APPENDIX C: DRAFT WATERSHED MANAGEMENT PLAN

Wailuku Watershed Management Plan

2026

Prepared by:
The State of Hawai`i
Department of Land and Natural Resources
Division of Forestry and Wildlife
1151 Punchbowl Street
Honolulu, Hawai'i 96813

AND

[Name and Address of Water Lessee]

Pursuant to:
§171-58(e) Hawai'i Revised Statutes

Watershed(s): Wailuku, Hawai'i Island

Water Lease No. _____

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Part 1. Purpose

Hawaii's watershed forests directly contribute to fresh water supply and must be properly managed in order to protect current and future fresh water resources.[1] As part of the water lease requirements, pursuant to section 171-58(e) of Hawaii Revised Statutes (HRS), water lessees must jointly develop and implement a watershed management plan with the Department in order to prevent the degradation of surface water and ground water quantity and quality within the water lease area.

Through this lens, [Name of Water Lessee], in partnership with the Department of Land and Natural Resources (Department) has developed this plan to satisfy the requirements of HRS section 171-58(e). This plan is specific to the watershed(s) associated with the lease (the sources that feed the lease area) and management is based on current needs and estimated costs associated with implementation. Management actions are informed by the following existing watershed management plans, which are referenced herein and attached as appendices.

- Mauna Kea Watershed Alliance (MKWA), Mauna Kea Watershed Management Plan (2010)
- Department of Hawaiian Home Lands (DHHL), `Āina Mauna Legacy Program (2009)
- Division of Forestry and Wildlife (DOFAW), Hilo Forest Reserve Management Plan (Draft)

[Paragraph to explain who the water lessee is and why they need the water]

Under Water Lease No. _____(Water Lease), [Name of Water Lessee] proposes to use ___ million gallons of water per day (MGD).

This plan is considered a living document and will be updated every five (5) years during the term of the Water Lease. Management actions and management costs are subject to change as discussed below in Part 4. Budget – Wailuku Watershed.

Successful implementation of the plan will increase water supplies in the Wailuku River that contribute to hydropower as well as continuous flow that sustains stream life and the cultural importance of the river. While climate change will be the main factor affecting stream flow, land cover in the watershed also dramatically influences water quantity as well as the stability of flow. Numerous studies have documented the effects of vegetation, particularly multi-storied ecosystems, which lead to water infiltration into aquifers rather than run-off into streams –

[1] https://dlnr.hawaii.gov/rain/files/2014/02/The-Rain-Follows-the-Forest.pdf

increasing stable baseflow levels while reducing harmful flash flooding events.[2] In Hawai‘i, native forests are characterized by these multi-storied vegetation structures with canopy, mid-level plants, and ground cover. Invasive vegetation in Hawai‘i rarely exhibits these characteristics as they tend to have a mono-type overstory that shades out all ground cover. The multi-story native ecosystem is also more conducive to absorbing large quantities of cloud moisture into the aquifer.[3] Finally, common invasives in Hawai‘i such as strawberry guava have been shown to evapotranspire more than native ‘ōhi‘a trees, further emphasizing the need to protect and restore the native forests that have evolved over millennia on the flanks of Mauna Kea.

The goals of this plan are consistent with Chapter 195D, Hawaii Revised Statutes, which seeks to protect indigenous plants and wildlife.

Part 2. Watershed Inventory

Mauna Kea, Hawai‘i Island’s tallest mountain, provides the primary source of water for the Wailuku watershed area. Primary water inputs to Mauna Kea’s ground and surface water resources are rainfall, snow, and fog drip. The wet forests of Mauna Kea are vital to the capture of rainfall that fills the aquifer and streams. The Wailuku River is the second longest perennial river in the state of Hawai‘i (total stream length is 196 miles) and the largest source of surface water to Hilo Bay. An average of 275 million gallons of water flows through the Wailuku to Hilo every day. During intense storms, the discharge can be more than 20 times greater.

Multiple watershed plans have described in detail the natural resources of the Wailuku watershed, linked at the end of this document. In summary, the Wailuku River is habitat for three native species of fish, and 35 species of invertebrates, primarily insects. The Wailuku watershed contains approximately 80,000 acres of native forest, home to multiple endangered plant, insect, and forest bird species. This plan aims at preventing further degradation of the existing native forest, as well as outplanting to restore degraded areas.

