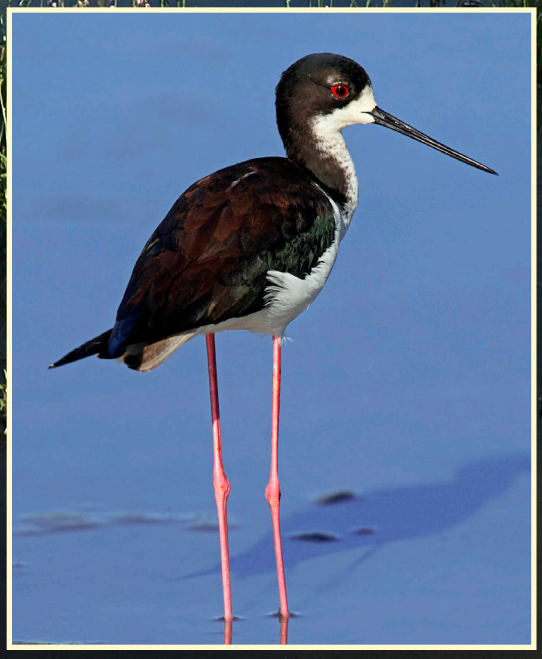
U.S. Fish & Wildlife Service

Hanalei National Wildlife Refuge

Environmental Assessment for Draft Wetlands Management and Waterbird Conservation Plan



ENVIRONMENTAL ASSESSMENT FOR DRAFT WETLANDS MANAGEMENT AND WATERBIRD CONSERVATION PLAN

Hanalei National Wildlife Refuge

HAWAI'I

AUGUST 2020

Prepared by

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Estimated Lead Agency Total Costs (Rounded to Nearest Thousand) Associated with Developing and Producting this Environmental Assessment: $50,000

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Availability of Environmental Assessment and Draft Plan

We are requesting public comments on the Draft Wetlands Management and Waterbird Conservation Plan (dWMWCP) and Environmental Assessment (EA), draft Appropriate Use Findings (AUFs), and draft Compatibility Determinations (CDs). Availability of materials for review and comment will be announced via direct mailings, media releases, and public meetings. The plan, AUFs, and CDs may be modified between the draft and final depending upon comments received from the public or other agencies and organizations. As part of the public notice and review process, the dWMWCP and EA will be available for a 30-day review. Comments or requests for additional information may be submitted through any of the following methods:

Email: hanalei@fws.gov. Include "Hanalei NWR Wetlands Management and Waterbird Conservation Plan" in the subject line of the message.

U.S. Mail: U.S. Fish and Wildlife Service, Attn: Heather Tonneson, Project Leader, P.O. Box 1128, Kīlauea, Hawaii 96754.

Fax: Attn: Hanalei NWR Wetlands Management and Waterbird Conservation Plan, (808) 828-6634.

All comments received from individuals become part of the official public record. We will handle all requests for such comments in accordance with the Freedom of Information Act and CEQ's NEPA regulations in 40 CFR 1506.6(f). Our practice is to make comments, including names and home addresses of respondents, available for public review during regular business hours. Individual respondents may request that we withhold their home address from the record, which we will honor to the extent allowable by law. If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comments.

Determination:

This section will be filled out upon completion of any public comment period and at the time of finalization of the Environmental Assessment.

☐ The Service's action will not result in a significant impact on the quality of the human environment. See the attached **"Finding of No Significant Impact".**

☐ The Service's action **may significantly affect** the quality of the human environment and the Service will prepare an Environmental Impact Statement.

Preparer Signature: _____Date:_____

Name/Title/Organization: _____

_____

Reviewer Signature: _____Date:_____

Name/Title: _____

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ABBREVIATIONS

AHWP annual habitat work plan
AUF appropriate use findings
AVMA American Veterinary Medical Association
BIDEH Biological Integrity, Diversity, and Environmental Health
BMP best management practices
CAA Cooperative Agricultural Agreement
CD compatibility determinations
CEQ Council on Environmental Quality
CFR Code of Federal Regulations
cfs cubic feet per second
CZM Coastal Zone Management
DM Department Manual
DO dissolved oxygen
DOI Department of the Interior
dWMWCP Draft Wetlands Management and Waterbird Conservation Plan
EA Environmental Assessment
EIS Environmental Impact Statement
EO Executive Order
EPA Environmental Protection Agency
ESA Endangered Species Act of 1973
FONSI Finding of No Significant Impact
FW U.S. Fish and Wildlife Service Manual
GMC Genetically modified crops
HDBEDT Hawai‘i Department of Business, Economic Development, and Tourism
HDOH Hawai’i State Department of Health
HNWRHAD Hanalei National Wildlife Refuge Historic and Archaeological District
I&M Inventory & Monitoring
IMP Inventory and Monitoring Plan
IPM Integrated Pest Management
KNWRC Kaua‘i National Wildlife Refuge Complex
MBTA Migratory Bird Treaty Act of 1918
NAGPRA Native American Graves Protection and Repatriation Act
NEPA National Environmental Policy Act
NHPA National Historic Preservation Act of 1966
NOAA National Oceanic and Atmospheric Administration
NTHP National Trust for Historic Preservation
NRCS Natural Resources Conservation Service
NRHP National Register of Historic Places
NWR or Refuge National Wildlife Refuge
NWRS or Refuge System National Wildlife Refuge System
ORP oxidation/reduction potential
QMUA Quarterly Management Unit Assessments
Refuge Administration Act National Wildlife Refuge System Administration Act of 1966
Refuge Improvement Act National Wildlife Refuge System Improvement Act of 1997
RHPO Regional Historic Preservation Office
RM Refuge Manual
SHPD State Historic Preservation Division
SHPO State Historic Preservation Office
SLR Sea level rise
SUP Special Use Permit
TMDL total maximum daily loads
U.S.C. United States Code
USFWS or Service U.S. Fish and Wildlife Service
WMWCP Wetlands Management and Waterbird Conservation Plan

EXECUTIVE SUMMARY

The United States Fish and Wildlife Service (Service) is proposing to implement a Wetlands Management and Waterbird Conservation Plan (WMWCP) on Hanalei National Wildlife Refuge (Refuge), Kaua‘i County, Hawaii. In accordance with the National Environmental Protection Act (NEPA), this Environmental Assessment (EA) presents a need for the proposal, examines a range of management alternatives, analyzes possible environmental effects of the alternatives, and serves as the basis for a decision by the Service on which alternative to implement. The management actions being presented in this EA include: Alternative A (no-action alternative; continue existing management) and Alternative B (action alternative; modified habitat management processes and procedures on approximately 480 acres of rotational managed wetland [moist-soil] units, lo‘i kalo [wetland taro fields], ditches and dikes, fallow, riparian habitat, and associated uplands to provide for the life history needs of threatened and endangered Hawaiian waterbirds and other native wildlife and plants). Alternative B would include changes to the Refuge’s farming program, which would be conducted by permittees/cooperators under Cooperative Agriculture Agreements (CAAs), to improve habitat conditions for threatened and endangered waterbirds; restoration of 3–18 acres of wetlands and 14–24 acres of riparian grasslands; and enhancement of 21 acres of koloa maoli (Hawaiian duck, *Anas wyvilliana*) nesting habitat. Neither alternative is expected to cause significant, irreversible impacts to the environment; therefore, the anticipated determination is a Finding of No Significant Impact (FONSI).

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SECTION 1. PURPOSE AND NEED FOR THE ACTION

This Environmental Assessment (EA) is being prepared to evaluate the effects associated with the Draft Wetlands Management and Waterbird Conservation Plan (dWMWCP; proposed action) and complies with the National Environmental Policy Act (NEPA) in accordance with Council on Environmental Quality (CEQ) regulations (40 Code of Federal Regulations [CFR] 1500–1509) and Department of the Interior (DOI; 43 CFR 46; 516 Departmental Manual [DM] 8) and United States Fish and Wildlife Service (USFWS or Service; 550 U.S. Fish and Wildlife Service Manual [FW] 3) regulations and policies. NEPA requires examination of the effects of proposed actions on the natural and human environment.

1.1 PROPOSED ACTION

The Service is proposing to implement a Wetlands Management and Waterbird Conservation Plan (WMWCP; USFWS 2020) on Hanalei National Wildlife Refuge (NWR or Refuge) in Kauaʻi County, Hawaii. Under the WMWCP, the Service would modify habitat management processes and procedures on approximately 480 acres of rotational managed wetland (moist-soil) units, loʻi kalo (wetland taro fields), ditches and dikes, fallow, riparian habitat, and associated uplands to provide for the life history needs of threatened and endangered Hawaiian waterbirds[1] (koloa maoli [Hawaiian duck, *Anas wyvilliana*], ʻalae keʻokeʻo [Hawaiian coot, *Fulica alai*], ʻalae ʻula [Hawaiian common gallinule, *Gallinula galeata sandvicensis*], aeʻo [Hawaiian stilt, *Himantopus mexicanus knudseni*], and nēnē [Hawaiian goose, *Branta sandvicensis*]), and other native wildlife and plants. This would include changes to the Refuge's farming program, which would be conducted by permittees/ cooperators under Cooperative Agriculture Agreements (CAAs), as required by federal law and policy, to improve habitat conditions for threatened and endangered waterbirds. The Service is also proposing to restore 3–18 acres of wetlands, restore 14–24 acres of riparian grasslands for nēnē breeding and foraging, and enhance 21 acres of koloa maoli nesting habitat.

A proposed action is often iterative and may evolve during the NEPA process as the agency refines its proposal and gathers feedback from the public and other agencies. Therefore, the final proposed action may be different from the original. The proposed action will be finalized at the conclusion of the public comment period for the EA.

1.2 BACKGROUND

NWRs are guided by the mission and goals of the National Wildlife Refuge System (NWRS or Refuge System), the purposes of an individual refuge, Service policy, and laws and international treaties. Relevant guidance includes the National Wildlife Refuge System Administration Act of 1966 (Refuge Administration Act), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Refuge Improvement Act), Refuge Recreation Act of 1962, and selected portions of the CFR and FW.

[1] Throughout the document, the term "threatened and endangered waterbirds" will be used to refer collectively to these five species.

The mission of the NWRS, as outlined by the Refuge Administration Act, as amended by the Refuge Improvement Act (16 United States Code [U.S.C.] 668dd et seq.), is to:

"... to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans"

The Refuge Administration Act mandates the Secretary of the Interior in administering the National Wildlife Refuge System to:

- Provide for the conservation of fish, wildlife, and plants, and their habitats within the NWRS;
- Ensure that the biological integrity, diversity, and environmental health of the NWRS are maintained for the benefit of present and future generations of Americans;
- Ensure that the mission of the NWRS described at 16 U.S.C. 668dd(a)(2) and the purposes of each refuge are carried out;
- Ensure effective coordination, interaction, and cooperation with owners of land adjoining refuges and the fish and wildlife agency of the States in which the units of the NWRS are located;
- Assist in the maintenance of adequate water quantity and water quality to fulfill the mission of the NWRS and the purposes of each refuge; and
- Monitor the status and trends of fish, wildlife, and plants in each refuge.

Hanalei NWR is located in northern Kauaʻi in Hanalei Valley and contains one of the first protected wetlands in the State of Hawaiʻi. The 917-acre Refuge was established in 1972 under the authority of the Endangered Species Conservation Act of 1969 (16 U.S.C. 668aa; Statute 275) to aid in the recovery of federally endangered Hawaiian waterbirds through the preservation and management of habitat. The purpose of Hanalei NWR is to "conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. § 1534 (ESA; Endangered Species Act of 1973).

Hanalei NWR is one of two Refuges in the state where wetland habitat is managed to support all life history needs for five of the federally listed Hawaiian waterbirds year-round. Hanalei NWR represents 70 percent of the core habitat on Kauaʻi designated as essential to the recovery and delisting of four endangered waterbirds (USFWS 2011). Hanalei NWR currently permits kalo (taro, *Colocasia esculenta*) farming as a Refuge management economic activity to provide additional shallow-water habitat used by threatened and endangered waterbirds for foraging, loafing, and breeding. Until recently, kalo farming was authorized through general Special Use Permits (SUPs). Under the Service's 2017 updated Cooperative Agriculture policy (620 FW 2), CAAs must be in place. Kalo farming existed prior to and at the time of the establishment of the Refuge and is culturally and economically important both to the State of Hawaiʻi and local communities. Approximately, 40 to 60 percent of Hawaiʻi's kalo is grown on the Refuge (Gutscher-Chutz 2011; NASS 2012; Cho, Yamakawa, and Hollyer 2007).

1.3 PURPOSE AND NEED FOR THE PROPOSED ACTION

The purposes of this proposed action are to protect, restore, enhance, and manage wetland habitats of Hanalei NWR to meet the life history needs of threatened and endangered waterbirds to promote their recovery; and to protect, restore, and manage the riparian ecosystem to benefit the Refuge's

native plant and animal communities. The proposed action would meet the Service's priorities and mandates as outlined by the Refuge Administration Act to "provide for the conservation of fish, wildlife, and plants, and their habitats within the NWRS;" to "ensure that the biological integrity, diversity, and environmental health of the NWRS are maintained for the benefit of present and future generations of Americans;" to "assist in the maintenance of adequate water quantity and water quality to fulfill the mission of the NWRS and the purposes of each refuge;" and to "monitor the status and trends of fish, wildlife, and plants in each refuge" [16 U.S.C. 668dd(a)(4))].

The needs of the proposed action are to:

(1) Improve the Refuge's habitats for priority species and adjust habitat management processes and procedures to better meet life history requirements of threatened and endangered waterbirds;

(2) Reduce losses of threatened and endangered waterbirds due to predation by, competition with, or hybridization with non-native species;

(3) Reduce losses of threatened and endangered waterbirds to disease; and

(4) Ensure that the Refuge's farming and grazing programs are compatible with the Refuge purpose of recovering threatened and endangered species, and in compliance with applicable laws, regulations, and policies including the revised Service policy on Cooperative Agricultural Use (620 FW 2).

SECTION 2. MANAGEMENT ALTERNATIVES

The Refuge has prepared a dWMWCP for the Hanalei NWR (USFWS 2020), which describes the proposed Action Alternative in detail. The following is a brief summary of the no-action alternative (Alternative A) and the action alternative (Alternative B; implementation of the dWMWCP).

2.1 ACTIONS COMMON TO ALL ALTERNATIVES

Both alternatives contain some common features. These are presented below to reduce the length and redundancy of the individual alternative descriptions. For more information, refer to Section 4.1 in the dWMWCP.

Adaptive Management. Based upon the Adaptive Management Implementation policy (522 DM 1), the Refuge will employ adaptive management for conserving, protecting, and where appropriate, restoring lands and resources. The DOI Adaptive Management Technical Guide defines adaptive management as "…a decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process" (Williams, Szaro, and Shapiro 2009).

As described in the Service's Habitat Management Planning policy (620 FW 1), annual habitat work plans (AHWPs) provide the mechanism for effectively implementing adaptive management on a refuge over time. Specifically, adaptive management entails assessing and modifying management actions, as necessary, in order to achieve habitat objectives. Management strategies and prescriptions are evaluated by comparing results to desired outcomes to assess their effectiveness. The Refuge staff has articulated specific and measurable habitat management objectives associated with wetland management and waterbird conservation (see Sections 4.2 and 4.3 in the dWMWCP), where Refuge surveys within its forthcoming Inventory and Monitoring Plan would be assessing progress toward achieving them. Documenting survey results provides a feedback loop to inform any needed and timely adjustments to management actions. Because planned and implemented management actions to achieve habitat objectives would be documented by Refuge staff and permittees (kalo farming and livestock grazing) using a format consistent with specifications for AHWPs (620 FW 1, Exhibit 2), the Refuge staff would be supporting the fundamental components of managing Refuge resources adaptively (objectives, documenting management actions, and implementing surveys to evaluate progress) in accordance with Service and Departmental policies described herein.

Avian Botulism Surveillance and Control. Refuge staff, interns, and volunteers will continue to conduct regular surveillance of loʻi kalo and rotational managed wetland units in order to control and minimize the outbreak of avian botulism. Research and monitoring on the potential environmental drivers of avian botulism outbreaks (e.g., water quality and water use) will continue. Methods for improving efficiency and detection of avian botulism will continue to be explored. These currently include the use of highly trained dogs to locate carcasses and the development of a new diagnostic assay, which uses samples from avian blood, native and invasive invertebrates, fish, and/or amphibians. Other methods for responding to avian botulism outbreaks include immediate response for dead bird removal and sick bird treatment, as well as working with farmers on water management and other best management practices (BMPs) in accordance with the avian botulism prevention and response protocol.

The Refuge will continue to monitor and manage water levels to provide suitable waterbird habitat and prevent disease outbreaks such as avian botulism. Continued efforts over the life of this plan to improve various aspects of the Refuge water delivery infrastructure (e.g., supply pipelines, ditches and valves, water control structures, drains) will increase water quantity, improve water flushing ability, and reduce water temperatures where they are most needed. These efforts will help to minimize the presence of conditions conducive to botulism spore germination and with proper water management, will reduce the severity of outbreaks as they occur, especially in the northern kalo farming units on Hanalei NWR, which have been identified as avian botulism hotspots.

Cooperative Agricultural Use. In August 2017, the Service finalized the revised Cooperative Agricultural Use policy, which outlines objectives for the use of cooperative agriculture on Refuge System lands and provides an open, transparent, and competitive process for CAAs on refuges in compliance with the DOI policy on procurement contracts, grants, and cooperative agreements (505 DM 2). Additional federal laws providing authorities for this policy include the Federal Grant and Cooperative Agreement Act (31 U.S.C. 6301–6308), Fish and Wildlife Coordination Act (16 U.S.C. 661–667e), Migratory Bird Conservation Act (16 U.S.C. 715), Refuge Administration Act (16 U.S.C. 668dd), Refuge Revenue Sharing Act (16 U.S.C. 715s), and Refuge System regulations on economic uses and cooperative land management (50 CFR 29.1–29.2). Per policy, cooperative agriculture is when a person or entity uses agricultural practices on Refuge System lands in support of objectives for target species or their associated habitats that represent the biological outcomes the Service desires, and there is substantial involvement between the Service and the person or entity. Our policy is to use cooperative agriculture as a habitat management tool only in situations where we cannot meet our resource management objectives through maintenance, management, or mimicking of natural ecosystem processes or functions.

All agricultural uses on Hanalei NWR which are appropriate and compatible, specified in a current management plan for the refuge, and cooperative in nature must be documented and awarded using a CAA through an open and competitive process. All CAAs must be in compliance with legal requirements for federal actions (e.g., NEPA; National Historic Preservation Act of 1966 [NHPA] Section 106; ESA Section 7). This EA, along with associated documents (e.g., the dWMWCP and compatibility determinations) will fulfill the prerequisites for initiating an open and competitive process for selecting and awarding CAAs.

Under both alternatives, existing permittees who currently farm kalo on the Refuge and new CAA permit applicants would be required to apply for permits through a competitive application process. The Cooperative Agricultural Use policy allows for permits with terms of up to five years, subject to regular ongoing compliance review. Formerly, permits were allocated based on prior historic use and yearly compliance with permit terms. Under the revised policy, permits would be allocated based on farming experience and history, capacity (e.g., equipment), and ability and willingness to work with the Service to implement requirements and BMPs for farming in sustainable and wildlife-compatible ways.

Cost-sharing and Fair Market Value Study. Per the Cooperative Agricultural Use policy (620 FW 2), cost-sharing is defined as the portion of the costs for cooperative agriculture on Refuge System lands that are borne by the cooperator. Cost-sharing can vary depending on the needs and objectives of the particular refuge land. For example, the Service may provide the cooperator with the right to perform agricultural practices on Refuge land and a percentage of any resulting crop yield, as well as the ability to use Service allocated water, equipment, or Refuge staff time, depending on alignment with USFWS mandates and agreement structure. In exchange, the cooperator may provide the

Service with labor, equipment, and materials; a percentage of any resulting crop yield; or maintenance, rehabilitation, or reestablishment of specific habitat conditions on Refuge lands.

The Service policy on the administration of specialized uses (5 Refuge Manual [RM] 17) requires that specialized uses, which include economic, recreational, right-of-way, and other privileged uses, must be accompanied by a fee or cooperative exchange to recover the costs of administering the special use permit and use and/or the fair market value of the benefit received.

To comply with these above policies, under all alternatives, the Service will continue to work cooperatively with kalo farmers to describe and quantify the costs of the goods and services the Service provides to the farmers, the benefits the Service receives as a result of allowing kalo farming on the Refuge, and the fair market value for kalo farming (including evaluation of land rents for comparable agriculture-related residential and farm-storage uses) to develop a fair and rational cost-sharing program related to kalo farming. This study will facilitate collaboration between the Service and the kalo farmers by providing cost-benefit analysis and illustrating both parties' responsibilities and contributions towards kalo farming on the Refuge. The details of the cost-sharing program are not determined at this time and will be developed and shared with the public prior to the application process.

Cultural and Historic Resource Protection and Section 106 Compliance. Cultural and historic resources on refuges receive protection and consideration in accordance with federal cultural resources laws, Executive Orders, regulations, and policies and procedures established by the DOI and the Service. Actions with the potential to affect cultural and historic resources will undergo a thorough review before being implemented, as is consistent with the requirements of cultural resource laws. All ground-disturbing projects will undergo a review (including, but not limited to, archaeological and cultural surveys) under Section 106 of the NHPA. The Service will provide our Regional Historic Preservation Officer (RHPO) a description and location of projects and activities that affect ground and structures, including project requests from third parties. Information will include any alternatives being considered. We will also coordinate and consult with the State Historic Preservation Division (SHPD) and seek assistance from the Native Hawaiian community and organizations on issues related to cultural resources, education, and interpretation; special programs; and NHPA.

Implementation Subject to Funding Availability. After the WMWCP is completed, actions will be implemented as funding becomes available. Draft project priorities and projected staffing/funding needs are in Appendix E of the WMWCP, although special funding initiatives, unforeseeable management issues, and other budget issues will likely require adjustments to the implementation schedule in the future. The WMWCP assumes adequate staffing and funding for implementation. However, without these resources some strategies may be deferred or modified.

