



Department of Energy
National Nuclear Security Administration
Sandia Field Office
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MAR 07 2019


FINDING OF NO SIGNIFICANT IMPACT

CONTINUED OPERATION OF THE KAUAI TEST FACILITY
SANDIA NATIONAL LABORATORIES, HAWAII

The United States Department of Energy (DOE) National Nuclear Security Administration (NNSA) has prepared an environmental assessment (EA) for Continued Operation of the Kauai Test Facility, Sandia National Laboratories, Hawaii (DOE/EA-2089). The EA analyzed the potential effects of a proposal to continue operations at KTF, increase the number of annual single rocket launches from the facility, and implement replacement and modernization of facilities to sustain and enhance launch capabilities based on anticipated/envisioned NNSA and national security needs. The rail and vertical launch facilities and infrastructure at KTF are needed to maintain the continued launch capability for the NNSA to support broader national security mission needs, as well as sustain and enhance the unique capabilities that support NNSA core competencies. The EA analyzed impacts to air quality, water resources, biological resources, noise, human health and safety and associated cumulative effects. A detailed description of the proposed action and its environmental consequences is presented in the EA.

Based on the analysis presented in the EA and the concerns of interested stakeholders, the NNSA finds that there would be no significant impacts associated with the proposed action. The NNSA makes this Finding of No Significant Impact pursuant to the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 et seq.), the Council on Environmental Quality implementing regulations (40 CFR 1500), and the DOE NEPA regulations (10 CFR 1021). The proposed action does not constitute a major federal action that would significantly affect the human environment within the mandate of NEPA. Therefore, no environmental impact statement is required for this proposal.

Signed in Albuquerque, New Mexico this 7 day of March, 2019



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Acronyms and Abbreviations

ACGIH – American Conference of Governmental Industrial Hygienists

ACHP – Advisory Council on Historic Preservation

ACS – American Community Survey

AEB – Auxiliary equipment building

AEC – Atomic Energy Commission

AIRFA – American Indian Religious Freedom Act

ALTRV – Altitude Reservation

API – Agricultural Preservation Initiative

ARPA – Archaeological Resource Protection Act

ARTCC – Air Route Traffic Control Center

ATCAA – Air Traffic Control Assigned Airspace

BASH – Bird/Aircraft Strike Hazard

BMP – Best Management Practice

BO – Biological Opinion

CA – Comprehensive Agreement

CAA – Clean Air Act

CEQ – Council on Environmental Quality

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act

CFR – Code of Federal Regulations

CZMA – Coastal Zone Management Act

CO – Base Commanding Officer

D&D – Decommissioning and demolition

DLNR – Department of Land and Natural Resources

DNL – Day/Night Average Sound Level

DoD – Department of Defense

DOE – Department of Energy

DoN – Department of the Navy

DOT – Department of Transportation

EA – Environmental Assessment

EEZ – Exclusive Economic Zone

EFH – Essential Fish Habitat

EIS – Environmental Impact Statement

EISA – Energy Independence and Security Act

EMS – Environmental Management System

EO – Executive Orders

EPCRA – Emergency Planning and Community Right-to-Know Act

ESA – Endangered Species Act

ES&H – Environmental, Safety, and Health

ESQD – Explosives safety quantity distance	M&O – Management and Operating
ETR – Extended Test Range	MAB – Missile assembly building
FAA – Federal Aviation Administration	MBTA – Migratory Bird Treaty Act
FL – Flight Level	MDA – Missile Defense Agency
FLSC – Flexible Linear Shaped Charge	MDF – Mild Detonating Fuze
FR – Federal Register	MMPA – Marine Mammal Protection Act
FRDC – Federally-Funded Research and Development Center	MSAT – Mobile Source Air Toxics
FTF – Flexible Target Family	MSL – Mean sea level
FTS – Flight Termination System	MST – Missile Service Tower
GFCI – Ground-Fault Circuit Interrupter	NAAQS – National Ambient Air Quality Standards
GHA – Ground Hazard Area	NAGPRA – Native American Graves Protection and Repatriation Act
GMD – Ground-Based Midcourse Defense	NAS – National Airspace System
HAP – Hazardous Air Pollutants	NEPA – National Environmental Policy Act
HAPC – Habitat Areas of Concern	NESHAP – National Emission Standards for Hazardous Air Pollutants
HE – Hazard Evaluation	NEW – Net Explosive Weight
HI – Hazard Identification	NHPA – National Historic Preservation Act
HIANG – Hawai'i Air National Guard	NHRP – National Register of Historic Places
HUD – Housing and Urban Development	NNSA – National Nuclear Security Administration
HVAC – Heating, ventilation and Air Conditioning	NOAA – National Oceanic and Atmospheric Administration
ICAO – International Civil Aviation Organization	NOTAM – Notice to Airmen
ICRMP – Integrated Cultural Resource Management Plan	NOTMAR – Notice to Mariners
IDP – Installation Development Plan	NPDES – National Pollutant Discharge Elimination System
INRMP – Integrated Natural Resource Management Plan	NSP – Noncovered Source Permit
ISMS – Integrated Safety Management System	NTESS – National Technology and Engineering Solutions of Sandia, LLC
ISO – International Organization for Standardization	OEIS – Overseas Environmental Impact Statement
KIUC – Kaua'i Island Utility Cooperative	ORS – Operationally Responsive Space
KGP – Kaua'i General Plan	ORV – Off road vehicle
KPNWR – Kilauea Point National Wildlife Refuge	OSHA – Occupational Safety and Health Act
KTF – Kaua'i Test Facility	
LOB – Launch Operations Building	

PHS – Primary Hazard Screening	WPRFMC – Western Pacific Regional Fishery Management Council
PMR – Pacific Missile Range	
PMRF – Pacific Missile Range Facility	WWVH – NIST Radio Station
RCC – Range Commander’s Council	
RCRA – Resource Conservation and Recovery Act	
RMSA – Rocket Motor Staging Area	
ROI – Region of Influence	
SARA – Superfund Amendments and Reauthorization Act	
SDIO – Strategic Defense Initiative Organization	
SHPO – State Historic Preservation Officer	
SIP – State Implementation Plans	
SMP – Safety Management Plan	
SNL – Sandia National Laboratories	
SOH – State of Hawai’i	
SOP – Standard operating procedure	
SPCC – Spill Prevention, Control, and Countermeasure	
SPP – Strategic Partnerships Projects	
STARS – Strategic Target System	
SWEA – Site Wide Environmental Assessment	
SWPPP – Stormwater Pollution Prevention Plan	
THAAD – Thermal High Altitude Area Defense System	
UN – United Nations	
U.S. – United States	
USAEC – U.S. Army Corps of Engineers	
USASMDCC – U.S. Army Space and Missile Defense Command	
USC – United States Code	
USEPA – U.S. Environmental Protection Agency	
USFWS – U.S. Fish and Wildlife Service	
USGS – United States Geological Survey	

Measurements

#T – pounds of thrust

% – percent

cm – centimeters

cu ft. – cubic feet

CY – cubic yards

dB – decibels

dBA – A-weighted sound levels

DNL – day/night average sound level

°F – degrees Fahrenheit

ft – feet

FY – fiscal year

gal – gallons

Hz – hertz

in – inches

K – thousands

km – kilometers

kW – kilowatt

kWh – kilowatt hours

lbs – pounds

LF – linear feet

L_{\max} – maximum sound level

m – meters

M – millions

min. – minimum

PM – particulate matter

ppb – parts per billion by volume

ppm – parts per million by volume

psi – pounds per square inch

sq. ft. – square feet

$\mu\text{g}/\text{m}^3$ – micrograms per cubic meter of air

V – volt

Chemicals

Al_2O_3 – Fused aluminum oxide

Cl – Chlorine

CO – Carbon monoxide

CO_2 – Carbon dioxide

HCl – Hydrogen chloride

H_2O – Dihydrogen Monoxide

H_2S – Hydrogen sulfide

N_2 – Nitrogen

Pb – Lead

PCB – polychlorinated biphenyls

SO_2 – Sulfur dioxide

VOC – Volatile organic compounds

Purpose and Need

The United States (U.S.) Department of Energy (DOE), National Nuclear Security Administration (NNSA) is preparing this environmental assessment (EA) for the continued operation of the Sandia National Laboratories (SNL), Kaua'i Test Facility (KTF) located on the U.S. Navy's Pacific Missile Range Facility (PMRF), Barking Sands, Kaua'i, Hawai'i. NNSA will continue to conduct launch activities at the site and proposes to expand its vertical launch capabilities. KTF operations sustain and enhance critical capabilities, technologies, and specialized range competencies needed for the NNSA mission as well as supporting critical national security programs such as missile defense and hypersonic systems. Currently the Management and Operating Contractor (M&O), National Technology & Engineering Solutions of Sandia (NTESS), LLC, a wholly owned subsidiary of Honeywell International, Inc, operates SNL for NNSA.

NNSA is a semi-autonomous agency within the DOE with a core mission of enhancing national security through the military application of nuclear science. In support of this mission, the M&O contractor performs research, development, and testing to support the launch of sounding rocket flight vehicles and payload experiments within a highly-dynamic flight environment for component development and flight testing. Through this process the combined environments allow the payload experiments to demonstrate performance in applicable flight test operations as well as collect flight test data for further analysis. This testing also provides valuable hands-on experience to sustain and enhance personnel proficiency in NNSA Nuclear Weapons related processes and techniques such as research, development, and test and evaluation. Nuclear devices have never been launched from KTF and operations at KTF do not (currently or in the past) involve radioactive materials.

SNL is a multidisciplinary national laboratory and a Federally-Funded Research and Development Center. Through the NNSA Strategic Partnership Projects (SPP) Program, work is performed

for non-DOE entities by M&O personnel utilizing unique NNSA facilities and capabilities for work that is not directly funded by DOE/NNSA appropriations. The SPP program provides the opportunity for NNSA and the M&O contractor to collaborate with representatives from other government agencies, the industrial sector, and universities to address science and technology challenges that are of interest to the nation.

At KTF, the NNSA M&O contractor manages day-to-day operations, conducts rocket launching activities and collaborates with mission partners including PMRF, the U.S. Department of the Navy (DoN), and Missile Defense Agency (MDA). In addition, the M&O contractor works with several U.S. Department of Defense (DoD) sponsors on a launch-campaign basis to address critical national security challenges. Examples of this support include: the Advanced Hypersonic Weapon (AHW) for the United States Army, the Conventional Prompt Global Strike for the Navy; and the Super Strydi Orbital mission for the Operationally Responsive Space (ORS) Program.

National security imperatives require that for current test support and associated experimental activities at KTF to be continued, some new construction must be undertaken to improve the KTF test support functions, and the needs of new test programs for vertical-launch type vehicles be accommodated.

Background

The KTF has been an active rocket launching facility since 1962. It exists as a facility at the north end of the DoD PMRF within the PMRF boundaries. PMRF is located on the island of Kaua'i.

The KTF launch field was originally designed to accommodate 40 launch pads, but only 15 pads were constructed. Of these, 11 have had their launchers removed. Beyond the original plan, two additional launch pads were constructed: one at Pad 41 (Kokole Point) and one at Pad 42 (Missile Service Tower [MST]). In addition to rocket launch pad sites, KTF facilities include missile and payload assembly buildings, launch operations and data acquisition facilities, maintenance shops, and a trailer dock compound for administration and other office processing.

The administrative area of KTF, known as the Main Compound, and the launch field are located within fenced areas near the North Nohili access road at PMRF. Inside the compound, a number of trailers and structures are connected together with a network of concrete docks and covered walkways. The majority of these facilities are used during mission operations to support customer and

defense contractor personnel and technical staff from SNL, New Mexico; general maintenance activities are performed during non-campaign operations.

Additionally, there are a number of permanent buildings and shelters in the Main Compound and launch field, some of which are in use year-round to support and maintain KTF facilities. The Kokole Point launch complex and associated facilities were transferred to the U.S. Navy in 2013; however, SNL programs may launch from this location on a case-by-case campaign basis.

KTF has been used for testing rocket systems with scientific and technological payloads, advanced development of maneuvering reentry vehicles, and scientific studies of atmospheric and exoatmospheric phenomena, and it currently supports MDA and Navy programs.

The vehicle rocket assemblies associated with these programs are briefly described as examples in Section 2.2.2. The environmental impacts of these vehicle rocket assembly types are discussed in detail in the following documents:

- U.S. Army Space and Missile Defense Command (ASMDC)/Army Forces Strategic Command. AHW Program, EA. June 2011
- U.S. DOE. Kaua'i Test Facility EA, DOE/EA-0492, Sandia National Laboratories. July 1992.
- U.S. DoD, DoN. Final EA/Overseas EA for Flight Experiment 1 (FE-1), PMRF. August 2017.
- U.S. DoD, MDA. Flexible Target Family EA. October 2007
- U.S. DoN. Hawaii-Southern California Training and Testing Final EIS/OEIS, August 2013
- U.S. DoD, DoN. Hawaii Range Complex, Final Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS), PMRF. May 2008.
- U.S. DoN. PMRF Enhanced Capability, Final EIS. December 1998
- Office of Operationally Responsive Space. ORS Project–Super Strydi Proof-of-Principle Satellite Launches, PMRF, Final EA. December 2012.
- U.S. DoD, U.S. Army Space and Missile Defense Command. North Pacific Targets Program, EA. April 2001

These documents are incorporated by reference in this SNL/KTF Site-Wide Environmental Assessment (SWEA), which has been prepared in compliance with the National Environmental Policy Act (NEPA).

Proposed Action and Alternatives

2.1 Introduction

The DOE is required to use the review process established by NEPA, as amended (42 *United States Code* [U.S.C.] §4321 *et seq.*). The Council on Environmental Quality (CEQ) regulations (40 *Code of Federal Regulations* [CFR] Parts 1500-1508) and the DOE regulations (10 CFR Part 1021) implementing NEPA require that DOE evaluate not only the proposed action, but also identify and review reasonable alternatives to the proposed action, as well as a “no action” alternative. This comprehensive review ensures that environmental information is available to public officials and citizens before decisions are made and before actions are taken.

This chapter describes the proposed action and two alternatives, summarized as follows:

- Proposed Action (Section 2.2). DOE would continue to operate KTF as a launch facility, with additional construction and operational changes to allow for an expansion of the frequency of launch operations and an increase in the size of rockets to be used.
- No Action Alternative (Section 2.3.1). DOE would continue to support launch operations at currently allowed levels, with facility construction and upgrades limited to projects related to modernization and improvements in operational efficiency.
- Closeout of DOE Tenancy at KTF Alternative (Section 2.3.2). DOE would either transfer KTF facilities to another government agency or decommission and demolish KTF facilities.

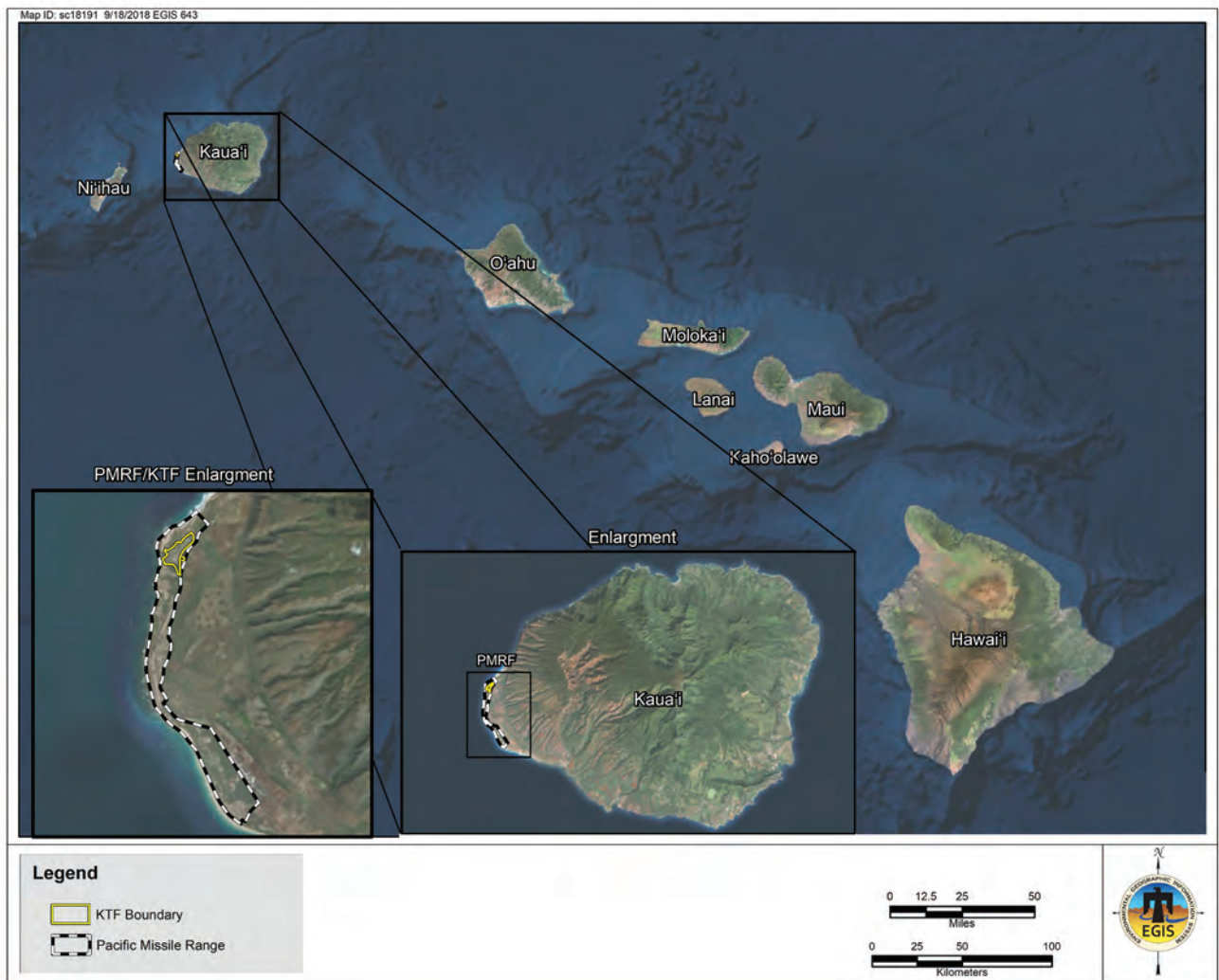


Figure 1: Map of Kauai Test Facility

This chapter also describes (Section 2.4) an alternative for constructing a new launch tower on another part of KTF that was considered but eliminated from detailed analysis.

2.2 Proposed Action

The NNSA's proposed action is to continue operations at KTF (see Figure 1), increase the number of annual single rocket launches from the facility, and implement replacement and modernization of facilities to sustain and enhance launch capabilities based on anticipated/envisioned NNSA and national security needs. The rail and vertical launch facilities and infrastructure at KTF are needed to maintain the continued launch capability for the NNSA to support broader national security mission needs, as well as sustain and enhance the unique capabilities that support NNSA core competencies. It is anticipated that current and future national security programs will support KTF as a critical, sustainable and unique national security capability for the foreseeable future.

The launches associated with these national security programs are described as reasonably foreseeable events arising from the proposed action; thus, they are considered in the impact analysis. Further, separate EAs and environmental impact statements (EISs) prepared by the DOE, DoD, USASMDC, U.S. Navy, and Operationally Responsive Space (ORS) Office and others for the various national security programs are incorporated by reference in this document.

This section describes the proposed action as three major types of activities:

- Construction and modifications
- Launch operations
- Non-launch operations

Additionally, described below are the operational controls and processes defined under existing environmental programs, under which all activities at KTF are performed.

No nuclear weapons or nuclear explosive payloads have ever been launched from KTF nor are any launches of these types planned for the future.

2.2.1 Construction and Modifications

New construction and modifications to existing KTF facilities and infrastructure would be expected over the next 10 years to accommodate reasonably foreseeable changes in rail-launch and vertical-launch national security program capabilities. Construction elements associated

with proposed operations, routine maintenance, and facilities and infrastructure modifications or upgrades would include:

- Construct a larger, more capable Missile Service Tower (MST) at the same location; the new tower would be approximately 120-feet (ft.) by 40 ft. wide and 26 ft. deep.
- Construction and modifications to strengthen the existing launch operations building (LOB)
- Heating, Ventilation, and Air Conditioning upgrades to provide explosion proof operation to maintain temperature and humidity control
- MST door modifications to allow for larger test objects to be serviced
- Minor site power upgrades to support new HVAC systems
- Interior electrical distribution to be Class 1 Division II
- Electrical, water, and communication utilities upgrades; construction with these utilities assumes approximately 1,500 linear feet (LF) of trenching for power and communication upgrades, plus an additional 1,500 LF of trenching for a new water main; each trench is approximately 2 ft. wide by 3 ft. deep
- Structural improvements to various outbuildings that require maintenance
- Lightning protection upgrades
- System controls upgrades
- General site-wide reroofing activities
- Replace and maintain approximately 10,000 LF of fencing throughout the site
- Replacement of modular building access/loading platform structures
- Concrete pad improvements as required to support test and maintenance operations; construction assumes up to six slabs with dimensions of approximately 8 in. by 50 ft. by 100 ft. per slab for a total of approximately 700 cubic yards (CY) of concrete
- A new 20 ft. by 30 ft. precast concrete auxiliary equipment building (AEB) on a concrete foundation and slab
- Diesel generator replacement
- Replacement of modular trailers with like-for-like structures

These construction and modification efforts may require cutting, drilling, and welding steel or rebar. They may also require the need for siting a temporary laydown yard for construction equipment and materials.

NNSA anticipates that a new, smaller, modified rail launch system would need to be constructed in the future. This new rail-launch system would be located within the boundaries of KTF. This smaller launch facility would possess a ground hazard area (GHA) of approximately 4,500 ft. and fit within the current 10,000 ft. GHA boundary. This new rail-launch system would be constructed similar in size to the current Pad 1 site located within KTF. Construction elements associated with this component of the proposed action would include:

- A new road extension: approximately 1,000 ft. long by 24 ft. wide
- An asphalt apron around the concrete launch pad: approximately 80 ft. by 60 ft.
- New concrete pad (20 ft. by 60 ft. by 1.5 ft.): approximately 70 CY
- New concrete foundation (10 ft. by 10 ft. by 15 ft.): approximately 60 CY
- New electrical utilities
- New boring for lightning protection poles: four poles at 3 ft. diameter at 16 ft. deep
- New launcher foundation boring: 10 ft. diameter at 12 ft. deep
- New trenching for utilities: approximately 1,000 LF at 2 ft. wide by 3 ft. deep for power and communications; 1,000 LF by 1 ft. wide by 3 ft. deep for water lines; and 400 LF by 1 ft. wide by 2 ft. deep for lightning protection system
- A new AEB
- New rails

2.2.2 Launch Operations

The NNSA and M&O contractor anticipate that future rail-launch and vertical-launch test vehicle systems for national security programs are reasonably foreseeable activities at KTF and should be analyzed as part of the proposed action. Planned, single rocket launches of test vehicle systems for national security programs are considered part of the continuation of KTF operations. Several of these national security programs have been analyzed in the following NEPA documents:

Ground Hazard Area

A Ground Hazard Area (GHA) is established for each launch to designate the outer limit of allowable dispersion of debris in the event that a test vehicle system (rocket motor assembly) must be destroyed immediately following launch or experiences an accident on the launch pad. For KTF, the land portion of a GHA may take in areas from 300 to 10,000 ft. from the launch point.

The maximum GHA for KTF is 10,000 feet from Pad 42 and has been negotiated between PMRF, the State of Hawai'i, and the interested parties near the PMRF environs; see Figure 2. If a proposed launch for a national security program were to exceed the 10,000 ft. GHA, the project would require further NEPA analysis.

The GHA varies considerably depending upon the type of launcher being used, rocket motor system being launched, the payload involved, and other factors.

The GHA is an area that must be cleared of nonparticipants (workers or the public) prior to a launch taking place. PMRF is responsible for clearing the GHA and enforcing access control to prevent members of the public from entering explosives safety quantity distance (ESQD) arcs from launch pads and explosive operating buildings.

The GHA is in effect only during the actual launch operation. The off-base portion of these respective GHAs are located within a restrictive easement that was acquired from the State and expires on 31 December 2030 (PMRF 2016)



Legend

- Ground Hazard Area (GHA)
- KTF Boundary
- Pacific Missile Range

Ground Hazard Area (GHA)

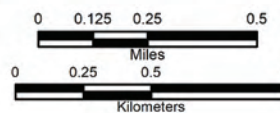


Figure 2: Map of Kauai Test Facility GHA

Table 1- Current and Proposed Test Vehicle Assembly Types

Vehicle Category	Net Explosive Weight (NEW)*	UN Explosive Class	Annual Launches (Max)
Small Rail Class e.g., Terrier/Malemute or e.g., Terrier/Oriole	2,500 lbs.	1.3 1.1	12
Large Rail Class Tallos/Castor	10,500 lbs.	1.1	4
Medium Vertical Class e.g., Polaris A3 1 st Stage Polaris A3 2 nd Stage Orbus 1 3 rd Stage	31,000 lbs.	1.1	2
Large Vertical Class e.g., C4/M57 or others	55,000 lbs.	1.1	2

* Note: The **net explosive weight (NEW)** of a shipment of [munitions](#), [fireworks](#) or similar products is the total mass of the contained [explosive substances](#), without the packaging, casings, bullets etc. It also includes the mass of the [TNT](#)-equivalent of all contained energetic substances.

UN Explosive Class

The United Nations (UN) Recommendations on the Transport of Dangerous Goods form the basis for most regional, national, and international regulatory schemes of hazardous materials. These classifications include:

- 1.1 — Explosives with a mass explosion hazard (nitroglycerin/dynamite, ANFO)
- 1.2 — Explosives with a blast/projection hazard
- 1.3 — Explosives with a minor blast hazard (rocket propellant, display fireworks)
- 1.4 — Explosives with a major fire hazard (consumer fireworks, ammunition)
- 1.5 — Blasting agents
- 1.6 — Extremely insensitive explosives

- U.S. Army Space and Missile Defense Command/ Army Forces Strategic Command. Advanced Hypersonic Weapons Program, EA. June 2011
- U.S. DOE. Kaua'i Test Facility EA, DOE/EA-0492, Sandia National Laboratories. July 1992.
- U.S. DoD, DoN. Final EA/Overseas EA for Flight Experiment 1 (FE-1), PMRF. August 2017.
- U.S. DoD, MDA. Flexible Target Family EA. October 2007
- U.S. DoN. Hawaii-Southern California Training and Testing Final EIS/OEIS, August 2013
- U.S. DoD, DoN. Hawaii Range Complex, Final Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS), PMRF. May 2008.
- U.S. DoN. PMRF Enhanced Capability, Final EIS. December 1998
- Office of Operationally Responsive Space. ORS Project-Super Strypi Proof-of-Principle Satellite Launches, PMRF, Final EA. December 2012.
- U.S. DoD, U.S. Army Space and Missile Defense Command. North Pacific Targets Program, EA. April 2001

2.2.2.1 Launch Activities and Vehicles

NNSA would continue operational support and launch activities for defense missions and flight tests. The proposed action considers a new launch capability in the form of a larger vertical class test assembly. The total launch support proposed by NNSA allows for up to 20 launches within a calendar year. Most launches occur between January and September. The months of September to December are considered a protected period for threatened and endangered species and any proposed launches during this timeframe would follow requirements set forth by PMRF.

