit significant amounts of environmental pollutants. Currently the Maui Kā'anapali Villas are not using any landscape equipment that is battery or electric power operated. RFLMP recommends using electric landscape equipment as it will help to reduce noise level and the resort's carbon footprint. Also, advantages of electric mowers would be reduced operating cost by saving on gas and reduced maintenance by eliminating needs for oil changes, new spark plugs and replacing air filters. STHL product line provides a wide range of battery operated and fuel efficient equipments.

2.7 Cost Consideration

The main objective of Reef Friendly Landscape Management Plan is to reduce chemical inputs to our landscape. Reduced chemical usage will help minimize costs related to materials, equipment, and labor. It will also reduce health risks and liability for operating personnel as well as visitors/residents while helping to protect the environment.

2.7.1 Fertilizer Use: Reducing fertilizer application will prevent excessive and unusually fast plant growth that weakens the plant and in turn increases maintenance and generates excess plant debris. Reducing fertilizer usage will reduce waste disposal and require less maintenance which will lead to lower costs. One way to reduce fertilizer usage is to leave grass clippings on the grass areas after mowing, which will help to provide nutrients and water back to the soil. The addition of organic mulch in garden beds will also reduce the need for fertilizer application by supplying the nutrients necessary for healthy plant growth and improve the soil condition.

2.7.2 Pesticide Use: Minimizing pesticides not only reduces water pollution but also helps support soil life, which cycles nutrients and promotes resistance to plant disease. In the long run minimizing pesticide saves landscape maintenance cost by creating a healthy environment for plants.

2.7.3 Organic Mulch: Organic materials, including compost and chipped landscape debris, supply the soil and plants with nutrients over time, which reduces the need for fertilizer. Further savings can be achieved by on-site composting which helps to keep valuable nutrients and organic matter in the garden and reduces pollution associated with transporting waste as well as disposal costs.

Organic mulch and compost tea provide a possibility for multiple savings via; water conservation, enhanced plant health/growth, reduced weed growth, disease suppression, reduced need for trimming and maintenance around plants and an aesthetically pleasing landscape appearance. By adding these natural products into a landscape maintenance program, it will help to reduce the landscape maintenance that is required.

2.7.4 Landscape Equipment: Landscape equipment is typically chosen for efficiency and ease of use. However, reducing fossil fuel consumption is one of the most important cost savings for landscape maintenance and for protecting the environment. Where possible, hand powered or electric equipments should be used.

At first, manual labor may reduce efficiency; however, long term, it can cut costs while protecting the health of your staff, enhancing visitor experience, and improving local air and water quality. Lower operating costs from manual and electric equipment can often recover higher initial purchase costs of new equipment, and more importantly, the contribution to a healthier environment and enhanced visitor experience will benefit the resort and increase pride of the landscape maintenance staff.

Chapter 3: R-1 Water Irrigation System Transition

3.1 R-1 Water Background

From Reef Friendly Landscape Management Stand, the use of reclaimed water is preferred for landscape irrigation. The purpose of this chapter is to encourage the transition to R-1 Water Irrigation System. Kā'anapali Operations Association, Inc. (KOA) currently uses R-1 water from the golf course and has reduced the use of chemical fertilizers on grass areas due to high rate of nitrogen content in R-1 water. Please also refer to "A Guide for West Maui's Resorts and Condominium Properties" prepared by Coral Reef Alliance, which provides a comprehensive review and extensive resources on the use of recycled water. The CORAL document can be found at: http://www.coral.org/files/pdf/recycled_water_for_reefs_v1.pdf

Maui County Ordinance 2525 mandates use of reclaimed water for irrigation where R-1 water is available. "Available reclaimed water service" is defined as "existence of a reclaimed water distribution main contiguous to or within one hundred feet of any consumer's property line." Where there is an available reclaimed water service, the existing irrigation systems are required to be switched to the reclaimed water system within one year of service availability. Cost of retrofitting the existing irrigation system will be credited by the County at a discounted rate of the reclaimed water rates services. This discounted rate (one-half (1/2) of the reclaimed rates) is to continue until the cost to retrofit has been recovered by the resort. Other charges to be applied for connecting to the R-1 water will include the initial installation charge and a connection fee based on peak daily usage

3.2 R-1 Water Permit Requirements

3.2.1 Department of Health (DOH):

The first step to be able to utilize reclaimed water usage in the State of Hawai'i is to apply for Department of Health (DOH) approval. Approval is based on the "Guidelines for the Treatment and Use of Recycled Water", prepared by the Hawai'i State DOH Wastewater Branch, dated May 15, 2002. The DOH permit requirements include the following items:

- Basis of Design Report
- Engineering Report
- Construction Plans
- Cross-Connection Approval
- Construction Inspection

Upon the approval of DOH, design and engineering reports may be waived for smaller reuse projects such as dust control or landscape and irrigation areas less than five acres.

3.2.2 County of Maui

The County of Maui application requires a basis of design report, engineering report, connection fee, Maui County application form (RW-1), an overall map as well as plans and specifications to determine an expected reclaimed water load and meter size.

3.3 Irrigation System Requirements

The State of Hawaii Department of Health (DOH) "Guidelines for the Treatment and Use of Recycled Water" provides technical guidelines and requirements for designing and installing a reclaimed water irrigation system. The following is a summary of what is required to convert a potable water irrigation system to R-1 reclaimed water irrigation system:

3.3.1 Procedure for converting the existing system to reclaimed water system

The first step would be to evaluate if the existing system can be converted to reclaimed use or if it would need to be replaced with a new system. Locating and testing existing irrigation lines to see if those lines can be converted to reclaimed water use per the Maui County Department of Water Supply (DWS) Standards is required. If the actual locations cannot be verified, it is recommended to install new system as per the DOH and DWS standards.

In order to install a reclaimed water irrigation system, the following requirements are to be met:

- Basket Strainer at the meter
- Irrigation Controller (color coded with label indicating "Recycled Water")
- Irrigation pipes with an identification tape with white or black printing on a purple field (color index 77742 violet #16, Pantone 512 or equal), having the words "CAUTION: RECYCLED WATER - DO NOT DRINK."
- Hose bib not allowed
- Horizontal, and vertical clearances between potable water and other utilities
- Minimum easement or right-of way widths, and minimum cover and requirements for recycled water
- All above ground existing and new facilities to be color coded purple
- Reclaimed water signs
- Inspection & Monitoring

Based on recent a study for R-1 water irrigation system and soils, it is indicated that a salt and sodium content in the soil tends to become higher in dry months from May to September and lower in rainy season. This seasonal trend indicates that the winter rains leach out salt and sodium from the soil. Before converting the existing system to reclaimed water, it is recommended to evaluate the existing plant materials to see how increased salt and sodium content would affect them.

Recycled water irrigation can be cost effective as it costs less than potable water and is exempt from sewer fees. In addition, since recycled water contains more nutrients than potable water, the need for fertilizer is expected to decrease.

Chapter 4: Reef Friendly Operation & Maintenance Checklist

In order to implement a successful Reef Friendly Landscape Management Plan, it is critical that all the resort communities work together. It is especially important that the hotel General Managers and management staff support and encourage landscape maintenance personnel to take an active role in implementing “reef friendly” practices in their daily operations. The checklist below provides a set of Reef Friendly Landscape Operation and Maintenance techniques and strategies to aid participating resorts within the Kā’anapali Beach Resort that re-validates their good practices and helps to identify areas for potential improvement.

Nutrient Management

- Fertilize ornamental planting beds with organic slow release fertilizer and/or foliar application (Liquid Hawaiian Horticultural Mix). Fertilizer should be covered with mulch or worked into the soil to prevent it from being washed away.
- Do not apply synthetic fertilizers
- No fertilizer on lawn.
- Remove plant debris (fallen leaves, branches, flowers, etc.) from grass, pavement, drain inlet, and along stream bank and shoreline.

Lawn Management

- Mow grass with electric or hand pushed mower.
- Use Mulching Mower to leave grass clippings in lawn areas.
- Mow grass taller (Seashore Paspalum 2 - 3” Tall, Bermuda 1 – 2” Tall)
- Leave grass clippings in lawn areas away from drain inlet and pavement.
- No herbicide used in lawn areas.
- Apply salts (instead of herbicides) to control weeds in lawn areas.
- Manually pull weeds once a week or as needed.

Soil Management

- Install 4" min. layer of mulch over all planter beds and under trees. Replenish at least biannually to maintain at least 3" cover.
- Keep wood mulch away from drain inlet, pavement, or any open water body.
- Topdress lawn areas and planter beds with composted soils and/or apply compost tea biannually.

Green Infrastructure

- Install Raingarden(s) near a drain inlet and/or outdoor shower to capture the runoff before going into a storm drain or the open water body.
- Install Bioswale to filter runoff before going into storm drain or the open water body

Integrated Pest Management

- Monitor landscape for pests weekly.
- Identify desirable insects (Lacewings, Lady Beetles, Pteromalid Wasps, Ichneumonid Wasps, and Braconid Wasps).
- Apply soap and oil to control insects (aphids, mealybugs, psyllids and spider mites) if beneficial insects are not present.
- Use foliar application insecticide as a last resort.
- Apply high pressure water jet to remove insects from plants (spider mites, aphids, small caterpillars, etc.).
- Remove/Replace infested plants with new plants rather than trying to use chemical to control insects.
- Apply and maintain 3-4" layers of wood mulch in planter beds.

Landscape Maintenance Equipment

- Reduce or Eliminate use of gas-powered landscape maintenance equipments. Use electric and manual equipments as much as practicable.
- Clean equipment thoroughly after each use.

General Landscape Improvements and Maintenance

- Designate a compost recycling bin locations and start creating own composts.
- Create vegetated buffer along makai side of the property with native Hawaiian plants such as Naupaka and Pohinahina.
- Establish no chemical, no irrigation zone for the areas within 30' from the certified shoreline and 10' from stream banks and other open water bodies.
- Prepare irrigation as-built plan (showing all irrigation controllers, weather station, all valves per controller, types of sprinklers (pop-up spray, impact, rotor, or drip).
- Check irrigation coverage and correct overspray to paved areas or buildings biannually.
- Check irrigation systems for leaks weekly.
- Make plans for transition to R-1 Water Irrigation System

Reef Friendly Landscape Management Plan

The Westin Kaanapali Ocean Resort and Villas

Chapter 1: Background

1.1 Why a Reef Friendly Landscape Management Plan?

A typical resort landscape consists of expansive lawn areas, dramatic water features, shade trees, palms and exotic ornamental plants, all of which are maintained through conventional landscape maintenance practices. This includes the use of automatic irrigation systems, power tools and chemically based fertilizers and pesticides. Routine mowing, pruning, and blowing requires frequent irrigation and fertilization, which can cause nutrient leaching, water runoff, soil erosion, and lead to degradation of coral communities.

Additional coral community degradation can also occur through the addition of coastal pollutants such as chemical runoff, which includes oil and gas from power equipment and irrigation runoff from improper or over watering. One of the major pollutant sources from landscape operation is nutrients from lawn and planter areas. Two potential sources of nutrients entering near shore environments are fertilizer and plant debris. Although the precise impact of this fertilizer on the shoreline properties and contamination of the water is difficult to quantify, the artificially increased nutrient load due to leaching and runoff of fertilizer will increase the nutrients, thereby inadvertently impacting the health of the corals. Excessive and/or improper application of fertilizers, whether organic or synthetic, can be costly and contribute to negative impacts on the coral reef such as explosive growth of algae which can cause disruptive changes to the coral ecosystem and ultimately kill fish and the coral community.

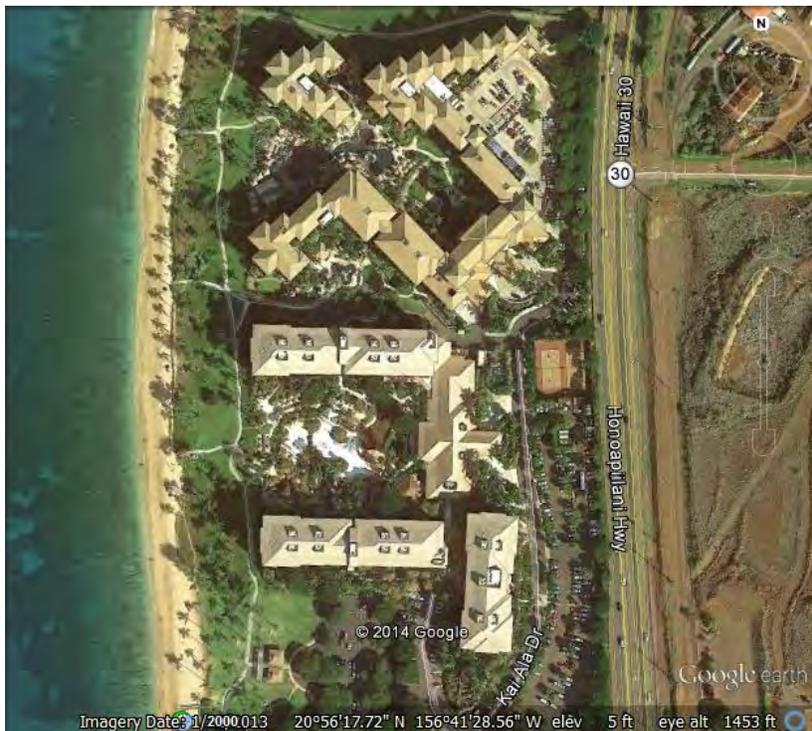
The health of the coral reef not only affects Hawai'i's natural resources but also the experience of tourists visiting Kā'anapali's world class beaches and resorts which in turn can effect Hawai'i's tourism industry. The West Maui Ridge to Reef Initiative (www.westmauir2r.com) was launched in 2012 to help to address some of the causes of land based pollution that are currently stressing our marine systems. As one of several partners in the initiative, the State Department of Land and Natural Resources (DLNR) Division of Aquatic Resources (DAR) has funded a project to work with the Kā'anapali Operators Association (KOA) to develop landscape management plans for participating resorts that reflect the best practices to meet the needs of an aesthetically pleasing landscape, while minimizing maintenance as well as the use of pesticides, fertilizers, and irrigation water.

