
CHAPTER 8

Implementation

The Matrix below identifies a categorized list of implementing actions that could further the intent of the Lana'i Water Use and Development Plan

Abbreviations used in the Implementation Matrix are as follows:

CCR	Castle & Cooke Resorts, LLC.
DOE	Department of Education
DOFAW	DLNR - Division of Forestry and Wildlife
DOT	State Department of Transportation
DWS	Department of Water Supply
LF&WP	Lana'i Forest and Watershed Partnership
LWAC	Lana'i Water Advisory Committee
LWCI	Lana'i Water Company Inc
MCC	Maui Community College
USDA	United States Department of Agriculture
US F&WS	United States Fish & Wildlife Service

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FIGURE 8-1. Implementation Matrix

Implementation Matrix			
Goal	Action Item	Key Parties	Time Frame Near Term Mid term Long Term or Ongoing
I. INFRASTRUCTURE MAINTENANCE, OPTIMIZATION & SUPPLY-SIDE MANAGEMENT STEPS			
	Develop or update storage inventory. Size, volume, geometry, age, materials, condition, fill cycle issues, leaks, estimated remaining useful life, potable or reclaimed, service zones, controls and call levels, inside lining, existing maintenance schedules, etc.	LWCI	Annual Update
	Evaluate costs and create or update ongoing tank and reservoir refurbishment schedule -annual, 5 year, Longer. 5 year storage CIP.	LWCI	Annual Update
	Develop or Update Pump Facilities Inventory. Model, Speed, Rated Head, Motor HP, Performance against manufacturers curves (efficiency), Control Configurations, Well or Booster, On-Off calls, Chemical Feeds (chlorine, corrosion control, other), Backup Power source, land use for source pumps, chlorides, water level fluctuations, etc. Last Replacement, Next scheduled maintenance, etc.	LWCI	Annual Update
	Compile 5 year pump maintenance & replacement schedule, including updated pump efficiency curves and calibrated efficiencies.	LWCI	Annual Update.
	Develop and /or update inventory of transmission and distribution lines in the system; from and to points, diameter, material, install dates, leakage or breakage problems, pressure and flow status, etc. leak or breakage history, etc.	LWCI	Near. Ongoing.
	Identify replacement and upgrade priorities for line repair and replacement and compile 5 year schedule	LWCI	Regular Updates

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	Implement hydrant maintenance program: operate, flush periodically, check drain rate, lubricate when needed, check, pressure, replace older hydrants as needed	LWCI	Annual Update.
	Perform or maintain similar inventory and maintenance schedule development for all system elements as well: valves, meters, treatment facilities, generators, etc.	LWCI	Annual Update
	Acquire leak detection equipment and or borrow/rent same. Perform& document regular leak detection on system.	LWCI	Near
	Perform annual unaccounted-for water audit.	LWCI / Possibly help from DWS.	Near
II. INFRASTRUCTURE & CAPITAL & MAINTENANCE PROJECTS			
	Replace Deteriorated Palawai Grid Pipeline	LWCI	Near
	Install Floating or Hypalon Ball Cover on 15 MG Brackish Reservoir	LWCI	Near
	Replace old asbestos segments in Lana'i City	LWCI	Near to Mid
	Replace deteriorated Hi'i Tank and 50 year old concrete lined Hi'i Reservoir with new 2 MG Tank	LWCI	Near to Mid
	Replace Old Substandard Pipeline to Kaumalapau	LWCI	Mid
	Replace Old Steel Line Segments in Lana'i City	LWCI	Mid
	Drill Well 15 to distribute brackish withdrawals	LWCI	Near term
	Replace Well 2-A to increase ease of operability and for better reliability.	LWCI	Near to Mid

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Implementation Matrix			
Goal	Action Item	Key Parties	Time Frame Near Term Mid term Long Term or Ongoing
	Replace Well 3 or drill new well that will serve same purpose for improved reliability and distribution of withdrawals.	LWCI / LHI	Near Term
	Replace Old Line Segments in Northwest End of Irrigation Grid	LWCI	Mid-Long
	Improve pump system to reclaimed reservoir especially around lower 9 at Koele. (can't pump out of reservoir as needed)	CCR	Mid
	Evaluate possible improvements to reclaimed water treatment facility and storage. Make any necessary improvements	CCR	Mid to Long
	Install additional wells for distribution to prevent declining water levels or over-use of either aquifer. Options identified in Chap 5.	LHI	Near, Mid & Ongoing
III. DEMAND-SIDE MANAGEMENT STEPS			
	Retrofit indoor fixtures including but not limited to 1.28 GPF toilets, showerheads, faucets, efficient clothes washers.	LWCI	Replacement in Proposed rate structure. Near to Mid term.
	Implement water conservation measures aimed at reducing outdoor usage (Conservation measures are more cost effective the earlier they get done.)	CCR; LWAC	Near and Ongoing
	Establish additional ET/weather stations for improved drought prediction, fire prevention and conservation.	LWCI, CCR, DLNR	Some existing. Additions Near and Mid.
	Review & update design guidelines and plant list	CCR; Planning Dept.	Near to Mid term
	Support establishment of certification program, and of certified source of native stock to protect existing communities of appropriate plants	CCR LWCI;	As Appropriate