The test vehicle assemblies associated with these launches would involve the use of multistage motors containing rocket propellant. Table 1 shows examples of the test vehicle assemblies by vehicle category types that could be launched from KTF in the future. Of the proposed vehicle assemblies, the M&O contractor would expect at a minimum, a single launch of the largest test vehicle assembly each year for the foreseeable future.

All of the motors associated with the proposed large vertical class test assembly fall within the UN Class 1.1 or 1.3 designation; ordnance within the assembly would be Class 1.1, 1.3, or 1.4 in designation. Due to the special

composition of the first stage motor being proposed, there is a 125% factor on its net explosive weight (NEW). For this proposed new test vehicle assembly, the total estimate NEW for the entire system (first stage, second stage, and any other ordnance on the system) would be bound by 55,000 pounds (lbs.) of Class 1.1. The proposed launch of the large vertical class test vehicle assembly would occur within the boundaries of the currently negotiated GHA of 10,000 ft.

A test vehicle assembly of a size similar to the proposed Large Vertical Class assembly was analyzed in the 2007 Missile Defense Agency Flexible Target Family (FTF) EA. Within the FTF EA, the "target" that closely matches the proposed test vehicle assembly is the LV-2, a Class 1.1 rocket motor with a total propellant quantity of 56,418 lbs. The proposed action described in that document stated:

The FTF would consist of common target components and ground support equipment. Targets are typically composed of one or more rocket motors (also known as boosters or stages) and a front section. Adapters or interstages separate the individual motors and also the motors from the front section of the target. Within the FTF, a collection of common boosters and interstage front section components would be used to assemble targets with different flight capabilities. The FTF front section components would include reentry vehicles, avionics control modules, and payload deployment modules. Common payload deployment modules could contain sensors, countermeasures, and simulants. These sensors, countermeasures, and simulants would be specific to the test being supported and would be analyzed as appropriate in subsequent environmental analysis for specific tests. (MDA 2007)

The LV-2, a C-4 First Stage test vehicle assembly, was analyzed for potential land launches from various locations.

The proposed Large Vehicle Class assembly would potentially release exhaust components in the atmosphere in amounts no greater than the following:

- Fused aluminum oxide (Al_2O_3) = 14,900 lbs.
- Carbon Monoxide (CO) = 12,100 lbs.
- Hydrogen chloride (HCl) = 900 lbs.
- Nitrogen (N_2) = 9,000 lbs.
- Dihydrogen monoxide (water) (H_2O) = 1,600 lbs.

- Carbon dioxide (CO₂) = 800 lbs.
- Chlorine (Cl) = 20 lbs.

Cleanup after launch would be limited to launch pad area. Prior to the next launch, necessary modifications, if any, to support configuration of the next test vehicle assembly would occur.

2.2.2.2 Transportation of Test Vehicle Assemblies and Propellants

The test vehicle assemblies identified above would be transported as individual segments via cargo flight to PMRF. PMRF personnel would have the responsibility for control of all ordnance and hazardous material movements inside and outside of KTF boundaries (SNL 2018c). For the types of test vehicle assemblies launched from KTF, the solid propellant systems would be self-contained within the individual segment in the assembly. PMRF personnel would be responsible for transporting the individual segments from the cargo carrier to the explosive storage site and from the storage site to the missile service tower. PMRF personnel and subcontractors are responsible for utilizing cranes to assemble the test vehicle assembly. PMRF would be responsible for flight safety which includes the movement and transportation of the test vehicle assembly.

Independent of the transportation of the test vehicle

assembly, qualified transporters would deliver liquid hypergolic propellant one to two times a year. The propellant would be transported in 50-gallon drums between Nawiliwili Harbor and KTF via ground truck or military cargo to the airfield. At KTF, liquid hypergolics would be permitted only in select buildings.

2.2.2.3 Launch Personnel

Over the course of a launch campaign, up to 500 individuals may transition in and out of PMRF/KTF. This number is comprised of individuals from Sandia Field Office, SNL/KTF, PMRF, SNL/NM, and the sponsoring organization and their contractors. Up to 100 launch-related individuals could be present at KTF during a

SNL Operations

NTESS currently manages the capabilities of Sandia National Laboratories with facilities and personnel at the following primary locations:

- Albuquerque, New Mexico (SNL/NM)
- Livermore, California (SNL/CA)
- Tonopah, Nevada (SNL/TTR)
- Kaua’i, Hawai’i (SNL/KTF)

Table 2 - Examples of Non-Launch Operational Activities Performed at KTF

Project/Activity Title	Project Activity Description (partial listing)
Maintenance Activities and Custodial Services	<p>The use of paint, caulking, adhesives, and sealants</p> <p>The use of organic materials such as solvents, cutting fluids, lubricating fluids, and epoxies</p> <p>Mowing, weeding, pesticide use</p> <p>Road repair, fence repair, minor building repairs, etc.</p>
Modifications of Research and Development spaces	<p>Removal, renovation and upgrade of utility, security, and fire safety systems</p> <p>Removal, replacement and installation of roof systems</p>
Environmental Monitoring	<p>Sampling and analysis of environmental media</p> <p>Installation, modification, and replacement of environmental monitoring-related equipment</p> <p>Environmental surveys (information gathering, site surveys, sampling)</p>

launch. These individuals would stay in either PMRF accommodations or off-facility Kaua'i hotels, motels, or rentals for the duration of the launch campaign.

KTF Launch Campaign

KTF Launch Campaign

- 6-8 week launch campaign
 - o Encompasses all pre-launch preparation activities through launch
 - o Up to 500 individuals transition in and out of PMRF/KTF during this time
 - o Approximately 100 individuals present at KTF at any one time

KTF Launch Pad Activity - final 1-2 weeks of campaign

- Final launch pad activities
- Up to 100 individuals present at KTF at any one time

Actual Launch

- Minimum number of mission essential personnel in the Launch Operations Building
- All other individual located outside the Ground Hazard Area

2.2.2.4 Generator Use at KTF

An increase in the proposed number of launches would be expected to affect the number of hours of generator use at KTF. The proposed action considers the current rate of generator use for currently planned launches as defined in the No Action Alternative, and extrapolates the potential use for the proposed increase, as stated below:

- No Action = 9 launches/annually = 3,968 hours generator use/annually = 440 hours generator use/launch (bounding number)
- Proposed Action = 20 launches/annually x 440 hours generator use/launch = 8,800 hours generator use annually (bounding number)

Operational use of the generators for a combined 8,800 hours annually would have the potential to emit approximately 70 tons of NO_x, which Hawaii Administrative Rules 11-60.1-1 define as significant.

To mitigate the potential of this occurring, the M&O contractor has proposed that the operational use of the generators be managed to stay under the currently permitted 6,000 hours of operation per running-year.

Compliance with this mitigation strategy would be managed through administrative goals.

2.2.3 Non-launch Operations

Some activities at KTF performed by the typically 14 full-time members of the workforce would be ongoing and not expected to change significantly. Table 2 provides examples of the non-launch operation activities that may be performed outside of a launch campaign. These activities would be common to both the Proposed Action and the No Action Alternative; however, they are included here for clarity. In general, these balance of operations activities would involve little or no toxic materials, and would be of low hazard. Balance of operations analyses are included for each resource area. The balance of operations activities include ongoing custodial services; preventive, predictive, and regular maintenance of facilities and infrastructure; the use of chemicals and organic materials; waste management; chemical/fuel storage; environmental monitoring; minor D&D projects; and minor modifications to research and development spaces.

2.2.3.1 Maintenance Support Activities

Maintenance and support activities would include frequently and routinely requested services for operational support of KTF facilities and infrastructure required to maintain and preserve structures and infrastructure in a condition suitable for fulfilling their designated operations. While these activities would be intended to maintain current operations, they would not allow for substantial upgrades or improvements.

2.2.3.2 Chemical Materials Management and Control

The primary goal for managing and controlling chemicals at KTF is to protect the health and safety of workers, the public, and the environment. Non-launch operations would include the need to maintain facilities and infrastructure in a condition suitable for operations. These activities would require the storage and use of chemicals and organic materials in levels needed for immediate use. Chemicals would be managed using administrative and physical controls designed to minimize exposure to an identified hazard. Facilities that use and store chemicals would be evaluated using an Integrated Safety Management System to determine appropriate

approaches to managing and controlling hazards. All chemicals would be tracked through the Chemical Inventory System.

2.2.3.3 Waste Management Activities

Waste would be generated during the routine maintenance or modification to a facility whose condition has deteriorated. Minor amounts of waste could be generated in the forms of steel, plywood, wipes, cleaning products, batteries, light bulbs, printer ink cartridges, and paper. M&O personnel would implement housekeeping safety procedures to manage the non-hazardous waste at KTF. All non-hazardous waste would be managed in conjunction with PMRF personnel and would be recycled or disposed of at the local landfill according to State of Hawai'i requirements.

2.2.3.4 Decommissioning and Demolition of Select Structures at KTF

As part of non-launch operations related to maintaining a capability in a near-ocean environment, the need to remove select structures (facilities, pads, or infrastructure components, etc.) would be required. The condition of these select structures would have been identified through condition assessment-based techniques. M&O personnel would identify those select structures that are excess, for eventual reuse, demolition, or release-for-use in other governmental activities or by the public. All of these select structures would no longer be in service and some would have deteriorated to the point where they could become a human health and safety concern for site operations.

Waste generated from the demolition of these select structures would be recycled in accordance with County of Kaua'i regulations or disposed of in the local landfill, as appropriate. M&O personnel would actively work with County of Kaua'i, State of Hawai'i, and Federal entities to maximize recycling of waste.

2.2.4 Night Launches at KTF

Under the proposed action, the potential impact in the form of fallout (disorientation and grounding) could occur to nocturnal seabirds from night lighting during construction and modifications, launch operations, and non-launch operations at KTF. The NNSA and the M&O contractor propose measures that would be implemented during operations to reduce the number of fallouts of the Newell's Shearwater, which would also benefit the Hawai'ian Petrel and Band-rumped Storm-Petrel, as described in the biological opinion issued by the United

States Fish and Wildlife Service (USFWS) (USFWS 2018; see Appendix A). These measures include, among others, the following:

- Scheduling non-time-sensitive night operations outside the peak of the seabird fledging season (September 15 through December 15) to the extent practicable;
- Turning off unnecessary external lighting during seabird fledgling season;
- Full cut-off fixtures would be used where security or safety concerns require night lighting;
- Staff would patrol to confirm any exposed lights during the night are truly required and meet the shielding requirements;
- Base-wide predator control would be implemented to enhance survival and minimize the risk of predation to any downed seabirds on the installation; and
- Monitoring would be implemented for downed seabirds on the installation during the seabird fledging season.

The USFWS determined that implementation of these measures would not completely eliminate the threat to nocturnal seabirds, and that it is likely that incidental takes of the shearwater would occur (USFWS 2018). Incidental takes are defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. In the biological opinion, the Incidental Take Permit allows for incidental take in the form of injury or death due to attraction and fallout from lighting of up to an average of seven (7) fledgling Newell's Shearwaters per year and a total maximum of sixty-three (63) fledgling Newell's Shearwaters. The Incidental Take Permit is for the PMRF as a whole, with the KTF as a tenant included in that whole, for a 50-year project term. The USFWS also issued the opinion that this take allowance would not likely jeopardize the continued existence of the Newell's Shearwater (USFWS 2018).

The biological opinion also contains measures to mitigate the significant impact and offset the total anticipated incidental take over the 50-year term of the permit. The biological opinion states the Navy and NNSA would provide funding to support management activities for predator and ungulate removal at an existing Newell's Townsend's Shearwater colony on Kaua'i where current management does not exist or is insufficient to adequately enhance the reproductive success of the shearwater. The funding is anticipated by the USFWS to support, annually, management for 30 breeding pairs in 2018 and build to

50 breeding pairs by 2022, and then continue annually in years after 2022 at the same level unless the Navy, NNSA, and USFWS reinstate consultation and this conservation measure is no longer deemed necessary. (USFWS 2018)

2.2.5 KTF Safety Requirements and Measures

Current work performed at KTF is governed by policies and processes approved by NNSA and implemented by the M&O contractor.

DOE and NNSA Oversight Policy ensures that a Contractor Assurance System (CAS) has been reviewed and assessed for effectiveness, and is defined and implemented as specified within the M&O contract. The M&O contractor would be responsible for implementing a CAS as defined by contract to ensure the safety requirements and measures governing all work at its FRDC locations, including SNL/KTF.

DOE implements guidance and requirements to manage the exposure of federal workers and contractors. The primary regulation for contractors is 10 CFR 851, *Worker Safety and Health Program*. Applicable DOE directives include DOE O 440.1B Change 2, *Worker Protection Program for DOE (Including the National Nuclear Security Administration) Federal Employees* for DOE employees as well as DOE G 440.1-1B Change 1, *Worker Protection Management for DOE Federal and Contractor Employees* for both DOE and its contractors. NNSA Policy Letter NAP-6A, *Federal Employee Occupational Safety and Health Program* covers the requirements for NNSA employees.

In order to ensure compliance with the contract requirements set forth by DOE and NNSA, the M&O contractor has developed SNL Policies to ensure M&O personnel perform work safely and in a manner that ensures adequate protection for all Members of the Workforce, the public, and the environment at all SNL locations. SNL Policies ensure M&O personnel are accountable for the safe performance of work; exercise a degree of care commensurate with the work and associated hazards; and integrate environment, safety, and health management into work planning and execution.

2.2.5.1 Implementation of the GHA

To minimize risk to the public at the time of a launch, security forces on the ground, in boats, and in helicopters (if necessary) would use sweep-and-search measures to ensure that all areas within the proposed GHA are verified to be clear of people (except mission-essential personnel) prior to each scheduled launch. In addition, security forces

would set up control points along roads leading into the proposed GHA to monitor and clear traffic during launch operations. Mission-essential individuals are located in the LOB inside the GHA. Immediately after a successful launch, security forces would provide the all-clear signal, and the public would be allowed to reenter the area.

2.3 Alternatives

2.3.1 No Action

Under the No Action alternative, operations at KTF would remain consistent with current levels established in previous NEPA documentation and are discussed briefly below. The safety requirements discussed in Section 2.2.5 would be applicable to all activities implemented under the no action alternative.

2.3.1.1 Construction and Modification

MDA determined that the MST at Pad 42 does not currently meet MDA's stringent safety, temperature and humidity requirements. Accordingly, the M&O contractor has undertaken several proactive safety and maintenance improvements. The construction and modifications would strengthen the KTF engineered safety measures and reduce reliance on administrative safety controls. The modifications ensure that KTF can accommodate current launches and eliminate a waiver required to meet MDA requirements. Upgrades to the Pad 42 launch pad and the MST are required to comply with MDA requirements and would enhance personnel safety, reduce technical risk, as well as promote timely mission execution. The currently approved upgrades to the MST under the no action alternative include:

- Enhance safety by installing kick-plates on central floor panels and replacing winches, to include lock-out features in both directions of travel
- Enhance the utility of retractable floor panels by redesigning them to accommodate a range of umbilical rigging and provide better access to umbilicals
- Upgrade MST internal environmental control by installing environmental seals to close door gaps
- Increase the internal MST target handling capability to maximize the physical clearance between the MST structure and launch vehicle
- Drill holes in the existing concrete launch pad and install inserts to support a new launch stand with increased load capacity to meet MDA's safety margin requirement

- Repair concrete at the edge of the blast plate: approximately 70 CY of concrete

The construction and modifications of KTF require cutting, drilling, and welding and painting steel. A crane and man lift are used to support movement and placement of equipment. All materials are brought inside for staging; therefore, there is a minor outdoor laydown area on the existing concrete pads (no soil disturbance) for transportainer storage. Approximately 50 cubic yards (CY) of waste may be generated as a result of this project and is considered standard waste (steel, plywood, etc.). All non-hazardous debris and solid waste is disposed of in approved landfills or recycled when possible.

2.3.1.2 Launch Operations

The No Action Alternative would allow launch activities at KTF using present facilities and infrastructure. This alternative would preclude KTF from conducting launches of new test vehicle systems for national security programs beyond those already described in the 1992 KTF SWEA and other NEPA documentation that has been prepared and approved to date. A total of up to 9 launches would be conducted annually.

The various test vehicle assemblies associated with these nine launches would involve the use of multistage motors. All the motors would fall into the UN category of 1.1 and 1.3. The largest motor currently flown from KTF

is a UN category 1.3 (modified Polaris A3R or A3P) with a total propellant weight equal to 31,000 pounds (lbs.). This largest test vehicle assembly would potentially release exhaust components in the atmosphere in amounts no greater than the following:

- Fused aluminum oxide (Al_2O_3) = 4,900 lbs.
- Carbon Monoxide (CO) = 3,900 lbs.
- Hydrogen chloride (HCl) = 4,100 lbs.
- Nitrogen (N_2) = 3,200 lbs.
- Dihydrogen monoxide (water) (H_2O) = 3,700 lbs.
- Hydrogen (H_2) = 300 lbs.
- Carbon dioxide (CO_2) = 630 lbs.
- Other = 65 lbs.

Various smaller motors (among others) as described in Table 3 would also be used by KTF; however, those emissions would be within the threshold limits identified above.

2.3.1.3 Launching Systems

The term rail launcher may be applied to launchers making use of rails, tubes, long ramps, and even tall vertical towers. All provide, to a varying degree, constraint to the flight vehicle while it is moving on the launcher, and they thus provide a considerable amount of flight

Table 3 - No Action Alternative Launch Operations

Vehicle Category	Net Explosive Weight (NEW)	UN Explosive Class	Annual Launches (Max)
Small Rail Class e.g., Terrier/Malemute or e.g., Terrier/Oriole	up to 2,500 lbs.	1.3 1.1	6
Large Rail Class e.g., Talos/Castor	up to 10,500 lbs.	1.1	2
Medium Vertical Class e.g., Polaris A3 1 st Stage Polaris A3 2 nd Stage Orbus 1 3 rd Stage	up to 35,000 lbs.	1.1	1

control. For uncontrolled flight vehicles, such as multi-stage rockets, the rails must be fairly long so that the test vehicle assembly is constrained for a longer portion of the rocket motor burning time to provide the necessary initial velocity vector control. If the missile is equipped with a guidance system, the rail length can usually be reduced. (U.S. Naval 2018)

Long-range test vehicle assemblies, larger and/or heavier launch vehicles, guided or unguided, normally may require a longer rail since their initial acceleration is comparatively low relative to short-range test vehicle assemblies. A rocket booster may be employed; however, to provide sufficient acceleration to permit reduction of rail length.

The term vertical launcher may be applied to launchers that make use of stands, or stools on which the flight vehicles are placed. These are utilized exclusively for guided flight vehicles, as they rely on the flight vehicle's Thrust Vector Control system to provide guidance as opposed to a rail system. Initial vehicle acceleration is still a factor, as surface winds must be considered in assessing control authority, however it has much less influence over the flight vehicle's overall performance and dispersion.

The Kauai Test Facility operates launching systems at four launch pads for NNSA. There are three rail-type launchers, Pads 1, 15, and 19; and one vertical launcher, Pad 42. In addition, KTF has the ability to support launching systems at two PMRF sites, their rail launchers at Kokole Point and Launch Area 2.

The M&O contractor occasionally assists in launch campaigns from PMRF and the Kokole Point launch complex. These launches have been addressed with separate EAs including the Super Stryi Program by ORS, and 50K PMRF launch. The Kokole Point launch complex and associated facilities were transferred from the NNSA to the U.S. Navy in 2013. This document does not cover any other work performed at PMRF or Kokole Point by the M&O contractor.

2.3.1.4 Environmental Management System at KTF

DOE Order 436.1, *Departmental Sustainability*, was established to ensure that Environment Management Systems (EMS) and site sustainability are at the forefront of decision-making. This directive is implemented through an International Organization for Standardization (ISO) 14001-certified (ISO 2004) EMS. The M&O contractor received initial ISO 14001 certification in June 2009 for the primary SNL operating locations and retained certification in the 2015 recertification audit. SNL/KTF

operations do not need to be included in the ISO 14001 Certification, provided that an internal assessment to the ISO 14001 standard (ISO 2004) at the site is conducted every three years.

An EMS ISO 14001 assessment of SNL/KTF operations was conducted in 2017. EMS identified natural resource use, hazardous materials use, and hazardous waste production as the top three significant aspects (any elements of activities, products, or services that can interact with the environment). When any changes in the environment, whether adverse or beneficial, wholly or partially resulting from activities, products, or services have been identified, objectives and measurable targets—at all operating levels—are established to guide efforts toward minimizing those aspects and impacts. (SNL 2018)

2.3.2 Closeout of NNSA Tenancy at KTF

Under this alternative, closeout of tenancy at KTF would result in a discontinuation of operation of KTF by NNSA. Closeout of tenancy could occur in, or in combination of, two ways:

- Transfer of KTF to another government agency
- Decommissioning and demolition (D&D) of KTF facilities

2.3.2.1 Transfer of KTF to another Government Agency

If the NNSA determines that transfer of ownership of KTF facilities to another government agency for operational use was the preferred method for closing out NNSA tenancy, several high-level discussions would have to occur between NNSA, DOE, the other government agency, and PMRF to address all the logistical implications, as well as draft and execute any contractual agreements. As part of these discussions, all parties would decide which facilities would be transferred and which facilities, given age and condition, would need to be demolished prior to transfer.

As part of the transfer, a termination Environmental Baseline Survey and Preliminary Real Estate Plan would be developed for NNSA/SNL-related operations at KTF. As part of the request for transfer, KTF real property assets would be listed with all government departments and agencies through the General Services Administration. The new agency in charge of KTF operations would engage NNSA and the M&O contractor for final remediation and site clean-up. If the outcome of transfer of ownership negotiations determines that select facilities require D&D, those activities would follow the same process as

described in Section 2.2.3.4.

new MST north of Pad 42 were not compelling enough at this time to open the renegotiation process.

2.3.2.2 Decommission and Demolition of KTF Facilities

Under this aspect of the alternative, operations at KTF would be discontinued and some, or all, facilities and infrastructure would be decommissioned. Decommissioning of all, or part, of KTF would be determined during the transfer of operations discussions. As part of the demolition process, all solid waste would be handled in accordance with local and state regulations. The recycling rate on Kaua'i is approximately 43% of all material recycled rather than taken to the landfill. The M&O contractor would work with the County of Kaua'i to increase the recycling percentage of KTF material. Prior to demolition, the M&O contractor would contact the County of Kaua'i Recycling Office to determine the current waste diversion rates and strategies.

2.4 Alternative Considered but Not Analyzed in Detail

This section discusses an alternative that was identified during the scoping of this document. This alternative was eliminated from detailed analysis, and the reason for its exclusion is briefly discussed.

2.4.1 New MST Construction at a Different Location Within KTF

Under this alternative, the construction of a new missile service tower located within the boundaries of KTF approximately 1,000 ft. to the north of Pad 42 was considered. Given the age of the current MST, the construction of a newer MST located on a new pad rather than modifying the current structure was also considered. The preliminary scope of the new construction would have included:

- Construction of a new tower approximately 110 feet tall with a crane on top of the building
- Inclusion of fixed and moveable platforms to accommodate a larger rocket assembly
- Construction of new auxiliary equipment building

During the preliminary analysis, it was determined that this alternative would require the renegotiation of the GHA currently defined as a 10,000 ft. radius from the central point located on Pad 42. This GHA had recently been agreed upon between the PMRF, the State of Hawai'i, and the interested parties surrounding the PMRF environs. NNSA determined that the advantages of constructing a

Affected Environment

3.1 Land Use

3.1.1 Definition of Resource

Land use refers to the intended use of land as determined by planning, or the lack thereof. Land use encompasses the management and modification to the environment to ensure the landscape meets the intended use of the area and that it can accommodate the designated functions. Land use definitions include the functional uses such as housing, industrial, commercial, residential, experimental, agricultural, and the natural resources – water, geology and soil, plants, animals, and ecosystems.

3.1.2 Region of Influence

The Region of Influence (ROI) includes the NNSA -managed land within the KTF boundary located within the PMRF and the lands, including shoreline, adjacent to the PMRF boundary that may be impacted by operations at KTF.

3.1.3 Affected Environment

The State of Hawai'i Office of Planning has designated all land within the state as one of four categorizations: urban, rural, agricultural, and conservation. On the island of Kaua'i, land use is governed by the Kaua'i County General Plan which is the primary policy directing long-range development, conservation, and the use and allocation of land and water resources (KCGP 2017). Through the General Plan, land use is planned for various general purposes such as agriculture, resorts, urban communities,

and preservation of natural, cultural and scenic resources (KCGP 2017). This also includes high technology industry and military areas.

3.1.3.1 KTF Land Use Agreement

The NNSA has operated at KTF since 1964. At that time the NNSA was named the Atomic Energy Commission (AEC). On 28 November 1966 the AEC and Department of the Navy (DoN) Pacific Missile Range (PMR) entered into PMR Agreement No. 117/AEC Contract No. AT(26-1)-279 to delineate the operational and support relationships between the parties for the AEC's Test Readiness Facility (AEC-TRF) located at the Pacific Missile Range Barking Sands Facility in Kaua'i, Hawaii. This agreement was the first formal document granting the use of PMR's land to the AEC. The agreement included a map delineating the boundaries of AEC's operations. This agreement was designed to "continue in effect for an indefinite period, unless modified, cancelled, or otherwise changed or terminated by mutual consent of the parties."

Over the next several decades, separate operational support agreements were executed between the agencies for ongoing operational support provided by the PRM Facility, commonly referred to as PMRF. The 1966 Agreement was cited by the DoN in 1990 in the PMRF Master Plan which similarly detailed the site's boundaries via a map depiction of the site (see Figure 3). NNSA and DoN are currently in negotiations to update the 1966 Agreement into a modern land use permit between the agencies.