Integrated Pest Management (IPM). Pests are defined as "living organisms that may interfere with the site-specific purposes, operations, or management objectives or that jeopardize human health or safety" from Department policy 517 DM 1 (Integrated Pest Management Policy). Similarly, 569 FW 1 defines pests as "invasive plants and introduced or native organisms that may interfere with achieving our management goals and objectives on or off our lands, or that jeopardize human health or safety." 517 DM 1 also defines an invasive species as "a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health." Throughout the remainder of this EA, the terms pest

and invasive species are used interchangeably because both can prevent/impede achievement of refuge wildlife and habitat objectives and/or degrade environmental quality.

In accordance with DOI and Service policies 517 DM 1 and 569 FW 1 respectively, an IPM approach would be used, where practicable, to eradicate, control, or contain pest and invasive species (herein collectively referred to as pests) on the Refuge. IPM uses methods based upon effectiveness, cost, and minimal ecological disruption, while minimizing potential effects to nontarget species and the Refuge environment. Pesticides may be used where mechanical/physical (e.g., mowing, brush-cutting, excavation, prescribed fire), cultural (e.g., water levels), and/or biological methods are impractical or incapable of providing adequate control, eradication, or containment. If a pesticide would be needed on Refuge lands or waters, the most specific (selective) chemical available for the target species would be used unless considerations of persistence or other environmental or biotic hazards would preclude it. In accordance with 517 DM 1, pesticide usage would be further restricted because only pesticides registered with the Environmental Protection Agency (EPA) in full compliance with the Federal Insecticide, Fungicide, and Rodenticide Act and as provided in regulations, orders, or permits issued by EPA may be applied on lands and waters under Refuge jurisdiction.

The Refuge's year-round program to control introduced predators is aimed at minimizing entry of species that threaten threatened and endangered species populations and native ecosystems. Methods include exclusion (e.g., fences, fish screens), habitat modification (e.g., removal of nonnative trees used by introduced cattle egrets for roosting, water drawdowns), hazing (e.g., for nonnative animal species), and control/eradication (e.g., reducing or eliminating populations of ants, mice, rats, barn owls, feral cats, feral dogs, feral pigs, and mongooses, if they are detected).

Pesticides, including periodic use of five percent borax (sodium tetraborate decahydrate), will continue to be used to control invasive ants that threaten threatened and endangered nesting birds. Humane kill traps will continue to be used to control rats and mice. Live traps will be used to capture nonnative animals such as bullfrogs, barn owls, and feral domestic animals (chickens, cats, dogs, and pigs). In addition to other methods, pellet guns may be used to humanely dispatch nonnative trapped rats, feral chickens, amphibians, and small reptiles. When other methods are impractical or unsafe, firearms will be employed to humanely dispatch introduced predators and other nonnative animals such as feral cats, feral pigs, feral chickens, barn owls, and cattle egrets. Given the need to minimize stress on animals, shooting at times is the most practical, humane, and effective method, particularly for wild or free-ranging animals. All methods of animal dispatch will follow the American Veterinary Medical Association (AVMA) guidelines for euthanasia (AVMA 2013). Firearms, which include pellet guns, will only be used by highly skilled shooters trained and federally certified in their use (USFWS 2017). Control of introduced predators and pests will be conducted by trained Service staff, volunteers, or contractors.

See Appendix D in the dWMWCP for the Refuge's IPM program documentation to manage pests.

Inventory, Monitoring, and Research. Inventory and monitoring (I&M) is required on Refuge System units based on legal mandates including the Refuge Improvement Act; NEPA final rule (43 CFR 46); and NEPA and agency decision-making (40 CFR 1505); as well as DOI and Service policies such as Habitat Management (620 FW 1); Biological Integrity, Diversity, and Environmental Health (BIDEH; 601 FW 3); Compatibility (603 FW 2); Fire Management (621 FW 1); IPM (517 DM 1, 569 FW 1); and Adaptive Management (522 DM 1).

Inventory and monitoring on refuges is intended to:

(1) Gather baseline data and record benchmark conditions used to support refuge planning;
(2) Estimate the status of and trends in fish, wildlife, plant populations, and their habitats;
(3) Assess trends in biological integrity, biological diversity, and environmental health (601 FW 3);
(4) Evaluate the effectiveness of management actions in contributing to established goals for fish and wildlife conservation by using adaptive management (522 DM 1);
(5) Provide surveillance to detect changes in the structure and function of ecological systems;
(6) Establish baseline measures and monitor wilderness character of designated wilderness on refuges to evaluate the effects of refuge management activities and uses (610 FW 2);
(7) Record impacts of environmental stressors, including climate change, on natural resources and ecological processes; and
(8) Support the Service's goal of landscape conservation by assessing similar management actions across refuges and with Service partners, including actions by multiple refuges, one or more Regions, Joint Ventures, and Landscape Conservation Cooperatives (701 FW 2).

High-priority research is facilitated on Refuge lands to provide the best science for habitat and wildlife management. Examples of research projects include habitat use and life history requirements for specific species/species groups, practical methods for habitat management and restoration, extent and severity of environmental contaminants, techniques to control or eradicate pest species, effects of climate change on environmental conditions and associated habitat/wildlife response, and modeling of wildlife populations. Projects may be species-specific, Refuge-specific, or evaluate the relative contribution of the Refuge to larger landscape (ecoregion, region, flyway, national, international) issues and trends. Like monitoring, results of research projects would expand the best available scientific information and potentially reduce uncertainties to promote transparent decision-making processes for resource management over time on Refuge lands and waters. In combination with results of I&M, research would promote adaptive management on Refuge lands and waters and be used to refine management strategies to achieve resource objectives. Scientific publications resulting from research on Refuge lands and waters will help increase the visibility of the Refuge System as a leader in the development of the best science for resource conservation and management.

In accordance with the Inventory and Monitoring policy (701 FW 2), Hanalei NWR is developing an Inventory and Monitoring Plan (IMP). The IMP will present current and expected I&M activities (surveys) for Hanalei NWR. Most surveys in the IMP will be Refuge-specific. They evaluate efficacy of resource management actions and measure progress toward resource management objectives in refuge planning documents. Some surveys gather baseline data to develop practical and measurable objectives for restoration projects or provide baseline data on biological integrity of the Refuge. The IMP will also include cooperative surveys addressing resource issues of the Service at larger landscape scales beyond the Refuge boundary or needs of other agencies and organizations. For cooperative surveys, Refuge lands are one of multiple sites, including other Refuges, to address broad-scale resource information needs. Key components of the IMP will include a comprehensive list of surveys, prioritization of these surveys, surveys selected for implementation, status of protocols for surveys, a rationale for each survey including its connection with management objectives, and a signature page documenting IMP review and approval. Although the IMP will identify many surveys needed on the Refuge, the number of surveys implemented on an annual basis is contingent upon a number of factors, including available Refuge funding and staffing as well as support from partners.

Feral Mallard and Mallard/Koloa Hybrid Removal. Feral mallards are one of the most serious threats to the continued existence of endangered koloa maoli throughout its geographic distribution (USFWS 2011). Feral mallards threaten koloa maoli with extinction through hybridization, which could lead to loss of koloa maoli as a unique Hawaiian species after only a few generations. DNA analysis indicates nonmigratory feral mallards (domesticated mallards that have escaped or been released into the wild) are cross-breeding with endangered koloa maoli (Uyehara, Engilis Jr., and Reynolds 2007; Fowler, Eadie, and Engilis Jr. 2009). In addition, feral mallards likely threaten koloa maoli and other threatened and endangered waterbirds by competing with them for limited wetlands resources, such as food and nesting sites. Removal of the threat of hybridization is a primary recovery action in the Hawaiian Waterbird Recovery Plan (USFWS 2011). DNA analysis indicates a very low level of hybridization is present on Hanalei and Hulē'ia Refuges (Malachowski et al. 2013). However, the status of the O‘ahu population is uncertain and the potential threats of new sources of feral or hybrid ducks flying or being shipped to Kaua‘i needs further evaluation.

Fish Screening. The presence and abundance of exotic fish species such as tilapia (*Oreochromis mossambicus*, *Sarotherodon melanotheron*) and poeciliid fish (*Poecilia* hybrid sp., *Gambusia affinis*) in coastal wetlands depletes food resources (e.g., aquatic insects) for native birds (McGuire 2006), degrades water quality (MacKenzie and Bruland 2012), introduces parasites (Font 2007), and increases the risk of avian botulism. Native ‘o‘opu can also enter wetlands, where they may become trapped and are unlikely to fulfill their lifecycles. The Service will continue to install and use fish screens at Hanalei NWR as a non-lethal method excluding both exotic and native fish from areas managed for threatened and endangered waterbirds. Where possible, barriers would be installed at the intake pipe of a given unit prior to the opening of the intake valves and subsequent re-inundation of the wetland.

Partnerships. Partnerships are critical components in maintaining and continuing efforts to implement resource management improvements (such as restoring habitat for threatened and endangered species). These partnerships typically involve joining forces with Federal, State, and local agencies as well as nongovernmental organizations, schools, and Friends of the Refuge groups.

2.2 ALTERNATIVE A – CURRENT MANAGEMENT (NO-ACTION ALTERNATIVE)

Alternative A describes current management activities—the baseline or “no-action” alternative for analysis of effects under NEPA. This alternative assumes little to no change in current management programs, based on pre-existing initiatives at the Refuge, and also includes actions identified in Section 2.1. A summary of differences between Alternatives A and B is provided in Table 1.

Currently, the Refuge provides a mosaic of approximately 209 acres of rotational managed wetlands and lo‘i kalo (ponds for wetland taro that are enclosed by earthen banks) for threatened and endangered waterbirds, as part of a statewide effort to implement the Hawaiian Waterbird and draft Nēnē Recovery Plans (USFWS 2004; USFWS 2011). Of the 209 acres, the Service currently manages 86 acres as rotational managed wetland (moist-soil) units (not including dikes and ditches). In addition to these managed wetland units, there is currently approximately 123 acres in lo‘i kalo of various crop stages and rotations at any point in time, including wet or dry fallows (Figure 1). A total of 160 acres is permitted for kalo farming, which includes associated dikes and ditches.

Under Alternative A, the Service would continue current management practices which include, but are not limited to, monitoring and managing protected bird species and associated habitats; coordinating, permitting, and overseeing kalo farming operations by permitees in the Refuge which provide habitat for protected bird species; maintaining 76 acres of in-use dikes and ditches; managing irrigation systems; providing law enforcement protection; and managing limited public uses and volunteer programs.

In rotational managed wetland units, moist-soil management involves the manipulation of soils, hydrology, and vegetation to mimic the natural dynamics of seasonally flooded natural wetlands. These techniques would continue to be used and improved upon in these units. Techniques such as mowing, disking, tilling, and water level management would be used to control pest species, provide forage, and create suitable habitat structure including a mosaic of native and naturalized beneficial plants. Water level management would continue to be used to provide suitable habitat and prevent disease outbreaks such as avian botulism. Measures to minimize adverse impacts to threatened and endangered waterbirds include a nest/brood search with an established protocol prior to implementing maintenance.

The provision of threatened and endangered waterbird habitat is a primary stipulation for being able to farm in the Refuge. The Service works with local farmers to continue the tradition of kalo farming in the Refuge while ensuring that the farming remains compatible with the conservation and recovery of the threatened and endangered birds that the Refuge was established to protect. Under Alternative A, permittees under CAAs would continue current kalo farming practices, which include providing a minimum 30-day wet fallow period, followed by optional dry fallow period of up to six months; reporting threatened and endangered waterbird nests within 48 hours of discovery; and maintaining a minimum three-foot radius buffer around threatened or endangered waterbird nests, leaving kalo and non-kalo plants in loʻi during harvest, until waterbirds have fledged.

The Service would continue to work with the Natural Resources Conservation Service (NRCS), kalo farmers, and other partners to develop kalo farming BMPs for improving water quality and flow and, in turn, reducing the number and severity of avian botulism outbreaks. The Service would conduct annual coordination meetings with each kalo farming permittee/cooperator (hereafter kalo permittees). Kalo permittees cooperate with the Service to implement several management activities across kalo farms in the Refuge. These include pest removal and management; avian botulism reporting and response; assistance with research and monitoring; and maintenance of fencing and water control infrastructure (dikes and ditches). Additionally, kalo permittees would continue to be required to provide records for fallow periods, herbicide and fertilizer use, ditch cleaning, and road maintenance to Refuge management annually.

If a kalo permittee has an existing residence on the Refuge, then only the permittee and their immediate family (legal parents, spouse, children) may reside in the residence. Use of Refuge lands for permittee-owned residences, storage sheds, and other facilities would not be allowed in situations where associated kalo farming CAAs are terminated.

Working with partners and stakeholders, 2–5 acres of hau (*Hibiscus tiliaceus*) would be removed per year in priority areas to enhance river corridor habitat, dependent on available funding. The Refuge would maintain fences, gates, roads, water control structures, and signs in partnership with the kalo farming permittees. The Kauaʻi NWR Complex (KNWRC) law enforcement officer would patrol the Refuge.

2.3 ALTERNATIVE B – IMPLEMENTATION OF WETLANDS MANAGEMENT AND WATERBIRD CONSERVATION PLAN – (PROPOSED ACTION ALTERNATIVE)

The chief distinction of this alternative from Alternative A is increased protection and management of biological resources, particularly regarding the kalo farming program. This alternative also includes actions identified in Section 2.1. A summary of differences between Alternatives A and B is provided in Table 1.

Under Alternative B, the Service would provide a mosaic of approximately 209–249 acres of wetland habitat (rotational managed wetlands and loʻi kalo) for foraging, loafing, and breeding threatened and endangered waterbirds throughout the year. Assignment of available lowland/wetland areas for rotational managed wetland units, loʻi kalo (via CAA), fallow, or upland habitat (e.g., koloa nesting habitat, dWMWCP Objective 2.3) would use a decision flowchart (dWMWCP, Figure 4-2) and be re-evaluated periodically using adaptive management. This flowchart allows for a more transparent decision-making framework for land use and management, while ensuring the USFWS is meeting legal mandates for recovering threatened and endangered species.

An additional 3–18 acres of rotational managed wetlands would be restored and managed as part of the above 209–249 acres (Figure 2). In rotational managed wetland units, the Refuge would focus on wetland management techniques (i.e., moist-soil management) that optimize threatened and endangered waterbird habitat such as high quality forage during critical life history periods. A range of 76–85 acres of dikes and ditches, including those in unallocated kalo farming areas and those associated with proposed wetland restoration areas, would be managed for improved water delivery and quality; and foraging and breeding waterbirds.

Under Alternative B, the Service would work with kalo permittees under CAAs and other experts to find or refine strategies that (1) benefit threatened and endangered waterbirds in support of BIDEH and the Refuge purpose and (2) take into consideration site characteristics and required kalo farming techniques. Specific strategies under Alternative B to improve waterbird habitat in loʻi kalo include: enhancement of vegetation structure during all crop stages by not intensively clearing selected non-kalo plant species that are beneficial to birds; maintaining a minimum 6-foot radius unharvested vegetation buffer around threatened or endangered waterbird nests and coordinating with Refuge staff on additional protective measures, as needed; protecting nests and broods during the harvest stage; reducing the number of drawdowns when nests are present; and managing suitable plant cover on dikes and ditches to provide food, cover, and nesting material. The amount of time stipulated for kalo permittees to report threatened or endangered waterbird nests to Refuge staff would be changed from 48 to 24 hours.

Additionally, the Service would work with NRCS and kalo permittees to develop and implement fertilizer and herbicide management plans. Kalo permittees would be required to participate in relevant aspects of the Avian Botulism Prevention and Response Protocol as part of their CAA, including thoroughly draining and aerating loʻi kalo after the wet fallow period, prior to replanting. Incentive mechanisms for kalo farmers would be explored to encourage the use of more sustainable practices above and beyond the required permit stipulations. For example, using a 60 day or longer wet fallow followed by a two to six month dry fallow after tilling organic matter into soil; experimenting with ecologically friendly alternatives to traditional chemical fertilizers; and exploring

organic kalo farming and "wildlife-friendly" BMPs or certifications. See the dWMWCP for more background information on kalo farming.

Farmers would be invited to bi-annual meetings/workshops; would meet quarterly with the Service on avian botulism response; participate in a water budget analysis; and assist the Service in developing a plan of operations for ditch cleaning and fence maintenance. Proposed changes regarding on-Refuge residences include: (1) No new farm residences on Refuge property, (2) At least one permit holder must live in the residence, and (3) Size of use area by permittee would be delimited in CAA.

Law enforcement would assist Refuge staff in developing a compliance monitoring system. The Refuge would focus on more partnering, workshops, outreach, and training for Refuge staff, permittees/cooperators, partners, and the community.

Mowing and using of prescriptive seasonal livestock grazing, without compromising water quality or riparian habitat, would enhance grasslands habitat for nēnē on approximately 14–24 new acres. In addition, approximately 21 acres would be enhanced as koloa maoli nesting habitat (Figure 2).

For full details on Alternative B, see the dWMWCP (USFWS 2020).

TABLE 1. SUMMARY OF DIFFERENCES BETWEEN ALTERNATIVES A AND B

Alternative A (Current Management)	*Alternative B (Proposed Action)*
Habitat Quantity	
86 acres of rotational managed wetland (moist-soil) units 160 total acres of kalo farms (9 parties), including dikes and ditches: • **123** acres of allocated loʻi kalo • 13 acres of unallocated loʻi kalo	Provide a mosaic of **209–249** acres of wetland habitat (rotational managed wetlands and loʻi kalo). The upper bound of acreage includes unallocated loʻi kalo and enhanced or restored seasonal/rotational wetlands. Assignment of acreage among rotational managed wetland units, loʻi kalo (via cooperative agriculture agreement [CAA]), fallow, or upland habitat (e.g., koloa nesting habitat) would be based on a decision flowchart and reevaluated periodically using an adaptive management framework
76 total acres of in-use dikes and ditches	**76–85** acres of dikes and ditches (including within unallocated kalo farming areas and associated with proposed wetland restoration areas) managed under BMPs to improve waterbird habitat and water quality
	Enhance or restore **3–18** acres of seasonal/rotational wetlands
	Use mowing and livestock grazing to enhance and manage **14–24** acres of riparian habitat for nēnē breeding and foraging Develop prescribed grazing and monitoring plan
	Enhance and manage **21** acres of upland habitat for nesting koloa maoli
Reduce hau by **2–5** acres/year in priority areas	Same as current
Permits for Cooperative Kalo Farming; Residences and Farm Storage Areas	
Currently permitted annually under general SUP but transition to CAAs, awarded through competitive application	Implement CAAs, awarded through competitive application, with terms up to five years subject to regular ongoing compliance review

Alternative A (Current Management)	*Alternative B (Proposed Action)*
Develop cost-sharing program through CAA Current SUP fee of $25/cultivated acre/year (does not apply to other farm use areas used for houses, storage, etc.) may or may not be waived or increased	Same as current
If permittee has an existing residence on the Refuge, then only immediate family (legal parents, spouse, children) may reside in the residence	Same as current, but also: • No new farm residences are authorized on Refuge property • At least one permit holder must live in the residence. • Size of use area by permittee would be delimited in CAA/SUP
Use of Refuge lands for permittee-owned residences, storage sheds, and other facilities would no longer be allowed when associated kalo farming **CAAs and SUPs** are terminated	Same as current
	Develop compliance monitoring system that is reviewed and updated annually
Kalo Farming Stipulations	
Minimum requirement of 30-day wet fallow followed by optional dry fallow <180 days total	Same as current
	Enhance vegetation structure of loʻi habitat (all stages) by maintaining either: • ≥10% cover of beneficial non-kalo emergent plants in understory within each loʻi; • ≥20% cover of beneficial non-kalo emergent plants in understory on ≥50% of loʻi; or • ≥10% of total loʻi acreage in vegetated wet fallow to promote growth of non-kalo emergent plants

Alternative A (Current Management)	*Alternative B (Proposed Action)*
Permittees are to report threatened or endangered waterbird nests within **48** hours of discovery **3-foot radius buffer** around threatened or endangered waterbird nests in loʻi kalo	Permittees are to report threatened or endangered waterbird nests within **24** hours of discovery **Minimum 6-foot radius buffer** around threatened or endangered waterbird nests in loʻi kalo. Permittees are to coordinate with Refuge staff to minimize impacts or take of birds by implementing additional protective measures as needed, such as delaying harvest in areas where nests are known to occur until the young birds fledge or leave the loʻi on their own accord Initiate a study of the relative effectiveness of different size nest buffers on nest and fledging success of threatened and endangered waterbirds within three years; modify buffer requirements and compatibility stipulations if necessary
	Permittees are required to maintain vegetation 4–6 inches in height on ≥75% of dike tops in each permit area using mowing or brush-cutting
Permittees provide to the Refuge logs of: • Specific dates and locations of wet and dry fallow periods • Herbicide and fertilizer application dates, types, and amounts • Ditch cleaning and road maintenance or repair	Same as current
	Each permittee must cooperate with the Refuge on developing fertilizer and herbicide management plans
Work with NRCS, farmers, and other partners to develop kalo farming BMPs, for improving water quality and flow and stemming avian botulism mortalities	Same as current

Alternative A (Current Management)	*Alternative B (Proposed Action)*
Permittees are to report sick/dead birds within **24** hours of discovery Permittees are encouraged to participate in relevant aspects of the Avian Botulism Prevention and Response Protocol as part of their SUP. If a given kalo patch is identified as an avian botulism hotspot, then work with Refuge staff to change environmental conditions.	Same as current but also: Permittees will be required to participate in relevant aspects of the Avian Botulism Prevention and Response Protocol as part of their **CAA and SUP**. In avian botulism prone areas, implement BMPs which include reconfiguring pipelines to remove all flow-through drains and draining, harvesting, and dry fallowing lo'i for ≥30 days, pending Refuge request
	Thoroughly drain and aerate every kalo patch after the 30-day wet fallow period prior to replanting
Regular coordination meetings (e.g., avian botulism-related) and cooperation on maintaining infrastructure; IPM; monitoring and research	Same as current
	Within three years of WMWCP completion, develop incentive mechanisms for the use of more sustainable and wildlife-friendly farming practices (e.g., maintaining larger nest buffers and use of ≥60-day vegetated wet-fallow period followed by a 2–6-month dry fallow period after tilling organic matter into soil

2.4 ALTERNATIVE(S) CONSIDERED, BUT DISMISSED FROM FURTHER CONSIDERATION

2.4.1 CULTIVATION OF GENETICALLY MODIFIED CROPS

In accordance with BIDEH policy (601 FW 3), the Service would not allow cultivation of genetically modified crops (GMCs) on the Refuge unless their use is essential to accomplishing the Refuge purpose and the Director approves the use. In order to consider GMC use, an Eligibility Questionnaire for Genetically Modified Crops must be completed and refuge compliance documents (e.g., Appropriate Use [603 FW 1], Compatibility Determination [CD; 603 FW 2], NEPA, and ESA Section 7) must be updated. Additionally, several other factors may prevent approval of the use of GMCs such as state or local laws. Currently, GMCs are not cultivated on Hanalei NWR. The use of GMCs is not essential for accomplishing the Refuge's purpose and consequently it is not included in the proposed action.