[2] Berio Fortini, L., Leopold, C.R., Perkins, K.S. Chadwick, O., Yelenik, S., Jacobi, J., Bishaw, K., Gregg, M., Rosa, S., 2021. Landscape level effects of invasive plants and animals on water infiltration through Hawaiian tropical forests. *Biol Invasions*. https://doi.org/10.1007/s10530-021-02494-8

[3] Takahashi, M., Giambelluca, T. W., Mudd, R. G., DeLay, J. K., Nullet, M. A. and Asner, G. P. 2011. Rainfall partitioning and cloud water interception in native forest and invaded forest in Hawai'i Volcanoes National Park. Hydrological Processes, 25: 448–464. doi: 10.1002/hyp.7797.

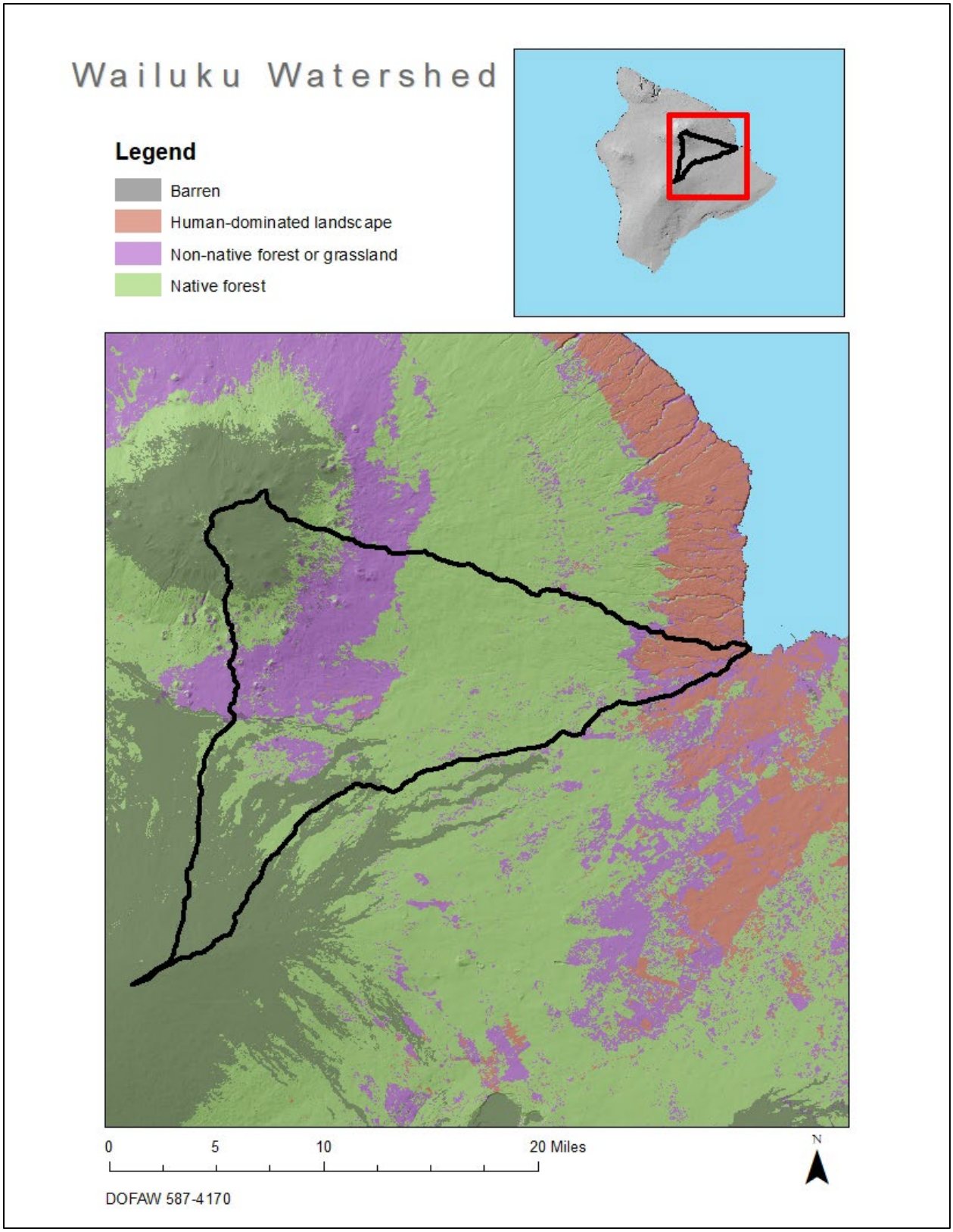


Figure 1 Habitat quality in the Wailuku Watershed

This plan seeks to maintain and stabilize stream flow by protecting native vegetation within the watershed. The main threats to the native vegetation in the Wailuku watershed are invasive plants such as gorse and strawberry guava and ungulates such as feral pigs, sheep, goats and cattle. These feral animals wound trees through rubbing, digging, tusking, and trampling, creating sites for the infection of rapid ʻōhiʻa death (ROD). Within the 142,000-acre watershed, approximately 19,000 acres is fenced from feral sheep and goats as part of the palila critical habitat fence. However, this area is largely barren and receives little moisture. An additional 3,000 acres is protected from feral animals within the Hakalau Forest National Wildlife Refuge and the Waimau (a.k.a.: Waipahoehoe) fence unit. DOFAW and DHHL have been attempting to remove feral cattle from the forest and are constructing cattle-proof fences and offering public hunts. However, there are still significant wild populations of these destructive animals.