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Goal	Action Item	Key Parties	Time Frame Near Term Mid term Long Term or Ongoing
	Identify and map areas where turf or other high-water-use plants are featured, and prioritizing them for retrofit - i.e. seeking places that can be converted to less thirsty plants.	CCR; Hotels, LWCI,	Near to Mid term included in rates
	Maintain and expand native plant nurseries; possibly with grant funding assistance -also establish or help other “certified” nurseries - as may be established, for example by Hui Malama, MCC or others.	CCR, LFWSP, DLNR, FWS	Increase focus on native & drought-tolerant non-invasive plants. Near to Mid term.
	Annually examine “per-unit” water use information; by customer class, location, size of meter, end uses; etc. Develop targets for reduction.	CCR;	Near to Long
	Develop tiered rate structure to encourage conservation, leave rates low for base “life-line” amount; increased rates for excessive use.	LWCI, LHI, CCR, PUC, Public	Proposed in Plan, PUC case in Near term.
	Revisit and consider conservation ordinance; including county-wide public review;	LWAC, LWCI, Public, Council	Near to Mid term
	Offer incentives and assistance to local hotels and businesses. Assist with pre-rinse spray nozzles, incentives for cooling efficiency improvements, efficient laundries, and other measures mentioned in Chapter 5.	LWCI	Included in proposed rate structure. Near to Mid term.
IV. WATER CONSERVATION OUTREACH & EDUCATION			
	Develop a “walking tour” of native/demonstration landscapes: identifying projects that have been well-landscaped with native plants;	Cultural Center, Conservation Dept., Community Groups, possibly Hotels, Schools	Mid

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Implementation Matrix			
Goal	Action Item	Key Parties	Time Frame Near Term Mid term Long Term or Ongoing
	Partner with other Community Resources to provide well-rounded education and outreach for landscape and other conservation opportunities.	Conservation, Cultural Center, MCC, Hui Malama and others.	Near Term and Ongoing
	For new developments, utilize native or non-invasive non-native plants to the maximum extent possible in landscaping	CCR other developers incl. government	Near, Mid and Long, Ongoing
	Re-plant selected hotel properties with native plants - secondary to restoring natives on the hale	CCR; Hotels, LWCI assistance program, Conservation Dept., help from Community Groups & Cultural Center as applicable.	Near to Mid and Long term. (should commence near term, and continue).
	Demonstration projects: community gardens, plantings etc. establish demonstration gardens at various sites. Note that the last community plan also stated that this be should done at government sites.	CCR; Conservation Dept., DOE County/State govt., Cultural Center, Community Groups as applicable.	Near and continuing
	Establish set of qualified speakers on various conservation topics. Visit schools & community groups, offer classes.	LWCI; CCR, MCC, Conservation Dept. Partner with others as applicable.	Near
	Conservation ads in Lana'i newspaper(s).	LWCI, CCR, Other co-sponsors as available.	Near

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Implementation Matrix			
Goal	Action Item	Key Parties	Time Frame Near Term Mid term Long Term or Ongoing
	Ads for radio, movie screen, other venues	LWCI, DWS	Near. DWS has Many Ads, can share.
	Ads for movie-screen	DWS; CCR	Optional
	Posters	DWS; CCR	Mid
	Information on and periodic distribution of appropriate plant types	CCR, BWS	ongoing arbor day upgrade with nursery Near to Mid & ongoing
	Maintain list of appropriate plant species. Review and update Urban Design Guidelines accordingly.	DWS; Planning Department; DLNR, HEAR Lana`i Planning Commission	Ongoing. Needs improvement. Near
V. SOURCE WATER PROTECTION			
	Conduct additional fog drip studies in order to refine recharge estimates. Update Lana`i Water Model accordingly.	CWRM; UH; USGS; CCR, DWS?	Study on Cooke Pine throughfall completed. No review of native forest.
	Adopt the well operating management guidelines in the plan; monitor performance against same.	CWRM, LWCI CCR	Included in Plan. Implementation Near, Mid & Long.
	Draft wellhead protection strategy and ordinance discussed with LWAC, needs broader community presentation and discussion.	DWS, LWCI, CCR, Public	Near
	Distribute withdrawals such that no more than 2.7 MGD each are pumped from Leeward and Windward Aquifers during plan period.	LWCI, LHI	Near to Long Term