In order to reduce landscape related harmful nutrients leaching into the ocean and help protect the near shore environments along the Kā'anapali Coast, the purpose of the Reef Friendly Management Plan is to achieve a balance between a beautiful aesthetically pleasing resort landscape and chemical inputs to the ground. The Reef Friendly Landscape Management Plans are a natural systems/ecological based approach to landscape maintenance that will maintain healthy and beautiful landscapes while helping to reduce stress to Kā'anapali Coral Reef Communities.

The goal of Reef Friendly Landscape Management Plan is to show that healthy and beautiful landscapes can coexist with healthy and diverse coral community in Kā'anapali by integrating the following practices:

- Reduce chemical inputs to coastal waters
- Reduce waste
- Reduce water & energy consumption
- Reduce runoff/erosion (retain topsoil)
- Improve soil environment to reduce fertilizing
- Create sustainable/harmonious landscapes
- Protect wildlife habitats
- Increase native plants and diversity
- Use integrated pest management to minimize chemical use

1.2 Existing Landscape Context of the Westin Kā'anapali Ocean Resort and Villas



The Westin Kā'anapali Ocean Resort and Villas is made up of 2 building clusters and is located on 6 Kai Ala Drive in Kā'anapali Beach Resort (Appendix A).

(Google Aerial View of the Property)

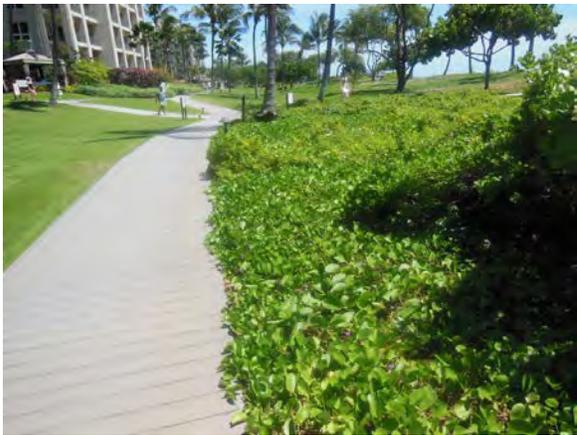


(Typical Landscape)



(Entry Sign Water Feature)

As with the other ocean front properties a meandering walkway (Kā'anapali Beach Walk) runs through the makai side of the resort property. The walkway material is composed of recycled plastic. On the Mauka side of the walkway are maintained lawns, while on the Makai side is planted with the native Hawaiian plant species that helps to create a vegetated buffer zone between the lawn areas and the beach.



(Good Example of Using Native Plants for Vegetative Buffer implemented at the Westin KOR)

The landscape on the mauka side of the walkway is comprised of Seashore Pasplum lawns, pools and water features, and lush tropical plants such as Ti, Monstera, Lauae Fern, Akia, Heliconia, Gardenia, Hibiscus, Spider Lily, palms, and various trees including Plumeria.

1.3 Current Landscape Practice

Currently, the landscape maintenance at the Westin Kā'anapali Ocean Resort and Villas is handled by SGS Hawaii, Inc. who also provides services for two other resorts in Kā'anapali. The following is a summary of chemical use activities for landscape maintenance at the Westin Kā'anapali Ocean Resort and Villas: It should be particularly noted that the Westin Kā'anapali Ocean Resort and Villas already makes significant steps forward for "Reef Friendly" landscape by incorporating wood mulch in their planter beds and promoting water efficient landscapes by converting shrub spray sprinklers to drip system. SGS Hawaii prefers the Integrated Pest Management approach and utilizes water spray and soap to control insects and molds and they do not actively spray insecticides except in extreme conditions.

- 1.3.1 Fertilizers:** Slow Release fertilizer is used at the Westin Kā'anapali Ocean Resort and Villas.
- 1.3.2 Herbicide:** On seashore paspalum grass, salt is being used to kill most weeds, and Sedgehammer is used to control nut sedge that arises in other lawn areas.
- 1.3.3 Pesticide:** Systemic pesticides, such as Safari and Merit are used as a root drench when necessary to control insects in most plants.
- 1.3.5 Compost:** Wood chip mulch is applied to all planting beds, and compost is applied to lawns annually and also when the lawns are showing signs of stress.

1.4 Soil Analysis

According to USA National Cooperative Soil Survey, the majority of the property is on makai half of the property is on Ewa Silty Clay Loam. Ewa Silty Clay Loam is typically found in coastal plains, is well drained, has slow to medium runoff and is moderate permeability.

As part of RFLMP three (3) representative soil samples (WES1, WES2, & WES3) were obtained from within the property. The soil analysis provides information on soil pH, Macronutrients (Phosphorous, Potassium, Magnesium, and Calcium), Soil Salinity, Nitrogen, and Micronutrients (boron, copper, iron, manganese, and zinc) levels in the soils and provide recommendations for the correct quantities and types of nutrients that may need to be applied.

WES1 was obtained from the grass area near a culvert located at the northern end of the property. WES2 was obtained from a Pohinahina Planter in front of the Tower 5. And WES 3 was obtained from a Gardenia planter located in front of the Tower 6. In all three samples, the Soil pH appears to be very high (alkaline) while Potassium is very low. Magnesium and Sulfur are low in WES1 and WES3, Iron is very low in WES2 and low in WES1 and Zinc is low in both WES1 and WES2.



Soil Sample Locations

Overall the soil analysis indicated very high pH and lack of nutrients in the area. It is typical to dry coastal environments. Instead of trying to add more chemical to reduce soil pH or add various nutrients, it is recommended that most "reef friendly" solution would be to use the plants that survive this kind of environment and/or to incorporate mulch/compost in the planter to help improve nutrients deficiency naturally, support soil microbial life, suppress weeds, and filter out pollutants.

The soil report indicated low sulfur content. Sulfur is an essential element in the life processes of all living things as it is an important part of the proteins that are needed to sustain life in all biological organisms including microorganisms and plants. Organic matter is a major source of sulfur in landscape and therefore regular application of organic amendments such as compost in the planting areas is recommended. Incorporating compost into the existing soil will also improve soil structure and drainage and help to improve iron deficiency.

In addition, Potassium, Magnesium, and Iron appears to be low to very low. If fertilizer application is needed to correct this problem, then slow release fertilizer or foliar application are recommended.

1.5 Current Landscape Equipment

Currently the Westin Kā'anapali utilizes battery powered landscape equipment, and manual reel mowers.

Chapter 2: Recommended Reef Friendly Landscape Management Plan Practices

2.1 Chemical Control and Nutrient Management

The most critical element of Reef Friendly Landscape Management is to reduce chemical inputs to the coral environments. The use of fertilizers and other landscape chemicals such as herbicides and pesticides should be kept minimal.

Here are proposed measures to reduce chemical inputs while preserving desirable appearance.

2.1.1 Plant Selection: Soil test results indicated high PH and alkaline soils found in the area, so it is recommended to use plants that thrive in such soils instead of trying to lower soil pH. Many of the Native Hawaiian plants that tolerate drought conditions, high pH and high soil salinity would do well in these locations.

2.1.2 Slow Release Fertilizer: Slow release organic fertilizers are preferred and should be covered with mulch or worked into the soil to prevent being washed away by rain or irrigation systems to walkways, drain inlets or the ocean.

As soil reports indicated high phosphorus, it is recommended that a low phosphorus fertilizer should be used in lawn areas. An organic base fertilizer such as Sustane 18-1-8 with 12 to 16 week release rates should be used as an alternative.

2.1.3 Foliar applied nutrients: Liquid Hawaiian Horticultural Mix is recommended as it is a complete micronutrient which includes both magnesium and sulfur. When plant nutrients are applied to the foliage of the plant, smaller quantities of the fertilizer material are required than when applying to the soil. From RFLM standpoint, it is also a desirable method to apply nutrients since leaching will be reduced when applied directly to the foliage of the plant. From resort operation and aesthetic improvement standpoint, foliar application has merit as it generally help plants absorb nutrients more rapidly than when applied to the soil and quickly correcting plant nutrient deficiencies, which in turn improves their appearance. It is important to avoid excessive application and prevent foliar applied nutrients from washed away by rain or sprinkler system.

2.1.4 Organic Mulch: Cover mulch should be placed in all planter beds and replenished biannually at minimum. It should not however, be used or stored near a drain inlet, on pavement, or close to any open water body to ensure it does not get carried into ocean waters.

Benefits of organic mulch include:

- Improves soil structure once it has decomposed
- Reduces soil compaction
- Supports soil microbial life
- Suppresses weeds
- Filters out pollutants
- Reduces water consumption, fertilizer, and pesticide
- Supports healthier plants

As well as having mulch, it is a good practice to leave plant debris on site to decompose as long as it is not unsightly.

2.1.5 Non-Chemical Zone: To further prevent additional chemicals from leaching into the water, any fertilizers (except foliar applied nutrients), herbicides, pesticides, or permanent spray irrigation system should not be used on sand dunes, within 30 feet of a certified shoreline, or within 10 feet of a stream bank.

2.2 Lawn Management

This property has a vast amount of lawn areas and being able to effectively maintain these lawn areas is the key to RFLMP. Maintenance practices such as mowing and blowing tend to shift plant debris from landscaped areas to nearby water bodies which can add pollution and nutrients to the water. Additionally, this practice removes all plant debris from planting areas reducing soil nutrients and health as well as depriving beneficial insects and micro-organisms of food and habitats.

It is suggested that lawn be limited to areas that serve a specific purpose such as; seating, gathering, and play areas.

2.2.1 Grass Type: Preferred lawn grass in the area would be Seashore paspalum, and the use of rock salt would be preferred over chemicals to treat weeds in this lawn type.

2.2.2 Mowing: Grass should be cut between 1 to 1.5" inches to help retain the moisture in grass and reduce runoff. Use a mulching mower to leave the grass clippings on the turf areas to decompose and re-release their nutrients back into the soil. Leaving the clippings on the lawn after mowing saves time, money and reduces greenhouse gases that result from hauling them to the landfill.

2.2.3 Fertilizer: If a fertilizer application is required, slow release fertilizer or foliar applications are recommended and organic slow release nitrogen and phosphorus-free lawn fertilizers such as Sustane 18-1-8+Fe or something similar should be used. As an alternative to fertilizer, periodically (at least twice a year) topdressing lawn areas with finely screened compost (max. 1/4 inches) can help to improve the health of the soil and grass.

2.2.4 Herbicide: To prevent leaching, no Herbicides are to be used in lawn areas within 30' from the shoreline or open water body.

2.2.5 Border: Lawn grass should be kept away from areas that have surface water runoff to reduce the runoff of fertilizer and grass clippings. The existing Naupaka hedge that separates the grass from the sand beach should be maintained, however if there is not adequate space for the Naupaka hedge, smaller plants such as Pohinahina should be used. Where feasible, it is recommended to convert lawn grass areas to sand dunes or native Hawaiian planting beds to reduce water consumption and chemical requirements. Reestablishing Hawaiian plants in the landscape will invite more native wildlife which will make the outdoor space “living & sustainable” and help to create a Hawaiian sense of place. Ensuring the proper selection of plant material will reduce maintenance, use of equipment, chemical outputs, pollution, and water consumption.

2.3 Soil Management

In order to reduce chemical input and maintain plant health, it is critical to start with good soil. Reducing pesticide usage helps to build healthy soil environments as many pesticides are toxic to microbes and other soil dwelling creatures such as earthworms, and can reduce the diversity of soil life.

2.3.1 Existing Soils: It is not practical, financially or environmentally sound to replace existing soil or to artificially supplement the soil with synthetic fertilizers. Feeding soils with natural compost and/or compost tea can help to create a healthy soil food web, which aids nutrient availability for the plants, resists pests and diseases and protects water quality. Also, keeping plant debris such as plant trimmings and grass clippings, in planter beds can provide a cost effective way to manage to nurture soil organisms and recycle organic matter while reducing waste and runoff.

Maintain a minimum of 2 inches of mulch in all planter beds.

Incorporating compost into the existing soil will not only improve the soils sulfur and iron deficiencies but also the soil structure and drainage ability As well as amending the soil with compost, a cover mulch should be placed in all planter beds and replenished as needed, as mulch cover can help to preserve soil moisture, support soil microbial life, suppress weeds, filter out pollutants as well as create a way to cover plant debris in an aesthetically pleasing manner.

2.3.2 New Grounds: If recreating or restoring lawn or garden areas, tilling a minimum of 4-inches of compost into the top 6–8 inches of soil is recommended to help improve the structure of the soil. The addition of materials such as mulch, volcanic cinders, crushed coral, or sand (calcium carbonate) should also be incorporated in all garden beds to help improve soil porosity and drainage.