3.1.3.2 Existing Land Use Plans and Land Use Controls

As stated in the PMRF Installation Development Plan (IDP), land use at Barking Sands is mainly comprised of range and airfield operations, range and base industrial, administrative, supply, community support, and open space. The primary operational area is located north of Kinikini Ditch and includes the airfield and aircraft-related operations, range operations and support, base administration, public works, supply, and various launch, program, and training sites. While space is not currently constrained in this area, land use planning seeks to consolidate the base administration, public works, and supply functions out of this area and to the south to prevent launch events from impacting these functions, and to ensure range operations have priority access to the airfield and shoreline to support long-term mission growth. The existing launch areas at the north end of the installation are well removed and secured from the rest of the installation. (PMRF 2016)

A consolidated community support and housing area is located south of Kinikini Ditch and includes bachelor and family housing, an exchange and related services, transient lodging, various recreational facilities, child development and youth centers, an all hands club, and beach cottage rentals. Also, south of the ditch, are operational areas for Hawai'i Air National Guard (HIANG), Aegis Ashore, Terminal High Altitude Area Defense System (THAAD), WWVH, the south launch site, and an antenna field. (PMRF 2016)

Outlying locations serve specific supportive functions, including ordnance storage (Kamokala Ridge Magazines), tracking and surveillance (Makaha Ridge Tracking Station, Kōke'e, and Ni'ihau sites) and waterfront operations (Port Allen). (PMRF 2016)

Both the State Land Use Commission and County of Kaua'i have zoned the surrounding offbase areas of Mānā Plain as agricultural, conservation/preservation, or public facility—land uses that are compatible with PMRF airfield and range operations. Land use controls over areas outside the installation boundaries are critical to range operations at PMRF and are governed by various real estate agreements. (PMRF 2016) Figure 3 depicts the large landowners of the PMRF/KTF area. Figure 4 shows the agricultural lands surrounding KTF. Figure 5 shows the special management areas surrounding KTF.

3.1.3.3 Shoreline Access

By state law, the shoreline is accessible and held in trust for the benefit of the public. Laws such as Public Access Shoreline Hawai'i (PASH) supports the public use of the shoreline. State law protects lateral shoreline access which is also referred to as a public beach transit corridor that exists seaward of the shoreline. Access concerns are also compounded by beach narrowing from erosion, whose rates are anticipated to increase as sea level rise occurs. Another concern was the lack of signed public access ways to the shoreline (versus access along the shoreline) and inadequate parking at popular access points. In some cases, public access is not allowed or desirable due to environmental, public safety, and other concerns. On the beach near and adjacent to PMRF, national and homeland security laws preempt State laws and public access is restricted. (KCGP 2017)

Coast Guard Regulation 33 CFR 165.1406 established a safety zone offshore from the facility. Entry into the current safety zone is prohibited at all times to prevent the interference with submerged cables. Special permission for transit through the area is obtained on an individual basis by prior arrangement with the local Captain of



Legend

- | | | | |
|--|-----------------------|--|-----------------------|
| | Federal Government | | KTF Boundary |
| | State Government | | Pacific Missile Range |
| | State Government DHHL | | |

Large Landowners

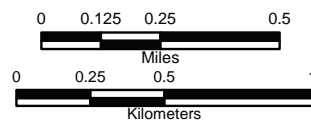


Figure 3: Large Landowners

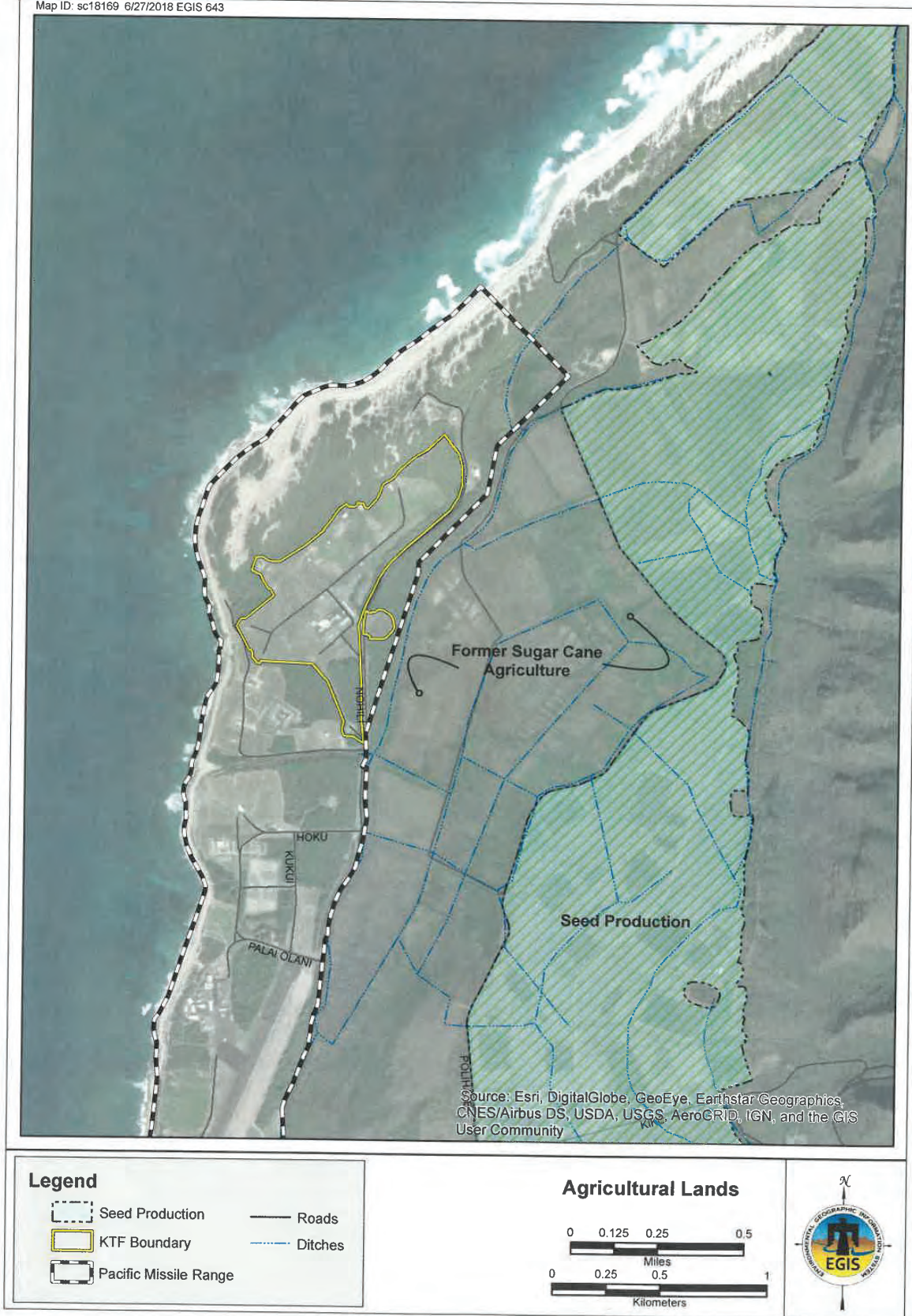







Figure 4: Map of Agricultural Lands Near KTF



Legend

-  Special Management Areas
-  KTF Boundary
-  Pacific Missile Range
-  Roads
-  Ditches

Special Management Areas

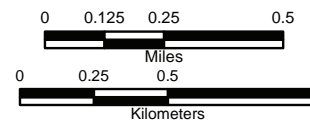


Figure 5: Map of Special Management Areas

the Port or U.S. Coast Guard District Commander, who controls entry and exit. (33 CFR)

3.1.3.3.1 Polihale State Park

Recreational activities at the shoreline can be publicly accessed via Polihale State Park to the north of PMRF/KTF. The state park is a remote beach on the western shore of Kaua'i. The state park can only be accessed via a dirt road navigated with four-wheel drive vehicles. In the area of Polihale State Park, "Queen's Pond" offers swimming opportunities for local residents.

3.1.3.4 Encroachment

Encroachment is defined as "primarily non-Navy action planned or executed which inhibits, curtails, or possesses the potential to impede the performance of Navy activities" (Department of the Navy 2007). Encroachment management focuses on the identification, quantification, mitigation, and prevention of encroachment. Encroachment pressures can come from private development adjacent to an installation, environmental degradation or restrictions, or growing competition for resources, such as waterfront or airspace. (PMRF 2016)

A form of encroachment partnering is employed at Barking Sands through an Agricultural Preservation Initiative (API). The API is a partnership between the Navy and the State of Hawai'i to preserve roughly 5,000 acres of land adjacent to Barking Sands for agricultural purposes. The API provides both an encroachment and security buffer to ensure that the Navy can continue to safely conduct important research and training operations at Barking Sands. The API and other real estate agreements expire in 2029. (PMRF 2016)

3.2 Geology and Soils

3.2.1 Definition of Resource

The discussion of geology includes the general geologic, physiographic, and topographic setting, and volcanic and seismic activity. The discussion of soils includes soil types and features, and soil contamination.

3.2.2 Region of Influence

The main concern of seismic activity is the effect on onsite facilities, specifically, whether damage from earthquakes could result in a contaminant release or human health hazard. Therefore, the Region of Influence (ROI) would be the extent of environmental or human health effects from such a release. Potential effects on soil include erosion

from construction activities and potential contamination of soil at or near a point of an uncontrolled release. Thus, the soils ROI is limited to KTF. Potential migration of soil contaminants into groundwater or surface water is addressed in Section 3.7.3.

3.2.3 Affected Environment

With a total area of 552 square miles, Kaua'i is the fourth largest island of the Hawai'ian archipelago (State of Hawaii 2017). The island is a single great shield volcano, similar to Mauna Loa on the island of Hawai'i. Formation of the island of Kaua'i was probably completed before the end of the Pliocene period. Kaua'i's varied geography includes Waimea Canyon and the Nā Pali Coast with its cliffs; Mount Kawaikini and Mount Waialeale, twin peaks at the summit of the old volcano; the Alakai Swamp, extending almost 10 miles northwest of the summit peaks; the flat-lying coastal Mānā Plain; and the Barking Sands dune field (DOE 1992).

PMRF stretches 8 miles along the western edge of a strip of low-lying coastal terrace called the Mānā Plain, from Kokole Point on the south to Nohili Point on the North. PMRF and KTF lie in a relatively flat, open, park-like setting with a northeast to southwest orientation. The Mānā plain bounds the western flank of the island, forming gentle westerly slopes ranging from about 2 percent grade near the volcanic uplands to relatively flat over the coastal margin occupied by PMRF. The plain does not form cliffs at the PMRF shoreline. Local relief is formed by low beach barrier dunes, mildly undulating blanket sands, and the more prominent Nohili Dune located in the northern portion of PMRF, adjacent to the northwestern side of KTF at Nohili Point. Ground elevations across PMRF average between 10 to 20 ft. to 100 ft. at Nohili Dune. PMRF is not traversed by perennial or ephemeral streams. Surface runoff is controlled by manmade channels located at Nohili Ditch on northern PMRF/Main Base, Kawaiele Drainage in central PMRF, and a drainage channel just south of Kawaiele Drainage. (U.S. Department of the Navy 2008).

The topography at KTF consists of a large level area bordered by dunes to the north and northwest. The main compound at KTF lies at an elevation of approximately 10 feet above mean sea level. Other KTF infrastructure lies between approximately 10 and 24 ft. above mean sea level. Dunes near KTF are up to 100 ft. in elevation. (DOE 1992)

3.2.3.1 Geology

The Hawai'ian Islands lie at the southeast end of the Hawai'ian-Emperor volcanic chain, a string of islands and

seamounts formed by eruption of lava onto the floor of the Pacific Ocean. The chain age is progressive, with younger volcanoes to the southeast and older volcanoes to the northwest. The oldest volcanoes in the chain are 75-80 million years old; the youngest island, Hawai'i, is still actively forming through volcanic eruptions. After the general acceptance of plate tectonics theory in the 1960s, the predominant theory was that the chain formed by movement of the seafloor over a fixed "hot spot" of material originating in the Earth's mantle (Clague and Dalrymple 1989). Recent study has challenged whether the hot spot is indeed "fixed" (Koppers et al. 2001).

Kaua'i is the oldest of the four largest Hawai'ian Islands. Nearly all volcanic eruptions in historic times have been confined to the island of Hawai'i, though Haleakala on Maui last erupted about 1790. No eruptions have occurred on Oahu or Kaua'i for more than 10,000 years (Mullineaux et al. 1987).

Volcanic rocks exposed in the western half of the island are composed of Pliocene-age basaltic flows of the Waimea Canyon Basalt (USGS 2007). Radiometric ages of these basalts range from 5.1 to 4 million years. The volcanic terrain forms an abrupt, crescent-shaped scarp at the eastern boundary of the Mānā Plain. Sediments of the Mānā Plain, in the vicinity of PMRF, consist of primarily of Holocene alluvium (particularly along the eastern edge) and lagoon deposits, with beach deposits along the shoreline and an area of dune deposits along the northern edge of KTF (USGS 2007).

Recently deposited sand along the PMRF beach is medium- to coarse-grained in contrast to the fine texture of the dunes. Fronting the beach in some reaches are strata of cemented sand which may be remnants of consolidated old dunes: a lithified or consolidated sand dune is type of sandstone that is formed when a marine or Aeolian sand dune becomes compacted and hardened. The beach berm is about 10 ft. high and is breached only where drainage canals have been excavated at Nohili and Kawaieale. (DOE 1992)

Most earthquakes in the Hawai'ian Islands originate on the island of Hawai'i and result from movement of magma at shallow depths. Some earthquakes are less directly associated with volcanic activity, and a few of these cause major damage. Such earthquakes originate every few years under the island of Hawai'i and are less frequent beneath and between other islands of the Hawai'i group (Mullineaux et al. 1987). Historically, no large earthquakes have been recorded on Kaua'i. NOAA's Earthquake Intensity Database records earthquakes felt on Kaua'i that originated on or near the island of Hawai'i;

as well as areas to the southeast of Kaua'i. The nearest earthquake felt on Kaua'i was a magnitude 4.0 earthquake in 1980 centered near Oahu, approximately 85 miles southeast of Kaua'i (NOAA 2018). Only one earthquake felt on Kaua'i exceeded an intensity of 5 ("Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.") on the Modified Mercalli Intensity Scale since 1900: a 1919 earthquake of unknown epicenter noted as intensity 7 ("Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken."). The U.S. Geological Survey categorizes Kaua'i in Seismic Design Category A, with a corresponding earthquake hazard of "very small probability of experiencing damaging earthquake effects" (USGS 2018).

3.2.3.2 Soils

3.2.3.2.1 Types and Features

The dominant soil within the PMRF area, including KTF, has been mapped as Jaucas loamy fine sand, 0 to 8 percent slopes (NRCS 2018). This soil is predominantly calcium carbonate, formed from coral and seashells and occurs on former beaches and on windblown sand deposits (NRCS 2018, SCS 1972). The soil is characterized by rapid infiltration of water, with correspondingly very low runoff. Saturated hydraulic conductivity (a measure of the ease with which pores in a saturated soil transmit water) ranges from "high" (6 in. per hour) to "very high" (approximately 20 in. per hour). Ponding is rare (NRCS 2018).

Bordering KTF to the north and west are dune land and fossil dunes. Dune land consists of hills and ridges of sand drifted and piled by the wind. The hills and ridges are actively shifting, or are so recently fixed or stabilized, that no soil horizons have developed. The sand is derived predominantly from coral and seashells. Older, fossil dunes within KTF consist of fine sand which is loose at the surface but weakly to strongly indurated consolidated several feet below. The indurated consolidated sands are bedded as laminae a few inches thick, typical of windblown deposits, as is the fine grain size and the admixture of silty sand. Clay is also part of the mixture but appears primarily where the dunes fade and are replaced by alluvium. (DOE 1992)

A beach borders KTF to the west. The rather fine-grained calcareous beach sand in this area contains a small proportion of grains of basaltic lava rock. The area is known as Barking Sands because, with just the right

degree of wetness, the sand makes a peculiar squeaking or yapping noise when it is walked on or squeezed sharply between the hands (DOE 1992).

3.2.3.2.2 Contamination

In the early 1990s, three sites were identified under the authority of *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) as having had an actual or potential release of hazardous substances to soil at KTF (Ardito 1996). A site inspection was conducted in 1995 and it was determined that there were no significant (as defined in the report) levels of contamination in soil vapor, groundwater, stormwater, sediment, or surface water (Copland 1995). Contaminants in soil at two of the sites were minimal and determined to pose no threat to human health or the environment. The United States Environmental Protection Agency (USEPA) decided that no further action was warranted at that time under CERCLA and that all requirements were met. The USEPA recommended reevaluation for environmental contamination at KTF due to its continued use as a rocket-launching facility.

The M&O contractor's Terrestrial Surveillance Program addresses the USEPA recommendation by the periodic (approximately every 5 years) collection of surface soil samples for metals analysis to determine whether there has been a release to the environment due to KTF operations. The most recent sampling event was conducted in 2018; this information will be available in the 2018 Annual Site Evaluation Report to be published in the Fall of 2019. A sampling event in 2012 determined that KTF operations made no detectable environmental impact (from metals) to the soil (SNL 2018).

3.3 Transportation and Traffic

3.3.1 Definition of Resource

This section describes the transportation infrastructure and its use on the island of Kaua'i, focusing on areas and elements with the greatest potential to be affected by KTF activities. Transportation includes descriptions of roadways, air, or marine transportation infrastructure that NNSA uses to support KTF operations, including movement of employees, hazardous material, waste, and test components.

3.3.2 Region of Influence

The transportation and traffic ROI consists of major roadways in southwestern portion of Kaua'i, along with routes to and from airports and nearby marine traffic channels.

3.3.3 Affected Environment

Steep topography in the central part of Kaua'i forces most traffic to circulate on several arterials near the perimeter of the island. Along the southern part of Kaua'i, Route 50 (Kaumualii Highway) connects Lihue with the PMRF. Except for a short four-lane segment near Lihue, Route 50 is two lanes. Speed limits vary from 25 miles per hour through communities (such as the business district of Waimea) to 50 miles per hour through less populated areas. (See Figure 6)

Over the 10 miles from Waimea to its western terminus at the PMRF, the number of vehicles traveling on Route 50 becomes progressively less (Table 4). A road continuing to the north past PMRF ends at Polihale State Park, just short of the cliffs of the Nā Pali Coast on the northwest part of the island.

Vehicles can enter PMRF through two gates accessed from Route 50: the PMRF Main Gate at Tarter Drive and the PMRF North Gate at Imiloa Road. As a military facility, access is controlled. Primary entry to KTF is through the Main Gate.

Lihue Airport is the primary airport on Kaua'i, providing a passenger terminal and regularly scheduled commercial flights to other Hawai'ian islands, the U.S. mainland, and Canada. An airfield at the PMRF supports helicopter and fixed-wing aircraft operations associated with PMRF's mission and also serves as a training facility for landings and takeoffs (Department of the Navy 2008).

Nawiliwili Harbor, near Lihue, provides a cargo commercial port for Kaua'i. Supplies arriving by ship for the PMRF and KTF are unloaded at Nawiliwili Harbor, loaded onto trucks, and transported along Route 50 to the PMRF (OORS 2012, Navy 2017).

Launch components, including rocket motors, are transported to KTF from the PMRF airfield. Ground transport takes place within the boundaries of PMRF. Non-KTF and non-PMRF personnel traveling to KTF for launches typically fly commercial airlines to Lihue and drive to KTF and PMRF, individually or with multiple people per vehicle.

3.4 Air Quality

3.4.1 Definition of Resource

Air quality in a given location is defined by the concentration of various pollutants in the atmosphere. A region's air quality is influenced by many factors including the type and amount of pollutants emitted

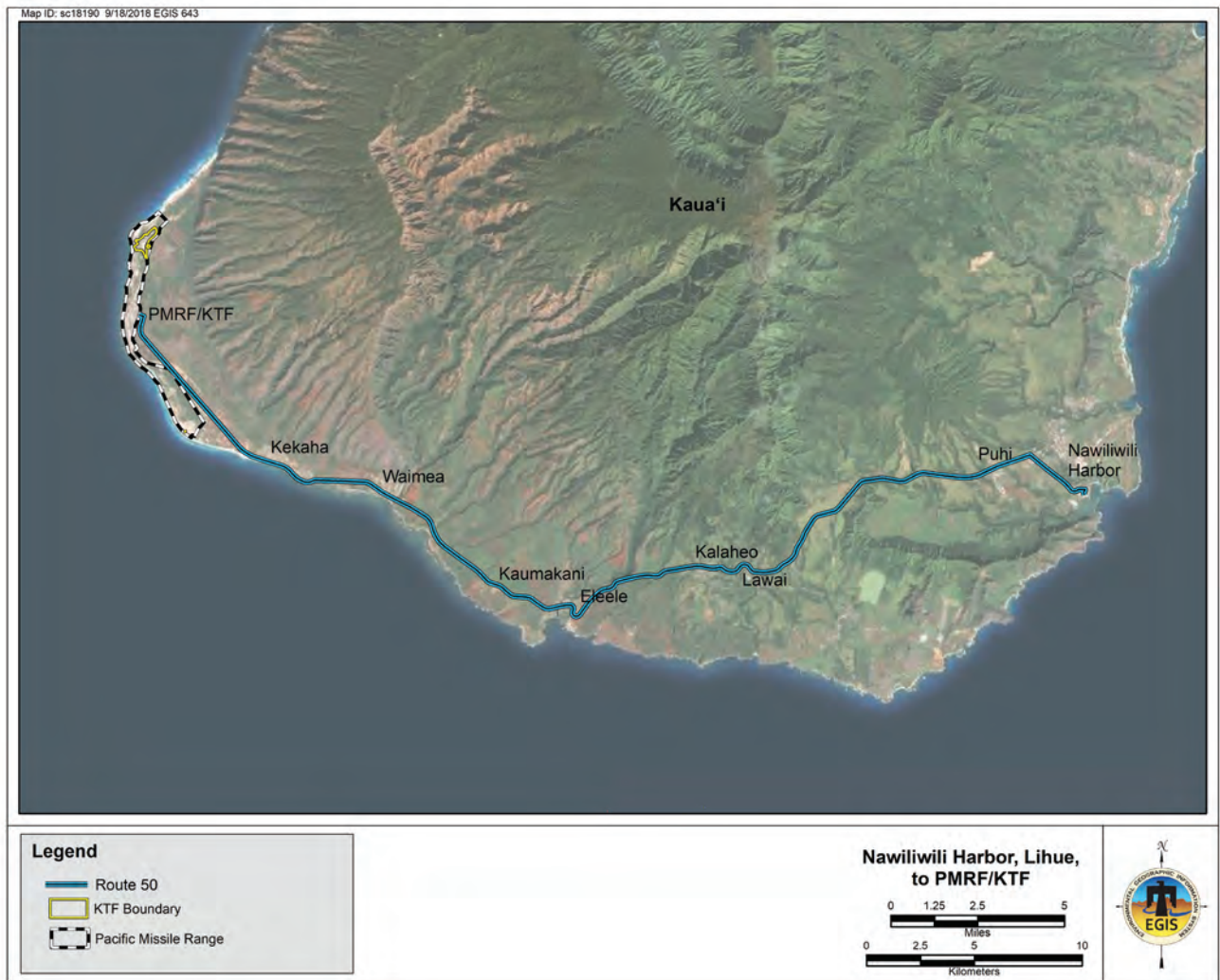


Figure 6: Route 50 (Kaumualii Highway) connects Nawiliwili Harbor at Lihue with the PMRF

Table 4 - Number of Vehicles on Route 50 (Kaumualii Highway) near the Pacific Missile Range Facility

Segment (mile)	Description	Vehicles per 24-Hour Period
22.47 to 23.08	Waimea River to Route 550 (through Waimea)	11,600
23.08 to 24.47	Route 550 to Kekaha Road (Waimea to Kekaha)	9,000
24.47 to 26.68	Kekaha Road to Akialoa Road (through Kekaha)	6,700
26.68 to 29.93	Akialoa Road to Tartar Drive (Kekaha to Tartar Gate of PMRF)	3,400
29.93 to 30.74	Tartar Drive to Kia Road	2,500
30.74 to 32.92	Kia Road to Kau Road Gate	510

Source: Hawaii Department of Transportation 2018

into the atmosphere, the size and topography of the air basin, and the prevailing meteorological conditions. Most air pollutants originate from human-made sources, including mobile sources (e.g., car, buses), stationary sources (e.g., factories, power plants), and indoor sources (e.g. building materials, cleaning solvents). Air pollutants are also released from natural sources such as volcanic eruptions and forest fires.

3.4.2 Region of Influence

The ROI for air quality assessment depends on the pollutant types, source emission rates and release parameters, the proximity of proposed emission sources to existing emission sources, and the local and regional meteorological conditions. For inert pollutants (all pollutants other than ozone and its precursors: volatile organic compounds [VOCs] and nitrogen oxides), the ROI is generally limited to an area extending a few miles downwind from the source. The ROI for ozone may extend much farther downwind than the ROI for inert pollutants; however, impacts from tropospheric ozone and its precursors would only be a concern in project areas that have heavy industry and/or a large amount of automobile traffic, neither of which occur on Kaua'i. Consequently, for the air quality analysis, the ROI for project activities is the existing airshed (the geographic area responsible for emitting 75% of the air pollution reaching a body of water) surrounding KTF, which encompasses the Mānā Plain and the PMRF Main Base (MDA 2007; Navy 2008 and 2017; OORS 2012).

3.4.3 Affected Environment

3.4.3.1 Regulatory Setting

3.4.3.1.1 Criteria Pollutants

The principal pollutants defining air quality, called *criteria pollutants*, include carbon monoxide (CO), sulfur dioxide (SO₂), nitrogen oxides, 8-hour ozone (as measured by its precursors: VOCs and nitrogen oxides), lead (Pb), suspended particulate matter less than or equal to 10 microns in diameter (PM₁₀), and fine particulate matter less than or equal to 2.5 microns in diameter (PM_{2.5}). CO, SO₂, Pb, and some particulates are emitted directly into the atmosphere from emissions sources. Ozone, nitrogen oxides, and some particulates are formed through atmospheric chemical reactions that are influenced by weather, ultraviolet light, and other atmospheric processes.

Under the *Clean Air Act* (CAA; 42 U.S.C. 7401 – 7671q), the USEPA has established the National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50) for criteria pollutants.

NAAQS are classified as primary or secondary. Primary Standards set limits to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards protect public welfare, which includes protection against decreased visibility and damage to crops, vegetation, animals, and buildings. Some pollutants have long-term and short-term standards. Short-term standards are designed to protect against acute, or short-term, health effects, while long-term standards were established to protect against chronic health effects.

Geographic areas that are and have historically been in compliance with the NAAQS are designated as attainment areas. Areas that violate a Federal air quality standard are designated as nonattainment areas. Areas that have transitioned from nonattainment to attainment are designated as maintenance areas and are required to adhere to maintenance plans to ensure continued attainment.

The CAA requires states to develop a general plan to attain and maintain the NAAQS in all areas of the country and a specific plan to attain the standards for each area designated nonattainment for a NAAQS. These plans, known as State Implementation Plans (SIPs), are developed by the state and local air quality management agencies and submitted to USEPA for approval.

The State of Hawai'i has adopted air quality standards that are equal to or more stringent than the NAAQS (Hawaii Administrative Rules, Title 11 Chapter 59). Additionally, there is a state standard for hydrogen sulfide (H₂S) that was established primarily to monitor the ambient air effects of geothermal energy production activities on the Island of Hawai'i. The NAAQS and state standards are shown in Table 5.

3.4.3.1.2 Hazardous Air Pollutants

In addition to the NAAQS for criteria pollutants, national standards exist for hazardous air pollutants (HAPs), which are regulated under Section 112(b) of the 1990 CAA Amendments. The National Emission Standards for Hazardous Air Pollutants (NESHAPs) regulate HAP emissions from stationary sources (40 CFR part 61).