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Goal	Action Item	Key Parties	Time Frame Near Term Mid term Long Term or Ongoing
	Establish an ongoing watershed management program with special emphasis on preserving native ecosystems and maximizing the fog drip component of the watershed	LFWP, DWS, US F&WS, DOFAW, County CCR, CWRM, NRCS,	Ongoing Long-term
	Continue to Identify Potential Sources of Funding, Including Appropriations, Assessments, Contributions, Grants, Donations from Public and Private Sources, and Recommend Funding Sources	CCR Conserva- tion, LF&WP	Near term and Ongo- ing
FENCING			
	Monitor the integrity of existing fences	CCR, LF&WP, USF&WS	Ongoing and Near
	Select appropriate fence materials for new fences or fence segment replacements, such as triple dip galvanized with welded seams, treated against corrosion, alloy, even plastic fence, consider fence materials researched at Kalaupapa, consider increase in height or visual barrier to deter deer	CCR; LF&WP, USF&W	Increment 1 Com- pleted Increment II in Prog- ress Increment III still pending.
	Ground and aerial survey of new Increment III alignment & surrounding areas; set proper alignment vis a vis terrain and rare species communities; survey area to insure that populations of important snail, insect or plant species are not disturbed, or that such disturbance is minimal & mitigated	CCR; LF&WP, USF&W	Increment I completed Increment II Near Increment III Near.
	Resolve access issues. Additional gates needed. Gates at Hi'i Bench, East and West Hauola. Koolanai and Waiwaiku need gates. Vandalism could lead to more animals in Hale.	CCR; Community	Mid Term.

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Goal	Action Item	Key Parties	Time Frame Near Term Mid term Long Term or Ongoing
	Maintain fence regularly	CCR Conservation, with help from other forest partnerships as needed.	Mid to ongoing
	Maintain buffer zones around fence	CCR	Mid to ongoing

FERAL UNGULATE MANAGEMENT

	Inside Fence		
	Herding effort to move deer out of each new increment of fenced area - foot, helicopter, etc.	CCR, DOFAW	Increment I - Done. Increment II - Near Increment III Near.
	Allow residents to hunt within fence first - ongoing staffed hunts if needed	CCR, DOFAW	Increment I - Done Increment II - Near Increment III - Near to Mid
	Hunting to elimination within fence for protection of watershed,	CCR, DOFAW, LFWP, Community	Mid to ongoing
	IF NECESSARY - Aerial hunts, spotlighting, snares, or traps if necessary in designated elimination areas -esp. remote areas, or where animal numbers are not dropping	CCR, DLNR	last resort only
	Outside Fence		
	Manage populations outside of fence	CCR, DLNR	Near term & continuing
	Investigate use of repellents, non-forage distasteful plants, other methods along buffer strip / corridor on outside of fence to discourage deer from approaching or trying fence	DLNR, USF&WS, CCR Conservation	Mid to Long

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	Continue to investigate other “non-kill” options that may be used with hunting: catch & transport; repellents, sterilizers, habitat alteration, etc.	DLNR, USF&WS CCR Conservation	Mid & continuing
	Provide training or review, as appropriate and necessary for certified volunteer hunters.	DLNR - license CCR - forest entry etc.	ongoing & continue
	Improve harvest reporting protocols and data. Harvest report should go to one central repository, such as DLNR-DOFAW	DLNR, Hunter Advisory Group, CCR	Near
OTHER ANIMAL MANAGEMENT			
RODENTS			
	Survey area to determine priority locations for treatments highly susceptible plant, bird or snail communities signs of excessive rodent activity	DLNR, USF&WS; LF&WP, CCR	Ongoing DLNR Conservation as needed
	Determine appropriate treatment schedule all year, or at least during fruiting/seeding of target native plants?	DLNR, USF&WS; LF&WP, CCR	As appropriate
	Eliminate rodents using traps, bait, other methods	DLNR, USF&WS; LF&WP; CCR	As needed
	Perform follow-up documentation and monitoring to evaluate usefulness	DLNR, USF&WS; LF&WP; CCR	Mid & continue as needed
INSECTS			
	Survey as needed to determine priority pests for removal based on threat to remaining target communities: mosquitoes, chinese rose beetle, chinese leaf hopper, others	DLNR, USF&WS; LF&WP; CCR	Mid & continue
	Research other removal experience with target insect pests determine protocols, spraying, equip needed, etc.	DLNR, USF&WS; LF&WP; CCR	Mid & continue as needed