2.4 Green Infrastructure

Green infrastructure, including swales and rain gardens, helps to divert excess water run-off from roofs and impervious surfaces. These sustainable landscape elements capture the "First Flush", which is the first inch of rainfall after a dry spell, which has been proven to carry the most pollutants to our waterways and ocean.

They also help to reduce fresh water runoff from a landscape, protect the ocean and other nearby waterways, and help to replenish groundwater aquifers.

The existing drain inlets on this site are typically located in lawn areas adjacent to the walkways. It is recommended to convert the grass area that surrounds the drain inlets to a wetland garden planted with native Hawaiian plants. These native gardens will mimic the natural environment and function as green infrastructure to help manage water runoff. This enhanced planting along the beach walk will not only add aesthetics but also provide an educational opportunity for visitors to learn about the sustainable approach that the hotel is taking to protect the nearby coral environments.

2.5 Integrated Pest Management

The use of pesticide should be avoided or used as a last resort as it not only causes environmental pollution but also kills beneficial microbes that naturally occur in healthy soils. Integrated Pest Management (IPM) is a sustainable approach to managing pests such as insects, plant diseases, and weeds by eliminating or reducing the use of potentially harmful pesticides. IPM is an environmentally friendly program that combines biological, cultural, physical and chemical tools to help manage pests to an acceptable level, but not necessarily fully eliminate them.

IPM is based upon three strategic steps:

2.5.1 Prevention: The key is to establish a healthy environment in which plants have the strength to resist disease and insect infestations and to out-compete weeds, and the least toxic pesticides are used only when necessary. Referring to previous sections of this Reef Friendly Management document, nutrient management, lawn management and soil management are all critical elements of IPM and aside from the measures indicated in the previous sections, the following actions should also be taken:

- Choose the right plant material for each environment.
- Choose plant material that also attracts beneficial insects.
- Plant all plant material at the correct depth and provide adequate spacing.
- Remove noxious weeds before they go to seed.
- Clean equipment thoroughly after each use.

2.5.2 Monitoring: Each landscape is living and complex and specific levels of different species of organisms are necessary for keeping it healthy. Regular monitoring of the site including: the condition of the plant material, population increase/decrease of pests, and population increase/decrease of beneficial organisms is critical in understanding the landscape and what the primary root of problem is. Elements such as: pests, incorrect plant selection, poor soil drainage or nutrient deficiency can all play a large part in a pest infestation.

2.5.3 Control: The purpose of control in IPM is to keep pests at acceptable levels thereby reducing the need for pesticides and in return pollutants are kept out of watershed. After routine monitoring, if it is determined that pests are causing an unacceptable level of damage, the following control measures may be taken before the use of pesticide is considered:

- **Cultural and Physical Control:** Some pests are associated with certain plants. Infested parts or entire plants may need to be removed by hand as soon as possible and replaced with appropriate native plants to create diversity in landscape. Apply water to spray off pests like aphids. Apply 2-inch layer of coarse mulch between and under shrubs and groundcovers to improve soil structure and control weeds.
- **Cultural and Physical Control:** Creating a monoculture through planting few plants species in a small area can cause an influx of pests and disease. Adding different and more pest resistant species will break up this monoculture and minimize infestations.
- **Biological Control:** In natural environments many organisms in the landscape are considered to be beneficial as they feed on pests and therefore minimize the necessity for pesticide. Some beneficial insects include hover flies, lacewings, lady beetles, predatory mites, bees and certain wasps. Small scale biological control can be implemented by creating a favorable environment with a variety of plant material that attracts predators/parasites, introducing beneficial microbes, and using less harmful pesticides which could potentially kill beneficial insects. **Appendix D** prepared by the College of Tropical Agriculture and Human resources (CTAHR), University of Hawaii, Manoa, provides a list of preferred beneficial insects. Healthy soils contain billions of beneficial organisms and using compost tea introduces large and diverse populations of microbes that can help to suppress some leaf and root diseases.

One of the primary landscape maintenance concerns at the Westin Kā'anapali Ocean Resort and Villas is Sooty Mold on the Gardenia plants. Sooty mold grows on secretions of such pests as aphids, scale, mealybug and whitefly. Once these pests are under control, sooty mold will also dissipate. Natural enemies of these pests include Lacewings, Lady Beetles, and Parasitic wasps such as Pteromalid Wasps, Ichneumon Wasps, and Braconid Wasps as well as some birds and spiders

Images of Natural Predators:



Lacewings



Lady Beetles



Predatory Mites



Pteromalid Wasps



Ichneumonid Wasps



Braconid Wasps

- Chemical Control: If infestations of pests or disease cannot be brought to an acceptable level through the use of cultural or biological control, IPM allows for chemical control as a last resort. If chemical application is necessary, only naturally occurring pesticides such as soaps and oils are to be used for control purposes only and not preventative purposes. All directions must be followed explicitly and pesticides must be kept out of gutters, storm drains, and off sidewalks, driveways and other hard surfaces. Disposal of leftover product should abide to EPA and state regulations.

<http://www.epa.gov/pesticides/regulating/disposal.htm>

2.6 Landscape Maintenance Equipment

Gas operated lawn mowers, chain saws and blowers create noise pollution and emit significant amounts of environmental pollutants. The Westin Kā'anapali Ocean Resort and Villas utilizes electric landscape equipment. RFLMP recommends using electric landscape equipment as it will help to reduce noise level and the resort's carbon footprint. Also, advantages of electric mowers would be reduced operating cost by saving on gas and reduced maintenance by eliminating needs for oil changes, new spark plugs and replacing air filters. STHL product line provides a wide range of battery operated and fuel efficient equipments.

2.7 Cost Consideration

The main objective of Reef Friendly Landscape Management Plan is to reduce chemical inputs to our landscape. Reduced chemical usage will help minimize costs related to materials, equipment, and labor. It will also reduce health risks and liability for operating personnel as well as visitors/residents while helping to protect the environment.

2.7.1 Fertilizer Use: Reducing fertilizer application will prevent excessive and unusually fast plant growth that weakens the plant and in turn increases maintenance and generates excess plant debris. Reducing fertilizer usage will reduce waste disposal and require less maintenance which will lead to lower costs. One way to reduce fertilizer usage is to leave grass clippings on the grass areas after mowing, which will help to provide nutrients and water back to the soil. The addition of organic mulch in garden beds will also reduce the need for fertilizer application by supplying the nutrients necessary for healthy plant growth and improve the soil condition.

2.7.2 Pesticide Use: Minimizing pesticides not only reduces water pollution but also helps support soil life, which cycles nutrients and promotes resistance to plant disease. In the long run minimizing pesticide saves landscape maintenance cost by creating a healthy environment for plants.

2.7.3 Organic Mulch: Organic materials, including compost and chipped landscape debris, supply the soil and plants with nutrients over time, which reduces the need for fertilizer. Further savings can be achieved by on-site composting which helps to keep valuable nutrients and organic matter in the garden and reduces pollution associated with transporting waste as well as disposal costs.

Organic mulch and compost tea provide a possibility for multiple savings via; water conservation, enhanced plant health/growth, reduced weed growth, disease suppression, reduced need for trimming and maintenance around plants and an aesthetically pleasing landscape appearance. By adding these natural products into a landscape maintenance program, it will help to reduce the landscape maintenance that is required.

2.7.4 Landscape Equipment: Landscape equipment is typically chosen for efficiency and ease of use. However, reducing fossil fuel consumption is one of the most important cost savings for landscape maintenance and for protecting the environment. Where possible, hand powered or electric equipments should be used.

At first, manual labor may reduce the efficiency at first; however, it can cut the costs while protecting the health of your staff, enhancing visitor experience, and improving local air and water quality. Lower operating costs from manual and electric equipment can often recover higher initial purchase costs of new equipment, and more importantly, the contribution to a healthier environment and enhanced visitor experience will benefit the resort and increase pride of the landscape maintenance staff.

Chapter 3: R-1 Water Irrigation System Transition

3.1 R-1 Water Background

From Reef Friendly Landscape Management Stand, the use of reclaimed water is preferred for landscape irrigation. The purpose of this chapter is to encourage the transition to R-1 Water Irrigation System. Kā'anapali Operations Association, Inc. (KOA) currently uses R-1 water from the golf course and has reduced the use of chemical fertilizers on grass areas due to high rate of nitrogen content in R-1 water. Please also refer to "A Guide for West Maui's Resorts and Condominium Properties" prepared by Coral Reef Alliance, which provides a comprehensive review and extensive resources on the use of recycled water. The CORAL document can be found at: http://www.coral.org/files/pdf/recycled_water_for_reefs_v1.pdf

Maui County Ordinance 2525 mandates use of reclaimed water for irrigation where R-1 Water is available. "Available reclaimed water service" is defined as "existence of a reclaimed water distribution main contiguous to or within one hundred feet of any consumer's property line." Where there is an available reclaimed water service, the existing irrigation systems are required to be switched to the reclaimed water system within one year of service availability. Cost of retrofitting the existing irrigation system will be credited by the County as discounted rate of the reclaimed water rates services. This discounted rate (one-half of the reclaimed rates) is to continue until the cost to retrofit has been recovered by the resort. Other charges to be applied for connecting to the R-1 water will include the initial installation charge and a connection fee based on peak daily usage. Application to the DOH Reclaimed Water Use approval is also required.

3.2 R-1 Water Permit Requirements

3.2.1 Department of Health (DOH):

The first step to be able to utilize a reclaimed water use in the State of Hawaii is to apply for Department of Health (DOH) approval. Approval is based on the "Guidelines for the Treatment and Use of Recycled Water", prepared by the Hawaii State DOH Wastewater Branch, dated May 15, 2002. The DOH permit requirements include the following items:

- Basis of Design Report
- Engineering Report
- Construction Plans
- Cross-Connection Approval
- Construction Inspection

Upon the approval of DOH, design and engineering reports may be waived for smaller reuse projects such as dust control or landscape and irrigation areas less than five acres.

3.2.2 County of Maui

County of Maui application requires a basis of design report, engineering report, connection fee, Maui County application form (RW-1), an overall map as well as plans and specifications to determine an expected reclaimed water load and meter size.

3.3 Irrigation System Requirements

The State of Hawaii Department of Health (DOH) "Guidelines for the Treatment and Use of Recycled Water" provides technical guidelines and requirements for designing and installing a reclaimed water irrigation system. The following is a summary of what is required to convert a potable water irrigation system to R-1 reclaimed water irrigation system:

3.3.1 Procedure for converting the existing system to reclaimed water system

The first step would be to evaluate if the existing system can be converted to reclaimed use or if it would need to be replaced with a new system. Locating and testing existing irrigation lines to see if those lines can be converted to reclaimed water use per the Maui County Department of Water Supply (DWS) Standards is required. If the actual locations cannot be verified, it is recommended to install new system as per the DOH and DWS standards.

In order to install a reclaimed water irrigation system, the following requirements are to be met:

- Basket Strainer at the meter
- Irrigation Controller (color coded with label indicating "Recycled Water")
- Irrigation pipes with an identification tape with white or black printing on a purple field (color index 77742 violet #16, Pantone 512 or equal), having the words "CAUTION: RECYCLED WATER - DO NOT DRINK."
- Hose bib not allowed
- Horizontal, and vertical clearances between potable water and other utilities
- Minimum easement or right-of way widths, and minimum cover and requirements for recycled water
- All above ground existing and new facilities to be color coded purple
- Reclaimed water signs
- Inspection & Monitoring

Based on recent a study for R-1 water irrigation system and soils, it is indicated that a salt and sodium content in the soils tends to become higher in dry months from May to September and lowers in rainy season. This seasonal trend indicates that the winter rains leach out salt and sodium from the soils. Before converting the existing system to reclaimed water, it is recommended to evaluate the existing plant materials to see how increased salt and sodium content would affect them.

Recycled water irrigation can be cost effective as it costs less than potable water and is exempt from sewer fees. In addition, since recycled water contains more nutrients than potable water, the need for fertilizer is expected to decrease.

Chapter 4: Guidelines for Reef Friendly Operation & Maintenance Checklist

In order to implement a successful Reef Friendly Landscape Management Plan, it is critical that all the resort communities work together. It is especially important that the hotel General Managers and management staff, i, take a lead to support and encourage landscape maintenance personnel to take an active role in implementing “reef friendly” practices in their daily operations.

The checklist below provides a set of Reef Friendly Landscape Operation and Maintenance techniques and strategies to aid participating resorts within the Kā’anapali Beach Resort community that re-validates their good practices and helps to identify areas for potential improvement.

Nutrient Management

- Fertilize ornamental planting beds with organic slow release fertilizer and/or foliar application (Liquid Hawaiian Horticultural Mix). Slow release fertilizer should be covered with mulch or worked into the soil to prevent it from being washed away.
- Do not apply synthetic fertilizers
- Avoid fertilizer application on lawn areas. (Use organic slow release fertilizer only when absolutely necessary)
- Remove plant debris (fallen leaves, branches, flowers, etc.) from grass, pavement, drain inlet, and along stream bank and shoreline.

Lawn Management

- Mow grass with electric or hand pushed mower.
- Use Mulching Mower to leave grass clippings in lawn areas.
- Mow grass taller (Seashore Paspalum 1 - 2” Tall)
- Leave Grass Clippings in lawn areas away from drain inlet and pavement.
- No herbicide used in lawn areas.
- Apply salts (instead of herbicides) to control weeds in lawn areas.
- Manually pull weeds once a week or as needed.