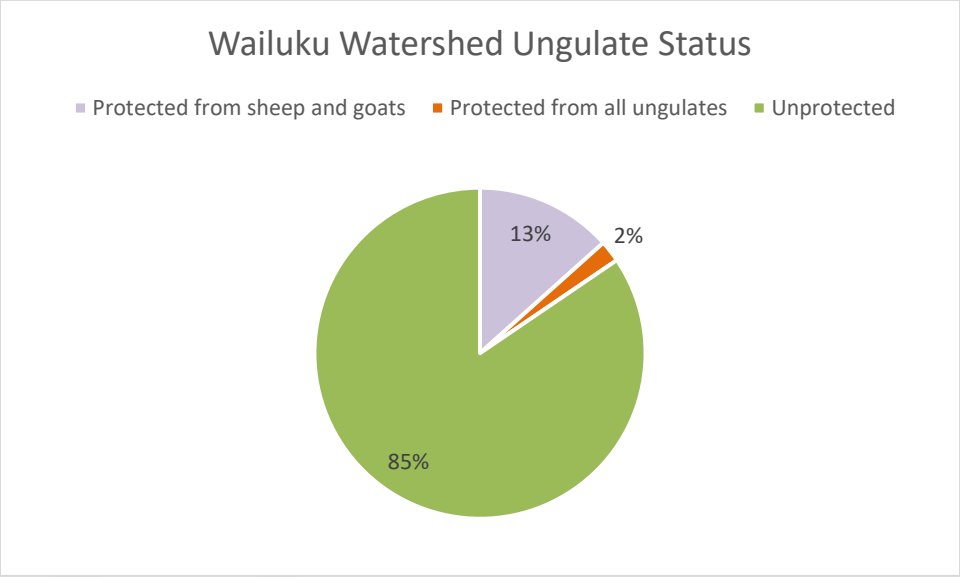


Figure 2 Ungulate status across 142,000-acre watershed

Invasive vegetation constitutes approximately 25,000 acres of the Wailuku watershed. This largely constitutes grasslands invaded by gorse in the upland elevation, and strawberry guava-dominated vegetation in the lowlands near human-dominated landscapes.

Part 3. Goals, Objectives, Management Actions, Methods, and Monitoring

In Hawai'i, it is understood that "The Rain Follows the Forest". Forests act like a sponge, collecting rain and moisture, slowly delivering fresh water into streams and aquifers. Without forests, there is no water. In order to increase water security, the upland native forest and vegetation must be kept healthy and robust. In practice, maintenance of the upper elevations where habitat is more intact is far more cost effective than trying to restore native biodiversity in areas where the native forest has been totally removed. In general, the goal of watershed protection is to identify priority outcomes essential to maintain or restore watershed integrity to the maximum function and yield. The goals and actions are focused on:

a. Directing intensive effort to contain and reduce target invasive species (i.e. gorse) at upper elevation areas while they are incipient, keeping their numbers as low as practicable.
b. Directing management effort at degraded areas where native canopy still exists as needed to maintain and increase native biodiversity and watershed function, prevent further degradation, and/or target selected species that pose special threats.