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	Implement removal protocols	DLNR, USF&WS; LF&WP; CCR	Mid & continue as needed
	Perform follow-up documentation and monitoring to evaluate usefulness	DLNR, USF&WS; LF&WP; CCR	Mid & continue as needed

FIRE PROTECTION

	This is especially important on Lana`ihale, since the native Hale plants are not well adapted to fire. Efforts should also address management of surrounding lands, including those taken out of pineapple.		
	Consult with other fire management agencies to review existing fire plan as related to Lana`i Hale protection.	DLNR, Fire Dept.; CCR	ongoing, re-evaluate Near to Mid
	Survey plant communities in pristine areas, fire prone areas	CCR	Mid
	Map & prioritize fire prone areas.	DLNR, Fire Dept.; CCR	ongoing, re-evaluate Near to Mid
	Inventory response crews, response times, etc.	DLNR, Fire Dept.; CCR	ongoing, re-evaluate Near to Mid
	Inventory/ obtain as needed emergency equip (helicopters/strategically placed reservoirs, water trucks, etc.)	DLNR, Fire Dept.; CCR	ongoing? re-evaluate? Near to Mid?
	Develop improved access as necessary (careful not to spread weeds).	DLNR, Fire Dept.; CCR	Mid
	Develop and conduct regular training, and/or joint training programs for fire fighting crews.	DLNR, Fire Dept.; CCR	ongoing & continue? or Mid?
	Review and update prioritized response plan as appropriate.	DLNR, Fire Dept.; CCR	ongoing, re-evaluate Near to Mid

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	Construct fire breaks or buffer zones as appropriate	CCR	Mid to Long
	Remove/ eradicate fire-inducing or fire-carrying weed species, especially in areas where small populations mean that a single catastrophic fire could eliminate the entire remaining population of a species. (Ex. Tetramolopium remyi)	CCR	Mid to Long
	Establish “fire-free” use zones	CCR	Mid to Long
	Heighten public awareness of dangers	CCR	Mid

REMOVAL OF NON-DESIRABLE PLANT SPECIES

	Survey area to locate and prioritize weeds for removal, based on aggressiveness of weed species; extent of spread; proximity to rare species; etc. - (ex. guava, eucalyptus, christmas berry, ironwood)	LF&WP; CCR; DLNR	Mid (after fence Phase I completion)
	Remove target weeds from selected areas by hand or mechanical removal; possibly with selective use of herbicides or bio-controls where appropriate	LF&WP; CCR; DLNR	Mid (after fence Phase I completion) to Long & continue
	Follow/up to remove re-germination	LF&WP; CCR; DLNR	Mid to Long and continue

PROTECTION FROM PATHOGENS, DISEASES

	Identify pathogens of concern to Lana`i watershed species communities. Possible examples include but are not limited to: _“Spike disease”- harmful to sandalwoods in India, believed to be in HI _Santalum seed fungus - destructive to viability of seeds (sandalwood) _Santalum heart rot _Others?	LF&WP; DLNR US F&W	Mid to Long term and continue
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	inventory disease problems affecting key species, known management strategies	LF&WP; CCR; DLNR	Long
	enhance quarantine & inspection to prevent further introduction	LF&WP; CCR; DLNR, DOT	Long
	implement treatment options where identified	LF&WP; CCR; DLNR	Long

EROSION MANAGEMENT & REFORESTATION

	Survey & select realistic / effective areas for management	CCR; LF&WP	Mid & continue
	Eliminate animal stresses that perpetuate erosion cycle	CCR; LF&WP	Mid & continue
	Strategic planting	CCR; LF&WP	Mid & continue
	Mycorrhizal inoculants can aid the establishment of out-planted seeds (down side?)	CCR; LF&WP	Mid to Long as appropriate
	Wattles and other soil trapping devices. silt basins?	CCR; LF&WP	Long
	Establish native plants on newly trapped soil	CCR; LF&WP	Long
	Outplant species grown ex situ.	CCR; LF&WP	Mid
	Seed broadcast	CCR; LF&WP	Mid to Long as appropriate