HAPs emitted from mobile sources are called Mobile Source Air Toxics (MSATs). MSATs are compounds emitted from highway vehicles and non-road equipment that are known or suspected to cause cancer or other serious health and environmental effects. In 2001, USEPA issued its first MSAT Rule, which identified 201 compounds as being HAPs that require regulation. A subset of six of the MSAT compounds was identified as having the

Table 5 - Federal and State Ambient Air Quality Standards

Air Pollutant	Hawai'i Standard	Federal Primary Standard	Federal Secondary Standard
Carbon Monoxide 1-hour average 8-hour average	8,700 ppb 4,400 ppb	35,000 ppb 9,000 ppb	None None
Hydrogen Sulfide 1-hour average	25 ppb	None	None
Lead 3-month average	1.5 µg/m ³ (calendar quarter)	0.15 µg/m ³ (running 3-month)	Same as primary
Nitrogen Dioxide 1-hour average Annual average	None 37.2 ppb	100 ppb 53 ppb	None Same as primary
Particulate Matter (PM₁₀) 24-hour block average Annual average	150 µg/m ³ 50 µg/m ³	150 µg/m ³ None	Same as primary None
Particulate Matter (PM_{2.5}) 24-hour block average Annual average	None None	35 µg/m ³ 12 µg/m ³	Same as primary 15 µg/m ³
Ozone 8-hour rolling average	79.97 ppb	70 ppb	Same as primary
Sulfur Dioxide 1-hour average 3-hour block average 24-hour block average Annual average	None 500 ppb 140 ppb 30 ppb	75 ppb - None None	None 500 ppb - -

Source - modified from State of Hawaii 2018

ppb = parts per billion by volume

µg/m³ = micrograms per cubic meter of air

greatest influence on health and included benzene, butadiene, formaldehyde, acrolein, acetaldehyde, and diesel particulate matter. More recently, USEPA issued a second MSAT Rule in February 2007, which generally supported the findings in the first rule and provided additional recommendations for compounds having the greatest impact on health. The rule also identified several engine emission certification standards that must be implemented (40 CFR parts 59, 80, 85, and 86; Federal Register Volume 72, No. 37, pp. 8427–8570, 2007). Unlike the criteria pollutants, there are no NAAQS for MSATs. The primary control methodologies for these pollutants for mobile sources involves reducing their content in fuel and altering the engine operating characteristics to reduce the volume of pollutant generated during combustion.

3.4.3.2 Regional Air Quality

Pollutant concentrations are measured against Federal and state ambient air quality standards that protect public health and welfare. Existing ambient air quality is

determined by analyzing air monitoring data obtained from monitoring stations located in representative areas and maintained by government agencies and comparing the data to the standards. The State of Hawai'i Department of Health, Clean Air Branch plans, operates and maintains the statewide ambient air quality monitoring network. Monitoring data is used for a variety of reasons including determining compliance with NAAQS, timely reporting of the EPA's Air Quality Index, tracking and characterizing air quality trends, evaluating emission control strategies, and supporting health studies. The state currently maintains 14 air monitoring stations on the four biggest islands; however, one of these stations on the island of Hawai'i (Puna E station) was overcome in May 2018 by lava from Mount Kilauea eruptions. One of the monitoring stations is located on Kaua'i at Lihue. The Clean Air Branch conducts an annual review, submitted to the EPA, to evaluate the state's ambient air monitoring network to determine adequacy in meeting monitoring objectives and ensure that air quality issue important to the state are being addressed. The State of Hawai'i is in attainment

for all NAAQS.

USEPA's general air conformity rule applies to Federal actions occurring in nonattainment or maintenance areas when the total indirect and direct emissions of the subject air pollutant exceed specific thresholds. An air conformity analysis is not required for the Proposed Action because the State of Hawai'i is in attainment for all NAAQS.

3.4.3.3 Climate

The climate at KTF is typical of maritime subtropical islands. Daily highs are in the 80s most of the year, with lows general in the mid-60s to low 70s. August and September are the warmest months of the year when high may reach into the lower 90s. The region is strongly influenced by the Pacific Sub-Tropical High Pressure system. Winter time highs occasionally dip below 80. There are two main seasons in tropical and subtropical areas. A wet season and a dry or windy season. (SNL 2018)

KTF is located on the lee-side of the island, which reduces the amount of annual rainfall as compared to the eastern and mountainous areas of Kaua'i. The lee-side of many islands exhibit desert like conditions in rain shadowed areas, and Kaua'i is no exception. The average annual rainfall approaches 22 inches around KTF. The wet season generally starts some time in November and lasts into March, and totals approximately 15 inches. June and July are the driest months of the year when less than one half an inch is recorded for each month. (WRCC Waimea station 519629). (SNL 2018)

Winds are mostly from the easterly directions on Kaua'i. The northeast and southeast trade winds generally blow between 15 and 25 miles an hour, though winds may not be quite as strong at times at KTF. This global subtropical trade-wind pattern occasionally gets disrupted in the winter when cool wet systems approach the island from the west or northwest. Relative Humidity ranges from 60 and 70 percent in the summer to near 80 during the wet season. Direct hits from typhoons or hurricanes are rare in the Hawai'ian Island chain, though damage from nearby storms may occur. The last direct impact and most destructive hurricane to hit Kaua'i was Hurricane Iniki in September of 1992. (SNL 2018)

3.4.3.4 Existing Emission Sources

There are no facilities on KTF that require Federal air emission permits. The only stationary sources of air emissions are diesel generators. KTF operates two standby 320-kW diesel engine generators during testing

activities. This use is necessary because there are critical systems in operation during launches that require no interruption of service for safety and system reliability. These systems include launch operations control, video surveillance, computer networking, assembly building power, launch communications, and telemetry. Relying on the Kaua'i Island Utility Cooperative (KIUC) system, which can experience irregular dropouts, would put personnel and equipment at risk. These generators are permitted for operation by the State of Hawai'i under a Noncovered Source Permit (NSP-0429-01-N, September 2015 to September 2020). The permit requires semi-annual reporting of operating hours and fuel quantity and content data. The permit limits the operating hours to a maximum of 6,000 hours in any 12-month period, the sulfur content of the fuel to a maximum of 0.0015% sulfur, and the fuel's cetane index to a minimum of 40. The highest number of operating hours in a 12-month period ending sometime in 2017 was from November 2016 to October 2017, when the generator hours totaled 3,968.30 hours. KTF's vendor of ultra-low sulfur highway diesel fuel provided testing data to show that the fuel's sulfur content was a maximum of 0.0009% and had a minimum cetane index of 61.9. In 2017, a total of 29,542 gallons of fuel were used. Thus, the operation of KTF's generators was in compliance with the stipulations of the state permit for the calendar year 2017 (SNL 2018).

Mobile sources from KTF include rocket launches, diesel-fueled vehicles, and vehicular traffic. PMRF has the same sources, plus aircraft operated and supported at the PMRF Airfield. Currently, there are as many as 46 missile launches per year from PMRF and KTF, which includes launches for Missile Defense Agency programs and target launches. These systems use both solid and liquid propellants. The most common exhaust components for typical rockets include aluminum oxide, carbon dioxide, carbon monoxide, hydrogen, hydrogen chloride, nitrogen, water, ferric chloride, ferric oxide, nitric oxide, chlorine, and sulfur dioxide. Because rocket launches are mobile sources, no reporting of quantity releases is required (SNL 2017); this is the case most years based upon the review of the launches, however there could be Toxic Release Inventory reporting if thresholds quantities are met. Air-monitoring results from the Strategic Flight Test Unit 1 in February 1993 and the Countermeasures Demonstration Experiment rocket launch in the summer of 1992 led to a determination by DOE that rocket launches at KTF are not a significant source of air pollutants because recorded emissions did not exceed Federal or state standards. The Strategic Target System (STARS)-type rocket produces the greatest air emissions of those launched at KTF and remains within regulated limits (SNL 2017).

3.5 Airspace

3.5.1 Definition of Resource

Airspace is defined as the space above a nation that is under its legal control. While generally viewed as being unlimited, airspace is considered to be a finite resource that must be managed for the benefit of all aviation sectors including government, commercial, and general. Its limits are defined horizontally, vertically, and temporally. The Federal Aviation Administration (FAA) is charged with the overall management of airspace over the United States and the U.S. territories, and has established criteria and limits for use of various sections of this airspace in accordance with procedures of the International Civil Aviation Organization (ICAO) (Department of the Navy 2008, 2017; FAA 2005).

The FAA designs and manages the national airspace based on guidelines from the Federal aviation regulations. The FAA has developed specific classifications for airspace to establish limits on its use. The main categories include controlled, uncontrolled, special use, and other (Table 6). Additional classifications include en route airways and jet routes, airports and airfields, air traffic/range control, and military training routes. The types of airspace are defined by the complexity or density of aircraft movements, the nature of operations conducted within the airspace, the level of safety required, and the national and public interest in the airspace.

The FAA manages commercial and general aviation activity within the airspace and the military, with FAA oversight, manages military aviation activity within special use and other airspace. Flight rules and air traffic control procedures govern safe operations in each type of designated airspace. A restricted area is airspace identified by an area on the surface of the Earth within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Activities within these areas are confined to permitted activities and limitations are imposed upon all other aircraft operations. Restricted areas generally are used to contain hazardous military activities. The term “hazardous” implies, but is not limited to, test vehicle assembly deployment, aircraft testing, and other activities that would be inconsistent or dangerous with the presence of non-participating aircraft.

3.5.2 Region of Influence

The ROI for airspace includes the airspace over KTF, PMRF, and surrounding areas. There are no military training routes in the ROI (Department of the Navy 2017).

3.5.3 Affected Environment

3.5.3.1 Regulatory Setting

The Federal Aviation Act of 1958 (Public Law 85-725) established the FAA and made it possible for the control and use of navigable airspace within the United States. The FAA created the National Airspace System (NAS) to protect persons and property on the ground, and to establish a safe and efficient airspace environment for civil, commercial, and military aviation. This system is comprised of a network of air navigation facilities, air traffic control facilities, airports, technology, and rules and regulations that are needed to operate the system. U.S. airspace is managed according to the procedures in FAA Handbook 7110.65, “Air Traffic Control” (Department of the Navy 2008, 2017; FAA 2005, 2007).

Areas beyond territorial limits are defined as international airspace where the procedures of the ICAO as outlined in ICAO Document 4444, “Procedures for Air Navigation Services, Air Traffic Management”, are followed. ICAO is a specialized agency of the United Nations whose objective is to develop the principles and techniques of international air navigation. FAA acts as the U.S. agent for aeronautical information to the ICAO, and air traffic in multiple oceanic control sectors of the Central Pacific is managed by the Oakland Air Route Traffic Control Center (ARTCC). The Honolulu Control Facility is the location in which the Honolulu ARTCC, the Honolulu control tower, and the Combined Radar Approach Control are collocated, and manages the Radar Control Area that includes the Hawai’ian Islands.

Specific aviation and airspace management procedures and policies to be used by the Navy are provided by OPNAVINST 3710.7, “Naval Aviation Training and Operating Procedure Standardization”. Other applicable guidance regarding special use airspace management include the Memorandum of Understanding between the Federal Aviation Administration and the Department of the Defense Concerning Special Use Airspace Environmental Actions (January 26, 1998). FAA Order 7490, “Policies and Procedures for Air Traffic Environmental Actions”, includes procedures and guidance for special use airspace environmental issues between FAA and DoD. FAA Order 7610.4H, “Special Military Operations”, specifies procedures for air traffic control planning, coordination, and services during defense activities, and special military operations conducted in airspace controlled by or under the jurisdiction of the FAA. All alterations and temporary closures of existing airspace are processed through the FAA, which reviews and approves all such modifications. Use of restricted airspace and warning areas requires the

issuance of the Notice to Airmen (NOTAM), which provides notice to all aircraft of the restricted and warning area via air traffic control. The FAA is the designated agency that coordinates the airspace activities (Department of the Navy 2001, 2008, 2017).

3.5.3.2 Existing Airspace Designations

The development of military lands prior to, during, and after World War II had the biggest impact on airspace in the Hawai’ian Islands. The expansion of military airfields continued as larger and more military aircraft were stationed in Hawai’i. Following World War II, the increase in tourism resulted in an expansion of civilian airfields and airports. As with the military, the civilian aircraft increased in numbers and size requiring expansion of the existing airports. This historic development resulted in close monitoring of airspace as the land area is small in Hawai’i with limited airspace (Department of the Navy 2008). The existing airspace over and surrounding KTF and PMRF is a mix of overlapping sectors, classes, and categories of airspace, as described below and shown in Figure 7.

3.5.3.2.1 Controlled Airspace

Controlled airspace refers to airspace used by aircraft operating under instrument flight rules that require different levels of air traffic service. The ROI is located within Oceanic Control Sector 9. The airspace outside the special use airspace described below is essentially international

airspace controlled by the Honolulu Control Facility and Oakland ARTCC. Class D airspace (generally that airspace surrounding airports that have an operational control tower) surrounds the PMRF airfield with a ceiling of 2,500 ft. (762 m.). It is bounded on the north, south, and east by Class E airspace with a floor of 700 ft. (213 m.) above the surface. Class A airspace includes the airspace overlying ocean waters within 12 nautical miles of the Kaua’i coast (Department of the Navy 2001, 2008, 2017).

3.5.3.2.2 Special Use Airspace

Large segments of controlled and uncontrolled airspace have been designated as special use airspace, where operations are considered hazardous to civil aircraft operating in the area. Special use airspace is divided into prohibited, restricted, warning, military operations, and alert areas. The ROI is within one restricted and two warning areas. Restricted Areas are airspace segments within which the flight of nonparticipating aircraft, while not wholly prohibited, is subject to restriction. These designated areas often have invisible hazards to aircraft, such as artillery firing, aerial gunnery, or guided missiles. Aircraft operations in these areas are prohibited during times when it is “active”. Restricted Area R-3101 has been established above the PMRF and over water west of Kaua’i (surface to unlimited ceiling) to provide the airspace required by PMRF to meet its primary missions. Its times of use are Monday through Friday from 0600 to 1800 hours, and it is controlled by PMRF. Warning Areas contain many of the same hazards as a restricted area,

Table 6 - Definitions of Airspace Categories

Category	Definition	Examples
Controlled Airspace	Airspace used by aircraft operating under Instrument Flight Rules that require different levels of air traffic service	Altitudes above FL 180 (5,500 meters [18,000 ft.] above MSL) Airport traffic areas, airport terminal control areas, jet routes, vector routes
Uncontrolled Airspace	Airspace primarily used by general aviation aircraft operating under Visual Flight Rules	As high as 4,420 meters (14,500 ft.) above MSL
Special Use Airspace	Airspace within which specific activities must be confined or access limitations are placed on non-participating aircraft	Restricted areas, military operations areas
Other Airspace	Airspace not included under controlled, uncontrolled, or special use categories	Military training routes

FL = flight level
MSL = mean sea level

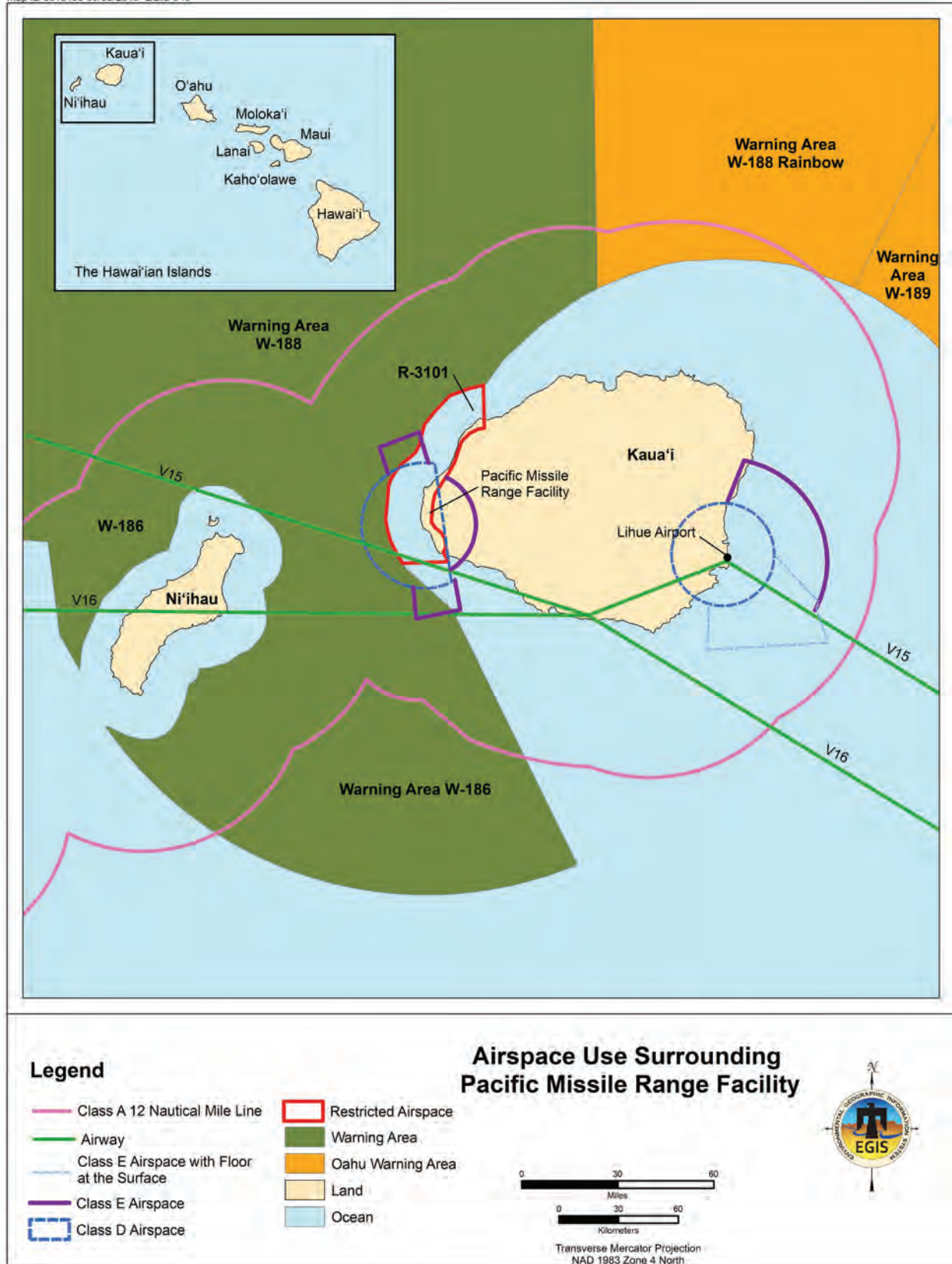


Figure 7: Airspace Use Surrounding PMRF

but because they can occur outside of U.S. airspace, aircraft operations cannot be legally restricted within the areas. The ROI includes portions of Warning Area W-188 (surface to unlimited ceiling) north of Kaua'i and Warning Area W-186 (surface to 9,000 ft.) southwest of Kaua'i. Both are in continuous use, with both controlled by PMRF in communication with the Honolulu Control Facility (Department of the Navy 2001, 2008, 2017; FAA 2007).

To ensure safe operations, PMRF requests use of specific areas of airspace from the FAA during rocket launch testing. The FAA issues a NOTAM to avoid specific areas until testing is complete. The NOTAM System is a telecommunication system designed to distribute unanticipated or temporary changes in the National Airspace System.

3.5.3.3 Airspace Use

3.5.3.3.1 *En Route Airways and Jet Routes*

There are no jet routes (above 18,000 ft.) within the ROI. Although relatively remote from the majority of en route airways (up to 18,000 ft.) that cross the Pacific, the ROI has two instrument flight rules, low altitude routes used by commercial air traffic: V15, which passes east to west through the southernmost part of Warning Area W-188, and V16, which passes east to west through the northern part of Warning Area W-186. The ROI is far removed from the low altitude airways carrying commercial traffic between Kaua'i and the other Hawai'iian islands. Although there is a high volume of helicopter sightseeing flights along the Na Pali coastline and over the Waimea Canyon, inland and east of the PMRF, these do not fly over the PMRF or into Restricted Area R-3101 (Department of the Navy 2001, 2008, 2017).

3.5.3.3.2 *Airports and Airfields*

The ROI contains two aircraft facilities, the PMRF airfield and the Kekaha airstrip approximately 3 miles (5 km) to the southeast of PMRF. Lihue, Kaua'i's principal airport, is located 20 nautical miles east of PMRF, outside of the ROI, and the standard instrument approach/departure procedure tracks are all to the east and southeast of the island well outside the ROI. In addition to helicopter and fixed-wing aircraft landings associated with PMRF's mission, the PMRF airfield serves as a training facility for landings and takeoffs. The 2009 air operations at PMRF were estimated to be 25,486 takeoffs and landings (Department of the Navy 2001, 2008, 2017).

3.5.4 Air Traffic Control

Use of the airspace by the FAA and PMRF is established by

a Letter of Agreement between the two agencies. Under this agreement, PMRF is required to notify the FAA by 2:00 p.m. the day before range operations would infringe on the designated airspace. PMRF Range Control and the FAA are in direct real-time communication to ensure safety of all aircraft using the airways and jet routes and the special use airspace. Within the special use airspace, PMRF activities in Warning Areas W-186 and W-188 are under PMRF control, and the PMRF Range Control Officer is solely authorized and responsible for administering range safety criteria, the surveillance and clearance of the range, and the issuance of the range RED (no firing) and GREEN (clearance to fire) (Department of the Navy 2001, 2008, 2017).

Because Warning Areas are located in international airspace, the procedures of the ICAO, outlined in ICAO Document 4444, are followed. The FAA acts as the U.S. agent for aeronautical information to the ICAO, and air traffic in the ROI is managed by the Honolulu ARTCC.

Other special airspace use procedures used by PMRF to meet its particular needs include assigning airspace and altitude reservation procedures. Air Traffic Control Assigned Airspace (ATCAA) is defined by vertical and lateral limits assigned by air traffic control to provide air traffic segregation between specified activities being conducted within the assigned airspace and other air traffic. ATCAAs support high altitude activities. Altitude Reservation (ALTRV) procedures are used as authorized by the Central Altitude Reservation Function (an air traffic service facility) or appropriate ARTCC (under certain circumstances) for airspace utilization under prescribed conditions. An ALTRV receives special handling by FAA facilities. According to FAA Handbook 7610.4H, ALTRVs are classified as either moving or stationary, with the latter normally defining the fixed airspace area to be occupied as well as the specific altitude(s) and time period(s) the area will be in use. ALTRVs may encompass certain rocket and missile activities and other special activities.

3.6 Noise

3.6.1 Definition of Resource

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water, and are sensed by an organism's ear. Noise is defined as any sound that is undesirable because it startles the receptor, interferes with communication, is intense enough to damage hearing, diminishes the quality of the environment, or is otherwise annoying. Noise receptors can include humans as well as terrestrial and marine wildlife, in particular wildlife protected by

law, each with higher or lower sensitivities to sounds of varying characteristics. Noise and wildlife interactions are discussed in Section 3.8.

3.6.2 Region of Influence

The ROI for noise analysis is the area within and surrounding the PMRF Main Base in which humans and wildlife may suffer annoyance or disturbance from noise sources originating from KTF.

3.6.3 Affected Environment

This section defines technical terms and measurements, modeling, and protective standards used in noise assessment. Potential sensitive receptors and the existing noise levels for the PMRF Main Base and KTF are also described.

3.6.3.1 Regulatory Setting

The *Noise Control Act* of 1972 (42 U.S.C. 4901 et seq.) directs all Federal agencies to carry out programs within their control in a manner that promotes an environment free from noise that may jeopardize the health or welfare of any person. The act requires a Federal department or agency engaged in any activity resulting in the emission of noise to comply with Federal, state, interstate, and local government requirements respecting control and abatement of environmental noise.

3.6.3.2 Terminology and Measurements of Sound

The physical characteristics of sound include parameters such as amplitude, frequency, and duration. Amplitude is the intensity or “loudness” of sound, expressed in terms of sound pressure. Frequency measures the number of wavelengths (i.e., cycles per second the air vibrates, measured in Hertz [Hz]) received by a receptor over a period of time. High frequency sounds have a high number of wavelengths over a period of time (e.g., 1 second), examples being sound from jet engines or train whistles. Low frequency sounds have a low number of wavelengths, examples being sonic booms or blast noises. Duration is the length of time over which the sound continues. Sound may be intermittent or continuous, steady or impulsive, and may be generated by stationary sources and transient sources.

Sound levels must be associated with a distance from the source to be meaningful. As sound travels away from the source, its amplitude decreases due to atmospheric spreading and absorption. Atmospheric spreading describes how the sound wave stretches to cover a

larger area as it moves away from the source, similar to ripples in a pond. Atmospheric absorption describes the energy the sound wave loses because it transfers energy to the air molecules it passes through. Atmospheric spreading has greater effect on sound level losses at relatively short distances, and atmospheric absorption has a greater impact as distance from the source increases. While these decreases in sound amplitude can be calculated at a regular rate from the source in noise modeling situations, in actuality the levels can be further affected by terrain, other obstacles (e.g., buildings), and atmospheric conditions (e.g., humidity) (ASMDC 2001). Intricate noise models in use today can take these site-specific characteristics into account when developing noise predictions.

Sound levels can be easily measured, but the variability in subjective and physical response to sound complicates the analysis of its impact on people. Physically, sound pressure magnitude (i.e., amplitude) is the intensity of sound and is measured and quantified in terms of a level scale in units of decibels (dB). However, while dBs are the basic measuring units, weightings, equivalents, averages, and other conversions are used to interpret sound levels and their effects.

Different sounds may have different frequency contents. Sound level measurements that incorporate adjustments to amplitude based on frequency are called weighted sound levels. When measuring typical sources of sound to determine its effects on a human population, A-weighted sound levels (dBA) are often used to account for the frequency response of the human ear. In general, it reduces the calculated impact of higher and lower frequencies because they are less perceptible to humans. This is the measurement most commonly used for planning and estimating community reaction. Figure 8, on the next page, provides a chart of dBA from typical sources. In this figure, some noise sources (e.g., air conditioner, vacuum cleaner) are continuous sounds that maintain a constant sound level for some period of time. Other measurements are the maximum sound produced during an event, like a vehicle pass-by. Finally, other sound measurements (e.g., urban nighttime) are averages taken over an extended period of time. When high-intensity impulsive sound is evaluated to determine its effects on a human population, C-weighted sound levels are used so that the low-frequency effects of the sound are considered. The low-frequency content of impulsive sound contributes to effects such as window rattling that influence people's perception of and reaction to noise (ASMDC 2001).