2.4.2 ELIMINATING KALO FARMING

Kalo farming in the Hanalei Valley existed prior to and at the time of establishment of Hanalei NWR and has continued under SUPs since that time. Kalo farms offer shallow-water habitat that can satisfy some of the life history requirements of threatened and endangered waterbirds (Gee 2007; Gutscher-Chutz 2011) and provide a means to manage supplemental waterbird habitat on Hanalei NWR. Kalo farming currently provides up to 160 acres of supplemental habitat (including dikes and ditches) in addition to the 86 acres of rotational managed wetland units on the Refuge. Along with associated upland and riverine habitats, the Refuge's loʻi kalo and rotational managed wetland units represent 70 percent of the core habitat on Kauaʻi designated as essential to the recovery and delisting of endangered waterbirds (USFWS 2011).

Both historically and in the present day, kalo has cultural, spiritual, economic, and political significance in Hawaiian society. During the 1980s, the Hanalei Valley was identified by the National Trust for Historic Preservation (NTHP) as an important site for rural preservation. Farming on Hanalei NWR represents a substantial portion of kalo acreage and production statewide, estimated at 40–60 percent (Cho, Yamakawa, and Hollyer 2007; Gutscher-Chutz 2011; NASS 2017). Kalo farming on the Refuge is of economic importance to the State of Hawaiʻi, including to the tourism industry and the local communities. The Service recognizes and values these cultural and historical dimensions of kalo farming on the Refuge. For these reasons, and in the context of current and anticipated staffing and resources limitations, the Service dismissed the alternative of eliminating kalo farming on the Refuge from further consideration.

Figure 1. Alternative A (No-Action Alternative) wetland habitat units and other management areas.

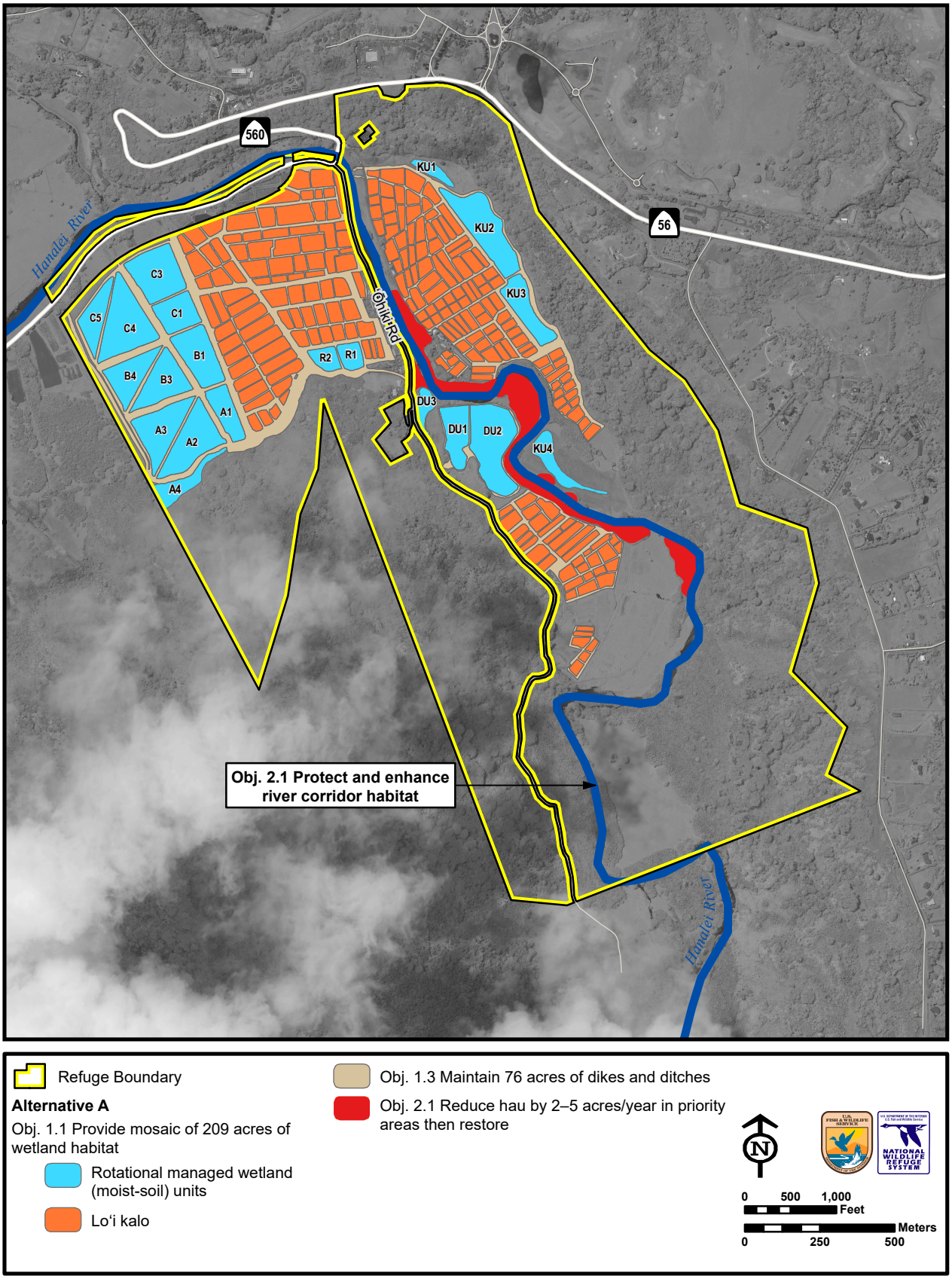
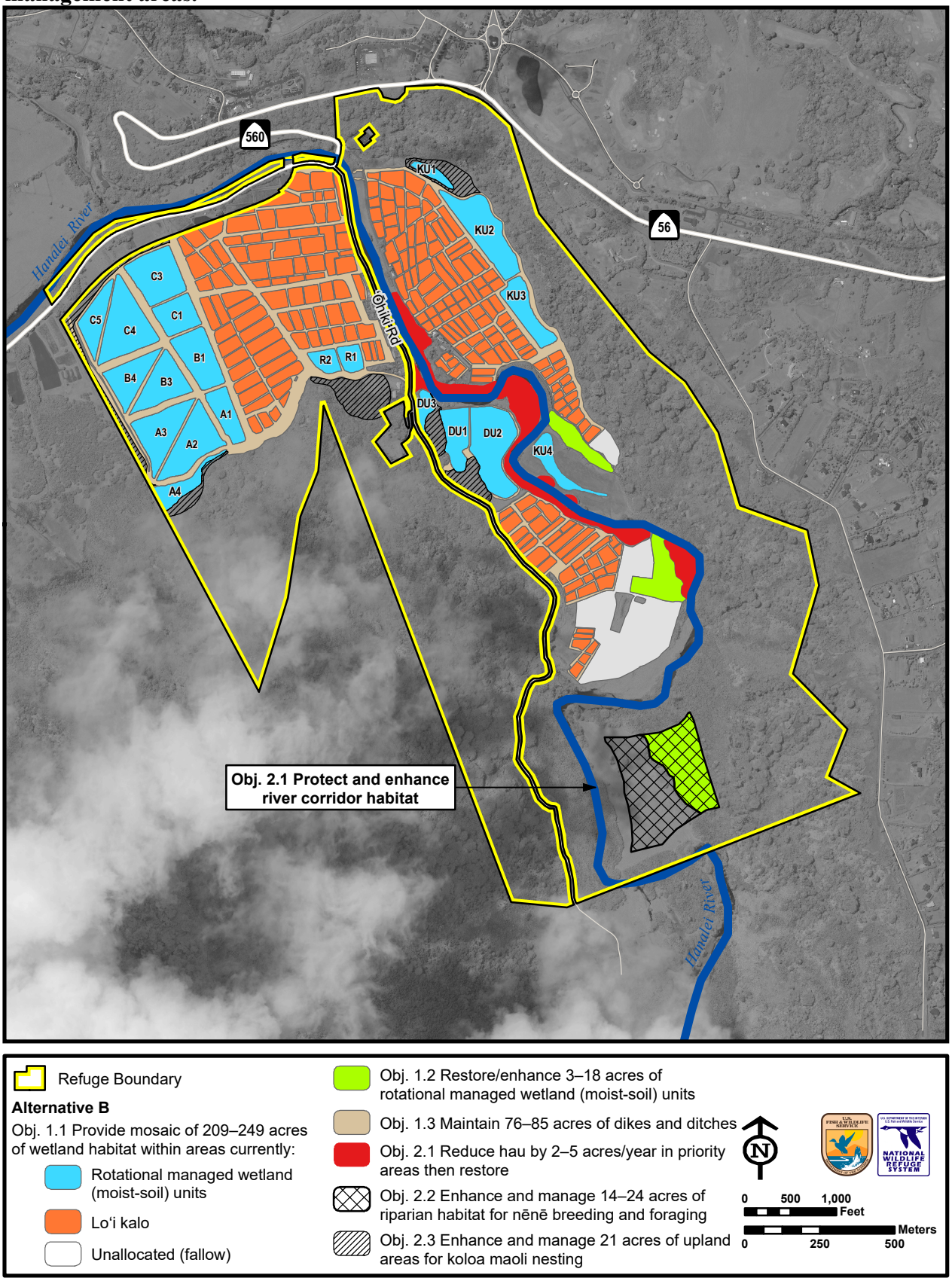


Figure 2. Alternative B (Proposed Action Alternative) wetland habitat units and other management areas.



SECTION 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This section describes the existing environmental and socioeconomic settings in the affected area and also analyzes the environmental consequences of the action on each affected resource, including direct and indirect effects. The affected environment for each affected resource is summarized first, followed by the effects of Alternative A, the effects of Alternative B. Cumulative impacts are described in Section 1.13. For more information regarding the affected environment, please see Chapter 2 of the Refuge's dWMWCP (USFWS 2020).

This EA includes analyses of the environmental consequences on a resource only when the effects on that resource could be more than negligible and therefore considered an "affected resource," or are otherwise considered important as related to the proposed action (even if the effects are negligible). The proposed action would have negligible effects to air quality and visual quality; these have therefore been dismissed from further analyses. Consequences are analyzed based on the following effect types:

- **Direct effects** are those which are caused by the action and occur at the same time and place.
- **Indirect effects** are those which are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable.
- **Cumulative impacts** result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions.

The terms below were used to describe the scope, scale, and intensity of effects on natural, cultural, social (including recreational), and economic resources. Effects may be identified further as beneficial or negative.

- **Neutral or Negligible.** Resources would not be affected (neutral effect), or the effects would be at or near the lowest level of detection (negligible effect). Resource conditions would not change or would be so slight there would not be any measurable or perceptible consequence to a population, wildlife or plant community, recreation opportunity, visitor experience, or cultural resource. If a resource is not discussed, impacts to that resource are assumed to be neutral.
- **Minor.** Effects would be detectable within the Refuge, but localized, small, and of little consequence to a population, wildlife or plant community, other natural resources; social and economic values, including recreational opportunity and visitor experience; or cultural resources. Mitigation, if needed to offset adverse effects, would be easily implemented and successful based on knowledge and experience.
- **Intermediate or Moderate.** Effects would be readily detectable and localized with measurable consequences to a population, wildlife or plant community, or other natural resources; social and economic values, including recreational opportunity and visitor experience; or cultural resources. Mitigation measures would likely be needed to offset adverse effects, and could be extensive, moderately complicated to implement, and probably successful based on knowledge and experience.
- **Significant (major).** Region-wide effects would be obvious and would result in substantial consequences to a population, wildlife or plant community, or other natural resources; social

and economic values, including recreational opportunity and visitor experience; or cultural resources. Extensive mitigating measures may be needed to offset adverse effects and would be large-scale in nature, possibly complicated to implement, and may not have a high probability for success. In some instances, major effects would include the irretrievable loss of the resource.

Time and duration of effects have been defined as follows:

- **Short-term or Temporary.** An effect that generally would last less than a year or season.
- **Long-term.** A change in a resource or its condition that would last longer than a single year or season.

3.1 GENERAL SETTING

Hanalei NWR consists of approximately 917 acres in Kauaʻi County in the State of Hawaiʻi. The Refuge lies in a relatively flat river valley ranging in elevation from 20 to 40 feet above sea level and includes some steep wooded hillsides reaching up to 1,600 feet. A portion of the Hanalei River, which is a designated American Heritage River, runs through the Refuge before emptying into Hanalei Bay. This river is perennial and low-gradient in this section of the Refuge. The proposed action is located in approximately 480 acres, including 86 acres of rotational managed wetland impoundments; 123 acres of loʻi kalo (wetland taro fields); and 189 acres of riparian habitat. (Figure 1). Approximately 80 acres of dikes and ditches and canals (range of 76–85 acres) are used to supply water to, and manage water in, rotational managed wetland units and loʻi. These are included in the acreage totals above.

3.2 THREATENED AND ENDANGERED SPECIES AND OTHER SPECIAL STATUS SPECIES

3.2.1 AFFECTED ENVIRONMENT

Five species of federally listed Hawaiian waterbirds use the Refuge's rotational managed wetlands, loʻi kalo, fallow, and riparian habitat for foraging, nesting, and brood rearing: endangered koloa maoli, endangered ʻalae keʻokeʻo, endangered ʻalae ʻula, endangered aeʻo, and threatened nēnē. Adjacent upland habitat is also used by koloa maoli for nesting. Endangered ʻōpeʻapeʻa (Hawaiian hoary bats, *Lasiurus cinereus semotus*) use the Refuge as a day roost. No critical habitat designations have been identified for these species.

Listed species receive special consideration in terms of refuge management. Federally listed species are trust resources that require additional consultation whenever an activity conducted by or permitted by the Refuge may have an effect on these species or their habitats. For Hawaiʻi, if a species is federally listed, it is also state listed. The following is summarized from the dWMWCP, Section 2.5.1:

Koloa maoli: The population size of koloa maoli is about 2,200 birds, including 2,000 on Kauaʻi and Niʻihau and 200 on Hawaiʻi Island. However, current population estimates are unreliable because detection rates and montane habitats were not included in calculations. Hanalei and Hulēʻia NWRs are the only NWRs and some of the only prime habitat currently supporting true (not hybridized with feral mallard) koloa maoli populations, elevating the importance of these Refuges in the species'

recovery. From 2010 to 2015, the average number of koloa maoli counted during monthly population monitoring at Hanalei NWR was 388 (range 131–817, SE 16.1) (dWMWCP, Figure 2-3).

ʻAlae keʻokeʻo: The statewide population is estimated to range between 2,000 and 4,000 birds. From 2010 to 2015, the average number of ʻalae keʻokeʻo counted during monthly population monitoring at Hanalei NWR was 254 (range 35–641, SE 16.2) (dWMWCP, Figure 2-5).

ʻAlae ʻula: The total population size is currently unknown; however, it is believed to be less than 2,000 individuals, but stable. From 2010 to 2015, the average number of ʻalae ʻula counted during surveys at Hanalei NWR was 391 (range 203–675, SE 11.3) (dWMWCP, Figure 2-6).

Aeʻo: Recent estimates place the population at approximately 1,400–2,200 birds. From 2010 to 2015, the average number of aeʻo counted during monthly population monitoring at Hanalei NWR was 233 (range 40–362, SE 9.0) (dWMWCP, Figure 2-8).

Nēnē: The 2017 statewide population of wild nēnē was estimated to be 3,252 individuals with 1,482 (46 percent) on Kauaʻi (USFWS unpublished). From 2010 to 2015, the average number of nēnē counted during monthly population monitoring at Hanalei NWR was 115 (range 40–211, SE 4.7) (dWMWCP Figure 2-10). On January 21, 2020, the Service reclassified nēnē from endangered to threatened status because species' status has improved such that it is not currently in danger of extinction throughout all or a significant portion of its range (84 FR 69918).

ʻŌpeʻapeʻa: The population size of ʻōpeʻapeʻa is unknown. Resident populations occur on Kauaʻi, Maui, and Hawaiʻi and possibly other main islands, with the highest abundance on Kauaʻi and Hawaiʻi. These bats have been observed on the Refuge, and an ongoing acoustic call detection study initiated in 2016 indicate bats are roosting on the Refuge during the day.

A significant proportion of threatened ʻaʻo (Newell's shearwater; *Puffinus newelli*) and ʻuaʻu (Hawaiian petrel; *Pterodroma sandwichensis*) were using the Hanalei Valley flyway (Cooper and Day 1995). Radar surveys showed ʻaʻo and ʻuaʻu transiting to and from breeding colonies in the morning and evening hours directly over the Refuge (Andre Raine 2012, pers. comm.). The endangered Hawaiʻi Distinct Population Segment of ʻakēʻakē (band-rumped storm-petrel) may also use the Hanalei Valley flyway.

3.2.2 EFFECTS OF ALTERNATIVE A (NO-ACTION)

THREATENED AND ENDANGERED HAWAIIAN WATERBIRDS

Habitat Quality/Rotational Managed Wetlands

Under Alternative A, current acreage and management of rotational managed wetlands would continue. No new wetlands would be created. Moist-soil management techniques used within rotational managed wetland units to manipulate native and naturalized beneficial nonnative vegetation provide important structure for threatened and endangered waterbird nesting, foraging, brooding, loafing, and thermal/escape cover. Annual plants resulting from moist-soil management produce an abundance of seeds that are readily available and consumed by waterbirds. As moist-soil annuals decompose, they provide substrate and forage for aquatic invertebrates which are also an important food resource for waterbirds, particularly young waterbirds and pre-laying hens.

The Refuge works to minimize direct or indirect mortality of threatened and endangered waterbirds (e.g., accidental destruction of nests, disturbance of young broods, flooding of nests) during habitat management such as mowing, disking, tilling, spraying herbicide, and pulsing water. For example, as possible, maintenance activities are scheduled outside of peak rail (ʻalae keʻokeʻo and ʻalae ʻula) breeding and koloa maoli molting season (May–July). Additionally, waterbird nest/brood searches are conducted, commensurate with breeding activity, prior to habitat management. If nests or broods are discovered, maintenance schedules are shifted with other work to avoid or minimize adverse impacts to threatened and endangered species. Without the habitat management described above, the managed wetlands units could become overgrown with invasive plants, such as California grass, within 1–2 years and would be of little value to waterbirds.

Water level drawdowns may result in die-offs of tilapia and other introduced fish species (e.g., Chinese catfish, mosquitofish), which could increase the risk of avian botulism outbreaks by providing a protein substrate for pathogens. However, this type of water level manipulation in managed wetland units is typically short (several days) and management units are re-inundated with freshwater afterwards. Thus, these techniques are overall beneficial and a necessary part of Refuge operations to provide functional wetlands habitat to meet the needs of the threatened and endangered waterbirds.

Overall, continuation of current management under Alternative A would result in minor to intermediate long-term benefits to threatened and endangered waterbirds since the amount and quality of habitat, and management techniques would remain the same as present.

Habitat Quality/Dikes and Ditches

Although the importance of dikes in meeting the life history needs of wetland birds is uncertain, dikes may provide opportunities for ʻalae keʻokeʻo and ʻalae ʻula to establish pair bonds. Koloa maoli use dikes for resting (Malachowski and Dugger 2018). Dikes are elevated and often provide good visibility, which possibly aids in predator detection, and quick access to escape cover. Dikes provide forage for grazers like nēnē, ʻalae ʻula, and ʻalae keʻokeʻo. ʻAlae ʻula forage on California grass shorter than four inches tall, which is a good source of protein and carbohydrates (DesRochers et al. 2009). Maintaining dikes with low to intermediate growing grasses and leafy forbs also helps to control pest plants and reduces concealment cover for introduced predators. Vegetated ditches supporting macroinvertebrates provide supplemental foraging and breeding habitat for ʻalae ʻula and koloa maoli.

Dikes are currently maintained by periodic mowing and ditches are maintained by using approved mechanical vegetation cutting and/or herbicides. Without maintenance, dikes and ditches become overgrown within months, limiting the value of the habitat and ability to manage wetlands, especially to properly drain and aerate units. Under Alternative A, continued maintenance of dikes and ditches would facilitate water level management within both rotational managed wetlands and kalo farms and provide minor to intermediate habitat benefits.

Habitat Quality/Riparian and Upland

Hanalei NWR has approximately 189 acres of degraded riparian habitat which extends from the active river channel to the upland edge of the 100-year floodplain. Under Alternative A, no additional riparian habitat would be managed as nēnē foraging and breeding habitat or upland koloa maoli nesting areas. Therefore, effects to threatened and endangered waterbirds would be neutral.

Habitat Quality/Kalo Farms

As currently practiced, kalo farming meets some of the life history needs of threatened and endangered waterbirds (Gee 2007; Gutscher-Chutz 2011) and supplements the native and naturalized habitats provided by the neighboring, rotational wetland (moist-soil) management units. However, loʻi kalo provides unstable (e.g., fluctuating water levels, artificial additives) and thus lower quality habitat for threatened and endangered waterbirds when compared to wetlands managed for a varied moist-soil plant community, carefully designed topography features and water depth, and less disturbance. Some kalo farming practices reduce food and cover, and cause disturbance to threatened and endangered birds. See dWMWCP Section 2.3 and Appendix B, Draft CD for Cooperative Kalo Farming; Residences and Farm Storage Areas (Residential [other] and Farming), for additional information.