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	<p>Perform complimentary actions aimed at restoration of native populations of insects, forest birds, sea birds, snails, etc. These will also help to restore and improve the nutrient cycle of the soil, healthy litter layer, etc.</p> <p>For example, Snails and insects provided important quantities of biomass & nutrients; Sea-birds provided nutrients such as nitrogen, phosphorous, etc. Insects helped to break down fallen trees, aided in decomposition and soil amendment. and provided biomass. restoration of these populations will also improve the health of the soil.</p>		
MONITORING AND EVALUATION			
	Establish & Maintain Monitoring Transects Using Standard Accepted Methodologies (point-line intercept or etc.)	CCR; with help from LF&WP	Mid to Long as appropriate
	Collect Data on Soils, Stream Flows, Rainfall & Other parameters	CCR; with help from LF&WP	Long & continue as appropriate
	Perform aerial and field survey, photography and mapping to inventory and characterize resource health	CCR; with help from LF&WP	ongoing & continue periodically
	Monitor, map and inventory on a regular basis to keep track of changes in plant communities, animal communities, ungulate activity, erosion, etc.	CCR; with help from LF&WP	Mid to Long & continue
	Survey and map major communities, threats, measures	CCR; with help from LF&WP	Mid to Long & continue
	Map monitoring plots, size and class of plants inside (desirable and non-desirable)	CCR	Mid to Long & continue
	Perform scheduled field checks	CCR	Mid & continue
	Perform additional checks after unusual events, catastrophes, etc.	CCR	Mid & continue
	Photo plots - especially plant communities - to monitor recovery / loss	CCR	Mid for base-line & continue

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	Water / soil gauges other special equipment for monitoring fog drip, etc.	CCR, LHFWP, DLNR, CWRM, USGS. UH	Mid to Long
	Provide report of quantitative and qualitative data w/ photos and maps	CCR	Mid for base-line & continue

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CONTROL OF INCOMING SPECIES

	Adequate screening and quarantine for incoming agricultural goods and plants	DOT, DLNR, USDA; CCR	Long
	Education of public / landowners on dangers of bringing in exotic species, potential contaminants	LF&WP; CCR; DLNR, DOT, USDA	Mid to Long
	Set up procedures to avoid introduction of non-desirable plants OR plant pathogens	LF&WP; USDA CCR; DLNR, DOT	Long
	Set up procedures to avoid introduction of non-desirable insects or insect pathogens	LF&WP; CCR; DLNR, DOT	Long

PROTECTION FROM HUMAN ACTIVITY

	Protect species prone to gathering by humans. For example, Sandalwood has been subject to removal by individuals seeking the heart wood, due to its high economic value.	CCR LFF	Long
	Develop and enforce protective measures: no collection of special species limit forest entry in selected areas such as exclosures, etc. proper forest entry practices, maintain a regulatory presence in the watershed, post signs for limited entry or special access concerns manage public activities and education interagency cooperation for these	CCR with help from members of LF&WP	Long
	Develop a recreational use plan for human activities in the watershed	CCR with help from members of LF&WP	Long

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	<p>Insure that existing protections are followed, and continue to evaluate the need for and support additional measures as appropriate</p> <p>Existing Legal & Regulatory Protections include the following: “It is illegal to remove, cut dig up, damage or destroy an endangered plant in areas not under Federal jurisdiction in knowing violation of any State law or regulation or in the course of any violation of a State criminal trespass law. (ESA §9(a)(2))</p> <p>Hawaii State Law prohibits taking of endangered flora and encourages conservation by State government agencies. “Take” means to harass, harm, collect, uproot, destroy, injure or possess endangered species of land plants, or to attempt to engage in any such conduct (HRS 195D-5(d))</p>	<p>CCR with help from members of LF&WP DLNR</p>	<p>Long</p>
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PEER REVIEW MANAGEMENT PLANS & IMPLEMENTATION TO AVOID MANAGEMENT ERRORS

	<p>Establish a regular system of inter-agency review to help avoid and /or correct errors such as the following: fencing without adequate monitoring, fencing without weed removal over-collection of seeds damage or spread of pathogens by incorrect collection of tissue cultures, careless management on part of humans (human trampling, unmonitored actions, etc.)</p>	<p>LF&WP</p>	<p>ongoing and continue</p>
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MANAGEMENT RECOMMENDATIONS TO PRESERVE NATIVE BIRDS