Soil Management

- Install 2" min. layer of mulch over all planter beds and under trees. Replenish at least biannually to maintain at least 2" cover.
- Keep mulch away from drain inlet, pavement, or any open water body.
- Topdress lawn areas and planter beds with composted soils and/or apply compost tea biannually

Green Infrastructure

- Install Raingarden(s) near a drain inlet and/or outdoor shower to capture the runoff before going into a storm drain or the open water body.
- Install Bioswale to filter runoff before going into storm drain or the open water body

Integrated Pest Management

- Monitor landscape for pests weekly.
- Identify desirable insects (Lacewings, Lady Beetles, Pteromalid Wasps, Ichneumonid Wasps, and Braconid Wasps).
- Apply soap and oil to control insects (aphids, mealybugs, psyllids and spider mites) only if beneficial insects are not present.
- Use foliar application insecticide as a last resort.
- Apply high pressure water jet to remove insects from plants (spider mites, aphids, small caterpillars, etc.).
- Avoid using pesticides.
- If use of chemical application is necessary, naturally occurring pesticides such as soaps and oils are to be used. (Use systemic pesticides only when absolutely needed.)
- Remove/Replace infested plants with new plants rather than trying to use chemical to control insects.
- Apply and maintain 2" layers of mulch in planter beds.

Landscape Maintenance Equipment

- Reduce or Eliminate use of gas-powered landscape maintenance equipments. Use electric and manual equipments as much as practicable.
- Clean equipments after each use.

General Landscape Improvements and Maintenance.

- Designate a compost recycling bin locations and start creating own composts.
- Create vegetated buffer along makai side of the property with native Hawaiian plants such as Naupaka and Pohinahina.
- Establish no chemical, no irrigation zone for the areas within 30' from the certified shoreline and 10' from stream banks and other open water bodies.
- Prepare irrigation as-built plan (showing all irrigation controllers, weather station, all valves per controller, types of sprinklers (pop-up spray, impact, rotor, or drip).
- Check irrigation coverage and correct overspray to paved areas or buildings biannually.
- Check irrigation systems for leaks weekly.
- Make plans for transition to R-1 Water Irrigation System

Reef Friendly Landscape Management Plan

The Westin Maui Resort and Spa

Chapter 1: Background

1.1 Why a Reef Friendly Landscape Management Plan?

The coral reef in West Maui is in decline. There are many stressors contributing to the reef's declining health, and as such, a multifaceted approach involving many partners is needed to increase the probability of recovery. This project is an attempt to address one possible source of reef stress; landscape pollution.

A typical resort landscape consists of expansive lawn areas, dramatic water features, shade trees, palms and exotic ornamental plants, all of which are maintained through conventional landscape maintenance practices. This includes the use of automatic irrigation systems, power tools and chemically based fertilizers and pesticides. Routine mowing, pruning, and blowing requires frequent irrigation and fertilization, which can cause nutrient leaching, water runoff, soil erosion, and lead to degradation of coral communities.

Additional coral community degradation can also occur through the addition of coastal pollutants such as chemical runoff, which includes oil and gas from power equipment and irrigation runoff from improper or over watering. One of the major pollutant sources from landscape operation is nutrients from lawn and planter areas. Two potential sources of nutrients entering near shore environments are fertilizer and plant debris. Although the precise impact of this fertilizer on the shoreline properties and contamination of the water is difficult to quantify, the artificially increased nutrient load due to leaching and runoff of fertilizer will increase the nutrients, thereby inadvertently impacting the health of the corals. Excessive and/or improper application of fertilizers, whether organic or synthetic, can be costly and contribute to negative impacts on the coral reef such as explosive growth of algae which can cause disruptive changes to the coral ecosystem and ultimately kill fish and the coral community.

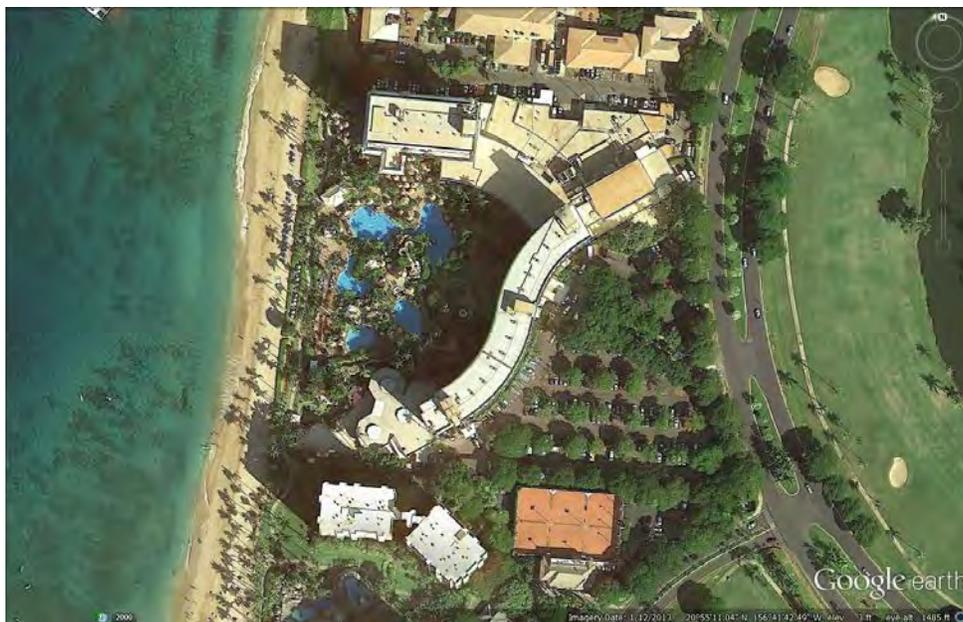
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The goal of Reef Friendly Landscape Management Plan is to show that healthy and beautiful landscapes can coexist with healthy and diverse coral community in Kā'anapali by integrating the following practices:

- Reduce chemical inputs to coastal waters
- Reduce waste
- Reduce water & energy consumption
- Reduce runoff/erosion (retain topsoil)
- Improve soil environment to reduce fertilizing
- Create sustainable/harmonious landscapes
- Protect wildlife habitats
- Increase native plants and diversity
- Use integrated pest management to minimize chemical use

1.2 Existing Landscape Context of the Westin Maui Resort and Spa

The 12 acre Westin Maui Resort and Spa is located on 2365 Kā'anapali Parkway in Kā'anapali Beach Resort (**Appendix A**).



(Google Aerial View of the Property)



(Major Water Feature + Pool located Makai of the Building)

The makai side of the property boasts large water features and swimming pools and, as with the other ocean front properties, the meandering Kā'anapali Beach Walk runs through the makai side of the property. The walkway is paved with concrete and lined with Coconut palms that are raised upon grass mounds. Both sides of the walkway are flanked by well maintained lawns areas while a narrow lawn strip along the mauka side of the walkway slopes up toward the property and is lined with Naupaka hedges create a visual screen. The makai side of walkway has small grass mounds that are bordered along the property line by hedges of red Hibiscus and Naupaka and the beach sand extend beyond the hedges toward the ocean.



(Good Example of Using Native Plants for Vegetative Buffer implemented at the Westin Maui Resort & Spa)

The walkway is located in lower elevations while the lawn and Naupaka Hedge function as a berm. Several drain inlets that are connected to drywells are placed along the walkway to help collect excess runoff to the walkway. A public beach shower has a drain inlet which daylights at the sand dune areas. Overflow water from the shower will surface flow to sand dunes as well.

The landscape on the Mauka side of the walkway is comprised of lawns, water features, flower beds filled with lush tropical plants such as Dwarf Date Palms, Ti, Lauae Fern, Heliconia, Philodendron, an assortment of palms, as well as many trees including Plumeria. The majority of the runoff collected on the property flows away from the ocean and drains into the drainage system at Kā'anapali Parkway.



(Meandering Walkway)



(Typical Landscape)

1.3 Current Landscape Practice

The Westin Maui Resort & Spa has fourteen (14) maintenance personnel. The existing irrigation system is operated by a central control system (WeatherTRAK and H2O system) with satellite based ET subscriptions and has two points of connection from the county potable water source. The point of connection and backflow prevention unit for the makai side irrigation system also supplies the water for the pools and a public shower.

The following is a summary of chemical use activities for landscape maintenance at the Westin Maui Resort and Spa (**Appendix B**):

- 1.3.1 Fertilizers:** HGP 14-14-14 controlled-release fertilizer is typically applied biannually to aid shrub health (4 ounces per shrub) while Osmokote 16-16-16 slow release fertilizer is used as needed for garden beds and No fertilizer is used on lawn areas.
- 1.3.2 Herbicide:** Sedgehammer is used twice a month to help eliminate weed species such as Hilo grass and crabgrass in the lawn areas and garden beds, and Fusilade is used once a month on groundcover, shrubs. In addition Salt is being used on the seashore paspalum grass to help control weeds.
- 1.3.3 Insecticide:** Azatrol (emulsifiable concentrate pesticide) is used twice a month on Hibiscus, Gardenia, and edible plants to help control mealy bug, white fly, scale, fungus and aphids, and DiPel is used only on potted Bougainvillea annually.
- 1.3.4 Pesticide:** Safari (Neonicotinoids pesticide) is used quarterly for Coconut palms, Plumeria, Gardenia, and large ornamentals to control insects such as caterpillars, white fly, mealy bug, and scale used for trees and shrubs biannually as a preventative measure. Coretech tablets are also used for the same purposes as alternate applications so the insects do not build up immunity.
- 1.3.5 Compost:** 2 yards of Maui EKO, sand/compost blend is applied annually to lawn areas and garden beds.

It should be particularly noted that the Westin Maui Resort and Spa already makes a significant step forward for “Reef Friendly” landscape by not using any fertilizers in lawn areas and providing compost for both lawn and planting bed areas.

1.4 Soil Analysis

According to USA National Cooperative Soil Survey, the makai half of the property is located on Jaucas Sand, the mauka half on Ewa Silty Clay Loam while Makai of the property line is beach sand. Jaucas soils are very deep, excessively drained and rapidly permeable soils that exist on vegetated beach areas along the sea coast. The soils profile is moderately alkaline with moderate salinity.

As part of RFLMP two (2) representative soil samples (W1 & W2) were obtained from within the property. The soil analysis provides information on soil pH, Macronutrients (Phosphorous, Potassium, Magnesium, and Calcium), Soil Salinity, Nitrogen, and Micronutrients (boron, copper, iron, manganese, and zinc) levels in the soils and provide recommendations for the correct quantities and types of nutrients that may need to be applied.



W1 was taken near the Naupaka hedge on a grass mound along the mauka side of the Beachwalk and W2 was taken from the lawn area on the makai side of the Beachwalk. Soil PH appears to be very high (alkaline) in both samples where Iron appears to be especially at the W2 location. W1 shows very high Sodium and low Sulfur.

Soil Sample Locations

Overall the soil analysis indicated very high pH and lack of nutrients in the area which is typical of dry coastal environments. Instead of adding chemicals to try to reduce soil pH or add various nutrients, it is recommended that the top “reef friendly” solution would be to use the plants that can tolerate high soil sodium content should be selected for this site. Incorporating mulch/compost in to the soil can also help to improve nutrients deficiency naturally.

The soils report indicated low sulfur content. Sulfur is an essential element in the life processes of all living things as it is an important part of the proteins that are needed to sustain life in all biological organisms including microorganisms and plants. Organic matter is a major source of sulfur in landscape and therefore regular application of organic amendments such as compost in the planting areas is recommended.

1.5 Current Landscape Equipment

Currently the Westin Maui Resort and Spa is not using any landscape equipments that are battery or electric power operated. Here is a list of the equipment:

<u>Quantity</u>	<u>Name</u>
1	10 blade McLane
1	8 blade McLane
2	Honda rotary Mower
2	Stihl Extendable Chainsaw
1	Stihl hedge trimmer
2	Shindaiwa Articulating Hedge Trimmer
1	Shindaiwa 2 stroke weedeater
2	Honda 4 stroke weedeater
1	Echo Chainsaw
2	Echo Backpack blower
1	Echo Hand held blower.

Chapter 2: Recommended Reef Friendly Landscape Management Plan Practices

2.1 Chemical Control and Nutrient Management

The most critical element of Reef Friendly Landscape Management is to reduce chemical inputs to the coral environments. The use of fertilizers and other landscape chemicals such as herbicides and pesticides should be kept minimal.

Here are proposed measures to reduce chemical inputs while preserving desirable appearance.

2.1.1 Plant Selection: Soil test results indicated high pH and alkaline soils found in the area, so it is recommended to use plants that thrive in such soils instead of trying to lower soil pH. Many of the Native Hawaiian plants that tolerate drought conditions, high pH and high soil salinity would do well in these locations.

2.1.2 Slow Release Fertilizer: Slow release organic fertilizers are preferred and should be covered with mulch or worked into the soil to prevent being washed away by rain or irrigation systems to walkways, drain inlets or the ocean.

As soil reports indicated high phosphorus, it is recommended low phosphorus fertilizer should be used in lawn areas. An organic base fertilizer such as Sustane 18-1-8 with 12 to 16 week release rates can be used as an alternative.

2.1.3 Foliar applied nutrients: Liquid Hawaiian Horticultural Mix is recommended by the soil analysis, which is a complete micronutrient complex that also contains magnesium and sulfur. When plant nutrients are applied to the foliage of the plant, smaller quantities of the fertilizer material are required than when applying to the soil. From RFLM standpoint, it is also desirable method to apply nutrients since leaching will be reduced when applied directly to the foliage of the plant. From resort operation and aesthetic improvement standpoint, foliar application has merit as it generally help plants absorb nutrients more rapidly than when applied to the soil and quickly correcting plant nutrient deficiencies. This is important to avoid excessive application and prevent foliar applied nutrients from washed away by rain or sprinkler system.