Under both alternatives, CAAs would include stipulations designed to ensure compatibility. Without adherence to stipulations, kalo farming practices could conflict with the establishment purpose of Hanalei NWR and other legal mandates such as the ESA. For example, Refuge kalo farming CAAs require that following harvest, loʻi be kept in wet fallow for a minimum of 30 days; however, field observations reveal that this is not always occurring (Gee 2007).

Under Alternative A, current management practices would continue, including potentially conflicting practices such as flooding and drying cycles timed to benefit kalo, rather than threatened and endangered waterbirds, their nesting requirements, or production of invertebrate and plant foods. Kalo farming often involves control of non-kalo plants through hand-weeding, mowing, dewatering loʻi, or application of pesticides. While these practices enhance kalo production, they reduce the value of habitat to threatened and endangered waterbirds (less forage, reduced cover, reduced availability of nesting structure and materials, and reduced invertebrate production) compared to less intensively managed loʻi and fallow loʻi where non-kalo emergent vegetation was present.

Therefore, under Alternative A, loʻi kalo would continue to provide for some life history needs of threatened and endangered waterbirds, but to a lesser degree than under Alternative B. Continuation of current management practices would result in less vegetative cover for nests and broods, and less available food resources (both non-kalo plants and invertebrates) compared to Alternative B.

Disease Mortality

Although the first case was reported in the late 1970s, outbreaks of avian botulism type C, a paralytic disease caused by ingestion of a toxin produced by the bacterium *Clostridium botulinum*, have occurred with regularity at Hanalei NWR since November/December 2011. Between 2011–2018, 1342 cases of avian botulism were recorded on the Refuge (Reynolds et al. 2019). These botulism outbreaks have killed individuals of all five federally listed waterbird species occurring on the Refuge and have been particularly detrimental to koloa maoli, which represents 62% of birds affected (Reynolds et al. 2019). Unlike mainland avian botulism events, outbreaks on the Refuge can occur year-round due to lack of seasonal variability in temperatures; however, they have been most prevalent in the northern loʻi kalo during the winter months.

Environmental conditions associated with avian botulism outbreaks include temperatures between 20– 40°C, low dissolved oxygen, pH between 7.5 and 9.0, negative redox potential, and sources of decaying organic matter (especially protein such as decaying fish) (Rocke and Bollinger 2007; Rocke and Samuel 1999). The hydrological infrastructure and management of the Refuge, particularly within certain areas of loʻi kalo, might influence the abiotic growth factors for *C. botulinum*, alter the

availability of growth media, or lead to buildups of the toxin in areas with less water flow to flush the toxin. Factors leading to *C. botulinum* growth might also vary naturally or with other management practices, such as loʻi kalo drawdowns, fertilization, or pesticide application. Hotspot (density) mapping of avian botulism cases based on data from 2011–2015 showed that although the location of hotspots varied somewhat from year to year, the most severe outbreaks (i.e., highest density botulism hotspot) occurred in loʻi kalo in the northern part of the Refuge. The kalo regions Refuge-wide had similar densities of live/healthy koloa maoli; however, the northern kalo regions (northeast and west) contained more dead/sick koloa maoli relative to the numbers of live/healthy koloa maoli using these areas (McDonald 2016).

Under Alternative A, current avian botulism surveillance and control, conducted by both Refuge staff and kalo permittees, would continue. Improved compliance with permit terms would have minor positive impacts to water quality, which may slightly reduce outbreaks. However, we would expect that under current management, there would be only minor improvements to water quality, and therefore the frequency and severity of avian botulism outbreaks are expected to remain similar to the present.

Predation

Under both alternatives, the Service would continue to use fencing, live trapping, and bait stations to control or exclude vertebrate pests. Feral mallards and other vertebrate pests are removed by Refuge staff and permittees, and three miles of protective fencing is maintained to exclude pigs and dogs. This fencing is, however, insufficient to exclude other vertebrate pests such as cats and rats.

Resident farmers are allowed to keep some domesticated animals on the lands they occupy associated with their houses (their permit areas). Because Hawaiʻi's threatened and endangered waterbirds evolved in the absence of mammalian predators and some birds nest directly on the ground, domestic animals, especially cats and dogs, running loose (i.e., feral animals) or being kept in areas that waterbirds use regularly on the Refuge, pose a threat to waterbird recovery, and can result in unlawful wildlife disturbance.

Storage of abandoned equipment and nonhazardous waste within or adjacent to permit areas, and improper disposal of organic material can attract pests, such as rats. These pests can prey on threatened and endangered waterbirds and be disease vectors. Under both alternatives, the Service would continue to work with kalo permittees to ensure compliance with permit stipulations regarding pets, livestock, proper disposal of trash and non-organic waste, and reducing the sources of vertebrate pests.

Under Alternative A, predation of threatened and endangered waterbirds by vertebrate pests is likely to continue at current levels.

Disturbance

Disturbance can cause both direct mortality (e.g., through nest abandonment) and reduced fitness (greater energy expenditure, reduced foraging) of wildlife. Currently, public use of the Refuge is extremely limited. Most disturbance occurs as a result of wetland management and kalo cultivation by Service staff and permittees. Refuge staff presence is consistent with a level necessary to conduct biological monitoring, botulism surveillance and response, predator control, water management, Refuge operations, and maintenance (under normal circumstances, one to five visits per week). Many of the activities associated with kalo farming disturb or have the potential to disturb wildlife,

including threatened and endangered waterbirds that use the loʻi and surrounding areas as habitat (Gee 2007).

The Hanalei Valley's warm and wet climate allows kalo farming to occur year-round, so loʻi kalo and associated features (e.g., dikes, ditches, and banks) are manipulated year-round. This includes numerous farm production activities, such as plowing, tilling, fertilizing, liming, planting, weeding, mowing, applying pesticides, managing water levels, and harvesting. Some activities (e.g., flooding and dewatering, weeding, and application of fertilizer and lime) are repeated multiple times throughout the production cycle (Gee 2007).

During nonbreeding periods, nēnē, aeʻo, and ʻalae keʻokeʻo appear to be fairly tolerant of disturbance. However, when birds are breeding or in heavy molt, they are all more vulnerable to disturbance and predation. Koloa maoli and ʻalaeʻula are very wary and often flush or move quickly into dense cover when disturbed (Gutscher-Chutz 2011). Flushing of birds or even raising their alert levels creates stress and requires animals to expend energy that would otherwise be invested in essential life history activities such as foraging, mating, nesting, brood-rearing, and predator avoidance. Disturbance can cause nest desertion; affect survival of individual birds, eggs, nestlings, or broods; and alter behavior of nonbreeding waterbirds. Overall, koloa maoli were disturbed less often in rotational managed wetlands than in kalo farms; however, the difference in human-related disturbances between wetland types was comparatively small (10 percent vs. 14 percent) and of uncertain biological significance (Malachowski and Dugger 2018).

Loʻi water levels are fluctuated and kalo corms, stalks, and leaves are harvested during times when some waterbirds are nesting over water in mature kalo plants. This can increase nest flooding, nest desertion, and increase the vulnerability of nesting waterbirds, their eggs, and their chicks to predation. Gee (2007) followed ʻalae ʻula nests that were primarily found during kalo harvest on the Refuge. These nests experienced average nest success, but low fledging success. Nest failure was attributed to predation, abandonment, and flooding.

Some kalo farming on the Refuge includes management or removal of unwanted vegetation from banks, ditches, and dikes. Dike top mowing allows enhanced predator visibility for foraging ʻalae keʻokeʻo, ʻalae ʻula, koloa maoli, and nēnē (Gee 2007). However, these management practices also create wildlife disturbance.

Under both alternatives, public use is minimal and most disturbance is associated with wetland management or kalo cultivation activities. A waterbird nest/brood search is done prior to maintenance or water level changes in rotational managed wetlands and maintenance is scheduled outside of peak rail breeding and koloa molting periods. In managed wetland units, Refuge staff minimize water level fluctuations during threatened and endangered waterbird laying and incubation periods. Requirements for dike maintenance (mowing) would assist waterbirds in detecting and avoiding non-native predators.

Overall, disturbance would be greater under Alternative A than under Alternative B.

Disturbance and Predation during Kalo Harvest

Under Alternative A, kalo permittees are required to maintain an unharvested vegetation buffer with at least three feet (radius) around threatened and endangered waterbird nests to provide concealment and protect breeding birds, nests, and young from weather, disturbance, and introduced predators. This nest buffer is not based on empirical data and appears to be inadequate (Gee 2007) and in need

of expansion and re-evaluation (Paveglio et al. 1999) to prevent detrimental effects on breeding adults and offspring. Thus, nest failure rates in loʻi kalo are likely to be higher under Alternative A than under Alternative B.

EFFECTS TO OTHER LISTED SPECIES

Effects to Other Listed Species

Alternative A should result in negligible impacts to other listed species. There is no evidence of wetlands management conflicts with the endangered ʻōpeʻapeʻa, which is a solitary tree-roosting species, or to listed seabirds that fly over the affected area.

3.2.3 EFFECTS OF ALTERNATIVE B (PROPOSED ACTION)

THREATENED AND ENDANGERED HAWAIIAN WATERBIRDS

Habitat Quantity and Quality/Rotational Managed Wetlands

Under Alternative B, increased management to benefit threatened and endangered waterbirds would occur primarily through increasing the amount of and improving the quality of habitats provided to meet the species' life history needs. An additional 3-18 acres of wetlands would be enhanced or restored under this alternative. Further, the transition of management paradigm to an adaptive management framework would promote the purpose of the Refuge by providing habitats that meet life history requirements for threatened and endangered waterbirds, while allowing for management flexibility to adjust to changing conditions (e.g., additional information from inventory and monitoring, disease outbreaks, availability of funding and resources, compliance with conditions of CAAs). This framework would also enable the spatial reconfiguration of management strategies; for example, retired or unallocated acreage could be allocated to rotational managed wetlands or exchanged for existing loʻi kalo acreage depending upon soil, hydrological, and other environmental conditions.

Overall, compared with both baseline conditions and Alternative A, there would be more opportunities under Alternative B for threatened and endangered waterbirds to survive and reproduce and establish self-sustaining populations, thus assisting with their recovery (and eventual downlisting and delisting from the Endangered Species List). The beneficial effects would be minor to intermediate and long-term.

Habitat Quantity and Quality/Dikes and Ditches

Under Alternative B, the acreage of dikes and ditches would be increased from 76 to a range of 76–85 acres, including those acres within unallocated kalo farming areas and those associated with proposed wetland restoration areas. In addition to an increase in area, dike habitat and some ditches would be enhanced with herbaceous vegetation and provide more forage and nesting cover (e.g., for ʻalae ʻula and koloa maoli [Gee 2007]). The development and implementation of BMPs for ditch maintenance would also improve water quality within the ditches themselves. In addition, a Plan of Operations associated with CAAs would be developed to document ditch cleaning responsibilities. This would enhance water delivery to both loʻi and rotational managed wetlands, facilitate drying and aerating of soils, and provide benefits to threatened and endangered waterbirds (improved ability to flood or dewater wetlands, improved water quality/quantity). Consequently, Alternative B would result in minor to intermediate benefits.

Habitat Quantity and Quality/Riparian and Upland

Under Alternative B, additional habitat would be managed for foraging and breeding nēnē and nesting koloa maoli. For nēnē, there would be 14–24 acres of floodplain habitat mowed or managed with seasonal livestock grazing. For koloa maoli, there would be 21 acres of upland habitat also mowed or managed with seasonal livestock grazing. Due to the increase in managed acreage and habitat quality, this alternative is expected to have overall beneficial and minor to intermediate long-term effects.

Habitat Quality/Kalo Farms

Loʻi kalo in post-harvest wet fallow are heavily used by threatened and endangered waterbirds, in part because this stage generates substantial invertebrate biomass. Its shallowly flooded sediments are easily accessed by wildlife and potential predators are clearly seen (Broshears and Parrish 1980; Gutscher-Chutz 2011). Under Alternative B, there would be incentive mechanisms in place for farmers to provide longer wet fallow and dry fallow periods compared to current management under Alternative A (60 days or more of vegetated wet-fallow, followed by a two to six month dry fallow period). This would result in longer periods of invertebrate availability for foraging ʻalae ʻula, ʻalae keʻokeʻo, and koloa maoli. This would also result in reduced predation during foraging, since foraging birds can detect predators more easily in fallow loʻi.

Under Alternative B, the vegetation structure of loʻi habitat (all stages) would be enhanced by requiring kalo permittees to manage for one of the following:

- ≥10% cover of beneficial non-kalo emergent plants (≥3 species of low-growing annuals, <6–12 inches tall; e.g., *Fimbristylis littoralis*, *Cyperus* spp., *Eleocharis* spp., *Ludwigia* spp., *Schoenoplectus juncoides*) in understory within each loʻi;
- ≥20% cover of beneficial non-kalo emergent plants in understory on ≥50% of loʻi; or
- ≥10% of total loʻi acreage in vegetated wet fallow to promote growth of non-kalo emergent plants.

Waterbirds are generally opportunistic and use plants that are available for foraging and breeding. Many kalo farmers intensively remove non-kalo emergent vegetation during the first 4–6 months of growth to prevent these plants from out-competing kalo, which can provide more open water habitat for aeʻo. However, this practice also decreases vegetative structure available to invertebrates, nesting ʻalae ʻula and ʻalae keʻokeʻo, and foraging ʻalae ʻula, ʻalae keʻokeʻo, and koloa maoli. Less intensive removal of selected emergent plants would provide additional seeds, leaves, and invertebrate food resources for threatened and endangered waterbirds and enhance visual obscurity for breeding ʻalae ʻula. Byrd and Zeillemaker (1981) found ʻalae ʻula favored grasses, sedges, and ferns over kalo to build their nests when these plants were available nearby, and Gee (2007) found 46% of 48 nests built in patches of annuals (*S. juncoides, C. difformis, L. palustris*) beneath the kalo canopy. Allowing non-kalo emergent plants beneficial to waterbirds would diversify invertebrates available for food (Gutscher-Chutz 2011) and increase the quantity and quality of plants available for forage, nesting material, and nest anchors for multiple waterbird species. In addition, non-kalo emergent plants would assist with filtration, assimilation, and retaining nutrients and sediments on land. In less intensively managed loʻi and fallow loʻi where non-kalo emergent vegetation was present, koloa maoli engaged in foraging behaviors similar to those used in rotational managed wetlands (Malachowski and Dugger 2018). Collectively, implementation of these options would result in enhanced habitat, while also maintaining open water habitat for shorebirds. Providing “non-kalo food

sources" and nesting material in and around the existing loʻi kalo would also reduce the potential for crop depredation.

The increase in plant diversity in loʻi, combined with longer fallow periods, would result in increased invertebrate diversity and an increase in habitat suitability for threatened and endangered waterbirds under Alternative B. Additional measures under Alternative B would provide enhanced benefits to threatened and endangered waterbirds compared to Alternative A by increasing habitat quality and reducing disturbance and predation by pest vertebrates.

Disease Mortality

Under Alternative B, measures to improve water quality (e.g., improving water capacity, reducing fertilizer use; see below) would be expected to reduce the frequency and severity of botulism outbreaks. Additional strategies would be implemented in the short- to medium-term to reduce the frequency and severity of outbreaks, including implementing avian botulism protocol BMPs in botulism-prone areas, which may include draining, harvesting, and dry fallowing loʻi for 30 days or more. Keeping ditches well-maintained and intakes flowing contributes to oxygenation of the water in the ditch and loʻi, and combined with cooler water temperatures would reduce the potential for botulism outbreaks, since this bacterium needs an anaerobic environment to thrive.

Conducting quarterly meetings with permittees on avian botulism and response under Alternative B would likely reduce lag times on response to botulism outbreaks and therefore limit the spread of disease. Compared to Alternative A, we expect reduced frequency and severity of avian botulism compared to current levels, with a resulting decrease in botulism mortality.

In summary, increased availability of natural waterbird foods, cover types, nesting materials, and roost sites for waterbirds and a decrease in the conditions that exacerbate avian botulism with an improved response efficacy within kalo habitat would be expected under Alternative B. Therefore, we would expect increased benefit of loʻi to threatened and endangered waterbirds. Improved quantity and quality of food resources would be expected to have beneficial effects to threatened and endangered waterbirds, including improved body condition and enhanced production, and support recovery goals for these species.

Predation

Under Alternative B, efforts to control and exclude vertebrate pests through fencing, trapping and removal, and permit stipulations would continue (i.e., same as Alternative A), but kalo permittees would also be required to report stray dogs or cats found on the Refuge to the Refuge manager or biologist as soon as possible, no longer than within eight hours of discovery. In addition, under Alternative B, the Service would conduct bi-annual meetings with kalo permittees and develop a compliance monitoring system. With increased communication and collaboration between the Service and permittees, we expect increased compliance with permit stipulations, and collaboration on other conservation measures for threatened and endangered waterbirds. Consequently, predation of threatened and endangered waterbirds by vertebrate pests would likely be lower in Alternative B, compared to Alternative A.

Disturbance and Predation during Kalo Harvest

Factors involved in depredation of Hawaiian waterbird nests are complex and include amount of vegetative cover, nest distance from dike, size of pond, linear feet of dike (predator travel lanes) in habitat. The occurrence of endangered waterbird nest failures within the 3-foot unharvested

vegetation buffer area could also be related to drawdowns and lack of camouflage, which could also be mitigated by no drawdowns after harvest until birds have left on their own accord, and moist-soil vegetation in harvested fields for plant and invertebrate forage and nest camouflage.

Under Alternative B, water level fluctuations in loʻi where waterbird nests are detected would be minimized. The current three-foot radius threatened and endangered waterbird nest buffer is likely insufficient to result in significant reductions in nest disturbance and predation compared to current levels (Paveglio et al. 2000). Therefore, we would initiate a study of the relative effectiveness of different radius nest buffers on nest and fledging success of threatened and endangered waterbirds within three years and modify buffer requirements and compatibility stipulations if necessary. Nest disturbance and predation would decrease in the long term as this new buffer size is determined and implemented. In the interim, in loʻi where threatened or endangered waterbird nests are found, the current three-foot radius buffer would be changed to a minimum six-foot radius buffer around nests. Kalo farmers would be required to keep the loʻi flooded and coordinate with Refuge staff to minimize impacts or take of birds by implementing additional protective measures as needed, such as delaying harvest in areas where nests are known to occur until the young birds fledge or leave the loʻi of their own accord. Additionally, Alternative B would require reporting of threatened and endangered waterbird nests within 24 hours of discovery, rather than 48 hours. Overall, fewer impacts to threatened and endangered waterbirds from disturbance and/or predation would be expected under Alternative B than Alternative A.

EFFECTS TO OTHER LISTED SPECIES

Effects to Other Listed Species

The proposed action would likely have negligible effects to other listed species. Actions taken to minimize disturbance to threatened and endangered waterbirds (e.g. during construction) would be likely to minimize effects to other listed species as well.

3.3 OTHER WILDLIFE AND AQUATIC SPECIES

3.3.1 AFFECTED ENVIRONMENT

In addition to the threatened and endangered waterbirds listed above, the habitats of Hanalei NWR within the scope of the WMWCP provide feeding, resting, or breeding habitat for a variety of both resident and migratory species. ʻAukuʻu (black-crowned night-herons, *Nycticorax nycticorax hoactli*) use wetland habitats for foraging. Of the 36 migratory waterfowl species documented for the Hawaiian Islands, at least 29 have been observed at Hanalei NWR. There are 27 species of migratory waterfowl (ducks, geese, swans) from both North America and Asia that use the Refuge as wintering/stopover habitat from approximately October–April. Koloa mohā (northern shoveler, *Anas clypeata*), koloa māpu (northern pintail, *Anas acuta*), and American and Eurasian wigeon, and green-winged teal represent 95 percent of the migratory waterbird records.

Twenty-three species of migratory shorebirds have been observed at Hanalei NWR. Of these, the most common are kōlea (Pacific golden-plovers, *Pluvialis fulva*), ʻūlili (wandering tattlers, *Heteroscelus incanus*), and ʻakekeke (ruddy turnstones, *Arenaria interpres*). Kōlea are by far the most numerous species, accounting for 90 percent of migratory shorebirds. They primarily forage on mowed dikes, but also use shallow wetlands and loʻi kalo. Fallow units with open mudflats are used

by shorebirds for night roosting, stopover, and rest/post-migration. Kōlea use the Refuge mainly August through April.

All five species of endemic Hawaiian ʻoʻopu (amphidromous gobies) inhabit the Hanalei River. Two species (ʻoʻopu akupa [akupa sleeper, *Eleotris sandwicensis*] and ʻoʻopu naniha [naniha goby, *Stenogobius hawaiiensis*]) use the lower reach for spawning and maturation. Species that inhabit the middle and upper reaches of the river pass through the Refuge during larval outmigration and juvenile upstream migration. Endemic Hawaiian shrimp (ʻōpae ʻoehaʻa, *Macrobrachium grandimanus*) occupy the lower reach (Yamamoto and Tagawa 2000). Native insects include the pinao (dragonflies) species *Pantala flavescens*, *Anax junius*, and *A. strenuus*. Refuge wetlands support at least three orders of annelids, five orders of mollusks, and 16 orders of arthropods.

3.3.2 EFFECTS OF ALTERNATIVE A (NO-ACTION)

Since current habitat management would continue, we would expect current use of the Refuge by these species to continue at current levels. Thus, effects to other native waterbirds and shorebirds would be minor positive.

3.3.3 EFFECTS OF ALTERNATIVE B (PROPOSED ACTION)

Proposed changes to management of loʻi would result in more diverse plant communities and increased food resources for other resident waterbirds (e.g. ʻaukuʻu) and migratory waterfowl and shorebirds (e.g. kōlea). More diverse plant communities, combined with longer fallow periods, would result in increased invertebrate production, and likely higher use of the Refuge by all of these species. Changes in wetland management to improve water quality (see below) would likely reduce the incidence and severity of avian botulism outbreaks, which would benefit native waterfowl and waterbirds.