Goal 1. Removal and control of non-native hooved animals (pigs, goats, deer, sheep, cattle) from important watershed forests.			
Action	**Metric**	**Timeline**	**Lead**
1a. Construct new Nukupahu watershed fence	1,000 acres	2023	DOFAW
1b. Construct new cattle fences (Pi'ihonua)	3175 acres	2021	DHHL
1c. Remove feral cattle from Hilo Forest Reserve and fenced areas.	Zero detections in aerial and ground monitoring	2025	DOFAW/DHHL/MKWA
1d. Maintain existing and new fence units and remove ungulates (Waimau, Hakalau, Mauna Kea, and cattle fences)	Approx. 36 miles	Yearly	DOFAW/DHHL/MKWA

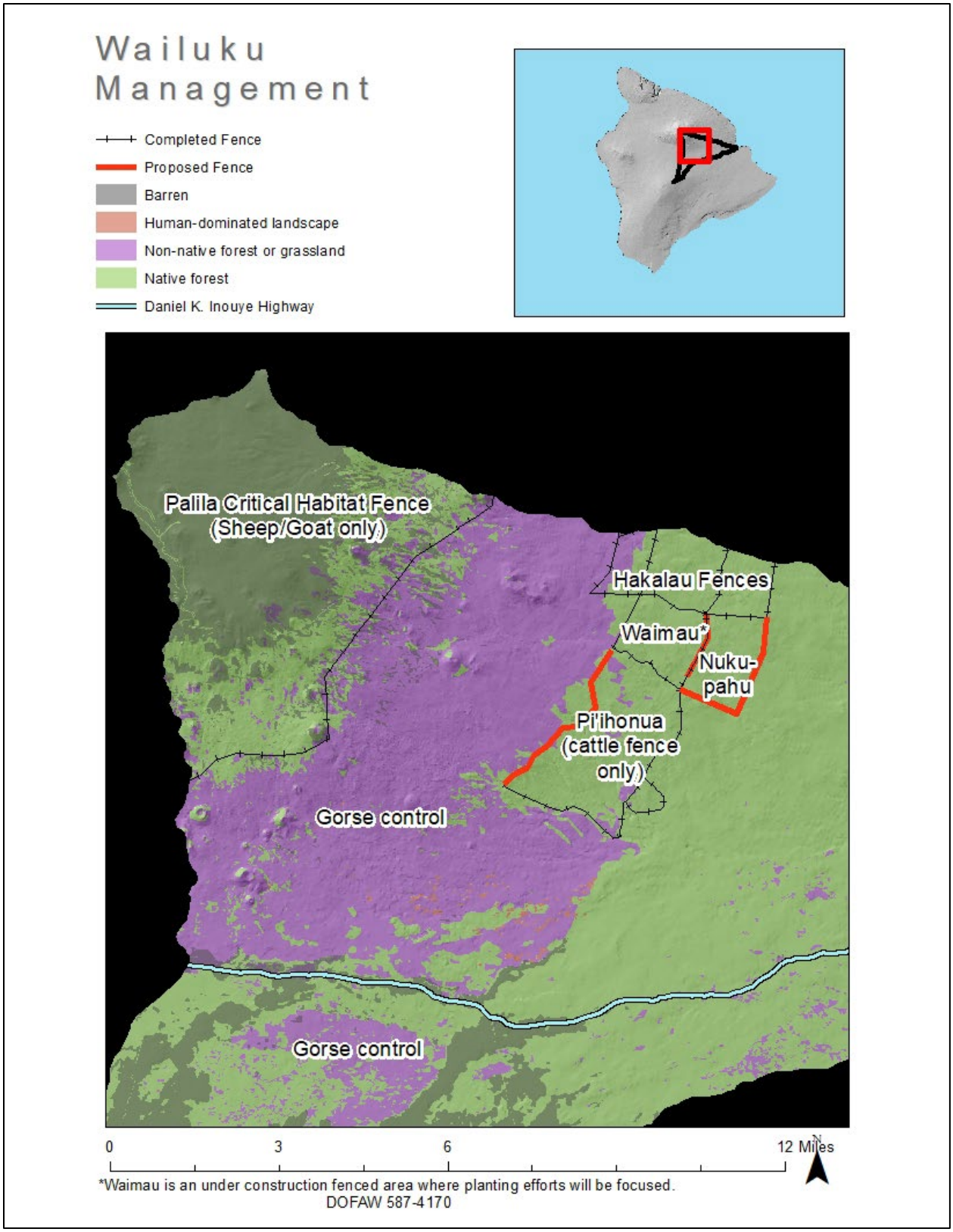
Goal 2: Removal or containment of damaging invasive plants that threaten important watershed forests.			
Action	**Metric**	**Timeline**	**Lead**
2a. Contain gorse population through ground and aerial methods	100 acres	Yearly	DHHL/MKWA