2.1.4 Organic Mulch: Wood cover mulch should be placed in all planter beds and replenished biannually at minimum. It should not however, be used or stored near a drain inlet, on pavement, or close to any open water body to ensure it does not get carried into ocean waters.

Benefits of organic mulch include:

- Improves soil structure once it has decomposed
- Reduces soil compaction
- Supports soil microbial life
- Suppresses weeds
- filters out pollutants
- Reduces water consumption, fertilizer, and pesticide
- Supports healthier plants

On top of having mulch, it is a good practice to leave plant debris on site as long as it is not unsightly.

2.1.5 Non-Chemical Zone: To further prevent additional chemicals from leaching into the water, any fertilizers (except foliar applied nutrients), herbicides, pesticides, or permanent spray irrigation system should not be used on sand dunes and lands within 30 feet of a certified shoreline, or within 10 feet of a stream bank.

2.2 Lawn Management

This property has a fair amount of lawn areas and being able to effectively maintain these lawn areas will be a key to RFLMP. Maintenance practices such as mowing and blowing tend to shift plant debris from landscaped areas to nearby water bodies which can add pollution and nutrients to the water. Additionally, this practice removes all plant debris from planting areas reducing soil nutrients and health as well as depriving beneficial insects and micro-organisms of food and habitats.

Lawn should also be limited to the areas that serve a specific purpose such as; seating, gathering, and play areas. The Westin Maui Resort and Spa has limited amount of grass areas as the majority of the outdoor environment is covered with the water features and pools and hardscape.

2.2.1 Grass Type: Preferred lawn grass in the area would be Seashore paspalum, and the use of rock salt would be preferred over chemicals to treat weeds in this lawn type.

2.2.2 Mowing: Grass should be cut between 1 to 1.5" inches to help retain the moisture in grass and reduce runoff. Use a mulching mower to leave the grass clippings on the turf areas to decompose and re-release their nutrients back into the soil. Leaving the clippings on the lawn after mowing saves time, money and reduces greenhouse gases that result from hauling them to the landfill.

2.2.3 Fertilizer: If a fertilizer application is required, slow release fertilizer or foliar applications are recommended and organic slow release nitrogen and phosphorus-free lawn fertilizers such as Sustane 18-1-8+Fe or something similar should be used. As an alternative to fertilizer, periodically (at least twice a year) topdressing lawn areas with finely screened compost (max. 1/4 inches) can help to improve the health of the soil and grass.

2.2.4 Herbicide: To prevent leaching, no Herbicides are to be used in lawn areas within 30' from the shoreline or open water body.

2.2.5 Border: Lawn grass should be kept away from areas that have surface water runoff to reduce the runoff of fertilizer and grass clippings. The existing Naupaka hedge that separates the grass from the sand beach should be maintained, but if there is not adequate room for Naupaka hedge, smaller plants such as Pohinahina could be used. Where feasible, it is recommended to convert lawn grass areas to sand dunes or native Hawaiian planting beds to reduce water consumption and chemical requirements. Reestablishing Hawaiian and Polynesian plants in the landscape will invite more native wildlife which will make the outdoor space “living & sustainable” and help to create a Hawaiian sense of place. Ensuring the proper selection of plant material will reduce maintenance, use of equipment, chemical outputs, pollution, and water consumption.

2.3 Soil Management

In order to reduce chemical input and maintain plant health, it is critical to start with good soil. Reducing pesticide usage helps to build healthy soil environments as many pesticides are toxic to microbes and other soil dwelling creatures such as earthworms, and can reduce the diversity of soil life.

2.3.1 Existing Soils: It is not practical or environmentally sounds to replace existing soil or to artificially supplement the soil with synthetic fertilizers. Feeding soils with compost and/or compost tea can help to create a healthy soil food web, which makes nutrients available to the plants, resists pests and diseases and protects water quality. Also, keeping plant debris (plant trimmings and grass clippings) in planter beds can provide a cost effective soil management to nurture soil organisms and recycle organic matter while reducing waste and runoff.

Maintain a minimum of 2 inches of mulch in all planter beds.

Incorporating compost into the existing soil will not only improve sulfur deficiency but also the soil structure, drainage ability and iron deficiency. As well as amending the soil with compost, wood cover mulch should be placed in all planter beds and replenished as needed, as wood mulch cover can help to preserve soil moisture, support soil microbial life, suppress weeds, and filter out pollutants.

2.3.2 New Grounds: If recreating or restoring lawn or garden areas, tilling at least a 4-inch layer of compost into the top 6–8 inches of soil is recommended to improve the structure of that soil layer. The additions of wood mulch, volcanic cinders, crushed coral, or sand (calcium carbonate) should also be installed in all planter beds to improve soil porosity and drainage.

2.4 Green Infrastructure

Green infrastructure, including swales and rain gardens, helps to divert excess water run-off from roofs and impervious surfaces. These sustainable landscape elements capture the "First Flush", which is the first inch of rainfall after a dry spell, which has been proven to carry the most pollutants to our waterways and ocean.

They also help to reduce fresh water runoff from a landscape, protect the ocean and other nearby waterways, and help to replenish groundwater aquifers.

The existing drain inlets are typically located in lawn areas adjacent to walkways. It is recommended to convert grass area around a drain inlet to a wetland garden planted with native Hawaiian plants. Native gardens mimic the natural system and function as green infrastructure. This enhanced planting along the beach walk will not only add aesthetics but also provide an educational opportunity for visitors to learn about the sustainable approach that the hotel is taking to protect the nearby coral environments.



(Potential Areas for Raingardens)

2.5 Integrated Pest Management

The use of pesticide should be avoided or used as a last resort as it not only causes environmental pollution but also kills beneficial microbes that naturally occur in healthy soils. Integrated Pest Management (IPM) is a sustainable approach to managing pests such as insects, plant diseases, and weeds by eliminating or reducing the use of potentially harmful pesticides. IPM is an environmentally friendly program that combines biological, cultural, physical and chemical tools to help manage pests to an acceptable level, but not necessarily fully eliminate them.

IPM is based upon three strategic steps:

2.5.1 Prevention: Key is to establish a healthy environment in which plants have the strength to resist disease and insect infestations and to out-compete weeds. The least toxic pesticides are used only when it is required. Referring to previous sections of this Reef Friendly Management document, nutrient management, lawn management and soil management are all critical elements of IPM. Aside from the measures indicated in the previous Sections, the following actions should also be taken:

- Choose the right plant material for each environment to help create more resistant plant material
- Choose plant material that also attracts beneficial insects.
- Plant at right depth and adequate spacing.
- Remove noxious weeds before seeding.
- Clean equipment after each use.

2.5.2 Monitoring: Each landscape is living and complex and specific levels of different species of organisms are necessary for keeping it healthy. Regular monitoring of the site including: condition of the plant material, population increase/decrease of pests, and population increase/decrease of beneficial organisms is critical in understanding the landscape and what the primarily root of problem is. Elements such as: pests, incorrect plant selection, poor soil drainage or nutrient deficiency can all play a large part in a pest infestation.

2.5.3 Control: The purpose of control in IPM is to keep pests at acceptable levels thereby reducing the need for pesticides and in return pollutants are kept out of watershed. After routine monitoring, if it is determined that pests are causing an unacceptable level of damage, the following control measures can be taken before the use of pesticide is considered.

- **Cultural and Physical Control:** Some pests are associated with certain plants. Infested parts or plants need to be removed by hand as soon as possible. Replace infected plants with appropriate native plants and create diversity in landscape and avoid a monoculture system. Apply water to spray off pests like aphids. Apply 2-inch layer of coarse mulch between and under shrubs and groundcovers to improve soil structure and control weeds.
- **Cultural and Physical Control:** Creating a monoculture through planting only a few plants species in a small area can cause an influx of pests and disease. Adding different and more pest resistant species will break up this monoculture and minimize infestations.
- **Biological Control:** In natural environments many organisms in the landscape are considered to be beneficial as they feed on pests and therefore minimize the need for pesticide. Beneficial insects include hover flies, lacewings, lady beetles, predatory mites, bees and certain wasps. . Small scale biological control can be implemented by creating a favorable environment for predators/parasites with a variety of plant materials, introducing beneficial microbes, and using less harmful pesticides which may kill beneficial insects. **Appendix D** provides a list of preferred insects prepared by the College of

Tropical Agriculture and Human resources (CTAHR), University of Hawaii, Manoa. Healthy soils contain billions of beneficial organisms and using compost tea introduces large and diverse populations of microbes that can help to suppress some leaf and root diseases.

The Westin Maui Resort & Spa currently controls insects such as mealy bug, white fly, scale, aphids, and caterpillars, by implementing plants that attract natural enemies of those pests including: Lacewings, Lady Beetles, Hover flies, Predatory mites, and Parasitic wasps as well as some birds and spiders, into the landscape, the need for chemical pesticides would be diminished.

Images of Natural Predators:



Lacewings



Lady Beetles



Predatory Mites



Pteromalid Wasps



Ichneumonid Wasps



Braconid Wasps

- Chemical Control: If infestations of pests or disease cannot be brought to an acceptable level through the use of cultural or biological control, IPM allows for chemical control as a last resort. If chemical application is necessary, only naturally occurring pesticides such as soaps and oils are to be used for control purposes only and not preventative purposes. All directions must be followed explicitly and pesticides must be kept out of gutters, storm drains, and off sidewalks, driveways and other hard surfaces. Disposal of leftover product should abide to EPA and state regulations.

<http://www.epa.gov/pesticides/regulating/disposal.htm>

2.6 Landscape Maintenance Equipment

Gas operated lawn mowers, chain saws and blowers create noise pollution and emit significant amounts of environmental pollutants. Currently the Westin Maui Resort and Spa is not using any landscape equipment that is battery or electric power operated. RFLMP recommends using electric landscape equipment as it will help to reduce noise level and the resort's carbon footprint. Also, advantages of electric mowers would be reduced operating cost by saving on gas and reduced maintenance by eliminating needs for oil changes, new spark plugs and replacing air filters. STHL product line provides a wide range of battery operated and fuel efficient equipments.

2.7 Cost Consideration

The main objective of Reef Friendly Landscape Management Plan is to reduce chemical inputs to our landscape. Reduced chemical usage will save material costs, equipment, and labor. Also, it will reduce health risks and liability for operating personnel and visitors/residents while protecting the environment.

2.7.1 Fertilizer Use: Reducing fertilizer application will prevent excessive and unusually fast plant growth that weakens the plant and in turn increases maintenance and generates excess plant debris. Reducing fertilizer usage will reduce waste disposal and require less maintenance which will lead to lower costs. One way to reduce fertilizer usage is to leave grass clippings on the grass areas after mowing, which will help to provide nutrients and water back to the soil. The addition of organic mulch in garden beds will also reduce the need for fertilizer application by supplying the nutrients necessary for healthy plant growth and improve the soil condition.

2.7.2 Pesticide Use: Minimizing pesticides not only reduces water pollution but also helps support soil life, which cycles nutrients and promotes resistance to plant disease. In the long run minimizing pesticide saves landscape maintenance cost by creating a healthy environment for plants.

2.7.3 Organic Mulch: Organic materials, including compost and chipped landscape debris, supply the soil and plants with nutrients over time, which reduces the need for fertilizer. Further savings can be achieved by on-site composting which helps to keep valuable nutrients and organic matter in the garden and reduces pollution associated with transporting waste as well as disposal costs.

Organic mulch and compost tea provide a possibility for multiple savings via; water conservation, enhanced plant health/growth, reduced weed growth, disease suppression, reduced need for trimming and maintenance around plants and an aesthetically pleasing landscape appearance. By adding these natural products into a landscape maintenance program, it will help to reduce the landscape maintenance that is required.

2.7.4 Landscape Equipment: Landscape equipment is typically chosen for efficiency and ease of use. However, reducing fossil fuel consumption is one of the most important cost savings for landscape maintenance and for protecting the environment. Where possible, hand powered or electric equipments should be used.

At first manual labor may reduce efficiency; however, it can cut the costs while protecting the health of your staff, enhancing visitor experience, and improving local air and water quality. Lower operating costs from manual and electric equipment can often recover higher initial purchase costs of new equipment, and more importantly, the contribution to a healthier environment and enhanced visitor experience will benefit the resort and increase pride of the landscape maintenance staff.