3.4 WATER RESOURCES (HYDROLOGY, WATER QUALITY)

3.4.1 AFFECTED ENVIRONMENT

A majority of Hanalei NWR lies on the floor of the Hanalei Valley, which contains the Hanalei River. The Hanalei watershed extends from Mount Waiʻaleʻale (elevation 5,148 feet) to the sea and has a drainage area of about 23 square miles (Timbol 1977). Approximately 3.1 miles of the 15.7-mile perennial Hanalei River flows through Hanalei NWR. It is the largest river in this watershed and has the greatest average discharge of any river or stream on Kauaʻi (HDBEDT 2009). The Hanalei River is characterized by good flow volumes throughout the year and from year to year. Monthly and yearly average discharge generally exceeds 150 cubic feet per second (cfs) (mean for both: 212 cfs), and on 60% of days, mean flow is above 100 cfs (USGS 2017; Pilson 2017). River flows are extremely flashy in nature, and substantial floods can occur during prolonged rains. Approximately 189 acres of riparian habitat extends from the active river channel to the upland edge of the 100-year floodplain. Vegetation in riparian habitat is currently dominated by invasive hau along river and ditch margins, and California grass and Guinea grass throughout. Hau, in particular, can exacerbate effects of flooding and quickly form dense stands of vegetation that are impassible.

Because of elevated levels of *Enterococci* and turbidity (total suspended solids), the State of Hawaiʻi Department of Health (HDOH) identified the Hanalei Bay Watershed as water quality limited under

Section 303(d) of the Clean Water Act (HDOH 2008). Elevated levels of nutrients (total nitrogen and total phosphorus) were also identified as a concern (Tetra Tech and HDOH 2008). HDOH established total maximum daily loads (TMDL) for the Hanalei River and Hanalei Estuary (HDOH 2008). The HDOH identified no dischargers with National Pollutant Discharge Elimination System permits or other point sources of pollution in the Hanalei River Watershed, so the TMDL address non-point sources. Loʻi kalo and several other anthropogenic and natural sources of pollutants were identified as sources of constituents of concern to the Hanalei River (Tetra Tech and HDOH 2008). Data collected over many years and used in the TMDL process have shown frequent exceedances of water quality standards for bacteria and turbidity and occasional exceedances for nutrients (nitrogen and phosphorus) in the Hanalei River.

A portion of the flow from the Hanalei River is diverted into wetland management units and loʻi kalo on the Refuge. Much of the flow is redirected back into the river after passing through the Refuge. Wetlands on the Refuge are highly managed using a system of dikes, ditches, and water control structures. For a detailed description of water control infrastructure and management of Refuge wetlands and loʻi kalo, see the dWMWCP, Section 2.2.

3.4.2 EFFECTS OF ALTERNATIVE A (NO-ACTION)

EFFECTS TO HYDROLOGY

Under Alternative A, the current acreage and configuration of loʻi kalo and rotational managed wetlands would be maintained. Wetland management strategies that would have effects to hydrology and water quality include mowing, disking, rototilling, herbicide spraying, and water level management. Under both alternatives, hau removal along river banks may reduce flood severity. However, this effect would be negligible due to the small acreage of hau removed annually compared to its prevalence in the watershed. Overall, effects to hydrology under Alternative A are minor, both beneficial and negative, and long-term for wetlands management actions.

EFFECTS TO WATER QUALITY

Section 2.2.7 in the dWMWCP summarizes water quality studies conducted on the Refuge. Historically and currently, kalo farmers typically use conventional, chemical fertilizers year-round. The exact amount of fertilizer applied differs from farmer to farmer. However, analysis of the nitrogen cycle in kalo ponds suggests that the conventional fertilization methods applied throughout most of the loʻi kalo are prone to loss and runoff over time and can lead to elevated nutrient levels in receiving waters.

Additional water quality concerns related to kalo farming are the prevalence of wet tilling and other soil disturbance during kalo production, which can cause turbid water to flow back into the river. Results from water quality monitoring conducted during spring (March–April) and summer (June–September) 2015, winter (January–March) 2016 in randomly selected managed wetland units and loʻi kalo in the northeast and southeast indicated differences between water quality in managed wetland units and loʻi kalo (Feddern 2016). The largest differences were dissolved oxygen (DO) and oxidation/reduction potential (ORP), both of which were lower in loʻi kalo than in the managed wetland units. Additionally, a strong correlation between low DO and low ORP was observed suggesting anoxic conditions contribute to negative ORP and thus higher avian botulism risk (Feddern 2015). In both loʻi kalo and managed wetlands, summer DO was lower than winter DO. DO

saturation and concentrations in the northeast loʻi kalo in winter were greatly lower than in southeast loʻi kalo.

Additional observations were made regarding algal and plant abundance in loʻi compared to managed wetlands. In some loʻi, large mats of *Azolla filiculoides* (a nitrogen-fixing aquatic fern) and algae were present, while in other loʻi and managed wetlands *Azolla* was absent and algal abundance was minimal. *Azolla* grows best in high-phosphorus conditions and at depths of 0.5 to 0.833 ft (Uchida et al. 2008). Based on this information it was hypothesized fertilization in loʻi kalo causes *Azolla* and algal blooms in response to nutrient inputs. It is likely plant and algae die-offs follow these blooms as nutrients are consumed and loʻi water depth decreases (water draw-downs typically follow kalo fertilization).

Kalo farmers routinely control unwanted vegetation using, among other methods, application of herbicides. Glyphosate is the only herbicide currently approved for use by kalo permittees per SUP. Wet tilling of farm soils; addition of fertilizer and pesticides; and ditch cleaning and removal of vegetation along ditch banks (depending upon the method used) may all contribute to this water quality impairment. Some kalo farming on the Refuge includes management or removal of unwanted vegetation from ditches and dikes. While these management practices provide loafing and foraging habitat for threatened and endangered waterbirds, they also potentially enhance sedimentation while reducing vegetative filtering of discharge water.

Other sources of water quality impairment along the Hanalei River include cesspools and contamination from farm equipment and farming-related supplies such as fertilizers, pesticides, and petroleum products. The Hanalei River watershed is large and steeply sloped in many areas. Flows in the lower river—which runs through a portion of the Refuge—are flashy, and the Refuge lands used for permittee residences, storage sheds, other facilities, and storage of equipment and supplies are subject to periodic flooding. This increases the risks to soil and water quality associated with flooding, either by washing fertilizer, pesticide, and petroleum residues into loʻi kalo and rotational managed wetland units, or through leaching into groundwater. This is a special concern for equipment, supplies, and other materials stored outdoors or in sheds and other buildings with dirt floors. Under Alternative A, the Refuge would continue to work with farmers to reduce these sources of contamination by authorizing the upgrading of septic systems as needed and improving storage sheds and buildings to include impervious floors, drains, and containment/filtering systems.

Ditch maintenance and cleaning is expected to have a positive effect on allowing water to flow more freely. The minor to moderate beneficial effects of the cleaning are not anticipated to negate flooding associated with major flood events.

Under both alternatives, vegetation removal (e.g., hau bush along river banks) could, in the short-term, have negative effects to water quality as soils may be disturbed at the root zone or if herbicides are applied to kill pest plants or suppress regrowth. However, based on past vegetation removal by the Refuge, the small acreages proposed (e.g., 2–5 acres of hau per year in priority areas), impacts to water quality are anticipated to be negligible. BMPs would be implemented to prevent sedimentation of waterways.

As noted above, Hanalei NWR has been identified as a contributor of elevated levels of sediment and nutrients to Hanalei River, and the impact of kalo farming (sediment, fertilizers, and herbicides) and outdated septic systems on water quality is a major area of concern (Tetra Tech and HDOH 2008). Overall, under Alternative A, sediment and nutrient discharge to the Hanalei River is likely to remain

similar to current levels, and would be likely to be have at least intermediate, negative long-term effects on water quality in the lower reach of the river.

EFFECTS OF FERAL PIG REMOVAL

Under both alternatives, the removal of feral pigs (through fencing, trapping, and shooting) as well as other vertebrate pests (e.g., rats, mice, cats, dogs, bullfrogs, chickens, barn owls, cattle egrets) would benefit water quality by reducing direct fecal contamination of water. This would indirectly benefit human health since human diseases such as leptospirosis have been linked to some of these animals. Other indirect effects associated with removal of pigs would be less ground disturbance associated with pig grubbing, rooting, and wallowing activities and less bare soil that could increase sediment loads in the Hanalei River. This effect, while beneficial, would be minor.

3.4.3 EFFECTS OF ALTERNATIVE B (PROPOSED ACTION)

EFFECTS TO HYDROLOGY

Effects to hydrology under Alternative B could include changes to the water table caused by contouring pond bottoms and creating sloughs in new wetland management units. These actions, if the unit is dry, may tap into water tables that are close to the surface, potentially lowering the water table. If the wetland units have water in them, they would probably feed the water table rather than tap into it since water moves along a gradient, from high potential energy (wetland) to lower potential energy (underlying aquifer) (T. Mayer pers. comm 2011). The enhancement of riparian zones and creation of new wetlands under this alternative would be beneficial to the floodplain as these habitats provide the ability to capture, hold, and attenuate flood waters, nutrients, and the erosive properties of moving water.

Given climate change, the availability of future water resources is uncertain. However, based on current hydrological data and studies, effects to hydrology under both alternatives are anticipated to be beneficial and minor, but long-term as these management strategies are ongoing. Additionally, Alternative B includes the development of a water budget and water efficiency study to gain a better understanding of water use and improve efficiency. Wetlands provide multiple functions and values including the ability to capture, hold, and attenuate flood waters, nutrients, and the erosive properties of moving water. Indirect effects caused by these minor direct effects may include loss of surface and groundwater for those downriver who may be using these existing resources, including river waters which exit to the ocean; however, these effects are anticipated to be negligible.

EFFECTS ON WATER QUALITY - WETLANDS MANAGEMENT AND NEW WETLAND UNITS

The management strategies used for rotational managed wetlands that would have effects to water quality include mowing, disking, rototilling, herbicide spraying, water level management, contouring pond bottoms, and creating sloughs. Currently, Hanalei has 86 acres of rotational managed wetlands. Under Alternative B, an additional 3–18 acres (up to an eight percent increase) is proposed. These new units would require installation of water control structures as well as water delivery systems. The creation of new wetland management units at Hanalei would not require additional water from Hanalei River. The primary water sources would be direct rainfall, runoff, and the existing ditch system and water allocation. Management strategies used to create new wetland units and that would have effects to water quality include dike removal and contouring of pond bottoms. However, effects would be temporary, occurring only during the activity period. Additionally, since the Refuge has

control over the hydrology in these units, sediment would be allowed to settle before resuming water management of these ponds and allowing outflow back to the Hanalei River. Therefore, effects to water quality are anticipated to be temporary and negligible. Overall, the addition of new wetlands results in more settling of suspended solids and more nutrient removal (by plants, by settling of solids, or by nitrification/denitrification).

EFFECTS ON WATER QUALITY - KALO FARMING

Kalo farming activities that affect hydrology and water quality include cultivation, adding fertilizer and lime, disking and/or tilling of the soil, and flooding to prepare loʻi for planting; planting of cut kalo plants (huli) or underground shoots (ʻoha); flooding, dewatering, and reflooding; removal of unwanted vegetation; harvesting; and dry and wet fallowing. Hanalei NWR has been identified as a contributor of elevated levels of sediment and nutrients to Hanalei River. In addition to other contributors (e.g., ungulates, road and trail erosion), kalo farming (e.g., herbicide, sewer system) on water quality is a major area of concern (Tetra Tech and HDOH 2008) and likely to be having at least intermediate, negative long-term effects.

Under Alternative B, lower levels of sediment, nutrient, and contaminant inputs to the Hanalei River resulting from kalo farming would be expected due to: (1) Developing, implementing, and monitoring effectiveness of BMPs to improve water quality and flow; (2) Developing and implementing fertilizer and herbicide management plans to minimize runoff of excess fertilizer and herbicide; (3) Working with kalo permittees to ensure accurate and specific annual fertilizer and herbicide reporting; (4) Encouraging the use of ecologically friendly alternatives to traditional fertilizers; and (5) Developing and utilizing BMPs for ditch maintenance to minimize adverse water quality impacts (reduce herbicide use, mechanically hedge, maintain vegetated banks, and explore methods to remove nutrients and sediment). Under Alternative B, permittees would be required to implement activities that would improve water quality. Examples include the use of IPM, reduced use of chemicals, less intense weeding, and developing and implementing BMPs with Refuge staff. For example, kalo farmers would be required to allow a portion of native and naturalized wetland plants to grow in loʻi, which would assist with sediment trapping and soil retention in the loʻi and nutrient conversion into bio-available forms for uptake by other plants and animals. As in Alternative A, we would enforce federal regulations, Service policies, and permit conditions related to storage of equipment and supplies, and the disposal of non-composted organic materials and nonhazardous solid waste. As in Alternative A, we would continue to work with farmers to reduce these sources of contamination by upgrading septic systems and improving storage shed and buildings to include impervious floors, drains, and containment/filtering systems.

EFFECTS ON WATER QUALITY - RIPARIAN HABITAT MANAGEMENT (MOWING, GRAZING)

Under Alternative B, there would be 14–24 acres of floodplain grasslands managed as nēnē foraging and breeding habitat, using mowing and/or seasonal livestock grazing. Seasonal grazing is not currently used on the Refuge and its use will be explored for managing these floodplain grasslands, as well as to create new managed wetland units. In areas transitioning to upland, native shrublands would be restored for additional foraging, nesting, and brood-rearing habitat.

Potential negative impacts to water quality from initial clearing and grubbing of existing invasive vegetation and installation of structures (e.g., pipelines, fencing) would be minimized by conducting these activities during the drier months in phases to allow for regeneration of native or naturalized

riparian vegetation from the existing seedbank. A ≥150-foot riparian and wildlife buffer zone would be established to reduce any unanticipated run-off from these activities.

Negative effects to water quality could result from the use of livestock (manure deposits in the river, compaction, or erosion). However, if this management strategy is employed, conservation measures and BMPs would be developed to reduce these effects. These measures include establishing the use of a buffer zone, fencing, watering troughs to keep livestock away from the river, and development of a prescribed grazing plan that would identify additional measures such as stocking rates and seasons (e.g., drier months May–Oct.) to enhance waterbird habitat and protect river resources. Therefore, negative water quality effects associated with grazing are anticipated to be minor and short-term. For more information, see dWMWCP, Appendix B, Draft Compatibility Determination for Cooperative Grazing.

SUMMARY

Under Alternative B, there would be a slight increase in the scope, scale, and intensity of effects to water quality due to habitat management actions. Overall, effects to water quality are anticipated to be beneficial, minor, and long-term. Additional riparian management actions proposed under Alternative B would result in short term negative impacts, but negligible to minor beneficial effects in the long term. Alternative B would result in improved water quality in the Hanalei River, benefitting native fish (ʻoʻopu), shrimp (ʻōpae ʻoehaʻa), and invertebrates.

3.5 GEOLOGY AND SOILS

3.5.1 AFFECTED ENVIRONMENT

The affected area is the northwest section of the Refuge, an open flat alluvial plain (floodplain) that extends west toward Hanalei Bay from the north end of the valley. Soils fall predominantly in the Hanalei soil series (Foote et al. 1972; NRCS 2017), formed in alluvium deposited by the Hanalei River in this low gradient and meandering section of the river. These silty clays and silty loams underlie most of the wetlands and loʻi and are characterized by poor drainage and moderate permeability. Soils in the northwest portion of the Refuge are sandier, indicative of former shoreline(s) when the sea level was higher (Chadd Smith 2017, pers. comm.). Finer silts are found in areas of the floodplain where settling occurs. Coarser, gravelly textures dominate point bars on the Hanalei River.

3.5.2 EFFECTS OF ALTERNATIVE A (NO-ACTION)

Wetland management activities involve using heavy equipment to till or disk and control pest plants (see dWMWCP, Appendix C for photos). During this process, large soil particles are broken up and soils are contoured to create variable shallow topographic features and microhabitats. Moist soils are worked within management units or basins impounded by dikes; thus, soil erosion effects are negligible. If units are wet-tilled, sediments and nutrients are allowed to settle for 1–2 weeks and pest plants are allowed to decompose before draining. When dikes are removed, soils would be disturbed through digging, plant removal, relocation, and compaction. These soils would be used to maintain other dikes as part of wetlands management. If heavy rainfall occurs when wetland management units are at a stage where there is substantial bare ground (soils are unvegetated or recently tilled), soils may be more vulnerable to erosion. However, water control structures would be set to impound water versus allowing it to run off, and most wetland management units are vegetated with wetland

plants that trap sediments and assimilate nutrients. Installation of new water control structures affects soil resources through disturbance of soils and removal of plant cover. However, based on past Refuge experience with wetlands management and installation of related structures, soil disturbance would be short-term, and revegetation of bare soil begins to occur within days in these fertile valleys. Therefore, negative impacts are anticipated to be minor and short-term.

Lo‘i kalo management involves numerous actions affecting soils, including cultivation, adding fertilizer and lime, disking and/or tilling of the soil, and flooding to prepare lo‘i for planting; planting of cut kalo plants (huli) or underground shoots (‘oha); flooding, dewatering, and reflooding; removal of unwanted vegetation; harvesting; and dry and wet fallowing. Fallowing and aerating helps increase yield per acre by resting lo‘i, improving soil health, and breaking disease and pest cycles (NRCS 2009).

The removal of pigs under both alternatives has a beneficial impact on soils, since pigs grub and root in search of food and create wallows. Removal of pigs would reduce such ground disturbance, including potential sedimentation of streams, which would be long-term beneficial for both soils and water quality.

Under both alternatives, invasive vegetation management (e.g., hau bush along river banks) could result in short-term negative effects as soils may be disturbed at the root zone or if herbicides are applied to kill pest plants or suppress regrowth. However, based on past invasive vegetation removal by the Refuge, the small acreages proposed (e.g., 2–5 acres of hau per year in priority areas), soil effects are anticipated to be negligible. BMPs would be implemented to prevent sedimentation of waterways.

Fallowing helps increase yield per acre by resting lo‘i, improving soil health, and breaking disease and pest cycles (NRCS 2009). Alternative A would have smaller acreages of fallow kalo habitat at any given time, which leads to slightly greater negative impacts to soils than under Alternative B. Overall, negative impacts due to soil disturbance are anticipated to be minor and short-term.

3.5.3 EFFECTS OF ALTERNATIVE B (PROPOSED ACTION)

As under Alternative A, management strategies that would affect soils include wetlands management (e.g., mowing, disking, rototilling, water level management, contouring pond bottoms, creating sloughs, and ditch maintenance); lo‘i kalo management; pig removal; and hau bush removal. In addition, under Alternative B, the following proposed actions would have effects to soils: the development of new wetland management units and related water control/delivery structures; and seasonal livestock grazing explored on an experimental basis, including pre- and post-monitoring.

Livestock grazing can be used as a valuable tool to manage grassland habitats. However, unless properly managed, livestock grazing can cause a variety of undesirable effects (Kirby et al. 1992), including soil compaction. Livestock can graze pastures unevenly. Negative impacts associated with use of livestock be minimized by requiring monitoring by a qualified biologist and adopting a prescribed grazing plan that would identify stocking rates and seasons (e.g., drier months May–Oct.). The provision of an in-pasture water supply and salt blocks would deter livestock from riparian areas and, as necessary, encourage more consistency in grazing pressure. Additionally, BMPs such as cross fencing and pasture rotations would also be considered and used, as appropriate. The acreage of potential seasonal livestock grazing at Hanalei NWR proposed under Alternative B is small, therefore leading to a minor long-term negative impact to soils.

Alternative B proposes greater acreages of fallow kalo habitat, which would lead to a greater beneficial effect on soil quality than under Alternative A. Overall, impacts under Alternative B are anticipated to be minor and short-term.

3.6 VISITOR USE AND EXPERIENCE

3.6.1 AFFECTED ENVIRONMENT

Visitor activities within the affected area include wildlife observation and photography, and fishing. Visitors access wildlife observation and photography opportunities via the Hanalei River, which runs through the Refuge but is not under Refuge jurisdiction, and the 2-mile long ʻŌhiki Road, a county-maintained road which bisects the Refuge and also provides access to the State ʻŌkolehao Trail. The interior areas of the Refuge are not open to the general public. Public access in closed areas may be authorized via SUP in situations where such access is compatible with the Refuge purpose and for compatible uses (e.g., National Wildlife Refuge Week, environmental education, and wildlife observation). The scenic valley in the heart of the Refuge is a popular subject of photographers on Kauaʻi and is often best captured from above at the Hanalei Valley Scenic Overlook located along Kūhiō Highway on Refuge land (outside of the action area), which is open to the public and available year-round for interpretation, wildlife viewing, and photography.

Environmental education has been offered at the Refuge in the past; however, due to funding and staffing cuts, it is provided only on a limited basis as noted above. The non-profit Hoʻopulapula Haraguchi Rice Mill organization, a 501(c)3 nonprofit, conducts limited commercial tours of the historic Haraguchi Rice Mill under a SUP. The rice mill was built in the 1880s, operated until the 1960s, and is listed on the National Register of Historic Places (NRHP). The rice mill buildings are privately owned by the Haraguchi family and are located on Hanalei NWR lands.

Fishing occurs on a limited basis on the Refuge from the banks of the Hanalei River. The majority of the use occurs along the banks of the Hanalei River, adjacent to the first half-mile of ʻŌhiki Road. Fishing methods include hook and line, and net consistent with Hawaiʻi Fishing Regulations. Most river fishing occurs from boats and is not under Refuge jurisdiction. Canoeing, paddle boarding, and kayaking also occur on the Hanalei River.

3.6.2 EFFECTS OF ALTERNATIVE A (NO-ACTION)

Under Alternative A, habitat management would remain the same as present, and while existing habitat would be maintained, no new habitat would be created. Therefore, opportunities to view or photograph native wildlife would remain the same as present. Water quality would remain the same as present, and therefore there would be negligible changes in effects to fish populations or fishing opportunities.

Overall, current management has negligible to minor impacts to the limited amount of public use occurring on the Refuge. Continuation of current management would not be expected to reduce the potential for high-quality, compatible, wildlife-dependent recreation into the future.