A variety of noise metrics have been developed to

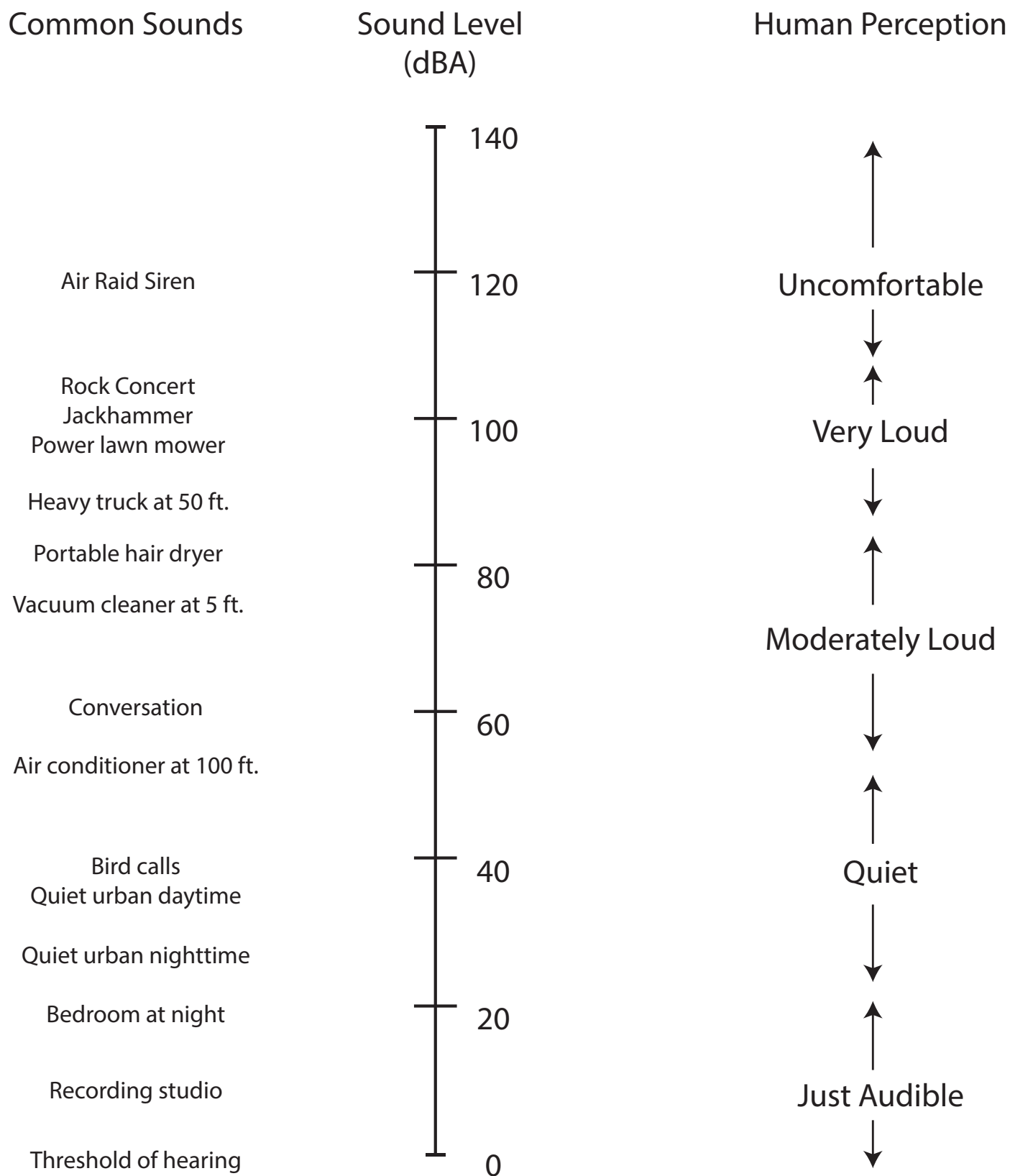


Figure 8: A-Weighted Sounds Levels from Common Sources and Human Perception

describe and quantify the noise environment over different time periods. The most commonly used tool for analyzing noise is the Day/Night Average Sound Level (DNL). This metric describes the average sound level during a 24-hour day in dBA. Because humans are more sensitive to noise at night, noises occurring during those times are penalized. For noise occurring between 10:00 p.m. and 7:00 a.m., 10 dBA are added to the measured noise level (MDA 2007; Navy 2017).

Noise from transportation sources, such as road vehicles and aircraft, and from continuous sources, such as generators, is assessed using the A-weighted DNL, which significantly reduces the measured pressure level for low frequency sounds and some high frequency sounds. Impulse noise resulting from artillery, demolitions activities, high energy blast noise, and other low frequency sounds capable of inducing vibrations in buildings is characterized by C-weighted DNL, which does not reduce the measured pressure level for the low frequency components of a sound (MDA 2007).

Studies of community annoyance in response to numerous types of environmental noise show that DNL correlates well with impact assessments, i.e., there is a consistent and accurate relationship between DNL and the level of annoyance. Most people are exposed to sound levels of 50 to 55 dBA DNL or higher on a daily basis. Research has indicated that about 87% of the population is not highly annoyed by outdoor sound levels below 65 dBA DNL; therefore, that noise level is used to help determine compatibility of proposed activities with local land use (Navy 2017).

Because DNL averages the noise event levels, it tends to obscure the periodically high noise levels of individual events and their possible adverse impacts. In recognition of this limitation, for noise events that have a high noise level and short duration, analysts also use single-event noise impact analyses. The maximum sound level (L_{max}) is a noise descriptor that can be used for these types of noise events, such as rocket vehicle launches. The L_{max} is the greatest sound level that occurs during a noise event. The term “peak” defines peak sound over an instantaneous time frame for a particular frequency (Navy 2008, 2017).

3.6.3.3 Noise Modeling

Computer modeling provides a tool to predict potential noise impacts. Using a library of field-measured noise levels produced by various sources, computer models are able to develop noise contours that show varying noise levels surrounding the source, while taking into account the terrain, other obstacles, and weather conditions. The result of modeling is noise contours or lines that define

zones (usually in 5 dB increments) that will experience a certain level of noise.

3.6.3.4 Protective Standards

The *Occupational Safety and Health Act* (OSHA) (29 U.S.C. 651 et seq.) was established to ensure safe and healthy working conditions for working men and women. Its implementing regulations govern the safety standards that employers are required to meet for all aspects of a worker’s environment. The regulations at 29 CFR 1910.95 pertain to the protection of workers from potentially hazardous occupational noise exposure. The regulations establish a maximum noise level of 90 dBA for a continuous 8-hour exposure during a working day and higher sound levels for shorter exposure times. The highest allowable sound level to which workers can be constantly exposed is 115 dBA and exposure at this level must not exceed 15 minutes within an 8-hour period. Exposure to impulse or impact noise should never exceed a 140-dB sound pressure level. Table 7 shows permissible noise exposures as defined by OSHA and American Conference of Governmental Industrial Hygienists (ACGIH). Protection against the effects of noise exposure must be provided when sound levels exceed these levels. If noise levels exceed these standards, employers are required to provide hearing protection equipment that will reduce sound levels to acceptable limits.

DOE implements guidance and requirements to manage the exposure of Federal workers and contractors to occupational noise. The primary regulation for contractors is 10 CFR 851, Worker Safety and Health Program. Applicable DOE directives include DOE Order 440.1B Change 2, Worker Protection Program for DOE Federal Employees which applies to both DOE and NNSA employees, as well as DOE G 440.1-1B Change 1, Worker Protection Management for DOE Federal and Contractor Employees which applies to both DOE and its contractors. NNSA Policy Letter NAP-6A, Federal Employee Occupational Safety and Health Program covers the requirements for NNSA employees. The DOE and NNSA occupational noise exposure and hearing conservation program standards are based on both the OSHA limits and the more stringent thresholds established by the ACGIH. The ACGIH limits are also shown in Table 7. There are no legally established national standards for noise outside of the work environment. However, noise level goals have been developed by the U.S. Department of Housing and Urban Development (HUD) to guide other U.S. agencies in dealing with noise issues. Noise zone classifications established by HUD, in collaboration with U.S. Department of Transportation (DOT), DoD, EPA, and Veterans Administration, which define noise level goals

Table 7 - Permissible Noise Exposure Limits Applicable to Workers

Duration (hours per day)	OSHA Limits (dBA) *	ACGIH Limits (dBA)
16	---	80
8	90	85
6	92	---
4	95	90
3	97	---
2	100	95
1 to 1.5	102	---
1	105	100
0.5	110	105
0.25	115	110
0.125	115	115

Source: 29 CFR 1910.95, Table G16

--- = No limit established for this time duration.

*Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level

for several categories, are shown in Table 8. HUD, the DOT, and USEPA recognize 55 dBA DNL as a goal for outdoor noise levels, established for residential areas to protect public health and welfare with an adequate margin of safety. For the general public, the USEPA recommends a 24-hour average noise level that does not exceed 70 dBA (DOE 1992).

3.6.3.5 Sensitive Receptors

The response of different individuals to similar noise events is diverse, and is influenced by the type of noise, perceived importance of the noise, duration of the noise, its appropriateness in the setting, time of day, type of activity during which the noise occurs, frequency of occurrence, distance between the source and receptor, and sensitivity of the individual (Navy 2008; ASMDC 2011). Sensitive receptors are humans or wildlife that are, or may be, sensitive to noise. They can be defined by type or location.

When conducting noise modeling of launch vehicles with thrust ratings of greater than 50,000 pounds, DOE identified as sensitive receptors for KTF launches the closest public spectators, launch personnel, other PMRF and KTF personnel, the closest residents in the closest town (Kekaha), and several previously identified potentially sensitive terrestrial and marine wildlife habitats (Table 9; DOE 1992). In addition, the nearest PMRF housing area is located approximately 5 miles (8 km) south of KTF.

3.6.3.6 Existing Noise Levels

Primary sources of noise on PMRF Main Base include airfield operations, range operations, and missile, rocket, and drone launches. Ambient noise levels from natural sources include wind and surf.

Noise generated at the airfield stem from one active runway, four helicopter operating locations, and maintenance operations. Airfield operations include take-offs and landings of high performance and cargo/passenger aircraft, as well as helicopter operations. Airfield noise levels tend to have a continuous impact on PMRF Main Base, with noise levels near the runway averaging as high as 75 dBA. Buildings in this area are insulated to achieve a noise reduction of up to 35 dBA. Noise levels further away from the runway are characteristic of a commercial park, with levels not exceeding 65 dBA. Airfield noise zones have been established to safeguard the public and station personnel from the effects of noise from air operations. Modeled noise contours based on 2004 airfield operations determined that noise levels around the airfield are low. The noise study determined that 3 locations were affected by 75-decibel noise levels (the highest noise level recorded in the study): the north end of the runway, the south end of the runway, and a 1-acre area located between ¼ and ½ mile northeast of the north end of the runway. No housing areas or populations were found to be impacted (Navy 2008; ASMDC 2011).

Range operations that may impact the sound environment include, but are not limited to, power

Table 8 - Noise Zone Classifications

Noise Zone	Noise Exposure Class	DNL (dBA)	HUD Noise Standards
A	Minimal Exposure	Not exceeding 55	Acceptable
B	Moderate Exposure	Above 55, not exceeding 65	
C-1	Significant Exposure	Above 65, not exceeding 70	Normally Unacceptable
C-2		Above 70, not exceeding 75	
D-1	Severe Exposure	Above 75, not exceeding 80	Unacceptable
D-2		Above 80, not exceeding 85	
D-3		Above 85	

Source: Federal Interagency Committee on Urban Noise, 1980

Table 9 - Distance from KTF Launch Pads to Sensitive Receptors

Receptors	KTF Launch Complex feet (meters)
KTF Launch Operations Building	1,240 (376)
Other KTF and PMRF Employees, agricultural workers, public spectators, and Polihale State Park Visitors	10,000 (3,030)
Residents of Kekaha	37,000 (11,212)
Wildlife at KTF	600 (182)
Offshore Wildlife	1,200 (364)

Source: DOE 1992

Table 10 - Noise levels modeled for launches occurring at the KTF Launch Complex.

Sensitive Receptor Distance feet (meters)	Maximum Sound Levels (dBA)			
	STARS 80,000 #T	EDX 50,000 #T	TALOS 125,000 #T	STRYPI * 146,000 #T
600 (182) Wildlife at KTF	122	122	129	126
1,200 (364) Offshore Wildlife	116	116	122	120
1,240 (376) KTF Launch Ops Bldg.	115	116	122	119
2,000 (606)	111	111	117	114
3,000 (909)	107	107	113	110
6,500 (1,970)	98	98	103	100
10,000 (3,030) Other KTF & PMRF employees, Sugar cane field workers; Public spectators; Polihale State Park visitors	92	92	97	94
37,000 (11,212) Residents of Kekaha	72	71	75	72

Sources: DOE 1992

#T = pounds of thrust

* = results obtained from NASA Sound Level Simulation Model

generation, support activities for training, research, and development, maintenance operations, and construction or renovation.

Activities with the most noticeable sound events are the launches of missiles, rockets, and drones. These launches result in high intensity, short duration sound events. Noise levels experienced during rocket launches are a function primarily of rocket system thrust (pounds, #T), though engine exhaust configuration and orientation of the rocket launch also influences noise levels. Because a rocket's velocity increases rapidly as it moves away from the launch pad, the increased noise levels are experienced by sensitive receptors usually for less than 30 seconds.

Typical launches at PMRF Main Base and at KTF include the STARS, Terminal High Altitude Area Defense, and Stryki missile launches; none have resulted in any public noise complaints. Table 10 shows noise levels modeled for various launch vehicles launching from the KTF Launch Complex. Data collection of actual noise levels during monitoring of a Stryki launch in 1991 showed that the actual noise levels were 2 dBA to 7dBA lower than the levels modeled, showing that the model provided the most conservative noise estimates (DOE 1992; Navy 2008; ASMDC 2011). Noise monitoring was conducted in February 1993 during a STARS FTU-1 launch to confirm the determination made in the STARS EIS that noise produced from the largest launch at KTF would be below maximum acceptable levels. Data collected in the nearest town of Kekaha indicated that levels were no louder than noise generated from passing vehicles on a nearby highway (SNL 2017).

In addition to noise from the rocket engine, launch vehicles can also generate sonic booms during flight. A sonic boom is a sound that resembles rolling thunder and is produced by a shock wave that forms at the nose and at the exhaust plume of a rocket that is traveling faster than the speed of sound. The audible sonic boom occurs when the shock wave reaches the ground, occurring some distance downrange of the launch site. Most of the region subjected to any sonic boom from launches at KTF is the surface of the ocean, thus, land-based populations are not affected (ASMDC 2011).

3.7 Water Resources

3.7.1 Definition of Resource

The discussion of water resources encompasses the following elements:

- The groundwater system beneath KTF, including a description of water-bearing units, groundwater

quality, and groundwater production and use.

- The surface water system at KTF, including topography and the direction of surface-water flow, wastewater management, and runoff. The nearby ocean aquatic environment is also discussed briefly. Surface water quality data and surface water use are also discussed.

3.7.2 Region of Influence

The ROI for groundwater are those water-bearing layers that could potentially be affected by contaminant release, as well as aquifers used for the KTF water supply. The ROI for surface water is onsite drainage channels and the watershed downstream from KTF.

3.7.3 Affected Environment

3.7.3.1 Groundwater

3.7.3.1.1 Hydrogeology

The three geological formations (bedrock, alluvium, dunes) at the PMRF constitute three different but hydraulically connected aquifers in the ROI. The bedrock of the Napali Formation (basement volcanics, primarily basalt) is highly permeable. The overlying sediments act as a caprock because of their low overall permeability, although individual layers, such as buried fossil coral reefs, may be relatively permeable. However, the hydraulic effect of these layers is local. The column of sediments is saturated but is not exploitable as an aquifer because of unfavorable hydraulic characteristics. In the PMRF area, the dune sand aquifer has a moderate hydraulic conductivity, probably 50 to 100 ft. per day, and an effective porosity of about 20 percent. The groundwater in the sediments is recharged from the basalt aquifer due to irrigation percolation and rainfall, especially where the sediments are thin near the inner margin of the Mānā Plain. (DOE 1992, U.S. Department of the Navy 2008)

3.7.3.1.2 Quality and Use

The bedrock of the Napali Formation contains brackish water that floats on seawater. Nowhere within the PMRF does the basalt aquifer carry either potable or irrigation grade water. The groundwater in overlying sediments is also brackish.

To keep the water table below the root zone of sugar cane, thousands of feet of drainages were excavated in the Mānā Plain east of KTF prior to the end of sugar cane cultivation in 2010. At the water table, brackish groundwater floats on sea water. Recharge originates with storm rainfall and as seepage from the caprock sediments. The only record

of an attempt to exploit this groundwater is of a well drilled for the Navy in 1974, 4 to 5 miles south of KTF in the present Kokole Point housing area. It was advanced to a total depth of 42 ft., encountering only fine sand and coral gravel. Tested at 300 gallons per minute, it initially yielded water having 2,800 milligrams per liter chloride, which is too brackish for irrigation. This well is not used. (DOE 1992, U.S. Department of the Navy 2008)

Potable water for the northern portion of the PMRF, including KTF, is pumped from Mānā Well, located about 2 miles east of the PMRF near the Mānā cliffs at the inland edge of the coastal plain (U.S. Department of the Navy 2008). Water supplied by Mānā Well meets all USEPA and State of Hawai'i drinking water standards (Naval Facilities Engineering Command 2017).

3.7.3.2 Surface Water

3.7.3.2.1 Hydrology

A natural drainage network does not exist at the PMRF or KTF because the sand is too permeable for rainwater to accumulate and travel laterally. Drainage from the alluvial portion of the Mānā Plain crosses the sand zone in two man-made drainage canals, one approximately 0.1 miles south of KTF, and the other immediately south of the PMRF runways, approximately 3 miles south of KTF. These canals were excavated to dewater marshes when the area was used for sugar cane cultivation. Pumps are required to lift the water from the alluvial plain to the slightly higher dune zone for passage to the Pacific Ocean. These canals are the only surface water in the area of KTF, although several ponds exist on PMRF and in agricultural lands approximately 1.0 to 1.5 miles to the east and south. (DOE 1992, U.S. Department of the Navy 2008)

The primary flood hazard is from overflow of the canals that drain the Mānā Plain. If the drainage canals are kept free of obstructions, flooding does not take place. However, the canals may become clogged with debris and mud, causing them to overflow onto the non-sandy part of the plain during extended periods of heavy rainfall. The last episode of flooding occurred in the fall of 1982. (DOE 1992, U.S. Department of the Navy 2017) See Section 3.7.3.4 for further discussion of floodplains.

3.7.3.2.2 Quality and Use

Use of surface water in the area of the PMRF is limited to irrigation ponds for agriculture. Mountain surface water and stormwater runoff drain onto agricultural lands and into irrigation ponds below the Mānā cliffs at the eastern edge of the Mānā Plain. The Mānā Plain is drained by canals that flow seaward. Typically, the water from the

canals that drain the agricultural lands is brackish. The waters in the agricultural ponds along the Mānā cliffs generally do not meet drinking water standards for chloride salts but are near neutral to slightly alkaline. The highest chloride salt levels, near those of seawater, are present in water from Mānā Pond near the north gate of PMRF. This may be due to the infiltration of brackish to saline groundwater into the pond basin or excessive evaporation to a low surface level. (U.S. Department of the Navy 2017)

Stormwater runoff at KTF is directed into two French drains and four area drains with pumping systems in accordance with Hawai'i Underground Injection Control regulations (SNL 2017). Activities at KTF produce sanitary sewage, which is directed into three DOE/NNSA-owned and state-registered septic tanks; all the tanks are currently in use. The first septic tank was built in 1965 and was replaced in 2004. Two additional septic tanks were built in 1990 to serve other areas. The septic tank systems are pumped periodically and inspected by licensed, state-certified contractors. Historically, no contaminants have been identified above the reporting limits from past sampling events. In 2016, one septic tank was pumped and in 2017, all three septic tank systems were inspected (SNL 2017, SNL 2018).

Energy Independence and Security Act of 2007

KTF is subject to the requirements of Section 438 of the *Energy Independence and Security Act of 2007*. This Act states "[t]he sponsor of any development or redevelopment project involving a federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."

3.7.3.3 KTF Water Quality Programs

Water quality-related programs at KTF include wastewater discharge and stormwater. There are no drinking water or groundwater monitoring wells in the vicinity of KTF. All drinking water at the site is either supplied by the PMRF

drinking water system or purchased from commercial suppliers. (SNL 2016)

KTF programs operate in accordance with a Spill Prevention, Control, and Countermeasure (SPCC) Plan, with requirements for the prevention of, preparedness for, and response to oil discharges. KTF uses the PMRF SPCC Plan, which describes oil storage facilities at KTF and the mitigation controls in place to prevent inadvertent discharges of oil.

3.7.3.4 Wetlands and Floodplains

There are no designated wetlands on KTF or PMRF. There are several man-made oxidation ponds and irrigation ditches at the PMRF Main Base that support protected bird species. However, there have been no United States Army Corps of Engineers wetland delineations for them and they have not been included in USFWS wetland inventories (Department of the Navy 2010). The Nohili Ditch and its freshwater discharge, located just south of KTF, appears to support the preferred turtle foraging habitat since it stimulates filamentous algae growth on the nearshore reef bench (Department of the Navy 2008). The ditch has been classified as Riverine System, Lower Perennial Subsystem, Open Water/Unknown Bottom Class, Permanent Non-Tidal, Excavated. Two wetland areas exist along the coastline west of KTF (DOE 1992). The USFWS has designated these areas as Marine System, Subtidal Subsystem, Reef Class, Coral Subclass, and Subtidal. There is potential for aquatic vegetation types and accompanying waterbird species to be present on or near KTF property during wet periods. Ditches along the eastern boundary of KTF and several reservoirs on the Mānā Plain serve as waterbird habitats and sanctuaries.

The coastal location and low elevation of KTF make the area susceptible to tsunamis and tidal waves. Several tsunamis have occurred in the past 70 years. The most damaging was in 1946 when a wave inundated an area of the PMRF Main Base almost as far inland as the Kaunauli Highway (DOE 1992). KTF is mainly located in Flood Insurance Risk Zone X which is outside of the 100-year floodplain. The southwestern portion of the facility is within two zones: AE, a 100-year flood zone with base flood elevations ranging from 13 to 17 ft., and VE, a 100-year flood zone with additional storm-wave hazards with base flood elevations ranging from 16 to 18 ft. The northwestern boundary of KTF, along the Nohili Dunes and including the Missile Service Tower, is also in the VE zone with base flood elevations ranging from 18 to 26 ft. (Hawaii DLNR 2018).

3.8 Biological Resources

3.8.1 Definition of Resource

Native or naturalized plant and animal species and the terrestrial or aquatic habitats within which they occur are collectively referred to as biological resources. Plant associations are generally referred to as vegetation and animal species are generally referred to as wildlife. Habitat is defined as the resources and conditions present in an area that support plant and animal species. Special status resources include species that are categorized by the Federal Endangered Species Act as endangered or threatened or that are afforded Federal protection under other laws, and habitat that has been determined to be critical habitat, and any species, subspecies, or population of indigenous wildlife listed in the State of Hawai'i Department of Land and Natural Resources (DLNR) rules in Exhibit 3 of Chapter 124.

3.8.2 Region of Influence

Although KTF does not include shore or offshore areas within its jurisdiction, because of its close proximity to these areas the biological resources of shore and offshore areas are included in this analysis. Thus, the ROI for biological resources includes the entire KTF site, plus adjacent land and near offshore areas that may be affected by elevated sound levels, deposition of debris, launch emissions, and increased human activity.

3.8.3 Affected Environment

For the purposes of this discussion, biological resources have been organized into vegetation and wildlife categories, and this is followed with descriptions of environmentally-sensitive habitat, essential fish habitat, wetlands and floodplains, and coastal zone management.

3.8.3.1 Regulatory Setting

A number of Federal laws, regulations, and Executive Orders (EOs) address biological resources and DOE responsibilities regarding them and are applicable to KTF. The U.S. Fish and Wildlife Service (USFWS) is responsible for the protection and conservation of special-status species. The Endangered Species Act (ESA; 16 U.S.C. §1531 et seq.) is the primary law that addresses Federally-listed species. The purpose of the ESA is to conserve the ecosystems upon which threatened or endangered species depend and to conserve and recover listed species. "Endangered species" are defined as any species that is in danger of extinction throughout all or a significant portion of its range. "Threatened species" means any species that is

likely to become endangered within the foreseeable future throughout all or a significant portion of its range. The ESA states that all Federal departments and agencies shall seek to conserve endangered and threatened species, including their designated critical habitat.

Critical habitat includes specific areas within the geographical area occupied by a species at the time it is listed and includes areas that are essential to conservation of the species. Section 7 of the ESA requires project proponents to consult with the USFWS or the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Services to ensure their actions are not likely to harm or jeopardize the continued existence of Federally-listed species or result in the destruction or adverse modification of designated critical habitat. Consequences that are to be avoided include directly killing or injuring a species; significant habitat modification or degradation that would harm a species by impairing essential behavioral patterns, including breeding, feeding, or sheltering; and intentional or negligent acts or acts of omission that create the likelihood of injury to a species by annoying it to such an extent as to significantly disrupt normal behavioral patterns such as breeding feeding, or sheltering.

The State of Hawai'i Department of Land and Natural Resources (DLNR) defines "endangered wildlife" as any species, subspecies, or population of wildlife that has been officially listed by the Federal government as endangered, and any species, subspecies, or population of indigenous wildlife listed in the DLNR's rules in Exhibits 1 and 2 of Chapter 124, *Indigenous Wildlife, Endangered and Threatened Wildlife, Injurious Wildlife, Introduced Wild Birds, and Introduced Wildlife*. "Threatened wildlife" is defined as any species, subspecies, or population of wildlife that has been officially listed by the Federal government as threatened, and any species, subspecies, or population of indigenous wildlife listed in the DLNR's rules in Exhibit 3 of Chapter 124. The rule prohibits, unless permitted by the Department, any attempt to take, possess, process, sell, offer for sale, or transport any endangered or threatened species, any young or egg, or the dead body or skin thereof within the State; to export any such species, or any young or egg, or the dead body or parts thereof, from the State; or to remove, damage, or disturb the nest of any endangered or threatened species.

All marine mammals are protected under the provisions of the Marine Mammal Protection Act (MMPA; 13 U.S.C. §1361 et seq.) that is implemented by the USFWS and the National Marine Fisheries Service of NOAA. The MMPA prohibits any person or vessel from "taking" (i.e., to attempt as well as to actually harass, hunt, capture,

or kill) marine mammals in U.S. waters or U.S. citizens from taking marine mammals on the high seas, without authorization. It also prohibits importation of marine mammals or marine mammal products into the U.S. Level A harassment is any act that has the potential to injure a marine mammal or marine mammal stock in the wild. Level B harassment is defined as any act that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing behavioral pattern disruptions, including but not limited to migration, breathing, nursing, breeding, feeding, or sheltering.