Chapter 3: R-1 Water Irrigation System Transition

3.1 R-1 Water Background

From Reef Friendly Landscape Management Stand, the use of reclaimed water is preferred for landscape irrigation. The purpose of this chapter is to encourage the transition to R-1 Water Irrigation System. Kaanapali Operations Association, Inc. (KOA) currently uses R-1 water from the golf course and has reduced the use of chemical fertilizers on grass areas due to high rate of nitrogen content in R-1 water. Please also refer to “A Guide for West Maui’s Resorts and Condominium Properties” prepared by Coral Reef Alliance, which provides a comprehensive review and extensive resources on the use of recycled water. The CORAL document can be found at: http://www.coral.org/files/pdf/recycled_water_for_reefs_v1.pdf

Maui County Ordinance 2525 mandates use of reclaimed water for irrigation where R-1 water is available. "Available reclaimed water service" is defined as "existence of a reclaimed water distribution main contiguous to or within one hundred feet of any consumer's property line." Where there is an available reclaimed water service, the existing irrigation systems are required to be switched to the reclaimed water system within one year of service availability. Cost of retrofitting the existing irrigation system will be credited by the County at a discounted rate of the reclaimed water rates services. This discounted rate (one-half (1/2) of the reclaimed rates) is to continue until the cost to retrofit has been recovered by the resort. Other charges to be applied for connecting to the R-1 water will include the initial installation charge and a connection fee based on peak daily usage

Currently there is no available reclaimed water system near the property; however, Kaanapali Parkway is included in the County of Maui’s potential distribution line location. The existing irrigation main lines supply water for the pools and a public shower. If the system is required to be converted to R-1 water, separation of the pools and a shower from the existing irrigation system would be necessary, which would require new potable water lines to those pools and a shower to be developed. It needs to be verified with the County whether or not the cost for bringing new water sources for the pools and the public shower be included in “cost of retrofitting the existing irrigation system.”

3.2 R-1 Water Permit Requirements

3.2.1 Department of Health (DOH):

The first step to be able to utilize a reclaimed water use in the State of Hawaii is to apply for Department of Health (DOH) approval. Approval is based on the “Guidelines for the Treatment and Use of Recycled Water”, prepared by the Hawaii State DOH Wastewater Branch, dated May 15, 2002. The DOH permit requirements include the following items:

- Basis of Design Report
- Engineering Report
- Construction Plans
- Cross-Connection Approval
- Construction Inspection

Upon the approval of DOH, design and engineering reports may be waived for smaller reuse projects such as dust control or landscape and irrigation areas less than five acres.

3.2.2 County of Maui

County of Maui application requires a basis of design report, engineering report, connection fee, Maui County application form (RW-1), an overall map as well as plans and specifications to determine an expected reclaimed water load and meter size.

3.3 Irrigation System Requirements

The State of Hawaii Department of Health (DOH) “Guidelines for the Treatment and Use of Recycled Water” provides technical guidelines and requirements for designing and installing a reclaimed water irrigation system. The following is a summary of what is required to convert a potable water irrigation system to R-1 reclaimed water irrigation system:

3.3.1 Procedure for converting the existing system to reclaimed water system

The first step would be to evaluate if the existing system can be converted to reclaimed use or if it would need to be replaced with a new system. Locating and testing existing irrigation lines to see if those lines can be converted to reclaimed water use per the Maui County Department of Water Supply (DWS) Standards is required. If the actual locations cannot be verified, it is recommended to install new system as per the DOH and DWS standards.

In order to install a reclaimed water irrigation system, the following requirements are to be met:

- Basket Strainer at the meter
- Irrigation Controller (color coded with label indicating “Recycled Water”
- Irrigation pipes with an identification tape with white or black printing on a purple field (color index 77742 violet #16, Pantone 512 or equal), having the words "CAUTION: RECYCLED WATER - DO NOT DRINK."
- Hose bib not allowed
- Horizontal, and vertical clearances between potable water and other utilities

- Minimum easement or right-of way widths, and minimum cover and requirements for recycled water
- All above ground existing and new facilities to be color coded purple
- Reclaimed water signs
- Inspection & Monitoring

Based on recent a study for R-1 water irrigation system and soils, it is indicated that a salt and sodium content in the soils tends to become higher in dry months from May to September and lowers in rainy season. This seasonal trend indicates that the winter rains leach out salt and sodium from the soils. Before converting the existing system to reclaimed water, it is recommended to evaluate the existing plant materials to see how increased salt and sodium content would affect them.

Recycled water irrigation can be cost effective as it costs less than potable water and is exempt from sewer fees. In addition, since recycled water contains more nutrients than potable water, the need for fertilizer is expected to decrease.

Chapter 4: Guidelines for Reef Friendly Operation & Maintenance Checklist

In order to implement a successful Reef Friendly Landscape Management Plan, it is critical that all the resort communities work together. It is especially important that the hotel General Managers and management staff, i, take a lead to support and encourage landscape maintenance personnel to take an active role in implementing “reef friendly” practices in their daily operations.

The checklist below provides a set of Reef Friendly Landscape Operation and Maintenance techniques and strategies to aid participating resorts within the Kā’anapali Beach Resort community that re-validates their good practices and helps to identify areas for potential improvement.

Nutrient Management

- Fertilize ornamental planting beds with organic slow release fertilizer and/or foliar application (Liquid Hawaiian Horticultural Mix). Fertilizer should be covered with mulch or worked into the soil to prevent it from being washed away.
- Do not apply synthetic fertilizers
- Avoid fertilizer application on lawn areas. (Use organic slow release fertilizer only when absolutely needed.)
- Remove plant debris (fallen leaves, branches, flowers, etc.) from grass, pavement, drain inlet, and along stream bank and shoreline.

Lawn Management

- Mow grass with electric or hand pushed mower.
- Use Mulching Mower to leave grass clippings in lawn areas.
- Mow grass Taller (Seashore Paspalum 1 - 2” Tall)
- Leave Grass Clippings in lawn areas away from drain inlet and pavement.
- No herbicide used in lawn areas.
- Apply salts (instead of herbicides) to control weeds in lawn areas.
- Manually pull weeds once a week or as needed.

Soil Management

- Install 2" min. layer of wood mulch over all planter beds and under trees. Replenish at least biannually to maintain at least 2" cover.
- Keep wood mulch away from drain inlet, pavement, or any open water body.
- Topdress lawn areas and planter beds with composted soils and/or apply compost tea biannually

Green Infrastructure

- Install Raingarden(s) near a drain inlet and/or outdoor shower to capture the runoff before going into a storm drain or the open water body.
- Install Bioswale to filter runoff before going into storm drain or the open water body

Integrated Pest Management

- Monitor landscape for pests weekly.
- Identify desirable insects (Lacewings, Lady Beetles, Pteromalid Wasps, Ichneumonid Wasps, and Braconid Wasps).
- Apply soap and oil to control insects (aphids, mealybugs, psyllids and spider mites) if beneficial insects are not present.
- Use foliar application insecticide.
- Apply high pressure water jet to remove insects from plants (spider mites, aphids, small caterpillars, etc.).
- Avoid using pesticides.
- If use of chemical application is necessary, naturally occurring pesticides such as soaps and oils are to be used. (Use systemic pesticides only when absolutely needed.)
- Remove/Replace infested plants with new plants rather than trying to use chemical to control insects.
- Apply and maintain 2" layers of mulch in planter beds.

Landscape Maintenance Equipment

- Reduce or Eliminate use of gas-powered landscape maintenance equipments. Use electric and manual equipments as much as practicable.
- Clean equipments after each use.

General Landscape Improvements and Maintenance.

- Designate a compost recycling bin locations and start creating own composts.
- Create vegetated buffer along makai side of the property with native Hawaiian plants such as Naupaka and Pohinahina.
- Establish no chemical, no irrigation zone for the areas within 30' from the certified shoreline and 10' from stream banks and other open water bodies.
- Prepare irrigation as-built plan (showing all irrigation controllers, weather station, all valves per controller, types of sprinklers (pop-up spray, impact, rotor, or drip).
- Check irrigation coverage and correct overspray to paved areas or buildings biannually.
- Check irrigation systems for leaks weekly.
- Make plans for transition to R-1 Water Irrigation System

Reef Friendly Landscape Management Plan

Whalers Village

Chapter 1: Background

1.1 Why a Reef Friendly Landscape Management Plan?

The reefs in West Maui are in decline. There are many stressors contributing to the declining health, and as such, a multifaceted approach involving many partners is needed to increase the probability of recovery. This project is an attempt to address one possible source of reef stress; run off from landscaping.

A typical resort landscape consists of expansive lawn areas, dramatic water features, shade trees, palms and exotic ornamental plants, all of which are maintained through conventional landscape maintenance practices. This includes the use of automatic irrigation systems, power tools and chemically based fertilizers and pesticides. Routine mowing, pruning, and blowing requires frequent irrigation and fertilization, which can cause nutrient leaching, water runoff, soil erosion, and lead to degradation of coral communities.

Additional coral community degradation can also occur through the addition of coastal pollutants such as chemical runoff, which includes oil and gas from power equipment and irrigation runoff from improper or over watering. One of the major pollutant sources from landscape operation is nutrients from lawn and planter areas. Two potential sources of nutrients entering near shore environments are fertilizer and plant debris. Although the precise impact of this fertilizer on the shoreline properties and contamination of the water is difficult to quantify, the artificially increased nutrient load due to leaching and runoff of fertilizer will increase the nutrients, thereby inadvertently impacting the health of the corals. Excessive and/or improper application of fertilizers, whether organic or synthetic, can be costly and contribute to negative impacts on the coral reef such as explosive growth of algae which can cause disruptive changes to the coral ecosystem and ultimately kill fish and the coral community.

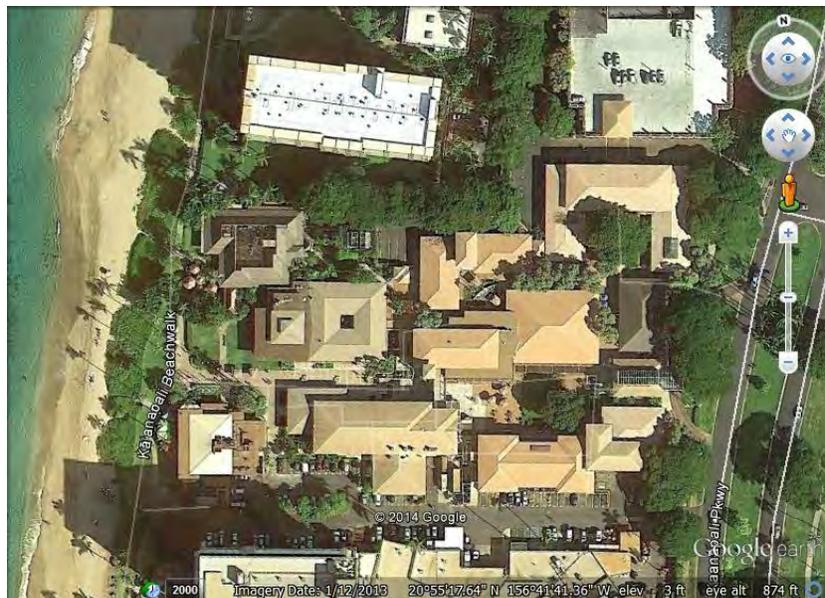
The health of the coral reef not only affects Hawai'i's natural resources but also the experience of tourists visiting Kā'anapali's world class beaches and resorts which in turn can effect Hawai'i's tourism industry. The West Maui Ridge to Reef Initiative (www.westmauir2r.com) was launched in 2012 to help to address some of the causes of land based pollution that are currently stressing our marine systems. As one of several partners in the initiative, the State Department of Land and Natural Resources (DLNR) Division of Aquatic Resources (DAR) has funded a project to work with the Kā'anapali Operators Association (KOA) to develop landscape management plans for participating resorts that reflect the best practices to meet the needs of an aesthetically pleasing landscape while minimizing maintenance as well as the use of pesticides, fertilizers, and irrigation water.

The goal of Reef Friendly Landscape Management Plan is to show that healthy and beautiful landscapes can coexist with healthy and diverse coral community in Kā'anapali by integrating the following practices:

- Reduce chemical inputs to coastal waters
- Reduce waste
- Reduce water & energy consumption
- Reduce runoff/erosion (retain topsoil)
- Improve soil environment to reduce fertilizing
- Create sustainable/harmonious landscapes
- Protect wildlife habitats
- Increase native plants and diversity
- Use integrated pest management to minimize chemical use

1.2 Existing Landscape Context of the Whalers Village

The 8.3 acre Whalers Village is located on 2435 Kaanapali Parkway in Kā'anapali Beach Resort (**Appendix A**). It contains 90 stores, common areas, and a parking structure. As with the other ocean front properties a meandering walkway (Kaanapali Beach Walk) runs through the makai side of the property which is paved with concrete and decorative tile. Any excess water that collects on the walkway is redirected to nearby Naupaka planting areas. Drain inlets along walkway and drains from two (2) beach showers collect runoff and redirect it to the nearby Naupaka planting areas adjacent to the sand dunes.



(Google Aerial View of the Property)



(Good Example of Using Native Plants as a Vegetative Buffer Implemented at Whalers Village)



(Makai of Beachwalk)



(Mauka of Beachwalk)

Both sides of the walkway have well maintained lawns and tropical landscape. The makai side of the walkway is mostly lawn with several Coconut Palms and a few large canopy trees. A Naupaka hedge borders the makai edge of the lawn areas. The Naupaka hedge extends toward the ocean and has been cut back four (4') feet from the certified shoreline by the Department of Land and Natural Resources (DLNR) to allow for more beach front. Beach Morning Glory grows naturally along makai side of Naupaka.

The landscape on the mauka side of the walkway is comprised of lawns and lush tropical plants that create accent points and screening. Plant material includes Bougainvillea, Ti, Croton, Ginger, Lauae Fern, Rhoeo, a variety of palms, and many trees including Plumeria.



(Typical Common Area Landscape)

1.3 Current Landscape Practice

Whalers Village has twenty two (22) maintenance personnel that care for all common areas. For the common area, the existing irrigation system is connected to a potable water source, while additional irrigation systems around some stores and restaurants have a separate point of connection.