3.6.3 EFFECTS OF ALTERNATIVE B (PROPOSED ACTION)

Alternative B strategies would enhance existing and create new habitat for threatened and endangered Hawaiian and migratory waterbirds. These strategies would indirectly increase

opportunities for wildlife observation and photography, environmental education, and interpretation, and/or increase the quality of these opportunities (e.g. number of native birds seen from designated parking along the ʻŌhiki Road, the Hanalei Valley Scenic Overlook, or during guided tours or special events). These indirect effects are anticipated to be beneficial and minor.

Proposed strategies to reduce sediment and nutrient inputs to the Hanalei River would be expected to improve water quality of the river and may be beneficial to the species that are fished. Therefore, there may be minor, indirect beneficial effects to fishing opportunities. Hunting does not occur on the Refuge, but pigs are a hunted species on lands adjacent to the Refuge. Efforts to control feral pigs on the Refuge would have negligible effects to off-Refuge hunting opportunities, given the large population and high reproductive rates of pigs.

3.7 CULTURAL RESOURCES

3.7.1 AFFECTED ENVIRONMENT

Archaeological investigations (1979–1993) on the Refuge identified loʻi, ʻauwai, stacked stone wall and historic concrete structure foundations, terraces, pondfields, habitation areas, religious structures (e.g., heiau), a Chinese cemetery still in use, trash deposits, the Miko taro house, rock ovens, the Princeville ranch headquarters, the Haraguchi Rice Mill, and a possible imu (underground oven) pit (Shapiro and Shapiro 1995). Most of these features are concentrated on the valley floor and eastern side of the Refuge and are either pre-European contact or historic, with agriculture being the primary function of most of the 43 sites.

The Hanalei National Wildlife Refuge Historic and Archaeological District (HNWRHAD; State Site 50-30-03-304) includes over 20 individually recorded archaeological sites. The HNWRHAD was listed on the NRHP in 1980. The significance of the district is based on archaeological evidence indicating that Hanalei Valley has been continuously occupied for over 1,300 years. Evidence indicates that the entire alluvial plain had been cultivated in pre-European contact times; however, there is limited evidence of actual habitation. Shortly following European contact, the valley came under the influence of foreigners, and physical evidence, such as the historic Haraguchi Rice Mill (State Site 50-30- 03-9385), provides an understanding of the economy of post-contact cultures in the valley. For example, the historic Hanalei Valley is one of the few remaining areas of significant kalo-producing acreage in the state, continuing the practice that dominated the valley for hundreds of years prior to European contact. Within the Refuge are also two historical irrigation systems (China and Kuna Ditches), which continue to supply the Refuge wetland management units and loʻi kalo. In the 1980s, the NTHP declared Hanalei Valley as one of the 10 most important sites for rural preservation in the western United States.

Kalo farming on Hanalei NWR is of cultural interest and importance to Native Hawaiians across the state and the general public. Farmers living in modest residences adjacent to the loʻi kalo where they work is representative of a traditional, tenant-farming system that has mostly disappeared in Hawaiʻi.

3.7.2 EFFECTS OF ALTERNATIVE A (NO-ACTION)

Under both alternatives, supporting loʻi kalo on the Refuge at Hanalei has beneficial impacts for cultural resources. Also under both alternatives, prior to undertaking any ground-disturbing or other activities that could affect cultural resources, the Service would continue to undertake appropriate surveys and engage in consultations as required by the NHPA (see Section 2.1). Where practicable,

cultural sites would be avoided. Mitigation of effects (e.g., through excavation and recording of data) and minimization of effects would be secondary choices. In the event that human bones, burial remains, or other archaeological or historic resources were inadvertently disturbed in the course of conducting Refuge management, maintenance, repair, construction, or other activities, the disturbing activity would be immediately discontinued and the relevant state, federal, and/or Native Hawaiian authorities would be notified. Refuge activities in the affected area would not be resumed until appropriate clearance had been obtained. Routine maintenance activities common to all alternatives (e.g., maintenance of existing ditches, dikes, and wetlands) are undertakings of the type that have no potential to cause effects to historic properties that may exist in the maintenance location (36 CFR 800.3.a.1). Therefore, it is anticipated that effects to cultural resources would be negligible.

3.7.2 Effects of Alternative B (Proposed Action)

Under Alternative B, several ground-disturbing activities are proposed that may affect cultural and historic resources. These actions revolve primarily around restoring seasonal wetlands, creating new wetland management units, installation of water control structures and related pipelines, improvements to the existing maintenance facility, mowing, livestock grazing, and invasive plant management. Since an archaeological investigation has been conducted and Refuge policy outlines procedures that stop all activities should cultural and historic resources be inadvertently discovered (as well as notify State Historic Preservation Office and RHPO), it is anticipated that effects to these resources would be negligible. However, when a ground-disturbing project described in this EA is specifically identified for implementation, the Service will follow the NHPA Section 106 process and consider the potential effect of the project on historic properties, if present in the project area.

3.8 Land Use

3.8.1 Affected Environment

The predominant land uses in the vicinity of the Refuge are agriculture (primarily grazing/pasture), resorts, golf courses, diversified agriculture, and residential. Nine permittees (individuals or families) farm kalo on the Refuge. There are currently 287 individual loʻi kalo with a total footprint of 160 acres (i.e. including dikes, ditches, and canals). There are 14.2 miles of ditches and approximately 15 miles of pipe on the Refuge, with a portion of that owned/maintained by kalo farmers. There are six primary residences that are owned and occupied by five of the nine permittees/cooperators (individuals or families) who farm kalo on the Refuge. The lands occupied by these residences and surrounding areas range in size from 0.4–2.8 acres each. There are three storage sheds on the Refuge used by Refuge kalo farmers who reside off-Refuge. The lands occupied by these storage sheds and surrounding areas range in size from 0.04–0.06 acres each. The kalo farming-related residences, storage sheds, and outbuildings on the Refuge (but not the underlying land) are the property of the kalo farmers. Most of these buildings were constructed prior to Service acquisition of the Refuge.

ʻŌhiki Road, a 2-mile, dead-end, one-lane road, runs approximately northwest to southeast, splitting Hanalei NWR in two, with the Refuge boundary adjacent to both sides of the road. The road is maintained by the County of Kauaʻi. This public road is primarily used by tourists, Refuge staff, and local residents who live either on the Refuge or in the back of the valley. This road provides access to an adjacent historic rice mill, the Service's maintenance baseyard, a dirt/gravel parking area where people park to access the ʻŌkolehao Trail (a state hiking trail), of which ¼ mile is on Refuge land, and private residences.

3.8.2 EFFECTS OF ALTERNATIVE A (NO-ACTION)

Under Alternative A the number of acres in cooperative agriculture would remain the same as current, unless acreage was given up or forfeited by existing farmers. Under both alternatives, if a kalo farming CAA and SUP is terminated for a given permittee, then the associated use of Refuge lands for permittee-owned residences, storage sheds, and other facilities would no longer be allowed and the permittee would need to remove their improvements (residences, storage sheds, outbuildings, and other structures), equipment, supplies, and other personal property from the Refuge. This scenario would result in a decrease in the number and footprint of structures on the Refuge.

No new wetlands would be developed, and there would be no new construction. Therefore, under Alternative A, there would be negligible to intermediate effects to land use.

3.8.3 EFFECTS OF ALTERNATIVE B (PROPOSED ACTION)

Alternative B would support the continuation of cooperative kalo farming on the Refuge and include exploration of cooperative livestock grazing as a habitat management tool. The number of acres of cooperative kalo farming would be subjected to decision-making under an adaptive management framework and may vary between years. Cooperative kalo farming CAAs and SUPs would be clarified such that no new farm residences are authorized on Refuge property.

Under Alternative B, creation of 3–18 acres of new wetlands would occur, including supporting infrastructure (e.g. pipe, water control structures). Consequently, under Alternative B, there would be minor to intermediate effects to land use.

3.9 REFUGE ADMINISTRATION

3.9.1 AFFECTED ENVIRONMENT

During fiscal year 2018, the equivalent of five full-time Service staff were involved in managing farming in the Refuge as part of their regular duties. Staff activities included fence construction and maintenance for feral pig control, avian botulism surveillance and response, water infrastructure improvement, general and special use permit coordination, ditch cleaning and maintenance, response to media, response to official inquiries, invasive tree removal, and other assistance. In addition to coordinating with kalo permittees, the Service also provides law enforcement protection against trespassers and other issues regarding human safety, helps coordinate disaster relief and reparation, controls invasive plants and wildlife, rescues sick and injured wildlife, constructs fencing, maintains ditches, and manages the irrigation system. We estimate that the Service provided the equivalent of approximately $132,656 in salaries or work time for staff, interns, biotechnicians, and volunteers for work related to kalo farming on the Refuge, based on the average wage rate and total logged hours (DJL Economic Consulting 2019). Equipment and material costs for habitat management in the Refuge including, but not limited to, fencing material, excavator, and water infrastructure materials has cost the Service $420,000 over the past several years. Based on estimated durability of purchased machinery, annualized machinery expenditures are approximately $25,833 per year. The cost of tree removal is approximately $1,250 per year (DJL Economic Consulting 2019).

3.9.2 EFFECTS OF ALTERNATIVE A (NO-ACTION)

Due in part to implementing the Service's revised cooperative agriculture policy, additional staffing would be required compared to current levels. $606,877 would be needed annually for staff salaries, (see WMWCP Appendix E for more information). Equipment and material costs for habitat management in the Refuge including, but not limited to, fencing material, excavator, and water infrastructure materials would be expected to remain similar to present. Therefore, there would be an anticipated minor to moderate impact to Refuge administration from implementing Alternative A.

3.9.3 EFFECTS OF ALTERNATIVE B (PROPOSED ACTION)

Implementation of Alternative B would require greater total costs for the Service as Alternative B includes more habitat management and species protection measures, which would result in the need for additional labor costs, supplies, and services. For example, the costs associated with restoring and enhancing the 3 to 18 acres of existing lowland in the Refuge to additional wetland management units. Alternative B also calls for the development of several additional management plans for the Refuge, such as fertilizer and herbicide management plans and a prescribed grazing plan. Additional labor and equipment costs would also result from increased resource monitoring and management requirements, e.g., grazing, CAAs, additional areas to manage invasive species and avian disease, and proposed drainage improvements included in Alternative B, such as contouring pond bottoms, installing water control infrastructure, and creating sloughs. Fully implementing this alternative would require the equivalent of 2.3 additional full-time Service staff members, and a $244,453 increase in annual staffing costs as compared Alternative A (see WMWCP Appendix E for more information). Thus, there would be an anticipated moderate impact to Refuge administration from implementing this alternative.

3.10 LOCAL AND REGIONAL ECONOMIES

3.10.1 AFFECTED ENVIRONMENT

The Refuge is adjacent to Hanalei Town, Kauaʻi County, Hawaiʻi, with a population of 254 in 2017. The nearest large town is Princeville with a population of 1,945 in 2017 (U.S. Census Bureau 2019a).

Kauaʻi's economy was founded on agriculture, which produced crops such as sugarcane and kalo. Although agriculture is still an important industry on the island, tourism has far surpassed agriculture as the county's leading industry. Kauaʻi County relies heavily on tourism for employment, with the service industry accounting for 57 percent of all non-farm jobs (IMPLAN 2011). The service industry includes hotel accommodations, restaurants, and visitor services such as tours or guided activities. Government, including federal, state, and local, accounts for 14 percent of employment and the trade industry makes up 13 percent of non-farm employment (IMPLAN 2011).

3.10.2 EFFECTS OF ALTERNATIVE A (NO-ACTION)

Under Alternative A, $337,150 would be spent annually for staff salaries, which is a $204,494 increase over current conditions. Equipment and material costs for habitat management in the Refuge including, but not limited to, fencing material, excavator, and water infrastructure materials has cost the Service $420,000 over the past several years. Based on estimated durability of purchased

machinery, annualized machinery expenditures associated with the kalo farming program are approximately $25,833 per year. The cost of tree removal is approximately $1,250 per year.

In 2009, total labor income in Kaua‘i County was estimated at $1.6 billion and total employment was estimated at 38,050 jobs (IMPLAN 2009 data; IMPLAN 2011). Thus, total economic impacts associated with Hanalei NWR operations under Alternative A represent less than one percent of total income (0.02 percent) and total employment (0.02 percent) in the Kaua‘i County economy. Therefore, although Alternative A would provide economic benefits, the impact would be insignificant as a percentage of total economic output for Kauai County

As with Alternative B, indirect benefits would result from ecosystem services. The Service manages wetlands in the Refuge, which provide critical ecosystem services, serving as filters, purifying, and improving the water quality of Hanalei River. The plant communities and soil within wetlands also sequester carbon, helping to moderate global climate change conditions. Other benefits to wetlands include:

- Dissipate energy: During heavy rainfall wetlands reduce stream speed and act as natural sponges that absorb water
- Improve water quality: wetlands purify water, filter out sediments and contaminants
- Control erosion: wetlands buffer shorelines against erosion and bind the soil with their roots
- Provide fish and wildlife habitat
- Supply ground waterflow: wetlands contribute to base flow of streams
- Reduce flooding: wetlands soak up and store water and slowly release into streams
- Protect the coast from storms: coastal wetlands buffer the large wave energy we receive during winter swells

These would provide indirect socioeconomic benefits such as improved recreational opportunities (e.g., bird-watching, fishing), better water quality, and reduced costs of replacing or repairing culverts and other public infrastructure due to a reduced frequency and intensity of high volume events (The Trust for Public Land 2010). Overall, conservation lands and other protected open space can reduce the need for costly public services and provide regional socioeconomic benefits.

Water quality in the Hanalei River has indirect effects to the economy by affecting river and ocean-based recreation. Sediment and nutrient inputs to the Hanalei River from the Refuge would be expected to be higher under Alternative A than under Alternative B, which would impact the lower reach of the river, and Hanalei Bay. Indirect negative effects to the bay and associated recreational activities would be expected to by slightly higher than under Alternative B, but still minor.

3.10.3 Effects of Alternative B (Proposed Action)

Direct effects of Alternative B on local and regional economies would be minor and beneficial, and slightly greater than under Alternative A. Implementation of Alternative B would include significantly more habitat management and species protection measures, which would result in greater expenditures by the Refuge for salaries, labor, supplies, and services, and greater benefits to the local economy that under Alternative A. Fully implementing Alternative B would require the equivalent of 2.3 additional Service staff members and a $244,453 increase in annual staffing costs as compared Alternative A.

Total labor income in Kauaʻi County was estimated at $1.6 billion and total employment was estimated at 38,050 jobs (IMPLAN 2009 data; IMPLAN 2011). Total economic impacts associated with Hanalei NWR operations under Alternative B represent less than one percent of total income (0.03 percent) and total employment (0.02 percent) in the Kauaʻi County economy. Therefore, although the economic benefits of Alternative B would be greater than under Alternative A, the impact would be insignificant as a percentage of total economic output for Kauai County. As with the implementation of Alternative A, the regional socioeconomic conditions under Alternative B would remain similar to existing regional socioeconomic conditions.

Indirect economic benefits would result from improved ecosystem services provided by the Refuge (discussed under Alternative A). Neighboring landowners would continue to benefit from additional stormwater mitigation from the additional wetland acreage, drainage improvements, and ditch maintenance.

The largest non-wildlife-dependent recreation on Kauaʻi by its visitors tends to be sightseeing, self-guided tours, beach activities, and ocean recreation. Indirect beneficial effects to these uses and the associated tourism economy may result from proposed management strategies under Alternative B that would improve water quality of the Hanalei River, which feeds the Hanalei Bay. Poor water quality could affect Hanalei Bay through loss of important spawning and nursery habitat for native fishes including ʻamaʻama, ʻoʻopu, and āholehole and other coral reef species. Closure of beaches due to water quality issues would have negative effects to the tourism industry. However, development of BMPs and other minimization measures under Alternative B would minimize negative effects to water quality resulting from kalo farming and other wetland management operations; therefore, indirect effects to the estuarine and nearshore environment are anticipated to be negligible. Overall, the indirect benefits to the local economy from improved ecosystem services and water quality would be greater under Alternative B than Alternative A, but the increase is difficult to quantify.

3.11 SECTOR OF THE ECONOMY (AGRICULTURE)

3.11.1 AFFECTED ENVIRONMENT

Kalo was ranked 20th in Hawaiʻi agricultural commodities in 2014 ($1.9 million) (NASS 2015). In the last four available Censuses of Agriculture (1997, 2002, 2007, and 2012), between 481 and 604 acres of kalo were harvested in Hawaii, producing between 3.5 and 6.5 million pounds of kalo (NASS 2017a). Of this, Kauaʻi County accounted for 32 to 56 percent of the state's kalo acreage and produced between 43 and 75 percent of the state's total production (NASS 2017a). On Kauaʻi there are 459 acres of farmland in wetland kalo production with about 65% (299 acres) of the acreage off the Refuge and 35% (160 acres) in the Refuge. Kalo production on the Refuge is estimated at 2,235,496 pounds per year or 13,799 pounds per acre farmed (DJL Economic Consulting 2019).

From 2000 to 2015, kalo production in Hawaiʻi decreased from 7 million pounds to 3.5 million pounds, and average yields per acre fell from about 15,000 pounds per acre to 10,300 pounds per acre. Although production has declined, price received has increased 130 percent from 29¢ per pound in 2000 to 68¢ per pound in 2015 (NASS 2017b, 2018). Overall, kalo production on Hanalei NWR represented about 1.5 percent of Kauaʻi County's total agricultural market value and utilized 0.1 percent of Kauaʻi County's agricultural land (NASS 2012).

Total revenues from sales of kalo grown on the Refuge are estimated at $1,437,230 or $8,983 per acre[2]. The cost of producing kalo in the Refuge, including growing, harvesting, and farm management, are $951,848 or $5,949 per acre. The cost of growing kalo includes land preparation, planting, fertilization, pest control, and irrigation. Harvesting costs include labor, shipping, transport, and fuel, as well as maintaining equipment. Farm management costs include office labor, capital resource costs, and land resource costs. Net revenue from farming on the Refuge is $485,382 per year or $3,034 per acre (DJL Economic Consulting 2019).

3.11.2 EFFECTS OF ALTERNATIVE A (NO-ACTION)

Under Alternative A, the Service and kalo permittees living and working in the Refuge would continue current wetland management and kalo farming practices. The total acreage of wetland habitat (loʻi kalo and managed wetlands) would remain the same as present. Both costs to produce kalo, and income from kalo production, would remain the same as present. As a result, the total economic benefit is expected to be between $1,500,000 and $2,000,000, with the net economic benefit between $500,000 and $1,000,000.

However, under both alternatives, permits would no longer be allocated based on prior historic use, but rather would be allocated based on references, compliance (if already farming on the Refuge), a proven track record of experience and capacity (e.g., equipment) for farming in sustainable and wildlife-compatible ways, and willingness and ability to work with the Refuge on recovery and ongoing management priorities necessary to continue to meet the establishment purpose of the Refuge for recovery of federally listed species. Both existing kalo permittees and new CAA permit applicants would be required to apply through the competitive application process. The new policy would allow for permits with terms of up to five years, subject to regular compliance review. The updated CAA policy would allow for farming permits lasting up to five years, which could improve the ability of future kalo permittees to obtain business loans, an economic benefit under both alternatives. The intent of the CAA is to establish a fair and rational cost-sharing program for use by the Service and permittees in the future; however, the details of this program are not determined at this time and will be developed prior to the application process.

3.11.3 EFFECTS OF ALTERNATIVE B (PROPOSED ACTION)

Implementation of Alternative B would have slightly greater economic impacts on kalo permittees than under Alternative A due to the additional farming stipulations and management services required to ensure compatibility of farming in the Refuge to allow its continuation. For example, instead of the 3-foot radius buffer surrounding bird nests in loʻi kalo mandated under Alternative A, Alternative B would require a minimum 6-foot radius nest buffer. While this increased buffer would provide greater protection to threatened and endangered waterbirds, it would also result in slightly lower kalo production in lo`i where nests occur. There may be additional costs to farmers associated with developing and implementing fertilizer and herbicide management plans, and implementing avian botulism BMPs, which may include draining, harvesting, and dry fallowing loʻi for more than 30 days. However, these potential additional costs are difficult to quantify because the details of the proposed additional requirements under Alternative B remain under consideration. Therefore, total

[2] We computed total revenues per farm based on reported sales and reported sales price for each farmer then summed across all farmer to obtain total revenue for the entire refuge. Average sales price = total revenue ÷ total pounds.

annual costs to kalo permittees for the production of kalo (i.e., growing, harvesting, and managing) under Alternative B would be slightly greater than the $951,848 total annual costs under Alternative A.

However, economic benefits to kalo permittees would remain similar to existing conditions due to additional benefits to the farmers under implementation of Alternative B. Kalo permittees would receive a similar net revenue from kalo sales, pay below market lease rents for farmland, and existing farmers and their immediate families would have access to their pre-existing housing in the Refuge under the CAAs. Additional drainage maintenance proposed under Alternative B would reduce flooding impacts to loʻi kalo in the Refuge and avian botulism and could also help further mitigate any potential property damage resulting in economic losses. Losses in production may be offset by lower cost of production over time (e.g. lower chemical inputs), or potentially higher prices for "wildlife friendly" or sustainable kalo. Further, the Service would incentivize additional management activities that would protect threatened and endangered waterbird species, such as establishing a wet fallow period of at least 60 days followed by a 2- to 6-month dry fallow period after tilling organic matter into the soil, as compared to the 30-day wet fallow period in lo`i kalo mandated by existing CAA permits. Similar to Service staffing, the economic benefit for kalo permittees living and working in the Refuge is expected to be similar to benefits under Alternative A, but some changes in costs and benefits would be expected due to factors beyond the Service's control (changes in market prices and supply costs). As a result, the total economic benefit is expected to be in a similar range to Alternative A (between $1,500,000 and $2,000,000, with the net economic benefit between $500,000 and $1,000,000).

3.12 ENVIRONMENTAL JUSTICE

3.12.1 AFFECTED ENVIRONMENT

Executive Order (EO) 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high or adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities.