Benefits of protecting remaining bird species and possibly restoring bird populations:
 Birds serve(d) various beneficial functions in the watershed, including:
 direct pollination of native plant species
 seed dispersal (ex: amakihi ate fruit and insects, spread seeds in feces)
 source of nutrients (esp from sea-bird feces)
 possible additional non-identified roles, as birds were integral part of ecosystem
 rare native plants may benefit from having native birds that served to pollinate and spread seeds restored.
 nutrient cycles, as affected by seabirds may effect soil and plant health by returning nutrients to soil

	<p>Protect habitat - including steps to preserve plant communities, snails, insects, etc.</p>	<p>CCR with help from members of LF&WP</p>	<p>ongoing as part of other plan elements.</p>
	<p>Prevent predator entry - fencing <i>(fencing will not keep out chief bird predators, but may reduce spread of weeds that attract them, reduce disruption of habitat, etc.)</i> adequate quarantine baiting predators</p>	<p>; LF&WP CCR</p>	<p>fence ongoing quarantine, Long term baiting, Long term</p>
	<p>Remove rats and cats from native bird habitats - catch, bait, etc.</p>	<p>CCR; LF&WP</p>	<p>Long</p>

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	Prevent entry of non-native birds - (avoid disease, competition)	CCR; DLNR, DOT	Long
	Prevent entry of mosquitoes and other problem insects	CCR; DLNR; DOAg; DOT	Long
	Control mosquitoes at breeding sites - insecticides, sterilizers, introduction of sterile or non-carrier mosquitoes	CCR; DLNR, Dof Ag; DOT	Long
	Specific strategic management of existing seabird colonies for enhanced protection	CCR; DLNR, DOT	Long
	Appropriate adjustments to fencing, such as flagging or etc. Fence must be visible to prevent birds from crashing during night landing. white flagging on top can help.	CCR; LFWP DLNR	Mid to Long
	Intensive rat & cat control	CCR; DLNR,	Long
	Consider carefully managed re-introduction programs for amakihi, i'iwi, maui creeper, others	CCR; DLNR, USF&WS	Long
	Preserve Lana`i specific genetic material.	CCR; DLNR, Bishop, NTBG, USF&WS	ongoing, continue and Long
	Consider minimum habitat size for sustainability of bird populations in deciding on deer fence option	CCR; DLNR, USF&WS	Mid to Long with Phases II and III
	Encourage sea birds to return by establishing safe, predator-free sites for them	CCR; DLNR, USF&WS	Long - as part of general plan elements

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	In order to successfully maintain existing apapane and seabird populations, and /or to restore previously existing species with close approximations (Maui equivalents) - adequate disease free habitat extent will be required.		
MANAGEMENT RECOMMENDATIONS TO PRESERVE NATIVE SNAILS			
	Preserve habitat, esp. upper elevation wet forest.	CCR with help from members of LF&WP	ongoing as part of other plan elements.
	Encourage reforestation with native species. Many non-natives, including Cook Pines and Eucalyptus, are not good hosts for native snails...(although snails have been found on some non-native plants where they are intermixed with natives).	CCR with help from members of LF&WP	ongoing as part of other plan elements Cook Pine area will be preserved, but extent of Cook Pine area will not be extended
	Enforce ban on collecting	CCR w/ LF&WP members	Long
	Educate public on damage caused by collecting	CCR w/ LF&WP members	Long
	Eliminate rat predation (<i>see also rodent control section</i>)	CCR w/ LF&WP members	Long
	Eliminate predatory snails, if applicable	CCR w/ LF&WP members	Long

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	<p>Prevent entry of non-native snails & slugs to avoid possible intro of diseases.</p> <p>CARE MUST BE EXERCISED in designing control of slugs. poisons designed to eliminate slugs would also be likely to affect snails. Slugs don't generally hurt snails, but there are no native slugs in Hawaii, and there is some chance that they could be a source of introduced disease, competition or habitat loss. slugs do appear to damage certain native plants</p> <p>If any poison or bait were used to control snails, it should be limited to extremely LOCAL applications in areas where it was fairly certain no native snails were present.</p>	CCR w/ LF&WP members	Long
	Captive rearing and reintroduction as appropriate	DLNR, Bishop, USF&WS,	Long
	<p>Construct and maintain enclosures for snails</p> <p>There are various means of constructing snail enclosures. one example is described here, but the design would be selected by the UH, USF&WS, DLNR or others as appropriate. this enclosure is roughly waist high. they are constructed of painted, corrugated aluminum roofing. a trench is dug, and in that trench the fence is installed with its foot buried about 6" into the ground, at the top of the fence is a shed-like "roof" that protrudes to either side. under that "roof" are two additional barriers, a trough of large crystal salt, and a 2-wire electric fence, constructed of two thin wires spaced 8mm apart. The electric wires are powered by solar panels mounted on the inside of the enclosure. the largest such enclosure currently existing is about 40x25 meters.</p> <p>Rat bait boxes may be placed on the outside of the enclosures for further protection.</p> <p>Tree limbs and other branches should be prevented from touching the fence enclosure structure, as they may provide a path for predators.</p>	DLNR, Bishop, USF&WS, UH, others	Long
	Consider careful removal of non-native plant species where appropriate, and replacement with native species. (again, this measure requires exercise of care to insure that no snails are sitting on the plants to be removed)	CCR with help from members of LF&WP	ongoing