It should be noted that the Whalers Village already makes a significant step forward for “Reef Friendly” landscape by limiting fertilizer usage in garden beds and limiting the use of insecticide by using soap water mix to treat minor pest problems. If shrub/ground cover areas are unsightly or unhealthy, Whalers Village will replace these plants rather than trying to treat them with chemicals.

The following is a summary of the chemicals that the landscape maintenance personnel at Whalers Village have in stock (**Appendix B**):

- 1.3.1 Fertilizers:** Biannually, 20-20-20 No Trace Soluble fertilizer is typically applied to the lawn and Osmokote Classic is used for the garden beds. Technigro Water Soluble Fertilizers is used as needed for flowering plants. Other fertilizer products that have previously been used on the property include: Best/Simplot Palm, Landscape 15-4-12 and YaraMila 21-7-14.

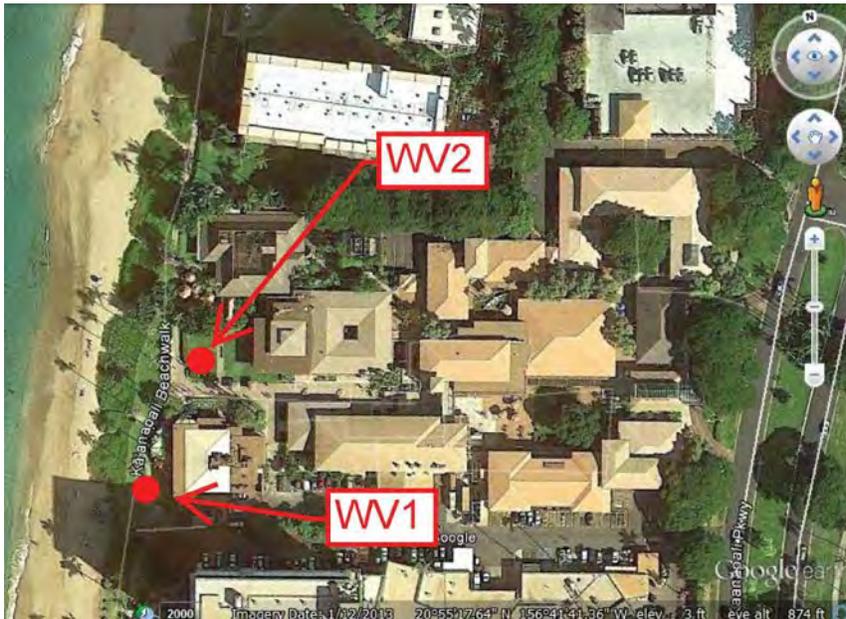
1.3.2 Herbicide: Ronstar G is used to eliminate weed species in garden beds and Diamond Crystal Solar Salt is used as needed to control crab grass in the lawn areas.

1.3.3 Insecticide: Deadline M-PS is used as needed. Deadline M-PS is mini-pallets bates for slugs and snails. Volck Oil is typically used to control white flies as needed.

1.4 Soil Analysis

According to USA National Cooperative Soil Survey, the makai half of the property is on Jaucas Sand, and the mauka half on Ewa Silty Clay Loam. Jaucas soils are found on vegetated beach areas along the sea coast, they are excessively draining, rapidly permeable, are moderately alkaline and have moderate salinity throughout the profile.

As part of RFLMP two (2) representative soil samples (WV1 & WV2) were obtained from within the property. The soil analysis provides information on soil pH, Macronutrients (Phosphorous, Potassium, Magnesium, and Calcium), Soil Salinity, Nitrogen, and Micronutrients (boron, copper, iron, manganese, and zinc) levels in the soils and provide recommendations for the correct quantities and types of nutrients that may need to be applied.



Soil Sample Locations

WV1 was obtained from a Bougainvillea hedge located on the makai edge of the lawn area that fronts Maui Fish & Pasta and WV2 was obtained from a lawn area on the southern border of the property in front of Leilani's restaurant. Soil pH is very high (alkaline) and Sulfur appears to be low in both samples. Sodium levels are very high in WV 2.

Overall the soil analysis indicates a very high pH and lack of nutrients in the area which is typical to dry coastal environments. Instead of trying to add chemicals to try to reduce soil pH or add various nutrients, it is recommended that a "reef friendly" solution be implemented by utilizing plants that that can tolerate high sodium levels and to incorporate mulch/compost into the soil to help improve nutrients deficiency naturally.

The soils report indicated low sulfur content. Sulfur is an essential element in the life processes of all living things as it is an important part of the proteins that are needed to sustain life in all biological organisms including microorganisms and plants. Organic matter is a major source of sulfur in landscape and therefore regular application of organic amendments such as compost in the planting areas is recommended.

1.5 Current Landscape Equipment

Currently Whalers Village is not using any landscape equipments that are battery or electric power operated.

Chapter 2: Recommended Reef Friendly Landscape Management Plan Practices

2.1 Chemical Control and Nutrient Management

The most critical element of Reef Friendly Landscape Management is to reduce chemical inputs to the coral environments. The use of fertilizers and other landscape chemicals such as herbicides and pesticides should be kept minimal.

Here are proposed measures to reduce chemical inputs while preserving desirable appearance.

2.1.1 Plant Selection: Soil test results indicated high PH and alkaline soils found in the area, so it is recommended to use plants that thrive in such soils instead of trying to lower soil pH. Many of the Native Hawaiian plants that tolerate drought conditions, high pH and high soil salinity would do well in these locations.

2.1.2 Slow Release Fertilizer: Slow release, oorganic fertilizers are preferred and should be covered with mulch or worked into the soil to prevent being washed away by rain or irrigation systems to walkways, drain inlets or the ocean.

It is recommended a low phosphorus fertilizer be used on lawn areas. An organic base fertilizer such as Sustane 18-1-8 with 12 to 16 week release rates can be used.

2.1.3 Foliar applied nutrients: Liquid Hawaiian Horticultural Mix is recommended as it is a complete micronutrient which includes both magnesium and sulfur. When plant nutrients are applied to the foliage of the plant, smaller quantities of the fertilizer is required than when applying to the soil. From RFLM standpoint, it is also a desirable method to apply nutrients since leaching will also be reduced when applied directly to the foliage of the plant. From a resort operations and aesthetic improvement standpoint, foliar application has merit as it generally helps plants absorb nutrients more rapidly than when applied to the soil and quickly correcting plant nutrient deficiencies, which in turn improves their appearance. It is important to avoid excessive application to prevent foliar applied nutrients from washed away by rain or irrigation systems.

2.1.4 Organic Mulch: Cover mulch should be placed in all planter beds and replenished biannually at minimum. It should not however, be used or stored near a drain inlet, on pavement, or close to any open water body to ensure it does not get carried into ocean waters.

Benefits of organic mulch include:

- Improves soil structure once it has decomposed
- Reduces soil compaction
- Supports soil microbial life
- Suppresses weeds
- filters out pollutants
- Reduces water consumption, fertilizer, and pesticide
- Supports healthier plants

On top of having mulch, it is a good practice to leave plant debris on site as long as it is not unsightly.

2.1.5 Non-Chemical Zone: To further prevent additional chemicals from leaching into the water, any fertilizers (except foliar applied nutrients), herbicides, pesticides, or permanent spray irrigation system should not be used on sand dunes and lands within 30 feet of a certified shoreline, or within 10 feet of a stream bank.

2.2 Lawn Management

This property has a vast amount of lawn areas and being able to effectively maintain these lawn areas will be a key to RFLMP. Maintenance practices such as mowing and blowing tend to shift plant debris from landscaped areas to nearby water bodies which can add pollution and nutrients to the water. Additionally, this practice removes all plant debris from planting areas reducing soil nutrients and health as well as depriving beneficial insects and micro-organisms of food and habitats.

Lawn should also be limited to the areas that serve a specific purpose such as; seating, gathering, and play areas.

2.2.1 Grass Type: Preferred lawn grass in the area would be Seashore paspalum. The use of rock salt would be preferred over chemicals to treat weeds.

2.2.2 Mowing: Grass should be cut between 2 to 3” inches to keep moisture in grass longer and reduce runoff. Use a mulching mower to leave the grass clippings on the turf areas to decompose and release their nutrients into the soil. Leaving the clippings on the lawn after mowing saves time, money and reduces greenhouse gases that result from hauling them to the landfill.

2.2.3 Fertilizer: If a fertilizer application is required, slow release fertilizer or foliar applications are recommended and organic slow release nitrogen and phosphorus-free lawn fertilizers such as Sustane 18-1-8+Fe or something similar should be used. As an alternative to fertilizer, periodically (at least twice a year) topdressing lawn areas with finely screened compost (max. 1/4 inches) can help to improve the health of the soil and grass.

2.2.4 Herbicide: To prevent leaching, no Herbicides are to be used in lawn areas within 30' from the shoreline or open water body.

2.2.5 Border: Lawn grass should be kept away from areas that have surface water runoff to reduce the runoff of fertilizer and grass clippings. The existing Naupaka hedge that separates the grass from the sand beach should be maintained, but if there is not adequate room for Naupaka hedge, smaller plants such as Pohinahina could be used. Where feasible, it is recommended to convert lawn grass areas to sand dunes or native Hawaiian planting beds to reduce water consumption and chemical requirements. Reestablishing Hawaiian and Polynesian plants in the landscape will invite more native wildlife which will make the outdoor space "living & sustainable" and help to create a Hawaiian sense of place. Ensuring the proper selection of plant material will reduce maintenance, use of equipment, chemical outputs, pollution, and water consumption.

2.3 Soil Management

In order to reduce chemical input and maintain plant health, it is critical to start with good soil. Reducing pesticide usage helps to build healthy soil environments as many pesticides are toxic to microbes and other soil dwelling creatures such as earthworms, and can reduce the diversity of soil life.

2.3.1 Existing Soils: It is not practical, financially or environmentally sound to replace existing soil or to artificially supplement the soil with synthetic fertilizers. Feeding soils with natural compost and/or compost tea can help to create a healthy soil food web, which aids nutrient availability for the plants, resists pests and diseases and protects water quality. Also, keeping plant debris such as; plant trimmings and grass clippings, in planter beds can provide a cost effective way to manage to nurture soil organisms and recycle organic matter while reducing waste and runoff.

Maintain a minimum of 2 inches of woodchip mulch in all planter beds.

Incorporating compost into the existing soil will not only improve the soils sulfur and iron deficiencies but also the soil structure and drainage ability. As well as amending the soil with compost, a cover mulch should be placed in all planter beds and replenished as needed, as mulch cover can help to preserve soil moisture, support soil microbial life, suppress weeds, filter out pollutants as well as create a way to cover plant debris in an aesthetically pleasing manner.

2.3.2 New Grounds: If recreating or restoring lawn or garden areas, tilling to a minimum of 4-inches of compost into the top 6–8 inches of soil is recommended to help improve the structure of the soil. The addition of materials such as mulch, volcanic cinders, crushed coral, or sand (calcium carbonate) should also be incorporated in all garden beds to help improve soil porosity and drainage.

2.4 Green Infrastructure

Green infrastructure, including swales and rain gardens, helps to divert excess water run-off from roofs and impervious surfaces. These sustainable landscape elements capture the "First Flush", which is the first inch of rainfall after a dry spell, which has been proven to carry the most pollutants to our waterways and ocean.

They also help to reduce fresh water runoff from a landscape, protect the ocean and other nearby waterways, and help to replenish groundwater aquifers.

The existing drain inlets on this site are typically located in lawn areas adjacent to the walkways. It is recommended to convert the grass area that surrounds the drain inlets to a wetland garden planted with native Hawaiian plants. These native gardens will mimic the natural environment and function as green infrastructure to help manage water runoff. This enhanced planting along the beach walk will not only add aesthetics but also provide an educational opportunity for visitors to learn about the sustainable approach that the hotel is taking to protect the nearby coral environments.



(Potential Areas for Raingardens)

2.5 Integrated Pest Management

The use of pesticide should be avoided or used as a last resort as it not only causes environmental pollution but also kills beneficial microbes that naturally occur in healthy soils. Integrated Pest Management (IPM) is a sustainable approach to managing pests such as insects, plant diseases, and weeds by eliminating or reducing the use of potentially harmful pesticides. IPM is an environmentally friendly program that combines biological, cultural, physical and chemical tools to help manage pests to an acceptable level, but not necessarily fully eliminate them.

IPM is based upon three strategic steps:

2.5.1 Prevention: Key is to establish a healthy environment in which plants have the strength to resist disease and insect infestations and to out-compete weeds. The least toxic pesticides are used only when it is required. Referring to previous sections of this Reef Friendly Management document, nutrient management, lawn management and soil management are all critical elements of IPM. Aside from the measures indicated in the previous Sections, the following actions should also be taken:

- Choose the right plant material for each environment to help create more resistant plant material
- Choose plant material that also attracts beneficial insects.
- Plant at right depth and adequate spacing.
- Remove noxious weeds before seeding.
- Clean equipment after each use.

2.5.2 Monitoring: Each landscape is living and complex and specific levels of different species of organisms are necessary for keeping it healthy. Regular monitoring of the site including: condition of the plant material, population increase/decrease of pests, and population increase/decrease of beneficial organisms is critical in understanding the landscape and what the primarily root of problem is. Elements such as: pests, incorrect plant selection, poor soil drainage or nutrient deficiency can all play a large part in a pest infestation.

2.5.3 Control: The purpose of control in IPM is to keep pests at acceptable levels thereby reducing the need for pesticides and in return pollutants are kept out of watershed. After routine monitoring, if it is determined that pests are causing an unacceptable level of damage, the following control measures can be taken before the use of pesticide is considered.