The Refuge is located within Census Tracts 401.03 (Princeville-Kīlauea) and 401.04 (Haʻena-Hanalei) in Kauaʻi County, Hawai`i. The percentage of population below the poverty level in this area (11.3±3.3% and 21.3±8.4%, respectively) is higher than the percentage below poverty level for Kauaʻi County (9.1±1.0%) as well as within the State of Hawaiʻi (10.3±0.3%). By comparison, the percentage of population below the poverty level within the U.S. is 14.6±0.1 percent (U.S. Census Bureau 2019b). Within the census tracts that encompasses the Refuge, 76.4 percent of the population is reported to be primarily Caucasian or Caucasian in combination with one or more other races. Approximately 15.1 percent of the population is reported to be primarily Asian or Asian in combination with other races and 5.1 percent of the population is Native Hawaiian or Pacific Islander (U.S. Census Bureau 2019c).

3.12.2 EFFECTS OF ALTERNATIVES

The Service has identified a low-income community, specifically within Census Tract 401.04. However, the Service has not identified any potential high and adverse environmental or human

health impacts from any of the alternatives. Conversely, the proposed action would be likely to improve water quality, including reducing coliform bacteria or other pathogens that would affect human health.

3.13 CUMULATIVE IMPACT ANALYSIS

Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). We expect agricultural land use in the project area to remain similar to current levels in the foreseeable future; therefore, cumulative impacts to land use will not be considered further.

3.13.1 OTHER PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIVITY IMPACTING AFFECTED ENVIRONMENT

DEVELOPMENT AND POPULATION INCREASE

Summary

In 2010, the U.S. Census Bureau estimated the total population of Kauaʻi to be 71,093 residents, or roughly five percent of Hawaiʻi's total population (U.S. Census Bureau 2019a). Kauaʻi's population grew by 14.8 percent from 2000 to 2010, outpacing the 12.3 percent growth rate for the state as a whole. Over the same period, the island's population density increased from 104 persons per square mile to 119 persons per square mile; meanwhile, the State of Hawaiʻi's population density increased from 189 to 212 persons per square mile (U.S. Census Bureau 2000, 2011). The Hawaiʻi Department of Business, Economic Development, and Tourism (HDBEDT) predicts that the population of Kauaʻi will continue to grow at an annual rate close to one percent through 2040, resulting in an estimated 2040 population of 93,000 (HDBEDT 2012).

Anticipated Cumulative Impacts

Non-native invasive species and water quantity and quality are the factors that are most likely to affect threatened and endangered waterbirds. Population growth will continue to place stress upon Hawaiian ecosystems, both through direct loss of remaining habitats and indirectly through fragmentation and degradation of wildlife habitat and demands on water. Management can do nothing to stem the trend of continuing loss and degradation of wetland habitat outside the Refuge to development over time, but Hanalei NWR and other tracts of habitats will become even more important as repositories of biodiversity and to maintaining populations of native waterbirds.

CLIMATE CHANGE

Summary

The following is summarized from the 4th National Assessment (Keener et al. 2008):

In Hawaiʻi, temperature has risen by 0.76 degrees F over the past century (and 2019 was the warmest year on record). Rainfall has decreased, but the frequency of severe weather events has increased.

While rainfall in Hawaiʻi generally has been decreasing, it is also becoming more extreme. Both extreme heavy rainfall events (causing increased runoff, erosion, and flooding) and droughts (causing

water shortages) have become more common. The number of consecutive wet days and the number of consecutive dry days are both increasing in Hawai‘i. However, rain intensity (the type of rainfall that contributes to stream overflow and flooding and is not beneficial for aquifer replenishment) has increased by approximately 12 percent from 1958 to 2007 (Fletcher 2010).

Most climate projections suggest that more intense wind speeds and precipitation amounts will accompany more frequent tropical typhoons/cyclones and increased tropical sea surface temperatures in the next 50 years. The intensity of tropical cyclones is likely to increase by 10–20 percent in the Pacific region when atmospheric levels of CO_2 reach double preindustrial levels (McCarthy et al. 2001). One model projects a doubling of the frequency of rainfall events of four inches per day and a 15–18 percent increase in rainfall intensity over large areas of the Pacific.

On Kaua‘i, based on monthly mean sea level data from 1955 to 2015, the mean sea level trend at Nāwiliwili is 0.056 inch per year with a 95 percent confidence interval of ±0.017 inch per year, which is equivalent to a change of approximately +0.46 foot in 100 years (NOAA 2017).

Anticipated Cumulative Impacts

Rising temperatures, decreasing average rainfall, and increasing rainfall extremes will place increasing pressure on the water resources throughout the Hawaiian Islands. However, in the foreseeable future (though approximately 2030), flows of the Hanalei River are expected to be adequate to maintain water diversions for Refuge wetlands. Measures to develop water budgets and use water more efficiently will allow the Refuge to maintain wetland habitat year-round in the foreseeable future.

Conditions which favor the development of avian botulism (e.g. higher water temperatures in the river and Refuge wetlands and lo‘i) will become more common. Improved water management and changes to ditch management under the proposed action would help to partially mitigate these effects.

Increased extreme rainfall events would make flooding of Refuge lowlands and infrastructure more frequent and severe, resulting in cumulative rates of reproductive failure for threatened and endangered waterbirds and instability of recovery of populations. The proposed action would slightly mitigate these effects but continued increases in staff and financial resources would likely be required to maintain and rebuild wetland management infrastructure. Although wetland kalo farmers are experienced in working in a flood-prone environment, flooding associated with extreme rainfall events damages infrastructure, homes, and equipment. Additional drainage maintenance under the proposed action would reduce flooding impacts to lo‘i kalo in the Refuge; however, the trend of increasing impacts would be likely to continue.

Because it is a few miles upstream from Hanalei Bay and protected by levees, Hanalei NWR is not likely to see changes in the location of its shoreline from sea level rise (SLR). However, SLR may impact the groundwater table and increase its salinity (saltwater intrusion) (Sustainable Resources Group International Inc. 2012). Also, if groundwater tables rise with sea level, flooding could be exacerbated, particularly during high tides that resist the flow of the river. Refuge wetlands may provide a source of groundwater recharge that could partially mitigate this effect.

Overall, the proposed action will help to mitigate the effects of climate change on threatened and endangered waterbirds and other native wildlife.

3.14 MONITORING

An Inventory and Monitoring Plan is being developed via a separate but related planning process to further describe survey activities and priorities. See Section 2.1 for a description of the role of adaptive management and inventory, monitoring, and research within the context of the dWMWCP. The following list of monitoring activities would be conducted to facilitate adaptive management by documenting wildlife and habitat response to management actions, and to ensure that the proposed action would have acceptable levels of effects on the environment. This list is not all inclusive:

- Avian botulism disease monitoring
- Nutrient and sediment analysis in loʻi kalo and rotational managed wetland units
- Water quality, water flow, and water level monitoring
- Waterbird reproductive success
- Waterbird distribution and index of abundance
- Quarterly Management Unit Assessments (QMUA)
- Invasive plant species presence, distribution, and abundance
- Mammalian predator relative abundance and control efficacy
- Barn owl detection and control efficacy
- Compliance monitoring

3.15 SUMMARY OF ANALYSIS

The purpose of this EA is to briefly provide sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement (EIS) or a FONSI.

3.15.1 ALTERNATIVE A – NO-ACTION ALTERNATIVE

This alternative meets the purpose and need of the Service as described above, because it would meet life history needs of threatened and endangered waterbirds and promote their recovery. However, compared to Alternative B, this alternative would provide fewer acres of wetland habitat that meets all life history needs of threatened and endangered waterbirds. Loʻi kalo would continue to provide for the some life history needs of threatened and endangered waterbirds, but to a lesser degree compared with Alternative B. Current management practices, including possible continued non-compliance with 30-day wet fallow requirement and intensive removal of non-kalo emergent plants used as food, cover, and nesting material by threatened and endangered waterbirds. This would result in less vegetative cover for nests and young and less available food resources (both non-kalo plants and invertebrates) compared to Alternative B. Factors involved in failure (e.g., depredation) of Hawaiian waterbird nests are complex; however, the nest buffer size of three-feet is inadequate and depredation rates of nests are likely to remain similar to current levels and be higher than under Alternative B. Water quality, and therefore the frequency and severity of avian botulism outbreaks, is expected to remain the same as present. Without additional resources to properly administer the Refuge farming permit program, there would likely to be some continued compliance issues (e.g., permittees not keeping dogs contained near residence, storage of refuse and abandoned vehicles on site, incomplete reporting of fertilizer, pesticide use, or discovered threatened and endangered bird nests).

Effects to Refuge wetlands and associated species would be expected to be negligible to minor positive. Existing water quality issues (e.g. sedimentation and nutrient enrichment of receiving

waters) would be expected to continue, similar to current levels. Effects to opportunities for wildlife-dependent recreation would be negligible.

Implementation of Alternative A would have a negligible change to economic impacts on kalo permittees, since the requirements for farming on the Refuge and the associated economic impacts of those requirements would remain similar to the current condition. Economic benefits to kalo permittees would remain similar to existing conditions. Refuge staffing would increase over current levels. Overall, the proposed action would be beneficial to Kauai's economy, but the effect would be negligible because Refuge staffing, purchases, and economic output (from kalo farming) represent a tiny fraction of the total jobs and economic output.

3.15.2 ALTERNATIVE B – PROPOSED ACTION ALTERNATIVE

This alternative helps meet the purpose of the Refuge and mission of the Service as described above, because it would meet life history needs of threatened and endangered waterbirds and promote their recovery. The Service has determined that the proposed action is compatible with the purposes of the Hanalei NWR and the mission of the NWRS. The Compatibility Determinations for cooperative kalo farming and grazing are included in the dWMWCP (Appendix B). Compared to Alternative A, Alternative B would better meet life history needs of threatened and endangered waterbirds and promote their recovery, for the following reasons:

1. Due to restoration of 3–18 acres, more habitat is proposed to be in rotational managed wetlands, which provide for all life history needs of waterbirds. Minimal water level fluctuations would occur in these wetlands during peak nesting periods, thereby minimizing nest losses.
2. A transparent decision-making framework would be used to assign wetlands for rotational management, loʻi kalo, or other habitat, thereby maximizing utilization of available habitat, and increasing efficient use of water resources.
3. Loʻi would have enhanced vegetation structure and composition, resulting in increased availability of nesting and foraging habitat. An increase in water availability, combined with improved vegetation cover (larger nest buffers and allowing non-kalo plants in loʻi), and decrease in water level manipulation during nesting and incubation would reduce nest depredation and disturbance.
4. Water level control (ability to drawdown and inundate wetlands manually) through the use of water control structures helps to quickly respond to avian botulism outbreaks by maintaining circulation and the ability to change hydrological conditions to arrest disease cycles. Improved water quality (e.g., cooler water temperatures, higher oxygen levels) reduce the potential for and severity of botulism outbreaks. Alternative B is preferred for its beneficial effects and this long-term, beneficial effect would be intermediate. There would be reduced pesticide and fertilizer use in Alternative B compared to Alternative A, with consequent improvement in water quality. This, combined with implementation of avian botulism protocol BMPs in the short to medium term, would be likely to reduce the frequency and severity of avian botulism outbreaks compared to Alternative A. Reducing threatened and endangered waterbird mortality from botulism would further add to recovery of these imperiled species.
5. Under Alternative B, strategies to incentivize cooperative wildlife-friendly farming would be implemented. There would be reduced nest losses from water level fluctuations and improved quality of both foraging and brood-rearing habitat. These improvements include increased availability of non-kalo plants for both food and cover and increased invertebrate production.

Increased body condition, reproductive fitness, and brood survival would be expected compared to the Alternative A.

6. For Alternative B, there would be reduced depredation of threatened and endangered waterbirds, young, and nests by feral cats and other pest vertebrates due to changes in water and vegetation management and improved coordination with permittees. Improved compliance with SUP terms would result in reduced disturbance of waterbirds by dogs, with a consequent reduction of nest abandonment and increased reproductive success. Research into the effectiveness of nest buffer size, in addition to better understanding of factors related to nest/fledging success would be initiated, which may improve nest and fledging success in the long term.

Reduced pesticide and fertilizer use under Alternative B, as a result of implementing fertilizer and herbicide management plans, and increased compliance with permit terms would result in lower inputs of sediments, nutrients, fecal bacteria (e.g., humans, ungulates), and other contaminants into receiving waters, with minor, positive effects to water quality in the lower reach of the Hanalei River. Development and implementation of a water quality and flow monitoring program and working with partners to implement a community-based watershed management and aquatic resources management plan would ensure that water quality issues are promptly identified and addressed.

Implementation of Alternative B would have slightly greater economic impacts on kalo permittees than under Alternative A due to the additional farming stipulations and management services required to ensure compatibility of farming in the Refuge to allow its continuation. Total annual costs to kalo permittees for the production of kalo (i.e., growing, harvesting, and managing) under Alternative B would be slightly greater than the total annual costs to kalo permittees under Alternative A. However, economic benefits to kalo permittees would remain similar to existing conditions due to additional benefits to the farmers under implementation of Alternative B. Overall, the proposed action would be beneficial to Kauai's economy, but the effect would be negligible because Refuge staffing, purchases, and economic output (from kalo farming) represent a tiny fraction of the total jobs and economic output.

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REFERENCES

Broshears, R. E., and J. D. Parrish. 1980. "Aquatic Habitat and Aquatic Food Sources for Endangered Waterbirds at Hanalei National Wildlife Refuge." *Hawaii Cooperative Fishery Research Unit Technical Report*. Honolulu, HI: Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife.

Byrd, G. V., and C. F. Zeillemaker. 1981. "Ecology of Nesting Hawaiian Common Gallinules at Hanalei, HI." *Western Birds* 12: 105–116.

Cho, J. J., R. A. Yamakawa, and J. Hollyer. 2007. "Hawaiian Kalo, Past and Future." *Sustainable Agriculture* SA-1. Honolulu, HI: University of Hawai'i, College of Tropical Agriculture and Human Resources, Cooperative Extension Service: 8 p. http://scholarspace.manoa.hawaii.edu/handle/10125/12594.

Cooper, B. A., and R. H. Day. 1995. "Kaua'i Endangered Seabird Study. Volume 1: Interactions of Dark-Rumped Petrels and Newell's Shearwaters with Utility Structures on Kaua'i, Hawai'i." *Final Report TR-105847-V1*. Palo Alto, CA: Electric Power Research Institute.

DesRochers, D. W., S. R. McWilliams, M. D. Silbernagle, and J. M. Reed. 2009. "Macronutrient Profiles of Wetland Plants Consumed by the Hawaiian Moorhen (*Gallinula chloropus sandvicensis*)." *Wetlands* 29 (3): 845–853. doi:http://dx.doi.org/10.1672/08-189.1.

DJL Economic Consulting. 2019. Socioeconomic Benefits and Costs of Taro Farming in the Hanalei National Wildlife Refuge. Report to the U.S. Fish and Wildlife Service on file at Kaua'i National Wildlife Refuge Complex, Kīlauea, HI.

Feddern, M. 2015. "Spatial Variation of Water Quality on Hanalei National Wildlife Refuge, July–September 2015." Unpublished report on file at Kaua'i National Wildlife Refuge Complex, Kīlauea, HI.

Feddern, M. 2016. "Relationships between Algal Blooms, Water Quality, and Fertilization on Hanalei National Wildlife Refuge, Kaua'i, Hawai'i." Unpublished report on file at Kaua'i National Wildlife Refuge Complex, Kīlauea, HI.

Fletcher 2010. However, rain intensity (the type of rainfall that contributes to stream overflow and flooding and is not beneficial for aquifer replenishment) has increased by approximately 12 percent from 1958 to 2007.

Font, W. F. 2007. "Parasites of Hawaiian Stream Fishes: Sources and Impacts." *Bishop Museum Bulletin in Cultural and Environmental Studies* 3: 157–169.

Foote, D. E., E. L. Hill, S. Nakamura, and F. Stephens. 1972. *Soil Survey of the Islands of Kaua'i, O'ahu, Maui, Moloka'i, and Lāna'i, State of Hawai'i*. U.S. Department of Agriculture, Soil Conservation Service.

Fowler, A. C., J. M. Eadie, and A. Engilis Jr. 2009. "Identification of Endangered Hawaiian Ducks (*Anas wyvilliana*), Introduced North American Mallards (*A. platyrhynchos*) and Their Hybrids Using Multilocus Genotypes." *Conservation Genetics* 10 (6): 1747–1758. doi:http://dx.doi.org/10.1007/s10592-008-9778-8.

Fredrickson, L. H., and T. S. Taylor. 1982. *Management of Seasonally Flooded Impoundments for Wildlife*. *U.S. Fish and Wildlife Service Resource Publication 148*. Washington, D.C.: U.S. Department of the Interior, Fish and Wildlife Service.

http://www.fwspubs.org/doi/suppl/10.3996/072013-JFWM-050/suppl_file/072013-jfwm-050.s4.pdf.

Gee, H. K. W. 2007. "Habitat Characteristics of Refuge Wetlands and Taro Lo'i Used by Endangered Waterbirds at Hanalei National Wildlife Refuge, Hawai'i." MSc thesis, South Dakota State University. http://www.sdstate.edu/wfs/publications/thesis/upload/Gee-Hugo-K-W-M-S-2007.pdf.

Gutscher-Chutz, J. L. 2011. "Relationships among Aquatic Macroinvertebrates, Endangered Waterbirds, and Macrophytes in Taro Lo'i at Hanalei National Wildlife Refuge, Kaua'i, Hawai'i." MSc thesis, South Dakota State University. http://openprairie.sdstate.edu/etd/448/.

HDBEDT (State of Hawai'i Department of Business, Economic Development, and Tourism). 2009. "2009 State of Hawai'i Data Book." http://dbedt.hawaii.gov/economic/databook/db2009/.

HDBEDT (State of Hawai'i Department of Business, Economic Development, and Tourism). 2012. "Population and Economic Projections for the State of Hawaii to 2040." State of Hawai'i Department of Business, Economic Development, and Tourism, Research and Economic Analysis Division. http://files.hawaii.gov/dbedt/economic/data_reports/2040-long-range-forecast/2040-long-range-forecast.pdf.

HDOH (State of Hawai'i Department of Health). 2008. 2006 State of Hawai'i Water Quality Monitoring and Assessment Report: Integrated Report to the U.S. Environmental Protection Agency and the U.S. Congress pursuant to Sections §303(D) and §305(B), Clean Water Act (P.L. 97-117). Honolulu, HI: State of Hawai'i Department of Health. http://health.hawaii.gov/cwb/files/2013/05/Integrated_2006_StateOfHawaii.pdf.

IMPLAN 2011. IMPLAN: Kaua'i County, Hawai'i.

Keener, V., D. Helweg, S. Asam, S. Balwani, M. Burkett, C. Fletcher, T. Giambelluca, Z. Grecni, M. Nobrega-Olivera, J. Polovina, and G. Tribble. 2018. Hawai'i and U.S.-Affiliated Pacific Islands. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 1242–1308. doi: 10.7930/NCA4.2018.CH27 URL: https://nca2018.globalchange.gov/chapter/hawaii-pacific

Kirby, R. E., J. K. Ringelman, D. R. Anderson, and R. S. Sojda. 1992. "Grazing on National Wildlife Refuges: Do the Needs Outweigh the Problems?" *Transactions of the 57th North American Wildlife and Natural Resources Committee*.

MacKenzie, R. A., and G. L. Bruland. 2012. "Nekton Communities in Hawaiian Coastal Wetlands: The Distribution and Abundance of Introduced Fish Species." *Estuaries and Coasts* 35 (1): 212–226. doi:10.1007/s12237-011-9427-1.

Malachowski, C. P., and B. D. Dugger. 2018. "Hawaiian Duck Behavioral Patterns in Seasonal Wetlands and Cultivated Taro." *The Journal of Wildlife Management* 82 (4): 840–49. doi:10.1002/jwmg.21429.

Malachowski, C. P., B. D. Dugger, K. Uyehara, M. Reynolds, A. Engilis, and D. Heard. 2013. "Koloa Recovery on Hanalei National Wildlife Refuge." Paper presented at Region 1 Science Excellence on National Wildlife Refuges Series.

Mayer, Tim. 2011. Supervisory Hydrologist, U.S. Fish and Wildlife Service, Region 1. Personal communication.

McCarthy et al. 2001. The intensity of tropical cyclones is likely to increase by 10–20 percent in the Pacific region when atmospheric levels of CO_2 reach double preindustrial levels.

McDonald, K. 2016. "Avian Botulism Monitoring and Mapping: Hanalei National Wildlife Refuge, Kauai, Hawaii." Unpublished report on file at Kauaʻi National Wildlife Refuge Complex, Kīlauea, HI.

McGuire, C. R. 2006. "Effects of Introduced Fish on Aquatic Insect Abundance : A Case Study of Hamakua Marsh, Oahu Hawaiʻi." MSc thesis, University of Hawaiʻi at Manoa. http://scholarspace.manoa.hawaii.edu/handle/10125/20452.

NASS (National Agricultural Statistics Service). 2012. "State of Hawaiʻi - Taro - Acres Harvested." *Quick Stats*. http://quickstats.nass.usda.gov.

NASS. 2015. "Top 20 Commodities in Hawai'i." U.S. Department of Agriculture, National Agricultural Statistics Service. https://www.nass.usda.gov/Statistics_by_State/Hawaii/Publications/Miscellaneous/Top 20 commodities 2014.pdf.

NASS. 2017a. "Quick Stats Database: Census: Crops: Field Crops: Taro." U.S. Department of Agriculture, National Agricultural Statistics Service. https://quickstats.nass.usda.gov/?source_desc=CENSUS.

NASS. 2017b. "Quick Stats Database: Survey: Crops: Field Crops: Taro." U.S. Department of Agriculture, National Agricultural Statistics Service. https://quickstats.nass.usda.gov/?source_desc=SURVEY.

———. 2018. 2018. Crop Values 2017 Summary (February 2018). ISSN: 1949-0372

NOAA (National Oceanic and Atmospheric Administration). 2017. "Mean Sea Level Trend 1611400 Nāwiliwili, Hawaii." https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=1611400.