The Migratory Bird Treaty Act (MBTA; 16 U.S.C. §703 et seq.) protects migratory birds, and their conservation by Federal agencies is mandated by Executive Order 13186 Responsibilities of Federal Agencies to Protect Migratory Birds. The MBTA makes it unlawful by any means or in any manner to pursue, hunt, take, capture, kill, possess, or attempt to take, capture, or kill, migratory birds or their nests or eggs at any time, unless permitted by regulation.

The Magnusson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.) provides for the conservation and management of U.S. fisheries and essential fish habitat (EFH), which consists of the waters and substrate needed by fish to spawn, breed, feed, or grow to maturity. It requires Federal agencies to consult with NOAA on activities that could harm EFH.

The Coastal Zone Management Act (CZMA; 16 U.S.C. 1451 et seq.) establishes a Federal-state partnership to provide for comprehensive management of coastal resources. Administered by NOAA, coastal states and territories develop management programs based on enforceable policies and mechanisms to balance resource protection and coastal development needs, and development and actions must ensure consistency with these plans and programs. The entire state of Hawai'i is included in Hawai'i's Coastal Zone Management Plan. Although federally-owned, leased, or controlled facilities are excluded from compliance, the CZMA does require that all Federal facilities ensure their activities are consistent to the maximum extent practicable with the enforceable policies of an approved state Coastal Zone Management Plan.

In 2010, the Navy prepared an Integrated Natural Resource Management Plan (INRMP; Department of the Navy 2010) to establish a framework for resource management at the PMRF. The INRMP serves as a repository for natural resource information, provides guidance on how PMRF is to meet compliance requirements, and sets management goals, required actions, and resources necessary to protect and manage the installation's natural resources. The information in the INRMP forms a basis for NNSA's

management and protection of biological resources at KTF. In 2014, the Navy prepared a biological assessment of the potential for PMRF infrastructure, operations, and maintenance to effect listed species (Department of the Navy 2014). The assessment included infrastructure and activities conducted at KTF. The Navy and the DOE co-submitted the assessment to the USFWS with a request for formal consultation. The USFWS issued their biological and conference opinions on August 20, 2018 (see Appendix A).

3.8.3.2 Vegetation

3.8.3.2.1 Terrestrial Species

There are six recognized vegetation communities on the undeveloped areas of the Main Base of PMRF: kiawe – koa haole scrub (*Prosopis pallida*–*Leucaena leucocephala*), a‘ali‘i – nama scrub (*Dodonaea viscosa* – *Nama sandwicensis*), pohinahina – naupaka dune (*Vitex rotundifolia* – *Scaevola sericea*), strand (shoreline), drainage-way wetlands, and ruderal disturbed vegetation. The two scrubs are the dominant vegetation in the undeveloped portions of the base. Dune vegetation is located on the seaward facing slopes of the Nohili sand dunes. A well-developed native strand community exists along the shoreline, including beach morning glory, beach heliotrope, milo, and hau. Drainage-way wetlands vegetation occupies only a small area. Ruderal (disturbed, weedy) vegetation is present along roadsides and other areas where people have disturbed the natural vegetation, and much of this is mowed on a regular basis (DOE 1992; NASA 2013; Department of the Navy 2010).

KTF is in the “kiawe and lowland scrub” zone of Hawai‘i, a classification used to describe areas below 1,000 ft. elevation where the annual rainfall is less than 20 inches (DOE 1992). Almost all of KTF is landscaped, with areas mowed on a regular basis. Kiawe – koa haole scrub is found in a small area at the southern entrance and a strip along the eastern boundary.

The areas adjacent to KTF include substantial stands of kiawe trees to the south and east where the trees can attain heights of 30 to 45 ft. and the crowns of the trees may interlock. In these areas, Koa haole cover is somewhat patchy with the shrubs occurring primarily along the margins of the tree cover or in areas where the canopy is more open. Guinea grass (*Panicum maximum*) is locally abundant with smaller scattered clumps of lantana (*Lantana camara*) shrubs.

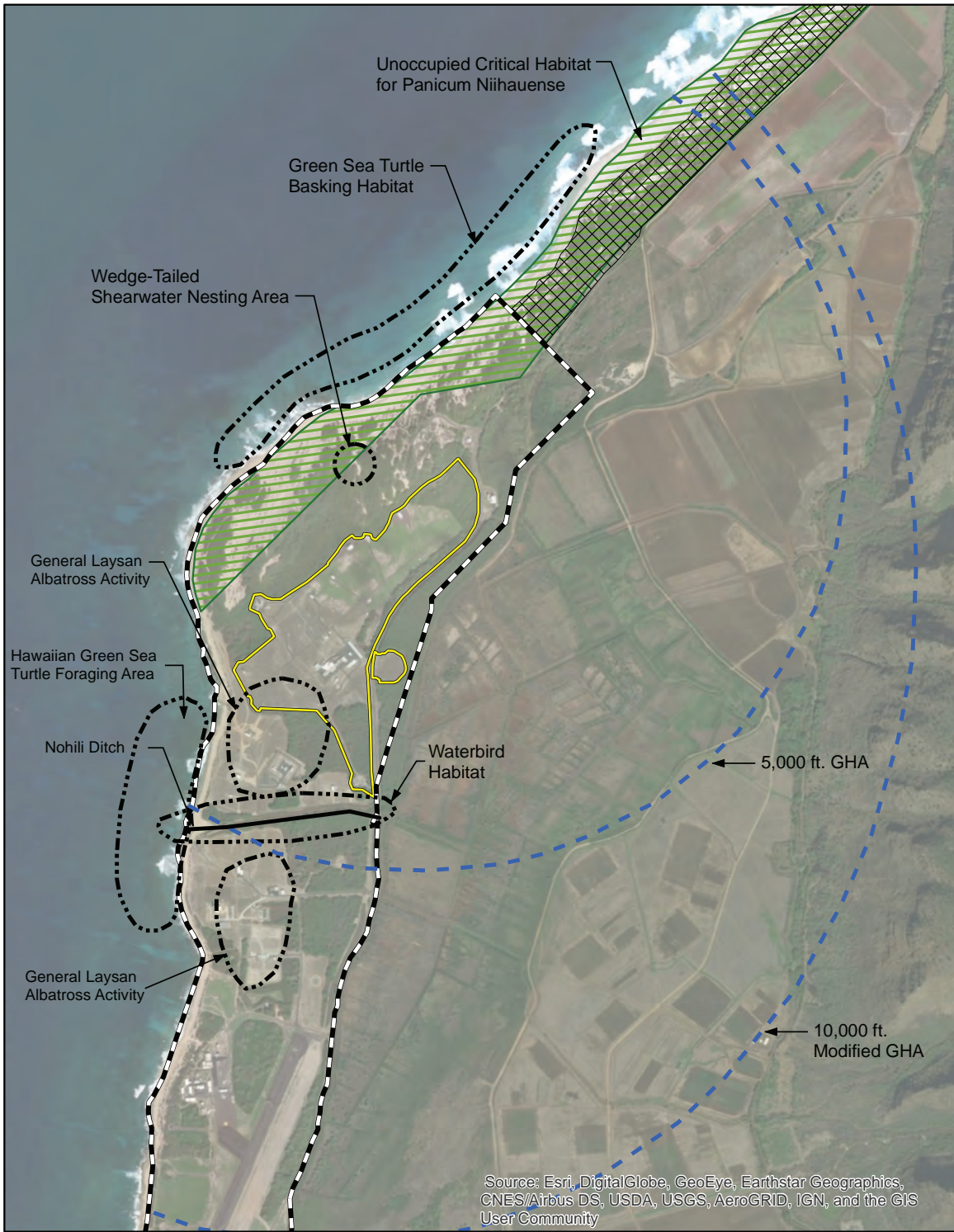
The areas to the north and west of the KTF, along the inland side of the dunes, include small, low, windswept patches of kiawe and koa haole scrub. A few clumps of

buffel grass (*Cenchrus ciliaris*), Bermuda grass (*Cynodon dactylon*), sourbush (*Pluchea carolinensis*), golden crown beard (*Verbesina encelioides*), ironwood trees (*Casuarina equisetifolia*), swollen-fingergrass (*Chloris barbata*), and pink purslane (*Portulaca pilosa*) are occasionally encountered here. Vegetation at the tops and seaward side of the Nohili dunes is pohinahina-naupaka dune vegetation, which includes low-lying pohinahina and naupaka shrubs and ‘akoko or spurge shrub (*Euphorbia celastroides*). Closer to the beach, mats of beach dropseed (*Sporobolus virginicus*) and beach morning glory vines (*Ipomoea pescaprae* and *imperata*) are common to abundant. Other native plants found close to the beach include ilima (*Sida fallax*), alena (*Boerhavia diffusa*), kaunaoa pehu or love-vine (*Cassytha filiformis*), akulikuli or shoreline seapurslane (*Sesuvium portulacastrum*), and a‘ali‘i (DOE 1992; NASA 2013).

3.8.3.2.2 Marine Species

Marine plant surveys have not been conducted at PMRF. However, observations made during other marine surveys provide limited information on algae observed growing on the bench fronting Nohili Point (Department of the Navy 2010). These algae species include: Limu lipuupuu (*Dictyosphaeria versluisii*), Limu pahalahala (*Ulva fasciatus*), Limu kala-lau-nunui (*Sargassum echinocarpum*), Limu kala (*S. obtusifolium*), *Acanthophora specifera*, Limu pepeiao (*Amansia glomerata*), Limu manaua (*Gracilaria coronopifolia*), Limu huna (*Hypnea* spp.), Limu huluilio (*Jania* sp.), Limu maneoneo (*Laurencia nidifica*), Limu plaewawae (*Laurencia* sp.), *Spyridia filamentosa*, *Desmia hornemannii*, and Limu loloa (*Pterocladia capillacea*). Other common plants found in the rocky intertidal habitats offshore of the PMRF include sea lettuce (*Ulva* spp.), Sargasso or kala (*Sargassum* spp.), coralline red algae (*Hydrolithon* spp.), fleshy red algae (*Melanamansia*, *Pterocladia*, and *Jania* spp.), brown algae (*Padina*, *Turbinaria*, and *Dictyota* spp.), and fleshy green algae (*Neomeris*, *Halimeda*, and *Caulerpa* spp.) (Department of the Navy 2017).

In addition, large pastures of limu kohu (*Asparagopsis taxiformis*) grow on the offshore reef bench throughout the Nohili Point area. On rocky intertidal coasts, Limu loloa occurs as a well-developed band in the lower intertidal zone from about mean low tide (zero) to about 12 in (30 cm) below mean low tide. These algal bands develop best in areas receiving some freshwater input such as the outflow from Nohili Ditch. On the beach fronting the ditch, Limu loloa is found from a point commencing about 263 ft. (80 m) north of the ditch discharge to the southern terminus of the limestone bench approximately 1,476 ft. (450 m) to the south of the ditch. *Pterocladia*, of



Legend

- | | |
|---|--------------------------|
| KTF Boundary | Polihale State Park |
| Pacific Missile Range | Ground Hazard Area (GHA) |
| Unoccupied Critical Habitat for <i>Panicum Niihauense</i> | |

Critical Habitat

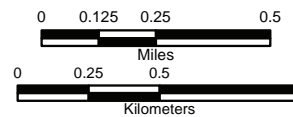


Figure 9: Kauai Test Facility Critical Habitat

which Limu loloa is one species, is an alga of the preferred forage genera for green turtles.

3.8.3.2.3 Threatened and Endangered Species

Currently, there are no known threatened or endangered plant species, terrestrial or marine, occurring at KTF or PMRF, or in the near offshore in the vicinity of KTF. However, there is unoccupied critical habitat for lau'ehu (*Panicum niihauense*) within the PMRF installation north of KTF (Figure 9). In addition, the Federally-listed endangered plant species 'ohai (*Sesbania tomentosa*) is found north of the PMRF at Polihale State Park. While these plant species have not been found on KTF or PMRF, there is the potential that they could occur. Discussion of these two designated areas is found below in Section 3.8.14.

3.8.3.3 Wildlife

3.8.3.3.1 Birds

Birds identified at the PMRF Main Base include species that are indigenous, non-native, migratory, and resident species. Bird surveys conducted at PMRF in 2000 in support of the INRMP indicate that introduced bird species are the most abundant bird species at the PMRF Main Base. Non-native bird species on Kaua'i are usually common field or urban birds such as the Zebra Dove (*Geopelia striata*), Japanese White-eye (*Zosterops japonicus*), Ring-necked Pheasant (*Phasianus colchicus*), Northern Cardinal (*Cardinalis cardinalis*), Northern Mockingbird (*Mimus polyglottos*), and House Finch (*Haemorhous mexicanus*) (NASA 2013). This is typical of lowlands in the Hawai'iian Islands, where most of the natural habitats have been altered by development and agriculture. Native bird species recorded include non-migratory waterbirds and migratory seabirds, shorebirds, and ducks. The number of waterbird species recorded is substantial given the limited amount and altered nature of wetlands on the PMRF. The ditches at PMRF provide habitat for waterbird species, and these wetlands and the exposed rocky intertidal zones are used for foraging. The oxidation ponds are attractive foraging grounds for all the resident species and other transient vagrants.

Table 11 lists the bird species that have the potential to be located on KTF and are protected by the ESA, MBTA, and/or State of Hawai'i (SOH).

Detailed descriptions of these species, their habitat and distribution, life cycle, threats to their survival, and conservation measures can be found at the USFWS's Environmental Conservation Online System (USFWS 2018a), and in the biological opinion (USFWS 2018) and

the PMRF INRMP (Department of the Navy 2010). No designated critical habitat for bird species is found on or near KTF.

Laysan Albatross (*Phoebastria immutabilis*) and Black-footed Albatross (*Phoebastria nigripes*) are known to occur at PMRF. A few individual Black-footed Albatross have been observed loafing on base during the breeding season, but this species has not attempted to nest at PMRF. In contrast, Laysan Albatross do attempt to lay eggs, particularly in the vegetated area to the west of the PMRF central runway, and use the lawn-like ruderal vegetation areas on KTF for courtship and nesting (Figure 9). During the field reconnaissance of the STARS site, six pairs of Laysan Albatross were observed in the KTF area (DOE 1992). As part of the Navy's Bird/Aircraft Strike Hazard (BASH) management activities, an albatross air hazard abatement program has been carried out by the Navy since 1988. This program consists of relocating breeding adults and sub-adult (non-breeding) albatross from PMRF to an existing albatross breeding colony, primarily Kilauea Point National Wildlife Refuge (KPNWR) on the north side of Kaua'i.

Brown Boobys, Sanderlings, Wandering Tattlers, Ruddy Turnstones, and Pacific Golden Plovers are commonly observed at KTF. An important seabird species at KTF is the Wedge-tailed Shearwater, which nests in the Nohili dune area north and west of KTF from February through November (Figure 9). In 2006, the dune colony had 276 active burrows, with an occupancy rate of 56 percent.

The four ESA-endangered waterbird species (Hawai'iian Duck, Coot, Gallinule, and Black-necked Stilt) have been observed utilizing the ditches, including Nohili Ditch and the ditch systems along the eastern edge of KTF, and ponds and reservoirs on the PMRF; however, there is no evidence that they nest on the installation (Figure 9; Department of the Navy 2010; ASMDC 2011). These waterbirds regularly utilize wetland areas adjacent to PMRF including Kawaiele Waterbird Sanctuary and Mānā Plains Forest Reserve as well as degraded aquatic habitat. In March 2012, as many as 18 Hawai'iian Stilts and 14 Hawai'iian Coots were observed at the PMRF oxidation pond. Hawai'iian Moorhen and Hawai'iian Duck occur almost exclusively in the agricultural ditches (USFWS 2014).

Although the ESA-threatened Newell's Shearwater, and the endangered Hawai'iian Petrel and Band-rumped Storm-Petrel, are not known to nest or roost at the PMRF Main Base, they are known to fly over or near the area (Department of the Navy 2010, 2017). Night-time artificial lighting has been found to affect these nocturnal seabirds during their flights between inland breeding colonies in

Table 11 - Protected Bird Species Known or Expected to Occur in the Vicinity of KTF.

Scientific Name	Common Name (Hawaiian Name)	ESA Regulatory Status	SOH Regulatory Status	MBTA Protection
<i>Anas clypeata</i>	Northern Shoveler (Koloa mōhā)	---	---	Yes
<i>Anas crecca</i>	Green-winged Teal	---	---	Yes
<i>Anas wyvilliana</i>	Hawaiian Duck (Koloa maoli) Hawaiian	E	E	Yes
<i>Arenaria interpres</i>	Ruddy Turnstone	---	---	Yes
<i>Asio flammeus sandwichensis</i>	Hawaiian Short-eared Owl (Pueo)	E	E	Yes
<i>Branta sandvicensis</i>	Hawaiian Goose (Nene) Hawaiian	---	---	Yes
<i>Bubulcus ibis</i>	Cattle Egret	---	---	Yes
<i>Calidris alba</i>	Sanderling (Huna kai)	E	E	Yes
<i>Fulica alai</i>	Hawaiian Coot (ʻAlae keʻokeʻo) Hawaiian	E	E	Yes
<i>Gallinula galeata sandvicensis</i>	Hawaiian Gallinule (ʻAlae ʻula) Hawaiian	---	---	Yes
<i>Himantopus mexicanus knudseni</i>	Hawaiian Black-necked Stilt (Aeʻo) Hawaiian	E	E	Yes
<i>Leucophaeus atricilla</i>	Laughing Gull	---	---	Yes
<i>Nycticorax nycticorax</i>	Black-crowned Night-Heron (Aukuʻu)	---	---	Yes
<i>Oceanodroma castro</i>	Band-rumped Storm-Petrel	E	E	no
<i>Phoebastria albatrus</i>	Short-tailed Albatross	E	E	Yes
<i>Phoebastria immutabilis</i>	Laysan Albatross (Mōli)	---	---	Yes
<i>Phoebastria nigripes</i>	Black-footed Albatross	---	---	Yes
<i>Pluvialis fulva</i>	Pacific Golden Plover (Kōlea)	---	---	Yes
<i>Pluvialis squatarola</i>	Black-bellied Plover	---	---	Yes
<i>Pterodroma sandwichensis</i>	Hawaiian Petrel (ʻUaʻu) Hawaiian	E	E	Yes
<i>Puffinus auricularis newelli</i>	Newell's Shearwater (ʻAʻo)	T	T	Yes
<i>Ardena pacifica</i>	Wedge-tailed Shearwater (ʻUaʻu kani)	---	---	Yes
<i>Sula leucogaster</i>	Brown Booby (A)	---	---	Yes
<i>Tringa incana</i>	Wandering Tattler (ʻUlili)			

T = Threatened; E = Endangered; ESA = Endangered Species Act; SOH = State of Hawaii; MBTA = Migratory Bird Treaty Act
Sources: USFWS 2018a; USFWS 2018b; USFWS 2014; NASA 2013; Department of the Navy 2010 and 2017

the mountains of Kauaʻi and their at-sea foraging areas (Navy 2010; ASMDC 2011). Night lighting can lead to fallout, a situation in which birds are attracted to the light, become disoriented, and fall toward the ground exhausted. Such fallout can also cause collisions with structures, particularly those with tall, narrow profiles. Standard white night lighting also poses a risk due to its interference with the birds' magnetic orientation. Birds require lights from the blue-green portion of the spectrum for orientation, and this orientation is disrupted by red wavelengths and white light. Birds often continue to be disoriented on the ground, with fallout potentially

leading to injury or death due to collision trauma or exposure to predators (ASMDC 2011).

Newell's Shearwater, Hawaiian Petrel, and Band-rumped Storm-Petrel are known to have been victims of fallout on the PMRF previously. At the PMRF Main Base, over the seven-year period of 2007 to 2013, a total of 34 Newell's Shearwaters were recovered (found alive on the ground after fallout and collected) (USFWS 2014). Adult Hawaiian Petrel use of the PMRF area is likely less than that of Newell's Shearwaters because most Hawaiian Petrels are thought to nest in the northwest region of

the island of Kauaʻi. Prior to 2000, 11 Hawaiʻian Petrels were recovered at the PMRF Main Base, but none were discovered between 2000 and 2014 (USFWS 2014). Between 2007 and 2014, two Band-rumped Storm Petrels were recovered from the PMRF, one in 2008 and one in 2011.

Measures that are implemented at PMRF to reduce the number of fallouts of the Newell's Shearwater and other nocturnal seabirds are described in the biological opinion issued by the USFWS (USFWS 2018; see Appendix A). These measures include, among others, the following:

- Scheduling non-time-sensitive night operations outside the peak of the seabird fledging season (September 15 through December 15) to the extent practicable;
- Turning off unnecessary external lighting during seabird fledgling season;
- Using full cut-off fixtures where security or safety concerns require night lighting;
- Conducting patrols to confirm any exposed lights during the night are truly required and meet the shielding requirements;
- Controlling base-wide predators to enhance survival and minimize the risk of predation to any downed seabirds on the installation; and
- Monitoring for downed seabirds on the installation during the seabird fledging season.
- Recovering seabirds that fall out, taking them to a fallout station located inside the PMRF gate, and reporting when birds fall out.

The USFWS determined that implementation of these measures would not completely eliminate the threat to nocturnal seabirds, and that it is likely that incidental takes of the shearwater would occur (USFWS 2018). Incidental takes are defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. In the biological opinion, the Incidental Take Permit allows for incidental take in the form of injury or death due to attraction and fallout from lighting of up to an average of seven (7) fledgling Newell's Shearwaters per year and a total maximum of sixty-three (63) fledgling Newell's Shearwaters. The Incidental Take Permit is for the PMRF as a whole, with the KTF as a tenant included in that whole, for a 50-year project term. The USFWS also issued the opinion that this take allowance would not likely jeopardize the continued existence of the Newell's Shearwater (USFWS 2018).

The biological opinion also contains measures to offset

the total anticipated incidental take over the 50-year term of the permit. The Navy and NNSA would provide funding to support management activities for predator and ungulate removal at an existing Newell's Shearwater colony on Kauaʻi where current management does not exist or is insufficient to adequately enhance the reproductive success of the shearwater. The Navy and NNSA would direct funds to the Hawaiʻian Seabird Conservation Account, administered by the USFWS for the management of seabird breeding colonies on Kauaʻi. The contributions are anticipated to support, annually, management for 30 breeding pairs in 2018 and increase to 50 breeding pairs by 2022, and then continue annually in years after 2022 at the same level unless the Navy, NNSA, and USFWS reinitiate consultation and this conservation measure is no longer deemed necessary.

The Hawaiʻian Goose has been observed and nested at the PMRF Main Base near the runway and beach cottages; however, KTF lacks suitable nesting habitat for the species (Department of the Navy 2010; ASMDC 2011). From 2000 to 2014, the numbers of Hawaiʻian Goose at PMRF Main Base have increased, likely in conjunction with an effort by the State of Hawaiʻi to translocate them to Kokee State Park on the west side of the island, upland of the installation. Translocation includes capturing adults and young and collecting eggs, and moving them to other areas. After translocation to Kokee, Hawaiʻian Goose have been observed flying down into lower elevation habitats on Mānā Plain and PMRF. In July 2012, as many as 32 Hawaiʻian Goose were observed at one time at the PMRF airfield. Hawaiʻian Goose are also attracted to the adjacent Kinikini Ditch and State-managed Kawaiie Waterbird Sanctuary that occur just east of the base. In July 2012, a record high of 91 Hawaiʻian Goose were observed near Kawaiie Wetlands, within sight of the PMRF runway (USFWS 2014).

Despite efforts to discourage Hawaiʻian Goose use of the PMRF through hazing (i.e., harassment) and translocation, nesting at the PMRF Main Base continues to occur. In December 2009, a Hawaiʻian Goose pair initiated a nest near a PMRF administration building. The Hawaiʻian Goose family group was translocated to Kilauea National Wildlife Refuge on the north shore of Kauaʻi, under agreement with the USFWS. Another nest was initiated in January 2011, in the same area, but the nest failed during the incubation period. Two Hawaiʻian Goose nests were laid in December 2011, one near the administration building and one within the fenced area of the sewage oxidation ponds in the southern portion of the PMRF. Three nests occurred in the August 2012 – June 2013 breeding season, with one pair nesting at the administration building and two nests at the oxidation

ponds. The same number of nests occurred in 2013-2014 season, one at the beach cottages (this pair formerly nested at the administration building) and two nests at the oxidation pond (one in same location as 2012 and one new nest) (USFWS 2014).

There has been only one sighting of the ESA-endangered Short-tailed Albatross at PMRF Main Base, and that occurred on March 28, 2000 when a juvenile Short-tailed Albatross was observed at the installation, resting on the grass on the inland side of the PMRF runway (ASMDC 2011).

3.8.3.3.2 Mammals

Table 12 lists the mammal species that have the potential to be located on or near KTF and are protected by the ESA and/or SOH. Detailed descriptions of these species, their habitat and distribution, life cycle, threats to their survival, and conservation measures can be found at the USFWS's Environmental Conservation Online System (USFWS 2018a), and in the PMRF INRMP (Department of the Navy 2010). No designated critical habitat for any mammal species is found on or near the KTF (Department of the Navy 2017).

The only native terrestrial mammal is the endangered Hawai'ian Hoary Bat (*Lasiurus cinereus semotus*). All other terrestrial mammal species are non-native. Feral cats (*Felis catus*) and rats are the most common species recorded at PMRF (Department of the Navy 2010). Signs of feral pigs (*Sus scrofa*) and Black-tailed Deer (*Odocoileus columbianus*) were also found on the most recent survey (Navy 2010). The common House Mouse (*Mus musculus*) was also captured. During a species survey in July 1990,

three species of mammal were observed within KTF: one dog, two cats, and mice. At least four species of rodent are expected to be present at KTF: House Mouse (*Mus Musculus*), Norway Rat (*Rattus norvegicus*), Roof Rat (*Rattus rattus*), and Pacific Rat (*Rattus exulans*) (DOE 1992). Feral dogs (*Canis lupus familiaris*) are also likely to inhabit the areas around the KTF. Cats, rats, dogs, and pigs are of environmental concern to native bird species as they prey on the eggs and young and destroy essential nesting and foraging habitat.

The endangered Hawai'ian Hoary Bat has been observed at PMRF Main Base, and it is known to occur at the Polihale State Park north of KTF (DOE 1992). In 2000, a group of four bats was observed at the sewer oxidation ponds in the southern area of the installation, and five bats were seen foraging over open ocean near the Nohili Ditch outfall and Recreation Area #1 (USFWS 2014; Department of the Navy 2010). For a week in July 2010, Anabat detectors were deployed along Nohili Ditch to survey for bats. During this one-week deployment, no bats were detected (NASA 2013). In 2010 and 2011, the Navy contracted U.S. Geological Survey (USGS) biologists to survey for bat occurrence at PMRF, including the Main Base. At the Main Base, seven stations were sampled using Anabat detectors in an area spanning south of KTF to the oxidation ponds. While detectability and bat call activity remained relatively consistent year-round, monitoring results showed bat occurrence was highest between September and December, and dropped between February and May. Detection data indicated that the PMRF Main Base may be used during the fall months by adult bats for "fall swarming" in preparation for mating (USFWS 2014).