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	In cases where native snails seem to be adapting to introduced plants, selective use of these non-native plants may be considered. Snails that seem to be exhibiting adaptation according to Severns (conversation) include: <i>Partulina variabilis</i> , and <i>Partulina semicarinata</i>		
MANAGEMENT RECOMMENDATIONS TO PRESERVE NATIVE INSECTS			
	Protect native habitat on which native insects rely, especially host plants	CCR with help from members of LF&WP	ongoing as part of other plan elements.
	Eliminate non-native predator insects, especially yellow-jackets and ants. Possible methods include: pheromone traps; find and destroy nests with freezing or insecticides; bait as appropriate	CCR w/ LF&WP members	Long
	Develop improved quarantine measures and other controls to prevent entry of non-native insects	CCR; DLNR, Dof Ag; DOT	Long
	Monitor native insect populations to determine species requirements, critical habitat, population size, etc.	CCR; DLNR, USF&WS, others	Long
COLLECTION AND MAINTENANCE OF GENETIC MATERIAL			
	Inventory existing ex-situ populations & identify needs for more, if any	CCR; DLNR, USF&WS, others	Mid to Long
	Involve experts in collection of seeds, live plants, plant tissue	DLNR, Bishop, USF&WS, UH, others	Long
	Maintain ex-situ seeds, live plants, plant tissue, plant populations	DLNR, Bishop, USF&WS, UH, others	Long

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	Note: Ex situ collections must be managed with care to avoid in-breeding, collection of genetically weakened specimens, cross-contamination of genetic material with other variations of the species. Should be handled by outside experts such as NTBG, Bishop Museum, University, or other qualified organizations.
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SELECTIVE AUGMENTATION / RE-INTRODUCTION OF SPECIES
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	See cautions above. It is important that such projects be carried out with close attention to proper collection and identification of appropriate seed sources, as well as care to avoid contamination in nurseries, germination media, plant materials		
	Identify priorities for restoration efforts. Rare species, important species, etc. Restoration of certain plant, bird and insect species may help to restore and improve pollination opportunities. plants provided food for birds and insects, forest birds and insects provided important pollinators. Restoration of these components will help support a healthy ecosystem.	DLNR, Bishop, USF&WS, UH, others	Mid to Long
	Identify appropriate sources (seed collection, ex-situ collections, etc.)	DLNR, Bishop, USF&WS, UH, others	Long
	Identify and obtain necessary equipment	DLNR, Bishop, USF&WS, UH, others	Long
	Survey and prepare out-planting sites	CCR w / DLNR, LFWP Bishop, USF&WS, UH, others	Long
	Protect, monitor and maintain out-plantings. (consider smaller enclosures)	CCR w / DLNR, LFWP Bishop, USF&WS, UH, others	Long

Implementation

PREVENTION & EARLY DETECTION

	<p>Through wind dispersion and other means, plants introduced in only a few sites well outside the watershed can and do spread to the watershed.</p> <p>Through active identification efforts, plants may be detected at earlier stages of naturalization, or even prior to naturalization, avoiding widespread damage.</p>		
	Develop a database of cultivated and naturalized non-native species on the island of Lana'i through survey of nurseries, botanical gardens, parks, hotel and other public landscape and other likely introduction sites.	CCR w / DLNR, LF&WP DOT	Long
	Cross check data on naturalized species in Lana'i with databases of historically invasive plants in similar climates elsewhere. The best predictor of invasiveness for most taxonomic groups is a record of invasiveness in similar climates elsewhere in the world. Cross-checking these lists may help to identify species of concern.	CCR w / DLNR, LF&WP DOT	Long
	Develop and/or refer to existing species reports for targeted species, summarizing both literature and field research, and include results from gps data collection and distributional mapping, as well as information on attributes of other invaded ecosystems, control data, and so forth. A potential protocol for obtaining and structuring such information has been developed and implemented in Maui.	CCR w / DLNR, LF&WP DOT	Long
	Monitor likely routes of introduction, such as roadsides, parks, refuse sites, vacant lots, harbors, airports and residential areas for new communities of potentially invasive species. Many of the key corridors by which invasive alien species are introduced are not the same areas where active management transects are located.	CCR w / DLNR, LF&WP DOT	Long