NRCS (U.S. Department of Agriculture Natural Resources Conservation Service). 2009. "Practices to Enhance Native Wildlife Habitat on Wetland Taro Farms." *Biology Technical Note* 21: 21 pp. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_036706.pdf.

NRCS. 2017. "Soil Survey Geographic Database (SSURGO)." Accessed: 2017 April 6. https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm.

Paveglio, F., A. Engilis, J. Kauffeld, M. Silbernagle, and G. Zahm. 1999. "Hawaiian Wetland Refuge Habitat Management Review, April 7–16, 1999." Portland, OR: U.S. Department of the Interior, Fish and Wildlife Service, Region 1.

Pilson, S. 2017. "Hanalei National Wildlife Refuge Water Resource Inventory and Assessment." Portland, OR: U.S. Department of the Interior, Fish and Wildlife Service, Region 1, Division of Engineering, Branch of Water Resources.

Reynolds, M. H., Uyehara, K. J., Johnson, K., Hess, S., & Dewey, D. 2019. "Efficacy of detection canines for avian botulism surveillance and mitigation." Paper presented at Region 1 Science of the Service.

Rocke, T. E., and T. K. Bollinger. 2007. "Avian Botulism." In *Infectious Diseases of Wild Birds*, edited by N. J. Thomas, D. B. Hunter, and C. T. Atkinson, 377–416. Ames, IA: Blackwell Publishing Professional. doi:10.1002/9780470344668.ch21.

Rocke, T. E., and M. D. Samuel. 1999. "Water and Sediment Characteristics Associated with Avian Botulism Outbreaks in Wetlands." *Journal of Wildlife Management* 63: 1249–1260.

Shapiro, L., and W. Shapiro. 1995. *Archaeological Investigations of Hanalei National Wildlife Refuge*. Kailua, HI: Biosystems Analysis, Inc.

Sustainable Resources Group International Inc. 2012. *Watershed Management Plan for Hanalei Bay Watershed, Volume 1: Watershed Characterization*. Kailua, HI: Sustainable Resources Group International, Inc. for Hanalei Watershed Hui. http://www.hanaleiwatershedhui.org/sites/default/files/docs/projects/2012/HBWMP_Vol1_Oct2012.pdf.

Tetra Tech and HDOH (Tetra Tech, Inc., and State of Hawai'i Department of Health). 2008. *Total Maximum Daily Loads for the Hanalei Bay Watershed: Phase 1—Streams and Estuaries*. San Diego, CA and Honolulu, HI: Tetra Tech, Inc. and State of Hawai'i Department of Health. http://health.hawaii.gov/cwb/files/2013/05/Integrated_HanaleiPhase1.pdf.

The Trust for Public Land. 2010. The Economic Benefits and Fiscal Impacts of Parks and Open Space in Nassau and Suffolk Counties, New York. Accessed: 29 August 2018. Retrieved from: http://cloud.tpl.org/pubs/ccpe--nassau-county-park-benefits.pdf.

Timbol, A. S. 1977. "A Report on the Aquatic Survey of Stream Macrofauna for the Hydroelectric Power Study for Hawai'i." Honolulu, HI: Report prepared for the U.S. Army Corps of Engineers, Pacific Ocean Division.

Uchida, J., P. Levin, S. Miyasaka, G. Teve, J. Hollyer, S. Nelson, and J. Ooka. 2008. "How to Grow Azolla." In *Taro Mauka to Makai: A Taro Production and Business Guide for Hawai'i Growers*, edited by D. Evans, 87. Honolulu, HI: University of Hawai'i, College of Tropical and Human Resources.

U.S. Census Bureau. 2000. "American FactFinder: 2000 Profile of General Demographic Characteristics." http://factfinder2.census.gov.

U.S. Census Bureau. 2019a. "American FactFinder: 2013–2017 American Community Survey 5-Year Estimates: Total Population." Accessed: 23 December 2019. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_B01003&prodType=table .

U.S. Census Bureau. 2011. "American FactFinder: 2010 Selected Economic Characteristics." http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.

U.S. Census Bureau. 2019b. "American FactFinder: 2013–2017 American Community Survey 5-Year Estimates: Poverty Status in the Past 12 Months." Accessed: 23 December 2019. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_S1701&prodType=table .

U.S. Census Bureau. 2019c. "American FactFinder: 2013–2017 American Community Survey 5-Year Estimates: Universe: Total Population." Accessed: 23 December 2019. Retrieved from: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_C02003&prodType=table

USFWS 2011. *Recovery Plan for Hawaiian Waterbirds, Second Revision*. Portland, OR: U.S. Department of the Interior, Fish and Wildlife Service. https://ecos.fws.gov/docs/recovery_plan/Hawaiian Waterbirds RP 2nd Revision.pdf.

USFWS. 2004. *Draft Revised Recovery Plan for the Nēnē or Hawaiian Goose (Branta sandvicensis)*. Portland, OR: U.S. Department of the Interior, Fish and Wildlife Service. https://ecos.fws.gov/docs/recovery_plan/040924a.pdf.

USFWS. 2017. "Pacific Region Division of Refuges Firearms Policy for Non-Law Enforcement Personnel (Version 1.1)." Portland, OR: U.S. Department of the Interior, Fish and Wildlife Service, Region 1.

USFWS. 2020. Draft Wetlands Management and Waterbird Conservation Plan for Hanalei National Wildlife Refuge.

USGS (U.S. Geological Survey). 2017. "USGS 16103000 Hanalei River Nr Hanalei, Kauai, HI." https://waterdata.usgs.gov/nwis/inventory/?site_no=16103000&agency_cd=USGS.

Uyehara, K. J., A. Engilis Jr., and M. Reynolds. 2007. "Hawaiian Duck's Future Threatened by Feral Mallards." *U.S. Geological Survey Fact Sheet 2007-3047*. http://pubs.usgs.gov/fs/2007/3047/fs2007-3047.pdf.

Williams, B. K., R. C. Szaro, and C. D. Shapiro. 2009. *Adaptive Management: The U.S. Department of the Interior Technical Guide*. 2009 ed. Washington, D.C.: U.S. Department of the Interior, Adaptive Management Working Group. https://www2.usgs.gov/sdc/doc/DOI- AdaptiveManagementTechGuide.pdf.

Yamamoto, M. N., and A. W. Tagawa. 2000. *Hawai'i's Native and Exotic Freshwater Animals*. Honolulu, HI: Mutual Publishing.

APPENDIX A. CONSULTATION, COORDINATION, AND PUBLIC OUTREACH

The Refuge's Comprehensive Conservation Plan (CCP), which is currently being developed, will cover all aspects of Refuge management, including those outside of the scope of the WMWCP such as forest management, visitor services, cultural and historic resources, facilities, and law enforcement. Habitat management goals, objectives, and strategies described in the WMWCP will be revised as appropriate and incorporated into the CCP. Per 43 CFR 46.305, public scoping is not required for EAs. However, since the planning processes for the WMWCP and CCP overlap, some issues and priorities raised during public scoping for the CCP have been considered in development of the WMWCP. This section describes the cumulative public outreach efforts relevant to wetlands management and waterbird conservation planning at Hanalei NWR.

Public scoping for the CCP process for the KNWRC, which includes three national wildlife refuges—Hanalei, Hulēʻia, and Kīlauea Point—began in the fall of 2009 with a notice in the Federal Register (74 FR 49399). Public meetings and talk story sessions were held in Hanalei, Hulēʻia, Kīlauea, and Līhuʻe from October 2009–January 2010. In all, over 80 people participated. Public input was also solicited through planning updates distributed to our mailing list. Additionally, workshops/meetings with local, state, federal agencies, community groups, Refuge users, nonprofits, and others were held. This helped us to further identify issues and priorities to consider during plan development. Following is a brief summary of public involvement for CCP-related efforts for the KNWRC:

- September 28, 2009 – Federal Register Notice announcing a notice of intent to prepare the draft CCP/EA and public open house meetings;
- October 8, 2009 – Talk story session at Hanalei;
- November 4, 2009 – Talk story session at Kīlauea;
- January 2010 – Planning Update 1 announcing the official start of public scoping with public open house meetings, summarizing talk story sessions already held, and previewing preliminary issues and goals for CCP consideration;
- January 12, 2010 – Talk story session at Hulēʻia;
- January 22, 2010 – News release to announce public open house meetings;
- January 26, 2010 – Public open house at Līhuʻe Public Library;
- January 28, 2010 – Public open house at Kīlauea Elementary School cafeteria;
- February 2011 – Planning Update 2 summarized the public scoping efforts and outlined the next steps in CCP development;
- 2010–2011 – Refuge staff also held specific meetings to provide updates and discuss management considerations with partners and interested parties (e.g., Division of Forestry and Wildlife, kalo farmers, Kīlauea Point Natural History Association (KPNHA), National Oceanic and Atmospheric Administration (NOAA), Hanalei Watershed Hui, elected officials);
- January 2013 – Refuge staff met with Refuge kalo farmers to discuss the draft CD for kalo farming on the Refuge, and new permit requirements; and
- 2016 – Refuge staff met with the DOI's Office of Native Hawaiian Relations to discuss the use of kalo farming on the Refuge and the draft CCP.

Distribution and notification of the opportunities above was accomplished using multiple methods, including news releases; a mail/email list of over 500 people, including interested individuals, kūpuna, local conservation and interest groups, research organizations, Native Hawaiian organizations, and local, state, and federal government agencies and elected officials; community and association events/meetings; and CCP-specific websites.

In 2015, due to staff and funding resource limitations, planning for the Hanalei and Hulēʻia NWR CCP was put on hold in order to complete the Kīlauea Point NWR CCP. Upon finalization of the Kīlauea Point NWR CCP in July 2016, planning for the other two refuges in the Complex (Hanalei and Hulēʻia NWRs) resumed. In August 2017, the Service finalized the revised Cooperative Agricultural Use policy, which outlines objectives for the use of cooperative agriculture on Refuge System lands and provides an open, transparent, and competitive process for awarding CAAs on refuges in compliance with the DOI policy on procurement contracts, grant and cooperative agreements (505 Department Manual [DM] 2). In order to comply with this revised policy, the WMWCP process was initiated. Following is a brief summary of public involvement for WMWCP-related efforts for Hanalei NWR:

- 2017 – Refuge staff, interns and/or volunteers met with Refuge kalo farmers to discuss and gather information about the relationships between kalo farming practices and avian botulism;
- 2018 – Refuge staff met with Refuge kalo farmers to discuss and gather information on the economic costs and benefits of kalo farming on the Refuge; and
- Annual – Special use permit meetings with all Refuge kalo farmers to discuss current permit requirements, compliance, and other issues and draft proposed changes to Refuge kalo farming program.

WMWCP goals, objectives, strategies, and alternatives were shaped by the issues identified and feedback received during public involvement. The following table summarizes the comments received during public involvement and identifies where and/or how it was addressed in the draft WMWCP and EA.

SUMMARY OF SCOPING COMMENTS

Issue	*Where/How Addressed in Draft WMWCP and EA*
Elevate species recovery (especially for koloa maoli) as a higher priority within KNWRC (includes imbalance of staff and funding for wetland habitat management and enhancement).	Koloa maoli focus can be found in Goal 1.
Focus additional effort on water security and quality for wetland Refuges.	This issue is addressed in Goal 2.
Protection of culturally significant farming in the Hanalei Valley and the role of the valley in providing food security for Kauaʻi.	The significance of farming in the valley is discussed under Goal 1.
Recognition of symbiotic relationship between farmers and birds.	The Service recognizes that kalo farming does provide habitat for wetland birds, which is addressed in in Chapter 4, under Goal 1 and Appendix B (CD on kalo farming).
Recognition of Hanalei River as an American Heritage River and conservation of the river's	All points can be found under Goal 2.

Issue	*Where/How Addressed in Draft WMWCP and EA*
water quality, instream flow, and water quantity; a water budget for the Refuge and farming operations and riverine resources.	
Identification of partnership opportunities to meet species and habitat goals for endangered species both on the Refuge and other areas throughout the island.	Partnering is a critical component of achieving Refuge goals (as stated in the first part of Chapter 4). Specific partnering opportunities can be found in Goals 1 and 2.
Concern that impoundments have changed hydrology of the river and worsened effects of flooding.	Hydrology discussion can be found in Chapter 2.
‘O‘opu habitat protection study needed.	Will be considered through in-progress related Inventory and Monitoring Plan and future planning efforts to address water management control structures.
More emphasis on managing the Hanalei River for biological values and reducing invasive species populations (e.g., hau bush, mangroves).	Identified under Goals 1 and 2.
Historic intent of the Refuge creation and clarifying what records say about kalo farming and what part kalo farming would play in the future of the Refuge.	Refuge establishment and purpose can be found in Chapter 1. Specific information on kalo farming and its future can be found in Chapter 4, under Goal 1 in the rationale sections as well as in Appendix B (CD on kalo farming).
Improve the Refuge’s coordination with the kalo farmers. The plan should articulate the past and current role of kalo farming at the Refuge, from both a cultural and biological perspective.	See above. Continued coordination with kalo farmers are specifically identified as strategies under Goal 1.
Concern about kalo mutation/genetically modified organism hybridization from adjacent lands.	Control of lands outside of Refuge boundaries is not in the jurisdiction of the Service. However, the issue of kalo mutation/genetically modified organisms on the Refuge is addressed as part of the CD addressing kalo farming (Appendix B).
Potential use of cattle as a wetland management tool (is it effective for waterbird habitat improvement?).	Strategy identified under Goal 1.

APPENDIX B: OTHER APPLICABLE STATUTES, EXECUTIVE ORDERS, AND REGULATIONS

Resource Area and Statutes	*Relevance Summary*
Cultural Resources	
American Indian Religious Freedom Act, as amended, 42 USC 1996 – 1996a; 43 CFR Part 7 Antiquities Act of 1906, 16 USC 431-433; 43 CFR Part 3	Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to take into account the effects of their undertakings on historic properties. This includes complying with the NHPA and other cultural resource preservation laws and consulting with the State Historic Preservation Division (SHPD) and appropriate Native Hawaiian organizations over management actions which may affect cultural resources.
Archaeological Resources Protection Act of 1979, 16 USC 470aa – 470mm; 18 CFR Part 1312; 32 CFR Part 229; 36 CFR Part 296; 43 CFR Part 7 National Historic Preservation Act of 1966, as amended, 16 USC 470-470x-6; 36 CFR Parts 60, 63, 78, 79, 800, 801, and 810 Paleontological Resources Protection Act, 16 USC 470aaa – 470aaa-11 Native American Graves Protection and Repatriation Act, 25 USC 3001-3013; 43 CFR Part 10 Executive Order 11593 – Protection and Enhancement of the Cultural Environment, 36 Fed. Reg. 8921 (1971) Executive Order 13007 – Indian Sacred Sites, 61 Fed. Reg. 26771 (1996)	Pursuant to Section 106 of the NHPA and promulgated regulations, the Service has determined the proposed action constitutes an undertaking under the NHPA (36 CFR 800.3(a)) but would not adversely affect cultural resources/historic properties. When projects described in this EA are specifically identified for implementation, the FWS will carry out the NHPA Section 106 process and take into account the potential effects of the project on historic properties. The proposed action would comply with the NHPA because the Service would follow established procedures for protecting archaeological and cultural resources if encountered during ground-disturbing activities. If a cultural resource were inadvertently discovered, activities in the area of the resource would be stopped and the SHPD would be contacted to determine how to proceed. The presence of human remains or graves in the project area (floodplain) is unlikely, but we would comply with Native American Graves Protection and Repatriation Act (NAGPRA) if these are inadvertently discovered. Implementing the proposed action would not hamper, impede, or otherwise limit the exercise of traditional, customary, or religious practices of Native Hawaiians in the immediate area, to the extent the practices are provided for by the Constitution of the State of Hawaii and by Hawaii statutory and case law. Executive Order (EO) 11593 established the policy that the federal government provides leadership in preserving, restoring, and maintaining the historic and cultural environment of the United States. The Service would comply with EO 11593. The Refuge contains no known paleontological resources and is unlikely to contain such resources.
Fish & Wildlife	
Endangered Species Act of 1973, as amended, 16 USC 1531-1544;	The ESA directs all federal agencies to work to conserve endangered and threatened species and to use their authorities to further the purposes of the ESA. Section 7 of the ESA is the

Resource Area and Statutes	*Relevance Summary*
36 CFR Part 13; 50 CFR Parts 10, 17, 23, 81, 217, 222, 225, 402, and 450 Fish and Wildlife Act of 1956, 16 USC 742 a-m Lacey Act, as amended, 16 USC 3371 et seq.; 15 CFR Parts 10, 11, 12, 14, 300, and 904 Migratory Bird Treaty Act, as amended, 16 USC 703-712; 50 CFR Parts 10, 12, 20, and 21 Executive Order 13186 – Responsibilities of Federal Agencies to Protect Migratory Birds, 66 Fed. Reg. 3853 (2001)	mechanism by which federal agencies ensure their actions do not jeopardize the existence of any listed species. Under Section 7, federal agencies consult with the Service or the National Marine Fisheries Service when any action they carry out, fund, or authorize may affect a listed species. The Section 7 consultation associated with the WMWCP will be concluded after the EA public review and prior to the finalization of a NEPA decision document. This project would comply with the ESA because of the consultations performed and the incorporation of minimization measures. Migratory bird conventions and the Migratory Bird Treaty Act (MBTA) impose substantive obligations on the United States for the conservation of migratory birds and their habitats. EO 13186 directs executive departments and agencies to take certain actions to further implement the MBTA, including supporting the conservation intent of the migratory bird conventions, restoring and enhancing the habitat of migratory birds, as practicable, and preventing or abating detrimental alteration of the environment for the benefit of migratory birds, as practicable. The proposed action is consistent with both the MBTA and EO 13186 because the proposed action would maintain and enhance habitat for migratory birds.
Natural Resources	
Clean Air Act, as amended, 42 USC 7401-7671q; 40 CFR Parts 23, 50, 51, 52, 58, 60, 61, 82, and 93; 48 CFR Part 23 Wilderness Act, 16 USC 1131 et seq. Wild and Scenic Rivers Act, 16 USC 1271 et seq. Executive Order 13112 – Invasive Species, 64 Fed. Reg. 6183 (1999)	The proposed action would have negligible effects to air quality. Any actions that have the potential to negatively affect air quality would be temporary and short-term, and BMPs would be used to minimize these effects. The Refuge contains no areas suitable for wilderness designation. An American Heritage river (the Hanalei River) runs through the Refuge. The river is not under the jurisdiction of the Service, and the Service has no control over navigation or recreation that occur on the river. Water is withdrawn from and returned to the Hanalei River to provide wetland habitat for threatened and endangered waterbirds. The proposed action would conserve the river's water quality, instream flow, and water quantity. EO 13112 requires federal agencies to prevent the introduction of invasive species and provide for their control and minimize the economic, ecological, and human health impacts that invasive species cause. The proposed action would be consistent with this EO because non-native invasive plant and animal species would be removed as part of habitat management actions.
Water Resources	
Coastal Zone Management Act of 1972, 16 USC 1451 et seq.; 15 CFR Parts 923, 930, 933	Hawaii Coastal Zone Management Program (1990) describes the state's response to the Coastal Zone Management Act of 1972. The objectives of Hawaii's Coastal Zone Management (CZM) program are to protect and manage Hawaii's coastal resources. The Refuge

Resource Area and Statutes	Relevance Summary
Federal Water Pollution Control Act of 1972 (commonly referred to as Clean Water Act), 33 USC 1251 et seq.; 33 CFR Parts 320-330; 40 CFR Parts 110, 112, 116, 117, 230-232, 323, and 328 Rivers and Harbors Act of 1899, as amended, 33 USC 401 et seq.; 33 CFR Parts 114, 115, 116, 321, 322, and 333 Safe Drinking Water Act of 1974, 42 USC 300f et seq.; 40 CFR Parts 141-148 Executive Order 11988 – Floodplain Management, 42 Fed. Reg. 26951 (1977) Executive Order 11990 – Protection of Wetlands, 42 Fed. Reg. 26961 (1977)	lies within the state's CZM area. The CZM Act notes that federal lands and lands subject solely to the discretion of the federal government are excluded from the state's CZM area. A review of the project for CZM consistency will be conducted by the State of Hawai'i Office of Planning, the state agency administering the state's CZM program. The proposed action is consistent with state objectives for managing recreational resources, scenic and open space resources, and coastal ecosystems. The Refuge's wetland habitats are not located in an area not subject to tsunamis or storm waves. Measures to minimize pollution or hazardous materials that could affect public health are in place. The Refuge would continue to provide wildlife-dependent recreation opportunities that are free to the public and would support native Hawaiian wildlife for the benefit of all Americans. The Hanalei River runs through the Refuge. The river is not under the jurisdiction of the Service, and the Service has no control over navigation or recreation that occur on the river. Water is withdrawn from and returned to the Hanalei River to provide wetland habitat for threatened and endangered waterbirds. The proposed action would not interfere with or impede navigation of the river, and would conserve the river's water quality, instream flow, and water quantity. EO 11988 requires federal agencies to avoid to the extent possible long-and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative. The wetland and riparian areas of the Refuge lie within the Hanalei River floodplain. The proposed action is consistent with EO 11988 because Alternative B (preferred) is not anticipated to result in adverse impacts to the floodplain, such as raising the elevation of the floodplain or constructing impervious surfaces that would affect drainage, as a result of these modifications. However, beneficial minor effects to the riparian zone and floodplain would occur. If adverse effects become anticipated to occur during the course of plan implementation, the planned strategy would be designed to avoid or have minimal adverse effects or be mitigated under EO 11988 and other applicable laws. EO 11990 requires federal agencies to avoid to the extent possible long-and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. The National Wetlands Inventory map identifies the Hanalei Valley floor as a complex mix of palustrine and riverine wetlands. The proposed action would maintain and enhance these existing wetlands, and additional wetlands would be restored.

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Hanalei National Wildlife Refuge. Photo: USFWS
'Alae ke'oke'o (Hawaiian coot). Photo: Dan Clark/USFWS
Ae'o (Hawaiian stilt). Photo: Gary Kramer/USFWS