Table 12 - Protected Mammal Species Known or Expected to Occur in the Vicinity of KTF.

Scientific Name	Common Name (Hawaiian Name)	ESA Regulatory Status	SOH Regulatory Status	MMPA Protected
<i>Lasiurus cinereus semotus</i>	Hawaiian Hoary Bat ('ope'ape'a)	E	E	no
<i>Monachus schauinslandi</i>	Hawaiian Monk Seal (ilio-holo-i-ka-uaua)	E	E	Yes
<i>Megaptera noveangliae</i>	Humpback Whale	---	E	Yes
<i>Pseudorca crassidens</i>	False Killer Whale	E	E	Yes

T = Threatened; E = Endangered; ESA = Endangered Species Act; SOH = State of Hawaii; MMPA = Marine Mammal Protection Act
Sources: USFWS 2018a; USFWS 2014; NASA 2013; Department of the Navy 2010 and 2017

Of the 26 species of marine mammals with the potential to occur near the PMRF, the Hawaiʻian Monk Seal (*Monachus schauinslandi*), Humpback Whale (*Megaptera novaeangliae*), Spinner Dolphin (*Stenella longirostris*), and Bottlenose Dolphin (*Tursiops truncatus gilli*) are the most likely species to be observed within 12 nautical miles of the PMRF coastline. During a marine species monitoring survey in 2012, other species identified included Rough-toothed Dolphins (*Steno bredanensis*), False Killer Whales (*Pseudorca crassidens*), Spotted Dolphins (*Stenella attenuata*), and Pilot Whales (*Globicephala macrorhynchus*). Other mammals expected in the waters off the coast of Kauaʻi are Melon-headed Whales (*Peponocephala electra*) and Pygmy Killer Whales (*Feresa attenuata*) (NASA 2013).

Critical habitat for the endangered Hawaiʻian Monk Seal includes the main Hawaiʻian Islands. While specific habitat areas have not been identified by NOAA, public comments on the potential designation recommend key beach areas, sand spits, and islets, including all beach crest vegetation to its deepest extent inland, lagoon waters, inner reef waters, and ocean waters out to a depth of 100 fathoms or 600 ft. (183 m) around the islands (Department of the Navy 2010). At PMRF Main Base, Hawaiʻian Monk Seals are frequently sighted both in nearshore waters and hauled out on beaches. Since May 2006, the majority of PMRF observations of Hawaiʻian Monk Seals are north of Kinikini Ditch. There is considerable variability in the surface textures and elevations along the surf zone, creating pockets of sandy beach and sandy benches, along with long stretches of sandy beach. The latter is particularly apparent from Kinikini Ditch south to Kokole Point. North of Kinikini, there are areas of smooth bench (emergent reef) and other stretches, just above the pounding surf zones, where weathering of the limestone creates pock-marks with sharp points and edges. Hawaiʻian Monk Seals are most often observed in areas on the base where sandy beach, smooth bench or sandy pocket(s) are found (Department of the Navy 2010). The last pupping event on PMRF/Barking Sands beach took place in 1999, on a sandy beach between coral/limestone outcroppings. The location was “beach side”, across from the 2,000 ft. marker from the Kinikini ditch end of the active runway (Department of the Navy 2010; NASA 2013).

Primary occurrence of the state-endangered Humpback Whale is during the fall-winter period approximately 50 nautical miles offshore, including the areas off PMRF. The Hawaiʻi distinct population segment of the Humpback Whale was delisted under the ESA due to recovery on December 21, 2016 (81 FR 93639). However, the species remains categorized by NOAA as part of the Central

North Pacific stock, which continues to be designated as a depleted and strategic stock under the MMPA (NOAA 2017). In the warm waters of Hawaiʻi, the whales engage in mating, calving, and nursing activities from February through April. Part of the Hawaiʻian Islands Humpback Whale National Marine Sanctuary is located along Kauaʻi’s north shore. Anecdotal accounts from PMRF employees and visitors indicate that Humpback Whales are sighted off the coast of the Main Base frequently (Department of the Navy 2010).

False Killer Whales have been sighted off the west coast of Kauaʻi near PMRF Main Base (NASA 2013; Department of the Navy 2010). During a marine species monitoring survey in 2012, two False Killer Whales were documented (NASA 2013).

3.8.3.3.3 Amphibians and Reptiles

Terrestrial and marine reptiles and one species of amphibian have been recorded at PMRF. The reptiles Mourning Gecko (*Lepidodactylus lugubrus*), House Gecko (*Hemidactylus frenatus*), and Snake-eyed Skink (*Cryptoblepharus poecilopleurus*) have been documented at PMRF. The House Gecko was the most common reptile found during surveys. ESA-listed turtles are the only marine reptiles recorded at PMRF. The only amphibian recorded on PMRF is the Marine Toad (*Bufo marinus*) (Department of the Navy 2010).

Table 13 lists the reptile species that have the potential to be located on or near the KTF and are protected by the ESA and/or SOH (there are no such amphibian species). Detailed descriptions of these species, their habitat and distribution, life cycle, threats to their survival, and conservation measures can be found at the USFWS’s Environmental Conservation Online System (USFWS 2018a), and in the biological opinion (USFWS 2014) and the PMRF INRMP (Department of the Navy 2010). No designated critical habitat for any reptile species is found on or near the KTF (Department of the Navy 2017).

There are five species of marine turtles that are protected under the ESA and have the potential to inhabit the nearshore and offshore areas in the vicinity of the KTF. Two of them are known to occur in waters off Kauaʻi; the other three species may pass through the area but are not considered residents in Hawaiʻi. The threatened Green Turtle (*Chelonia mydas*) is common in the Hawaiʻian Islands and is known to forage, bask, and nest at the PMRF Main Base. The endangered Hawksbill Turtle (*Eretmochelys imbricata*) is considered rare compared to the Green Turtle and has not been observed on land at PMRF (Department of the Navy 2010).

Table 13 - Protected Reptile Species Known or Expected to Occur in the Vicinity of KTF.

Scientific Name	Common Name (Hawaiian Name)	ESA Regulatory Status	SOH Regulatory Status
<i>Caretta caretta</i>	Loggerhead Turtle	E	T
<i>Chelonia mydas</i>	Green Turtle (honu)	T	T
<i>Dermochelys coriacea</i>	Leatherback Turtle	E	E
<i>Eretmochelys imbricata</i>	Hawksbill Turtle (honu'ea)	E	E
<i>Lepidochelys olivacea</i>	Olive Ridley Turtle	T	T

T = Threatened; E = Endangered; ESA = Endangered Species Act; SOH = State of Hawaii
 Sources: USFWS 2018; USFWS 2014; NASA 2013; Department of the Navy 2010 and 2017

As adults, Green Turtles forage and rest in the shallow waters around the main Hawai'ian Islands in late summer and early fall. Reproduction in the Hawai'ian population occurs primarily in the northwest Hawai'ian Islands in the summer, but Green Turtles have used the PMRF Main Base sand beaches for nesting. Turtle nesting has been documented during five years at PMRF (1988, 1989, 1999, 2010, and 2015). In 2015, at least six Green Turtle nests hatched successfully, with a total of 468 hatchlings (Department of the Navy 2017).

The ideal Green Turtle habitat in Hawai'ian waters consists of suitable resting areas (caves, depressions, ledges, and undercuts) located within 0.6 mi (1 km) of abundant algal pastures situated in shallow water. Underwater observations near the Nohili Ditch area revealed an elongated depression approximately 65 ft. by 195 ft. (20 m by 60 m) in dimension with an area of numerous caves and undercuts directly offshore of Nohili Ditch. Two Green Turtles were observed underwater in resting behaviors within this depression. One Green Turtle was seen on the surface shoreward of the depression. The emergent limestone bench fronting Nohili Point has a diverse assemblage of macrothalloid algal species, many of which are preferred forage species for Green Turtles. The apparent lack of green turtles foraging on the bench at distances of more than 164 ft. (50 m) from shore may be related to the distribution of limu loloa (*Pterocladia capillacea*) that is abundant on the shoreline bench in the vicinity of Nohili Ditch (Department of the Navy 2010).

The combination of desirable nesting beaches, foraging habitat, and resting habitat all situated within a small geographic area combine to provide an ideal "complete habitat" for Green Turtles in the immediate area of

Nohili Ditch (Figure 9). The suitability of the forage area is enhanced by the combination of ideal intertidal physiography (limestone bench) and the abundance of preferred forage species of algae that are a response to nutrient subsidies provided by the freshwater discharge from Nohili Ditch (Department of the Navy 2010). Green Turtles are regularly observed basking onshore in the vicinity of the ditch and further north below the Nohili dunes; haul-outs of Green Turtles elsewhere on PMRF are rare (NASA 2013).

The Hawksbill Turtle has been reported in the open waters offshore of Kaua'i. There are no known records of Hawksbills coming ashore or nesting within or adjacent to PMRF (NASA 2013; Department of the Navy 2010). Hawksbill Turtles are most often found in shallow water around reefs, bays, and inlets. The main threats to the species are the reduction of nesting beaches due to construction and human presence, including vehicles, artificial lighting, nest predation, and exotic vegetation. In addition, marine debris from active and ghost fishing lines and lay nets cause incidental take. Pollutants and boat collisions may also be a threat.

3.8.3.3.4 Corals, Fishes, and Macroinvertebrates

Surveys of the marine environment off the PMRF coast in 2000 and 2006 involved point-to-point underwater swims at each dive site to evaluate abundance and other characteristics of marine communities. The investigations were limited to a maximum depth range of 65 ft. (20 m). The nearshore waters of PMRF Main Base consist of four sectors separated by distinct physiographic and biotic structures. The two sectors relevant to the ROI are Nohili Sector, which extends from the northern end of the PMRF

to approximately 984 ft. (300 m) south of Nohili Ditch; and Offshore Sector, within the 49- to 65-foot (15- to 20-m) depth contour (Department of the Navy 2010).

Nohili Sector

The shoreline of the Nohili Sector consists predominantly of a fossilized limestone bench which is emergent at low tidal stands and fronts the sand dunes. Seaward of the bench is a second zone at a depth of 7 to 35 ft. (2 to 5 m), which is the primary region that absorbs the impact of breaking waves. A relatively smooth fossilized limestone bottom devoid of most vertical relief as well as biotic assemblages characterizes this area. The solid carbonate rock is often covered by a thin sand veneer, and the surface has sparse coverage by macroalgae, hard coral, and other sessile invertebrates that do not obscure the underlying surface (Department of the Navy 2017). At approximately 16 ft. (5 m) depth, the flat bottom grades into a zone characterized by numerous deep, rubble-filled channels separating massive fossilized limestone fingers which are remnants of fossilized reef-platforms that have been highly eroded into karst-like topography. Such erosion results in numerous outcrops, ledges and caves within the fossilized reef-platform. Vertical relief of the reef structures is up to 10 ft. (3 m) in height, resulting in a substantially more complex substratum than other nearshore zones along the PMRF (Department of the Navy 2010).

Because the vertical relief afforded by the eroded reef structures provides abundant solid surfaces above the bottom (and shifting sediment), settlement of benthos, particularly reef corals, is substantially higher in the Nohili Sector than anywhere else along the PMRF area. The species covering this colonized pavement are dense enough to begin to obscure the underlying surface (Department of the Navy 2017). Survey data for the Nohili Sector reveal that total coral cover ranged from 32 percent to 39 percent of the total bottom cover. The most abundant species are Lobe Coral (*Porites lobate*), Rose or Cauliflower Coral (*Pocillopora meandrina*), and Ringed Rice Coral (*Montipora patula*). Other less abundant species in the area include *Porites compressa*, *Montipora capitata* (formerly *Montipora verrucosa*), and *Pavona varians*. Several additional corals were noted in the Nohili Sector, including *Porites evermanni*, *Pavona varians*, *P. duerdeni*, *Leptastrea purpurea*, *Montipora flabellata*, and *M. verrilli*. Coverage by these corals was small as a percentage of total living coral, with Lobe Coral and Rose Coral comprising the majority of cover. A multitude of man-made materials were also observed on the reef structure, including fouled fishing nets and metal objects (possible ordnance or test materials remnants) (Department of the

Navy 2010).

The topographical complexity of the channels provides considerable shelter for many fish and motile invertebrate species. The Nohili Sector contains the most abundant fish populations along the PMRF coast, in terms of both numbers of species and biomass. In one 30-minute survey, 78 varieties of fish and other species were identified.

Offshore Sector

The Offshore Sector is essentially continuous along the northern region of the PMRF Main Base seaward of the Nohili Sector. The predominant physical structure of the area is a flat, pitted limestone surface. The seaward extent of this biotope is defined by the limestone shelf break encountered at 65 to 82 ft. (20 to 25 m) in depth. This shelf break ranges from a vertical face to a 20-degree slope dropping away into sand at about 82 to 98 ft. (25 to 30 m) of water.

The predominant coral found in this zone is Antler Coral (*Pocillopora eydouxi*), which occurs as single large branching colonies. Because of the lack of wave forces at depth, these fragile branching forms are able to grow to heights of up to approximately 3 ft. (1 m). Other corals found on the platform are primarily smaller species that have a collective coverage of approximately 5 percent of bottom cover. Coral species recorded in the area include Rose Coral, Lobe Coral, Ringed Rice Coral, Corrugated Coral (*Pavona varians*), Flat Lobe Coral (*P. duerdeni*), Blue Rice Coral (*Montipora flabellate*), Verrill's Ringed Rice Coral (*M. verrilli*), *M. verrucosa*, Crust Coral (*Leptastrea purpurea*), and Mushroom Coral (*Fungia scutaria*). Also present along the shelf break are Black Coral (*Antipathes dichotoma*) and Wire Coral (*Cirripathes anguina*) (Department of the Navy 2010, 2017).

The general lack of cover and shelter sites for organisms is a prominent feature of this deep offshore plain. Thus, fishes and macroinvertebrates tend to concentrate in the areas of available shelter in the Nohili Sector. In the 2000 survey, 61 species of fish and 17 species of macroinvertebrates were recorded. In the 2006 survey, less emphasis was given to this offshore biotope because of its distance from shoreline; however, the low level of survey effort still resulted in 62 fish species seen and two macroalgal and 11 macroinvertebrates observed (Department of the Navy 2010).

3.8.3.4 Environmentally-Sensitive Habitat

There are no designated critical habitats located within or directly adjacent to the boundaries of the KTF.

The USFWS designated critical habitat for lau'ehu at Polihale State Park and sections of the PMRF Main Base (Federal Register Volume 68 (39): 9116-9479, February 27, 2003; Figure 9). The PMRF section, located north of KTF, is "unoccupied", meaning that even though lau'ehu has not been observed there during botanical surveys and there is no historical record of it having grown there, the USFWS has determined that these areas contain the primary constituent elements necessary for the recovery of the species and are essential to the recovery of the species because not enough areas outside of the PMRF exist to support recovery. This designation restricts adverse modification to the primary constituent elements of the species. Threats to the species recovery include competition with non-native species, destruction from offroad vehicles, naturally occurring catastrophic events, and reduced vigor due to low genetic representation.

'Ohai is a Federally-listed endangered plant that is found, and where critical habitat has been designated, north of the PMRF Main Base northern property line on Polihale State Park. 'Ohai is found in low shrublands and, rarely, in dry forests. Off Road Vehicles (ORVs), wildfire, grazing, and alien species competition have destroyed the preferred habitat on the main Hawai'ian Islands. No 'ohai plants were located during past surveys within the Nohili Dunes area of the PMRF installation.

3.8.3.5 Essential Fish Habitat

Fish and other marine species depend on their habitat to survive and reproduce. EFH is defined as waters and substrate necessary to fish for spawning, breeding, or growth to maturity. Through the Magnusson-Stevens Fishery Conservation and Management Act, which recognizes the importance of healthy habitat for sustainable commercial and recreational fisheries, NOAA protects and restores EFH to help maintain productive fisheries and rebuild depleted fish stocks in the U.S. NOAA identifies, describes, and maps EFH for almost 1,000 Federally managed fish species. High priorities for EFH conservation are called Habitat Areas of Particular Concern (HAPC) and merit special attention from NOAA Fisheries. HAPCs meet the following conditions: major ecological functions, sensitivity to decline, stress from development, and rare habitat. The Western Pacific Regional Fishery Management Council (WPRFMC) has authority over the fisheries and EFH and HAPC designations in and surrounding the State of Hawai'i, as well as other areas.

All Federal agencies whose work may affect fish habitats must assess potential project effects on EFH. Under the Act, an adverse effect means any impact that reduces

quality and/or quantity of EFH, and may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components (Department of the Navy 2017). Because all of the Hawai'ian Islands are surrounded by EFH, any launches from KTF would cross over EFH.

EFH occurs and is incorporated within Kaua'i's Exclusive Economic Zone (EEZ), the 200 nautical mile limit surrounding the island. EFH for adult and juvenile bottomfish includes the water column and all bottom habitats extending from the shoreline to a depth of 219 fathoms (1,314 ft.), which encompasses important steep drop-offs and high relief habitats. Shallow water (0 to 328 ft.) bottomfish species include grey snappers, thicklip trevallies, Hawai'ian groupers, emperors, amberjacks, and bluestriped snappers. Deep-water species include squirrelfish snapper, red snapper, pink snapper, and ironjaw snapper. Ocean HAPCs that include the offshore area are designated as the water column down to 3,280 ft. from the shoreline to the EEZ that lies above all seamounts and banks shallower than 1,100 fathoms (6,600 ft.). Marketable marine species include striped marlin, bluefin tuna, swordfish, albacore, skipjack, sailfish, tuna, and various sharks. Banks with summits less than 16.3 fathoms (97.8 ft.) have been designated as HAPC for crustacean species, including spiny lobsters, slipper lobsters, and Kona crabs (ASMDC 2011; Department of the Navy 2017).

3.8.3.6 Coastal Zone Management

All Federal development projects in a coastal zone and all Federal activities which directly affect a coastal zone must be consistent to the maximum extent practicable with the Coastal Zone Management Program as authorized by the Coastal Zone Management Act of 1972. The entire State of Hawai'i is included in Hawai'i's Coastal Program and Coastal Zone. Federally-owned, leased, or controlled facilities and areas are excluded from the State's Coastal Zone Management Plan and are thus outside of the Coastal Zone. The Proposed Action requires a determination evaluating the consistency of KTF activities with the policies of the Hawai'i Coastal Act (ASMDC 2011). Activities that occur at KTF were previously found to be consistent to the maximum extent practicable with the Hawai'i Coastal Act in the 1998 PMRF Enhanced Capability Final EIS (Department of the Navy 1998).

In December 2007 the Kaua'i County Council passed a science-based shoreline setback ordinance. The law mandates a 40-foot minimum setback for potential

development plus 70 times the annual coastal erosion rate as recommended in the Hawai'i Coastal Hazard Mitigation Guidebook. The law preserves beaches and protects property owner's coastal assets. Federally-owned, leased, or controlled facilities are not subject to such requirements, but the DOE would remain consistent to the maximum extent practicable (ASMDC 2011).

3.9 Cultural Resources

3.9.1 Definition of Resource

Cultural resources are physical manifestations of culture, specifically archaeological deposits, architectural properties, ethnographic resources and locations, and other historical resources relating to human activities, society, and cultural institutions that define communities and link them to their surroundings. They include expressions of human culture and history in the physical environment, such as prehistoric and historic archaeological sites, buildings, structures, objects, and districts, which are considered important to a culture or community. Cultural resources also include locations of important historic events and aspects of the natural environment, such as natural features of the land or biota, which are part of traditional lifeways and practices.

The National Register of Historic Places (NRHP) is a listing maintained by the Federal government of prehistoric, historic, and ethnographic buildings, structures, sites, districts, and objects that are considered significant at a national, state, or local level. Listed resources can have significance in the areas of history, archaeology, architecture, engineering, or culture. Cultural resources listed on the NRHP, or determined eligible for listing, have been documented and evaluated according to uniform standards, found in 36 CFR 60.4, and have been found to meet criteria of significance and integrity. Cultural resources that meet the criteria for listing on the NRHP, regardless of age, are called historic properties. Resources that have undetermined eligibility are treated as historic properties until a determination otherwise is made.

3.9.2 Region of Influence

The Region of Influence for cultural resources includes the entire KTF site. The resources include those already identified, as well as those that have not yet been discovered, such as buried archaeological sites and unknown Native Hawai'ian traditional resources. The ROI currently includes both built areas and undisturbed areas.

3.9.3 Affected Environment

3.9.3.1 Regulatory Setting

A number of Federal laws, regulations, and EOs address cultural resources and DOE responsibilities regarding them and are applicable to KTF. DOE Policy 141.1, Department of Energy Management of Cultural Resources (May 2001), ensures that DOE and NNSA programs integrate cultural resource management into their missions and activities, and raises the awareness of the importance of the Department's cultural resource-related legal and trust responsibilities. The policy directs that all DOE programs and missions will be implemented in a manner consistent with Federal laws, regulations, executive orders, and DOE directives protecting cultural resources.

Foremost among these statutory provisions is the National Historic Preservation Act (NHPA; 54 U.S.C. 300101 et seq.). Section 106 of the NHPA requires Federal agencies to take into account the effect of their undertakings on historic properties. The Advisory Council on Historic Preservation (ACHP) regulations that implement Section 106 (36 CFR Part 800) describe the process for identifying and evaluating historic properties; assessing effects of Federal actions on historic properties; and consulting to avoid, minimize, or mitigate any adverse effects. The NHPA does not mandate preservation of historic properties, but it does ensure that Federal agency decisions concerning the treatment of these properties result from meaningful consideration of cultural and historical values, and identification of options available to document the properties.

Other prominent cultural resource laws pertinent to KTF include the Archaeological Resources Protection Act of 1979 (ARPA; 16 U.S.C. 470aa-mm), which makes it a Federal offense to excavate, remove, damage, alter, or otherwise deface archaeological resources on Federal lands without authorization. ARPA permits allowing for professional archaeological excavations can be granted by the land-managing agency (in the case of KTF, granted by the Department of the Navy) pursuant to 32 CFR Part 229.8. The Navy's Integrated Cultural Resources Management Plan (ICRMP; Navy 2012) for the PMRF details procedures to be implemented to minimize harm to archaeological resources, including those located on KTF, includes procedures for monitoring ground-disturbing activities and processes for treatment of inadvertent discoveries of archaeological deposits.

The Native American Graves Protection and Repatriation Act of 1990 (NAGPRA; 25 U.S.C. 3001 et seq.) establishes

a process for Federal agencies to return human remains, associated and unassociated funerary objects, sacred objects, and objects of cultural patrimony to Federally-recognized Indian tribes and Native Hawaiʻian organizations. NAGPRA applies equally to items already in the possession of Federal agencies and those encountered during current actions and undertakings on Federal or tribal lands. NAGPRA consultation is required in the event of the planned excavation or unexpected discovery of such items on Federal lands. For KTF, which is located on Navy lands, NAGPRA responsibilities fall to the Navy. In 2011, the Navy and Na Ohana Papa o Mānā executed a NAGPRA Comprehensive Agreement (CA) establishing the Native Hawaiʻian group as the closest cultural affiliated group to any Native Hawaiʻian remains or items discovered on PMRF lands, including KTF. The CA documents the process for carrying out the requirements of the NAGPRA implementing regulations (43 CFR 10, Subpart B) for standard consultation procedures, determination of custody, treatment, and disposition of NAGPRA items (Department of the Navy 2011).

According to DOE American Indian Tribal Government Interactions and Policy, DOE has trust responsibility to include “Promotion and protection of tribal treaty rights, federally recognized reserved rights, and federally recognized interests of the beneficiary American Indian and Alaska Native nations; determining, documenting, notifying, and interacting with tribal governments with regard to the impact of Departmental programs, policies, and regulations to protect American Indian and Alaska Native traditional cultural ways of life, natural resources, treaty and other federally recognized and reserved rights.” (DOE 2009)

Section 101(d)(6) of the NHPA mandates that Federal agencies consult with Tribes and other Native American groups who either historically occupied the project area or may attach religious or cultural significance to historic properties in the region. The NEPA implementing regulations link to the NHPA, as well as to the American Indian Religious Freedom Act (AIRFA; 42 U.S.C. 1996), Executive Order (EO) 13007 Indian Sacred Sites (61 Federal Register [FR] 26771), EO 13175 Consultation and Coordination with Indian Tribal Governments (65 FR 67249), and the Executive Memorandum on Government-to-Government Relations with Native American Tribal Governments (59 FR 22951). These requirements call on agencies to consult with tribal leaders and others knowledgeable about cultural resources important to them. In November 2009, DOE updated its American Indian and Alaska Native Tribal Government Policy (DOE Order 144.1, Administrative Change 1), which provides guidance for consulting and coordinating with tribal

governments in compliance with Federal statutes and regulations. The policy sets forth the principles to be followed by DOE to ensure effective implementation of a government-to-government relationship with Tribes, and directs all DOE officials, staff, and contractors regarding fulfilling trust obligations and responsibilities arising from Departmental actions that may potentially affect tribal traditional, cultural, and religious values and practices; natural resources; and treaties and other Federally-recognized and reserved rights.

3.9.3.2 Historical Context

The area of KTF is part of the area known as the Mānā Plain, which includes the cliffs to the east, the sloping uplands, marshland, and the coastal plain on which KTF sits. Mānā means “arid”, describing the climatic conditions of the western side of Kauaʻi. Mānā was known for its singing dunes, mirages, and ghosts. Its upland areas are referred to in oral tradition as a place (called a leina-a-ka-uhane) from where the spirits of men, after death, would plunge into one of three spiritual realms for eternity (Department of the Navy 2008). These areas were generally avoided due to the presence of malevolent ghosts, and references to burials throughout Mānā are recorded in Hawaiʻian oral history (DOE 1992). It is one of many places in the Hawaiʻian Islands associated with the volcano goddess Pele and her older and younger sisters. According to tradition, Pele’s youngest sister, Hiʻiaka, was traveling through the area at one time and struck down a number of ghosts in the uplands area, then rejoined her traveling companions at the shore by Nohili Dune. It is said that the sands of Nohili ring out because of the wailing of the ghosts that Hiʻiaka destroyed in those sands (Department of the Navy 2012:17). Reportedly, Pō, the abode of the dead in Native Hawaiʻian tradition, lies just under the ocean just outside of Polihale, north of Nohili Dune.

The Hawaiʻian Islands are thought to have been initially occupied between A.D. 500 and 1200, though a radiocarbon date of A.D. 350 was recovered from northwestern Kauaʻi. Kauaʻi is unique among the islands because of its apparent prehistoric connections with the southern islands of Central Polynesia through stone implements, heiau (sacred site or temple) style, language, and oral traditions (DOE 1992). Mānā was prehistorically and historically important for habitation and temples in the upland areas, agriculture in the marshland, and ceremonial activities throughout (Department of the Navy 2008, 2012). Small, likely temporary, fishing camps that were linked to the permanent upland communities were located along the coast near beneficial locations such as where reefs provided rich habitats for near-shore marine resources. Some camps were located on

the protected lee sides of high dunes from Nohili Point north (Rieth 2017). Oral history refers to growing taro, sweet potatoes, sugar cane, and bananas, and to lure fishing. Brackish-water fish ponds were established in the marshlands. The Mānā area was especially known historically for its offshore fishing grounds, and for wet taro cultivation in the marshes inland of the dunes (Department of the Navy 2012).