Goal 3: Monitoring and controlling other forest threats including fires, predators, and plant diseases.			
Action	**Metric**	**Timeline**	**Lead**
3a. Aerial mapping and ground mapping of vegetation condition	30,000 acres surveyed	Every 5 years	DOFAW
3b. ROD mapping and monitoring	As needed	Yearly	DOFAW
3c. Installation of two water tanks for fire suppression	2 water tanks installed	2022	MKWA
3d. Maintenance of existing roads for wildfire breaks and access	3 miles/year	Yearly	DOFAW/MKWA

Goal 4: Restoring and out-planting native species in important watershed areas and buffer zones as needed.			
Action	**Metric**	**Timeline**	**Lead**
4a. Passive restoration through ungulate and weed suppression	See goals 1 & 2		
4b. Seed collection and propagation and outplanting (7,000 seedlings)	24 acres planted	Yearly	MKWA

Goal 5: Communication, outreach and community education to build capacity for citizen-based watershed protection.			
Action	**Metric**	**Timeline**	**Roles**
5a. Arrange for [Name of Water Lessee] employees to participate in MKWA activities, such as re-planting damaged forest areas, invasive plant removal, and educational field trips.	As needed	Yearly	DOFAW/MKWA/[Name of Water Lessee]

Partners will employ adaptive management strategies based on results from aerial and ground monitoring transects to determine the status of ungulate and weed population and distribution, seedling survivorship, and other indicators such as canopy cover of native forest compared to baseline and ROD detections.


Wailuku Management
Completed Fence
Proposed Fence
Barren
Human-dominated landscape
Non-native forest or grassland
Native forest
Daniel K. Inouye Highway
Palila Critical Habitat Fence (Sheep/Goat only)
Hakalau Fences
Waimau*
Nuku-pahu
Pi'ihonua (cattle fence only)
Gorse control
Gorse control
0
3
6
12 Miles
N
*Waimau is an under construction fenced area where planting efforts will be focused.
DOFAW 587-4170

Part 4. Budget – Wailuku Watershed

Item	Cost/Year
Mauka Boundary Fence Replacement (10 miles)	$ 50,000.00
ROD & invasive species monitoring	$ 25,000.00
Proposed Nukupahu 1,000 Ac unit*	$ 100,000.00
Nukupahu maintenance and ungulate removal	$ 50,000.00
Cattle control	$ 50,000.00
Half of field team (3 FTE, 2 interns)	$ 110,000.00
Per diem weekly camping	$ 15,000.00
Bulldozing, fuelbreaks, road maintenance ~3 miles annually	$ 24,000.00
Helicopter time gorse control w/boom 100 acres/year	$ 5,000.00
Helicopter time gorse control w/nozzle	$ 10,000.00
Seed collection	$ 2,000.00
Site prep for outplanting 24 acres/year	$ 10,000.00
Procure 7,000 seedlings	$ 21,000.00
Water catchment (2 tanks)*	$ 5,000.00
Vehicles (repairs, fuel)	$ 42,000.00
UTV/ATV (repairs, fuel)	$ 28,000.00
Administration (0.5 FTE)	$ 22,500.00
Equipment misc.	$ 24,000.00
Supplies misc.	$ 24,000.00
ANNUAL MANAGEMENT COSTS	$ 617,500.00

*One-time capital improvement costs amortized over a 10-year period.