- **Cultural and Physical Control:** Some pests are associated with certain plants. Infested parts or plants need to be removed by hand as soon as possible. Replace infected plants with appropriate native plants and create diversity in landscape and avoid a monoculture system. Apply water to spray off pests like aphids. Apply 2-inch layer of coarse mulch between and under shrubs and groundcovers to improve soil structure and control weeds.
- **Cultural and Physical Control:** Creating a monoculture through planting only a few plants species in a small area can cause an influx of pests and disease. Adding different and more pest resistant species will break up this monoculture and minimize infestations.
- **Biological Control:** In natural environments many organisms in the landscape are considered to be beneficial as they feed on pests and therefore minimize the need for pesticide. Beneficial insects include hover flies, lacewings, lady beetles, predatory mites, bees and certain wasps. . Small scale biological control can be implemented by creating a favorable environment for predators/parasites with a variety of plant materials, introducing beneficial microbes, and using less harmful pesticides which may kill beneficial insects. **Appendix D** provides a list of preferred insects prepared by the College of

Tropical Agriculture and Human resources (CTAHR), University of Hawaii, Manoa. Healthy soils contain billions of beneficial organisms and using compost tea introduces large and diverse populations of microbes that can help to suppress some leaf and root diseases.

Whalers Village typically controls insects such as mealy bug, white fly, scale, aphids, and caterpillars, by implementing plants that attract natural enemies of those pests. By attracting Lacewings, Lady Beetles, Hover Flies, Predatory Mites, and Parasitic Wasps as well as some birds and spiders, into the landscape, the need for chemical pesticides would be diminished.

Images of Natural Predators:



Lacewings



Lady Beetles



Predatory Mites



Pteromalid Wasps



Ichneumonid Wasps



Braconid Wasps

- Chemical Control: If infestations of pests or disease cannot be brought to an acceptable level through the use of cultural or biological control, IPM allows for chemical control as a last resort. If chemical application is necessary, only naturally occurring pesticides such as soaps and oils are to be used for control purposes only and not preventative purposes. All directions must be followed explicitly and pesticides must be kept out of gutters, storm drains, and off sidewalks, driveways and other hard surfaces. Disposal of leftover product should abide to EPA and state regulations.

<http://www.epa.gov/pesticides/regulating/disposal.htm>

2.6 Landscape Maintenance Equipment

Gas operated lawn mowers, chain saws and blowers create noise pollution and emit significant amounts of environmental pollutants. Currently Whalers Village is not using any landscape equipment that is battery or electric power operated. RFLMP recommends using electric landscape equipment as it will help to reduce noise level and the resort's carbon footprint. Also, advantages of electric mowers would be reduced operating cost by saving on gas and reduced maintenance by eliminating needs for oil changes, new spark plugs and replacing air filters. STHL product line provides a wide range of battery operated and fuel efficient equipments.

2.7 Cost Consideration

The main objective of Reef Friendly Landscape Management Plan is to reduce chemical inputs to our landscape. Reduced chemical usage will help minimize costs related to materials, equipment, and labor. It will also reduce health risks and liability for operating personnel as well as visitors/residents while helping to protect the environment.

2.7.1 Fertilizer Use: Reducing fertilizer application will prevent excessive and unusually fast plant growth that weakens the plants, increase maintenance, and generates plant debris. It will likely to reduce waste disposal. Reduced fertilizer use and less maintenance lead to lower costs. One way to reduce fertilizer use will be to leave grass clippings in the grass areas, which will provide nutrients. Organic mulch will also reduce needs for fertilizer application by supplying nutrients and improving soil health.

2.7.2 Pesticide Use: Minimizing pesticides not only reduces water pollution but also helps support soil life, which cycles nutrients and promotes resistance to plant disease. In the long run minimizing pesticide saves landscape maintenance cost by creating a healthy environment for plants. Also, landscape maintenance staff will not be applying dangerous pesticides, which reduce a liability to the staff as well as visitors/residents.

2.7.3 Organic Mulch: Organic materials, including compost and chipped landscape debris, supply nutrients over time, which also reduces need for fertilizing. Further savings can be achieved by on-site composting. Composting on-site keeps valuable nutrients and organic matter to the soil and reduces pollution associated with transporting waste as well as disposal costs.

Organic mulch provides a possibility for multiple savings via water conservation, enhanced plant health/growth, reduced weed growth, reduced need for trimming and maintenance around plants, and clean manicured landscape appearance. Compost tea introduces large and diverse populations of microbes that can suppress some leaf and root diseases. By adding organic mulch and compost tea in the landscape, it will turn into low maintenance landscape.

2.7.4 Landscape Equipment: Landscape equipment is typically chosen for efficiency and ease of use. However, reducing fossil fuel consumption is one of the most important cost savings for landscape maintenance and for protecting the environment. Where possible, hand powered or electric equipments should be used.

At first, manual labor may reduce efficiency; however, long term, it can cut costs while protecting the health of your staff, enhancing visitor experience, and improving local air and water quality. Lower operating costs from manual and electric equipment can often recover higher initial purchase costs of new equipment, and more importantly, the contribution to a healthier environment and enhanced visitor experience will benefit the resort and increase pride of the landscape maintenance staff.

Chapter 3: R-1 Water Irrigation System Transition

3.1 R-1 Water Background

From Reef Friendly Landscape Management Stand, the use of reclaimed water is preferred for landscape irrigation. The purpose of this chapter is to encourage the transition to R-1 Water Irrigation System. Kaanapali Operations Association, Inc. (KOA) currently uses R-1 water from the golf course and has reduced the use of chemical fertilizers on grass areas due to high rate of nitrogen content in R-1 water. Please also refer to “A Guide for West Maui’s Resorts and Condominium Properties” prepared by Coral Reef Alliance, which provides a comprehensive review and extensive resources on the use of recycled water. The CORAL document can be found at: http://www.coral.org/files/pdf/recycled_water_for_reefs_v1.pdf

Maui County Ordinance 2525 mandates use of reclaimed water for irrigation where R-1 water is available. "Available reclaimed water service" is defined as “existence of a reclaimed water distribution main contiguous to or within one hundred feet of any consumer's property line.” Where there is an available reclaimed water service, the existing irrigation systems are required to be switched to the reclaimed water system within one year of service availability. Cost of retrofitting the existing irrigation system will be credited by the County at a discounted rate of the reclaimed water rates services. This discounted rate (one-half (1/2) of the reclaimed rates) is to continue until the cost to retrofit has been recovered by the resort. Other charges to be applied for connecting to the R-1 water will include the initial installation charge and a connection fee based on peak daily usage.

Currently there is no available reclaimed water system near the property; however, Kaanapali Parkway is included in the County of Maui’s potential distribution line location. To prepare for transition, the locations and conditions of the existing irrigation system and nearby utility lines would need to be verified or surveyed so that decisions can be made whether it is feasible to convert the existing system to the R-1 water irrigation system.

3.2 R-1 Water Permit Requirements

3.2.1 Department of Health (DOH):

The first step to be able to utilize a reclaimed water use in the State of Hawaii is to apply for Department of Health (DOH) approval. Approval is based on the “Guidelines for the Treatment and Use of Recycled Water”, prepared by the Hawaii State DOH Wastewater Branch, dated May 15, 2002. The DOH permit requirements include the following items:

- Basis of Design Report
- Engineering Report
- Construction Plans
- Cross-Connection Approval
- Construction Inspection

Upon the approval of DOH, design and engineering reports may be waived for smaller reuse projects such as dust control or landscape and irrigation areas less than five acres.

3.2.2 County of Maui

County of Maui application requires a basis of design report, engineering report, connection fee, Maui County application form (RW-1), an overall map as well as plans and specifications to determine an expected reclaimed water load and meter size.

3.3 Irrigation System Requirements

The State of Hawaii Department of Health “Guidelines for the Treatment and Use of Recycled Water” provides technical guidelines and requirements for designing and installing a reclaimed water irrigation system. The following is a summary of what is required to convert a potable water irrigation system to R-1 reclaimed water irrigation system:

The State of Hawaii Department of Health (DOH) “Guidelines for the Treatment and Use of Recycled Water” provides technical guidelines and requirements for designing and installing a reclaimed water irrigation system. The following is a summary of what is required to convert a potable water irrigation system to R-1 reclaimed water irrigation system:

3.3.1 Procedure for converting the existing system to reclaimed water system

The first step would be to evaluate if the existing system can be converted to reclaimed use or if it would need to be replaced with a new system. Locating and testing existing irrigation lines to see if those lines can be converted to reclaimed water use per the Maui County Department of Water Supply (DWS) Standards is required. If the actual locations cannot be verified, it is recommended to install new system as per the DOH and DWS standards.

In order to install a reclaimed water irrigation system, the following requirements are to be met:

- Basket Strainer at the meter
- Irrigation Controller (color coded with label indicating “Recycled Water”)
- Irrigation pipes with an identification tape with white or black printing on a purple field (color index 77742 violet #16, Pantone 512 or equal), having the words "CAUTION: RECYCLED WATER - DO NOT DRINK."
- Hose bib not allowed
- Horizontal, and vertical clearances between potable water and other utilities
- Minimum easement or right-of way widths, and minimum cover and requirements for recycled water
- All above ground existing and new facilities to be color coded purple
- Reclaimed water signs
- Inspection & Monitoring

Based on recent a study for R-1 water irrigation system and soils, it is indicated that a salt and sodium content in the soils tends to become higher in dry months from May to September and lowers in rainy season. This seasonal trend indicates that the winter rains leach out salt and sodium from the soils. Before converting the existing system to reclaimed water, it is recommended to evaluate the existing plant materials to see how increased salt and sodium content would affect them.

Recycled water irrigation can be cost effective as it costs less than potable water and is exempt from sewer fees. In addition, since recycled water contains more nutrients than potable water, the need for fertilizer is expected to decrease.

Chapter 4: Guidelines for Reef Friendly Operation & Maintenance Checklist

In order to implement a successful Reef Friendly Landscape Management Plan, it is critical that all resort communities work together. It is especially important that the hotel management staffs, including General Managers, take a lead and support/encourage landscape maintenance personnel to implement “reef friendly” practices in their daily operation. Then each landscape maintenance personnel will take an active role in the field to establish a “Reef Friendly” landscape.

This checklist below provides a set of Reef Friendly Landscape Operation and Maintenance techniques and strategies to help participating resorts within the Kā’anapali Beach Resort community re-validating their good practices and identifying areas for potential improvements.

Nutrient Management

- Fertilize ornamental planting beds with organic slow release fertilizer and/or foliar application (Liquid Hawaiian Horticultural Mix). Fertilizer should be covered with mulch or worked into the soil to prevent it from being washed away.
- Do not apply synthetic fertilizers
- Avoid fertilizer application on lawn areas. (Use organic slow release fertilizer only when absolutely needed.)
- Remove plant debris (fallen leaves, branches, flowers, etc.) from grass, pavement, drain inlet, and along stream bank and shoreline.

Lawn Management

- Mow grass with electric or hand pushed mower.
- Use Mulching Mower to leave grass clippings in lawn areas.
- Mow grass taller (Seashore Paspalum 1 - 2” Tall)
- Leave grass clippings in lawn areas away from drain inlet and pavement.
- No herbicide used in lawn areas.
- Apply salts (instead of herbicides) to control weeds in lawn areas.
- Manually pull weeds once a week or as needed.

Soil Management

- Install 2" min. layer of wood mulch over all planter beds and under trees. Replenish at least biannually to maintain at least 2" cover.
- Keep wood mulch away from drain inlet, pavement, or any open water body.
- Topdress lawn areas and planter beds with composted soils and/or apply compost tea biannually

Green Infrastructure

- Install Raingarden(s) near a drain inlet and/or outdoor shower to capture the runoff before going into a storm drain or the open water body.
- Install Bioswale to filter runoff before going into storm drain or the open water body

Integrated Pest Management

- Monitor landscape for pests weekly.
- Identify desirable insects (Lacewings, Lady Beetles, Pteromalid Wasps, Ichneumonid Wasps, and Braconid Wasps).
- Apply soap and oil to control insects (aphids, mealybugs, psyllids and spider mites) if beneficial insects are not present.
- Use foliar application insecticide as a last resort.
- Apply high pressure water jet to remove insects from plants (spider mites, aphids, small caterpillars, etc.)
- Avoid using pesticides.
- If use of chemical application is necessary, naturally occurring pesticides such as soaps and oils are to be used. (Use systemic pesticides only when absolutely needed.)
- Remove/Replace infested plants with new plants rather than trying to use chemical to control insects.
- Apply and maintain 2" layers of wood mulch in planter beds.

Landscape Maintenance Equipment

- Reduce or Eliminate use of gas-powered landscape maintenance equipments. Use electric and manual equipments as much as practicable.
- Clean equipments after each use.

General Landscape Improvements and Maintenance.

- Designate a compost recycling bin locations and start creating own composts.
- Create vegetated buffer along makai side of the property with native Hawaiian plants such as Naupaka and Pohinahina.
- Establish no chemical, no irrigation zone for the areas within 30' from the certified shoreline and 10' from stream banks and other open water bodies.
- Prepare irrigation as-built plan (showing all irrigation controllers, weather station, all valves per controller, types of sprinklers (pop-up spray, impact, rotor, or drip).
- Check irrigation coverage and correct overspray to paved areas or buildings biannually.
- Check irrigation systems for leaks weekly.
- Make plans for transition to R-1 Water Irrigation System