Implementation Matrix

ADDITIONAL RESEARCH ON TARGETED PLANT COMMUNITIES

The following have been identified as research items which may help the project over the Longer term. This research may not be performed as part of Lana‘ihale management. However, funding of such research would be consistent with WUDP watershed goals.

	Associated ecosystem components	DLNR, Bishop, USF&WS, UH, others?	Long
	Relations between native plant communities / birds / insects (pollination, feeding, etc.)	DLNR, Bishop, USF&WS, UH, others	Long
	Critical habitat size / population size for species viability	DLNR, Bishop, USF&WS, UH, others	Long
	Growth and mortality at various stages of plant life, seasonal changes	DLNR, Bishop, USF&WS, UH, others	Long
	Optimum conditions for reproductive vitality, flowering/seeding conditions	DLNR, Bishop, USF&WS, UH, others	Long
	Light requirements at various stages of life	DLNR, Bishop, USF&WS, UH, others	Long
	Water, soil & nutrient requirements at various stages	DLNR, Bishop, USF&WS, UH, others	Long

Implementation

	Pollination vectors, seed dispersal	DLNR, Bishop, USF&WS, UH, others	Long
	Means to compensate for missing pollination vectors or other key-stone habitat concerns	DLNR, Bishop, USF&WS, UH, others	Long
	Minimum numbers needed for populations to be stable susceptibility to inbreeding	DLNR, Bishop, USF&WS, UH, others	Long

EDUCATION AND COMMUNITY OUTREACH

	Rare plants and their value Importance of watershed / importance of biodiversity Non-desirable plants and the threats posed by them How to enter forest / other areas while causing minimal risk of doing harm Dangers of open flames, esp. in certain areas Plant walks outside critical areas Deer impacts to environment / water resource Importance of watershed / biodiversity Plants of concern Appropriate forest entry practices	CCR w / DLNR, LF&WP members	Near & continuing upgrade
	Create pool of docents Field volunteer training Recruiting Reporting	CCR w / DLNR, LF&WP members	Near & continuing upgrade
	Workshop and lecture series Uses of plants in native culture Value of native resources Importance of watershed and connection with native vegetation Plant, animal and bird identification Threats & Long term effects of unabated threats (Rapa Nui lesson)	CCR w / DLNR, LF&WP members	Near & continuing upgrade

Implementation Matrix

	Solicit community input and contributions to educational efforts Link w/ other environmental agencies / develop partnerships	CCR w / DLNR, LF&WP members	Near & continuing upgrade
	Develop guided hike program / field trips to biological and cultural sites Trained docents as leaders Prepared informational materials Vehicles and logistical support	CCR w / DLNR, LF&WP members	Long
	Prepare interpretive materials for use in both community and by visitors Booklets, pamphlets Web sites Public access programs	CCR w / DLNR, LF&WP members	Mid & con- tinuing upgrade
	Identify and implement volunteer projects Weed control Restoration activities - outplanting, nursery, maintenance, erosion control Fence building and repair Hunting	CCR w / DLNR, LF&WP members	Mid to Long
	Develop native resources curriculum for the schools	CCR w / DLNR, LF&WP members	Near & continuing upgrade
	Develop and implement Long-term alien species awareness and prevention program Seek grant funding to develop a video Develop a tie-in with the local business community	CCR w / DLNR, LF&WP members	Long
	Establish media contacts for coverage of projects both local and statewide dissemination Regular means of communicating relevant information to the community	CCR w / DLNR, LF&WP members	as appropriate

Implementation

	Utilize existing community special events as venue for promoting education and increasing viability of projects: Aloha Festival Health Fairs Pineapple Festival Other Cultural Events	CCR w / DLNR, LF&WP members	Long
	Provide update on status of watershed and protection activities to LWAC and or to the Lana‘i Planning Commission twice per year.	CCR Con- servation	Near and Ongoing