Proposed Watershed Management Cost-Share Contribution:

Sources of funding for these activities include State funding from the Division of Forestry and Wildlife, Department of Hawaiian Homes Lands, federal grants from U.S. Fish and Wildlife Service, U.S. Forest Service, and the Natural Resources Conservation Service.

Current management funding is inadequate for the budgeted action items. Approximately $235,000 per year of operating funding is allocated to the Mauna Kea Watershed Alliance from the Division of Forestry and Wildlife, which works across the entire mountain. Similarly, $700,000 of operational funding is provided to the DOFAW Hawaii island Forestry program. However, the Hilo Watershed Forest Reserve is approximately a tenth of the entire acreage of the forest reserve system on Hawaii island. Recent capital improvement project funding has been provided for cattle fence construction and the Waimau and Nukupahu fence unit. In addition to the

funding proposed to be contributed by lessee, additional grants will be needed to supplement the yearly costs of managing this watershed.

As referenced above in Part 1. Purpose, this plan will be updated every five (5) years during the term of the Water Lease. Following the initial 5-year period under the Water Lease (i.e., 2022-2027), the cost share amount to be paid by [Name of Water Lessee] shall be adjusted by the five (5) year cumulative Consumer Price Index (CPI) for the Metropolitan Statistical Area of Honolulu, Hawaii. Thereafter, the cost share amount shall be adjusted at the end of every fifth year by the cumulative CPI for the previous five (5) year period until the expiration or earlier termination of the Water Lease. Staff believes that this is a fair result for both the Department and the licensee, as the CPI adjustment would be an objective measure that allows the licensee to anticipate future costs. Furthermore, it would provide DOFAW with a stable income stream to support ongoing management activities in the event of a budget reduction.

Watershed Management Cost-Share Formula =
Usage (MGD) divided by available (MGD) multiplied by $ Annual Management Cost

[Name of Water Lessee] usage: _56__ MGD
Median Wailuku flow: 250 MGD
Percentage of median stream flow used by [Name of Water Lessee]: 22.4___%
Annual management costs: $617,500
Proposed [Name of Water Lessee] contribution to management costs per year: $_138,320___

Proposed Discount to Watershed Management Cost-Share Contribution:

Discounts are proposed for uses that are non-consumptive and reduce carbon emissions which is a key strategy for climate change mitigation and forest health. The forests represented in the annual management cost ($617,500) occupy approximately 80,211.2 acres in the Wailuku hydrologic unit, resulting in a watershed management cost of $7.698 per acre. According to the Environmental Protection Agency (EPA) generalized greenhouse gas emissions data[4], each acre of forest sequesters the equivalent of 0.84 metric tons of carbon. The cost share discount will convert the tons of carbon saved[5] to forest acres, and then multiply that by the cost per acre to calculate a discount.

Discount =
Cost per Acre ($) multiplied by Forested Acres of Carbon Captured

[4] *https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references*
[5] For non-consumptive use (e.g.: hydropower), tons of carbon saved will be based on the MWhr generated per year. This may differ from year to year, resulting in a change to the discount rate. Discount rates will be reassessed annually.

Wailuku Watershed management cost per acre: $617,500 divided by 80,211.2 acres = $7.698
Forested Acres of Carbon Captured: 13,931 acres_____
Proposed [Name of Water Lessee] discount to management costs per year:
$107,240_____

Final Watershed Management Cost-Share Contribution:

Final Watershed Management Cost-Share =
Watershed Management Cost-Share Amount minus Discount Amount

[Name of Water Lessee] watershed cost-share: $138,320_____
Carbon discount for non-consumptive use: $_107,240_____
[Name of Water Lessee] annual watershed management cost-share: **$31,080.00 per year (rounded).**_____

Part 5. References, Sources, Appendices

Mauna Kea Watershed Management Plan

https://drive.google.com/file/d/16KrnNZKV0-S6ukwXJf7iVsri100P-KjG/view?usp=sharing

`Āina Mauna Legacy Program

http://dhhl.hawaii.gov/po/beneficiary-consultation/beneficiary-consultation-archives/aina-mauna-legacy-program/

Board of Land and Natural Resources, Submittal D-2, October 11, 2019

https://dlnr.hawaii.gov/wp-content/uploads/2019/10/D-2.pdf