In the late 1800s, European settlers began draining the Mānā swamp for development of plantations, and by the 1930s most of it had been drained. The Nohili Ditch, located south of KTF, was dug in 1922 through the dunes to the shore by H. P. Faye for draining and development of the Kekaha plantation. Initially rice was grown, but later this land was used for sugar cane cultivation (Department of the Navy 2012). Sugar mills were established and workers lived in plantation camps scattered among the fields. The back beach areas at Barking Sands, where KTF is located, were used for grazing cattle and goats.

In 1923, Mānā Park was established on the northern portion of PMRF's coastal strand. The 142.7-acre park was set aside by Executive Order 148 on government lease lands south of Nohili Dune and occupied most of the land on which KTF is currently located (Department of the Navy 2012; DOE 1992). In 1941, Mānā Park was withdrawn in order to expand the Mānā Airport Military Reservation northward. The installation, renamed USAF Bonham Airfield in 1954, was transferred to the Navy in 1964, after which the airfield was renamed PMRF (Department of the Navy 2008; DOE 1992).

The KTF was established as a tenant on what is now known as the PMRF in 1962 by the Atomic Energy Commission (AEC). Operated by Sandia Corporation for the AEC, KTF first functioned as a rocket-launching site supporting high-altitude atmospheric sampling during nuclear weapons testing in the Pacific, specifically 1962's Operation Dominic series of high-altitude tests. KTF also included a measurement antenna field when initially configured. Activities at KTF supporting nuclear weapons testing were short-lived, ending with cessation of atmospheric tests following the Limited Nuclear Test Ban Treaty of 1963. However, the treaty language included a stipulation that the United States could maintain its capability to resume atmospheric testing (on Johnston Island) and monitoring (at KTF). KTF grew during the 1963-1975 period when the Readiness Program was in place, and Sandia Corporation operated KTF for the remaining 30 years of the Cold War under this funded mandate. During these decades, other users had access to KTF facilities for a variety of studies. KTF supported rocket launches for a variety of purposes, including

testing rocket systems with scientific and technological payloads, advanced development of maneuvering re-entry vehicles, and scientific studies of atmospheric and exoatmospheric phenomena. In the late 1980s, KTF was revitalized with new capabilities and pursued rocket launches in support of the Strategic Defense Initiative Organization's (SDIO) development of non-nuclear missile defenses (SDIO became the Ballistic Missile Defense Organization and, since 2002, has been called the Missile Defense Agency). Pad 42 and its supporting structures were built in 1988 to support vertical rocket launches in support of this new mission, as was a new control building. The follow-on Strategic Targeting System became a KTF mission immediately post-Cold War, in 1993, requiring this dedicated launch pad for its three-stage test vehicle, a vehicle based on the Polaris ballistic missile (Department of the Navy 2012).

3.9.3.3 Cultural Resources in the Vicinity of KTF

Large portions of PMRF, surrounding KTF, have been surface surveyed for archaeological resources, and some areas have included subsurface investigations such as conducting excavations and monitoring ground disturbance. Cultural studies and historical research on the PMRF and the Mānā Plain has included historical research, review of documented Hawai'ian traditions, and oral history interviews with knowledgeable local community members (Department of the Navy 2008). Through this work, significant prehistoric and historic archaeological resources have been found at PMRF, some adjacent to KTF, including buried cultural deposits and surficial remains. Identified resources include burials, cemeteries, heiaus (temples), campsites, traditional house foundations, lithic (stone tools and tool-making debris) scatters, aquaculture ponds, and plantation-era resources. Many of these resources also have traditional cultural significance for Native Hawai'ians.

Burial sites have been identified throughout the Mānā Plain and are the most significant cultural concern in the area. Identified burials include individuals from both Native Hawai'ian and Plantation-era periods. The Nohili Dune, adjacent to KTF to the north, has been determined to be a site eligible for the National Register as a traditional cultural property for its importance to Native Hawai'ians (Department of the Navy 2008, 2012; DOE 1992).

3.9.3.4 Cultural Resources at KTF

Archaeological investigations on KTF have included surface survey, test excavations, auger tests, and monitoring. A surface survey conducted in 1990 covered

most of the KTF area. While no intact archaeological sites have been identified on KTF, archaeological deposits have been encountered, including charcoal, marine shell midden, and fragmentary human skeletal remains. In all cases, these deposits were fragmentary and isolated, or the area under investigation was limited (e.g., a bore hole), and none of the discoveries were recorded as sites (Rieth 2017; DOE 1992; Department of the Navy 2012). However, based on the findings of previous archaeological investigations both within and surrounding KTF, and on Native Hawaiʻian cultural traditions regarding the traditional history and uses of the area, especially Nohili Dune, the potential for significant subsurface archaeological deposits or human remains to be present within KTF remains.

The Navy has developed archaeological sensitivity areas to assist with planning and the management of cultural resources in the Barking Sands portion of the PMRF (Department of the Navy 2012). These demarcations are based on known archaeological deposits, archaeological site distribution, traditional land use patterns, oral history and historic written records, environmental factors that would influence prehistoric and historic land use, and locations of ground disturbance in the modern era. Most of KTF is designated as low sensitivity, likely due to the lack of significant, intact archaeological deposits and the extent of modern surface disturbance. A strip along the northwestern boundary and southern end of KTF are designated as medium sensitivity, due to proximity to Nohili Dune and the presence of undisturbed areas. Distinct high sensitivity areas are defined in three small areas: one area behind the MST within the Nohili Dune, and two areas south and east of the main compound (Department of the Navy 2012).

3.10 Hazardous Materials and Waste Management

3.10.1 Definition of Resource

This section discusses hazardous materials used at KTF, waste generation and management activities, and regulatory requirements. Also presented are quantities of hazardous materials and chemicals stored onsite and quantities of waste generated.

3.10.2 Region of Influence

The ROI for hazardous materials and waste management involves KTF. The ROI does not include offsite waste disposal facilities because they involve the private sector or other Federal facilities.

3.10.3 Affected Environment

3.10.3.1 Hazardous Materials

Hazardous materials at KTF are managed through compliance with several requirements:

Emergency Planning and Community Right-to-Know Act (EPCRA). EPCRA of 1986, also known as the *Superfund Amendments and Reauthorization Act* (SARA) Title III, establishes emergency planning requirements for Federal, state, and local governments and industry. SARA Title III amended Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements for releases to the environment and chemical inventory reporting as directed by EPCRA, sections 304, 311, and 312. All required information has been submitted to the State of Hawaiʻi. There were no reportable releases at KTF under EPCRA from 2014 through 2017. (SNL 2015, 2016, 2017)

The **Toxic Release Inventory** reporting requirement was established under Section 313 of EPCRA. Environmental releases and other waste management quantities of chemicals listed on the EPCRA Section 313 list of toxic chemicals must be reported for certain facilities in covered industry sectors if they manufacture, process, or otherwise use more than established threshold quantities of these chemicals. From 2014 through 2016, no releases resulting from KTF operations were reported above the threshold requiring a toxic release inventory report. (SNL 2015, 2016, 2017)

Federal Insecticide, Fungicide, and Rodenticide Act. The *Federal Insecticide, Fungicide, and Rodenticide Act*, enacted in 1910 and amended in 1972, controls the distribution and application of pesticides including herbicides, insecticides, and rodenticides. All pesticide use at KTF follows USEPA requirements. (SNL 2017)

Toxic Substances Control Act. The *Toxic Substances Control Act*, enacted in 1976 and later amended, regulates polychlorinated biphenyls (PCBs) and asbestos. The transformers at KTF site have been tested and are free of PCBs. A comprehensive asbestos survey was conducted by the SNL/NM Asbestos Management Team in July 2008. A total of 110 cubic yards of asbestos-containing materials were identified at KTF. (SNL 2018)

Clean Water Act. The *Federal Water Pollution Control Act* of 1948, amended in 1972 to become known as the *Clean Water Act*, requires any facility having an aggregate above-ground oil storage capacity greater than 1,320 gallons and a reasonable expectation of an oil discharge affecting navigable waters of the U.S. or adjoining

shorelines to develop and implement an SPCC Plan, with requirements for the prevention of, preparedness for, and response to oil discharges. KTF is included in the PMRF SPCC Plan, which describes oil storage facilities at KTF and the mitigation controls in place to prevent inadvertent discharges of oil. There are four DOE-owned storage tanks at KTF—one underground storage tank, one aboveground storage tank, and two generator base tanks. Additional oil storage capacity in 55-gallon drums, mobile and portable containers, mobile refuelers, and oil-filled operational equipment (e.g., transformers, hydraulic elevators) occurs throughout the site on an as-needed basis. (SNL 2017)

As an active test facility in a relatively remote area, KTF maintains a chemical inventory to perform facility maintenance and conduct responsive test operations. The inventory consists of aerosols, gases, liquids, and solids, mostly in “cabinet scale” quantities, with the exception of fuels. Small-quantity chemicals (less than 1 gallon or 10 pounds) are typically paints or coatings, lubricants, adhesives, cleaning agents, and caulking compounds. All chemicals are tracked by the M&O. All activities involving chemical use and storage are performed in accordance with M&O corporate requirements on hazards and controls related to the environment and industrial hygiene, as well as preparation for and management of emergencies.

Table 14 lists the quantities of chemicals in each physical state (e.g., aerosols, gases), as of April 2018, as an example of a typical chemical inventory.

During testing activities, additional chemicals are temporarily brought to the facility, usually as part of launch vehicles. Propellants contained in launch vehicles include commercial products, including but not limited to, cyclotrimethylene-trinitramine (RDX), lead azide, hydrazine, and Composition 4 (C4). All explosives are contained and are not in open powder form, so are not directly handled. All processes involving high-energy source use and storage are performed in accordance with DOE Explosives Order and 10 CFR 851 requirements on industrial safety, and industrial hygiene.

Under DOE Order 232.2 Admin. Change 1, the current order for occurrence reporting, an occurrence is defined as “one or more (i.e., recurring) events or conditions that adversely affect, or may adversely affect, DOE (including NNSA) or contractor personnel, the public, property, the environment, or the DOE mission. Events or conditions meeting criteria thresholds identified in DOE Order 232.2, or determined to be recurring through performance analysis, are considered occurrences.” In 2015, there

was one occurrence report at KTF: A Field Citation was issued to SNL/KTF by the Hawaii Department of Health, Underground Storage Tank Section, for failure to complete annual liquid tightness testing on the spill bucket of the underground storage tank used to store fuel. The situation was remedied with new equipment and procedures. There were no reportable occurrences in 2014 or 2016. (SNL 2015, 2016, 2017)

In July 2017, several on-site structures with asbestos-containing materials were decontaminated, demolished, and removed. Approximately 4.5 cubic yards of asbestos-containing materials were removed and disposed of in accordance with regulatory requirements (SNL 2018).

3.10.3.2 Waste Management

3.10.3.2.1 Solid Waste

Small amounts of non-hazardous solid waste are generated at KTF during routine operations in the form of standard office trash, construction debris, and metals (e.g., aluminum, alloys). Larger amounts of construction debris and D&D waste are generated during one-time construction or demolition projects. Waste minimization and recycling are incorporated whenever possible to minimize the quantities of solid waste generated. Solid waste is disposed of at the Kekaha Landfill, located adjacent to the southern end of the PMRF.

The Site Sustainability Plan establishes a commitment to meet pollution prevention goals identified in DOE’s Strategic Sustainability Performance Plan and Executive Order 13693, Planning for Federal Sustainability in the Next Decade. Pollution prevention and waste minimization data are reported in the Site Sustainability Plan (SNL 2017). Recycling facilities on Kaua’i include those for glass, plastic and aluminum beverage containers; and asphalt and concrete (SNL 2016).

3.10.3.2.2 Hazardous Waste

Hazardous waste at KTF is handled and managed in compliance with the following requirements:

- **Federal Facility Compliance Act.** The *Federal Facilities Compliance Act* of 1976 requires Federal facilities to comply with all Federal, state, and local requirements for hazardous and solid waste.
- **Resource Conservation and Recovery Act (RCRA).** RCRA, enacted in 1976, and the Hawai’i Revised Statutes regulate the generation, transportation, treatment, storage, and disposal of hazardous chemical waste and nonhazardous solid wastes.

Table 14 - Quantities of Chemicals by Physical State (April 2018).

Physical State	Description	Quantity	Type
Aerosol	RAID WASP & HORNET KILLER 33	6.3 gal	Insecticide
	GENIE LIFT BLUE	2.6 gal	Paint/coating
	INGERSOLL BEIGE	2.0 gal	Paint/coating
	KRYLON FARM & IMPLEMENT COLORS, OLD CATERPILLAR YELLOW	1.8 gal	Paint/coating
	PTOUCH 2X +SSPR 6PK GLOSS REAL ORANGE	1.6 gal	Paint/coating
	LUCAS CHAIN LUBE AEROSOL	1.0 gal	Lubricant
	LPA I PROTECTING AGENT	1.0 gal	Lubricant
	DUPLI-COLOR RUST BARRIER RUST PREVENTIVE COATING (AEROSOL) GLOSS BLACK	1.0 gal	Paint/coating
Gas	HELIUM	1168 cu ft.	Gas
	NITROGEN, COMPRESSED GAS	494 cu ft.	Gas
	OXYGEN	337 cu ft.	Gas
	ARGON, COMPRESSED	336 cu ft.	Gas
	ACETYLENE	309 cu ft.	Fuel (gas)
	PROPANE	14.4 cu ft.	Fuel (gas)
Liquid	DIESEL FUEL NO. 2	10000 gal	Fuel
	GASOLINES LEAD FREE	600 gal	Fuel
	INHIBITED RED FUMING NITRIC ACID	440 pounds	Fuel
	MIXED AMINE FUEL	150 pounds	Fuel
	HYDRAZINE (SEALED CONTAINERS)	100 pounds	Fuel
	DEVGUARD 4308 ALKYD INDUSTRIAL GLOSS ENAMEL WHITE AND TINT BASES	26.8 gal	Paint/coating
	ULTRA COOLANT	20 gal	Coolant
	INTERIOR LATEX SEMI-GLOSS WHITE	20 gal	Paint
	NAPA PREM PERF UFMO SAE 15W-40 MOTOR OIL	17 gal	Lubricant
	CHEVRON 1000 THF	15 gal	Hydraulic fluid
	DUR-A-GLAZE #4 WB PRIMER HARDENER	15 gal	Paint/coating
	DURATION GLOSS EXTERIOR LATEX COATING	14.4 gal	Paint/coating
	CHEVRON DELO GEAR LUBRICANT ESI	10 gal	Lubricant
	DUR-A-GLAZE #4 RESIN	10 gal	Paint/coating
	DUR-A-GLAZE #4 WB PRIMER-SEALER HARDENER	10 gal	Paint/coating
	ERAGUARD 1000	10 gal	Paint/coating
	THERMOFLEX TF-500	10 gal	Paint/coating
Solid	KLEEN BLAST	100 pounds	Abrasive
	SOLDER	58.4 pounds	Other
	SHEETROCK ALL PURPOSE JOINT COMPOUND	48.8 pounds	Other
	CHEVRON ULTI-PLEX GREASE EP	42 pounds	Lubricant
	GROUNDWORKS SLIP RESISTANT ADDITIVE	40 pounds	Other
	QUICK DRAIN PIPE OPENER	25.0 pounds	Other
	DURA-LITH GREASE EP 2	21 pounds	Lubricant
	AEROSHELL GREASE 7	17.6 pounds	Lubricant
	CHEVRON ULTRA-DUTY GREASE EP NLGI 0, 1, 2	13.1 pounds	Lubricant
	SHEETROCK ALL PURPOSE JOINT COMPOUND	12 pounds	Other
	PORTLAND CEMENT BASED REPAIR MATERIALS	10 pounds	Other

cu ft. = cubic feet

gal = gallon

Source: SNL 2018a

- **Pollution Prevention and Waste Minimization.** Pollution prevention concepts first appeared in RCRA. An expressed concern was to minimize the generation of hazardous waste through process substitution, materials recovery, recycling, reuse, and treatment. RCRA established the reduction or elimination of hazardous waste as national policy and required that hazardous waste generators and RCRA permit holders have a program in place to minimize waste. As required, waste generation and recycling information is reported annually to DOE through the Site Sustainability Plan.
- The **Site Sustainability Plan** establishes a commitment to meet pollution prevention goals identified in DOE's Strategic Sustainability Performance Plan. Pollution prevention and waste minimization data are reported in the Site Sustainability Plan.
- The **Pollution Prevention Act** of 1990 declares, as national policy, that pollution should be prevented or reduced at the source (42 USC § 13101 et seq.). A toxic chemical source reduction and recycling report is required for facilities that meet the reporting requirements under EPCRA, Section 313.

KTF operations produce small quantities of hazardous waste. Over the 5-year period from 2013 through 2017, a total of 373 gallons of used oil (e.g., motor oil, hydraulic fluid) and oil filters from vehicles and generators were collected by local disposal or recycling companies. Mercury-containing items, including switches, thermometers, batteries, and projection lamps were collected and picked up once during the 5-year period. Lead-acid batteries are collected by a vendor upon replacement. (SNL 2018b)

3.11 Infrastructure Resilience

3.11.1 Definition of Resource

Infrastructure resilience describes the susceptibility to KTF from climate-change-related events such as rising sea levels, increased storm frequency and/or intensity, and other weather events.

3.11.2 Region of Influence

The ROI applicable to the discussion of infrastructure resilience is limited to KTF.

3.11.3 Affected Environment

Changes in climate can affect coastal areas in a variety of ways. Coasts are sensitive to sea level rise, changes in the frequency and intensity of storms, increases in precipitation, and warmer ocean temperatures. Man-made infrastructure can be affected by shoreline erosion, coastal flooding, and high winds. (EPA 2017)

Ocean levels near KTF vary because of a variety of phenomena, including tides, cyclical atmospheric pressure and water temperature (e.g., El Niño) anomalies, and global sea-level rise. Tides at Hanapepe Bay, approximately 16 miles southeast of KTF, have an average variance of 1.84 feet between the daily highest high tide and lowest low tide (NOAA 2013). Between 1960 and 2014, Kaua'i has experienced a relative sea level rise of 2 to 4 inches (EPA 2017), and an average rate of relative sea level increase of 1.41 millimeters per year since 1955 (Hawai'i Climate Change Mitigation and Adaptation Commission 2017).

High tides, cyclical anomalies that cause elevated sea levels, and global sea-level rise can cause frequent coastal flooding; former agricultural areas of the Mānā Plain to the east (inland) of the KTF lie at approximately 8 feet above mean sea level. In addition, elevated sea levels can exacerbate the effects of short-term events such as storms and tsunamis. The added risk from event-based coastal flooding exacerbated by sea-level rise pose a potential for loss of human life and property, and for severe and long-term economic disruption (Hawai'i Climate Change Mitigation and Adaptation Commission 2017). Higher sea levels increase the erosion and infrastructure damage potential of waves. KTF is located in a tsunami evacuation zone.

On September 11, 1992, Hurricane Iniki hit Kaua'i. Damage to KTF was minimal but there was over \$1 billion in damage to the island, with 6 deaths and over 1,400 homes destroyed. Other tropical storms and hurricane near-misses that have caused site evacuations but no serious flooding issues. Evacuation procedures are typically triggered by a U.S. Navy PMRF-wide emergency response action; however, if KTF receives advance notice through other channels, KTF personnel will begin taking necessary actions before receiving notice from the U.S. Navy.

The main compound at KTF lies at an elevation of

approximately 10 ft. above mean sea level. Other KTF infrastructure lies between approximately 10 and 24 ft. above mean sea level. Buildings and launchers are as follows:

- Main compound. The main compound is essentially a dock with 28 slots. Located in those slots are a variety of mobile trailers. The dock itself is a reinforced concrete structure with steel posts that are mounted in the concrete that support a wood and metal roof structure above all the dock slots. The trailers are not anchored in place but supported from beneath by stacks of wood beams. In addition to the dock there are several maintenance buildings in the main compound that are built on concrete slab foundations from a variety of construction materials with the majority being steel frame and metal sheathing. There is also a generator control building constructed of concrete block. The Launch Operations Building is made of 6-foot-thick concrete and earth walls and ceiling. The Launch Operations Building is used as shelter during hurricane-force winds.
- Launch field. Generally, launch field assembly buildings are built on a concrete foundation with steel-frame construction skinned with metal sheathing. Smaller auxiliary equipment buildings are concrete slab with concrete block walls. The launch pads are 6- to 12 ft. deep concrete with rebar reinforcement. The 20K launcher is built with 1-inch-thick steel walls and anchored into the concrete with bolts. The MST is close to 80-ft. tall, constructed with large steel structural members and skinned with foam-filled metal panels. When stowed, the MST is anchored with multiple hurricane straps.

3.12 Energy and Water Use

3.12.1 Definition of Resource

This resource area discussion provides local and regional information on energy and water use; briefly describes KTF's infrastructure related to electrical transmission, other energy sources, and water; and discusses KTF's energy and water use.

3.12.2 Region of Influence

The ROI for energy and water use is confined to KTF and energy and water users who could be affected by KTF consumption.

3.12.3 Affected Environment

3.12.3.1 Energy

Electricity is the primary source of energy at the KTF. Kaua'i Island Utility Cooperative (KIUC) power is brought directly to the KTF via overhead power lines. KTF power usage is metered using a "smart meter" and billed direct to KTF monthly. KTF power lines are independent from the PMRF, other than crossing the PMRF to reach KTF. Onsite, there is an underground power distribution system in the launch field that supplies electricity to the launch pads and AEBs next to each pad. The backbone of this system was upgraded in 2016 and consists of five substations. (SNL 2018)

The electricity is primarily used for air conditioning, lighting, and computers. The large air conditioning units on the LOB, Missile Assembly Building (MAB), Rocket Motor Staging Area (RMSA), and MST consume the most power during heavy mission usage times. SNL also recently purchased seven electric utility carts. (SNL 2018)

Recent KTF usage of KIUC-supplied electricity is as follows (SNL 2018):

- Fiscal year (FY) 2015: 492,400 kilowatt-hours (kWh)
- FY 2016: 512,400 kWh
- FY 2017: 483,800 kWh

The KTF has two 320-kW diesel generators to provide consistent power to mission critical elements during mission times and to supplement the KIUC power. During non-mission times, generators are typically not running. Recent KTF generator usage is as follows (SNL 2018):

- FY 2015: 1413 hours
- FY 2016: 1173 hours
- FY 2017: 3995 hours

Other than electricity supplied by KIUC and onsite diesel generators, no other electricity or other sources of energy are used at KTF. (SNL 2018)

The system delivering KIUC electricity is at approximately 10 percent of capacity, on average. During heavy mission times (when all assembly buildings are occupied and 75-100 visitors numbers are onsite), KTF has approached 350 kW draw on the diesel generators, approximately 55 percent of capacity. (SNL 2018)

3.12.3.2 Water

Potable water is provided to the KTF through the PMRF infrastructure and is inspected daily by the PMRF operations and management contractor. Water is used for restrooms, laundry facility, cleaning, cooking, pre-launch fire prevention, and small construction projects. (SNL 2018)

Potable water for the KTF is pumped from Mānā Well, located about 2 miles east of the PMRF near the Mānā cliffs at the inland edge of the coastal plain (U.S. Department of the Navy 2008). The water distribution system is owned by the Naval Facilities Engineering Command, Hawai'i. Groundwater is naturally filtered as it travels from the surface to the aquifer below ground. The water is pumped up from the aquifer, disinfected, fluoridated, and piped into the distribution system (Naval Facilities Engineering Command 2017).

KTF does have a metered system but does not receive a report of specific usage.

3.13 Socioeconomics and Environmental Justice

3.13.1 Definition of Resource

Socioeconomics addresses the demographic and economic variables associated with community growth and development that have the potential to be directly or indirectly affected by changes in operations at KTF. KTF and the communities that support it can be described as a dynamic socioeconomic system. The communities provide the people, goods, and services required by KTF operations. KTF operations, in turn, create the demand and pay for the people, goods, and services in the form of wages, salaries, and benefits for jobs and dollar expenditures for goods and services. The measure of the communities' abilities to support the demands of KTF depends on their ability to respond to changing environmental, social, economic, and demographic conditions.

Environmental justice has been defined as the "fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies" (USEPA 2014). Concern that minority and/or low-

income populations might be bearing a disproportionate share of adverse health and environmental impacts led President Clinton to issue an EO in 1994 to address these issues. EO 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," directs Federal agencies to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations. When conducting NEPA evaluations, the DOE incorporates environmental justice considerations into both its technical analyses and its public involvement program in accordance with the USEPA and CEQ (CEQ 1997).

3.13.2 Region of Influence

The socioeconomics ROI is defined by the areas where KTF employees and their families reside, spend their income, and use their benefits, thereby affecting the economic conditions of the region. For this EA, the ROI consists of Kaua'i County.

For environmental justice, ROI is the area of potential impacts stated for each resource area.

3.13.3 Affected Environment

3.13.3.1 Population and Income

In 2010, the population of Kaua'i County was 67,091. The 2012-2016¹ population estimate for Kaua'i County was 70,477, an increase of approximately 5.0 percent (Census 2018a). Table 15 summarizes the demographics of the populations of Kaua'i County and the State of Hawai'i in the 2012-2016 period. Table 16 illustrates the age profile of those living in Kaua'i County over the same period.

The 2012-2016 U.S. Census surveys estimated the median household income in Kaua'i County at \$68,224. An estimated 9 percent of households had income below \$15,000 a year and 12 percent had income over \$150,000 or more. An estimated 10 percent of people were in poverty. An estimated 9 percent of related children under 18 were below the poverty level, compared with 8 percent of people 65 years old and over. An estimated 6 percent of all families had incomes below the poverty level. (Census 2018b)

¹ This section cites estimates determined by the U.S. Census bureau from the American Community Survey (ACS), a questionnaire sent annually to a random sample of more than 3.5 million households nationwide (Census 2018c). The ACS estimates provide recent data that can be compared across geographic areas. For this SWEA, DOE determined that the ACS was preferable to 2010 census data because of its currency, and also to minimize effects that the economic recession might have had on 2010 census data. This SWEA uses the ACS 5-year estimates, based on 60 months of data collected from 2012 through 2016.

Table 15 - Demographics of the Population of Kaua'i County and State of Hawai'i, 2012-2016

Subject	Kaua'i County		State of Hawai'i	
	Estimate	Percent	Estimate	Percent
Population				
Total	70,477		1,413,673	
Male	35,176	49.9	709,870	50.2
Female	35,271	50.1	703,803	49.8
Race				
One race	55,746	79.1	1,077,044	76.2
White	23,222	33.0	353,643	25.0
Black or African American	478	0.7	25,871	1.8
American Indian and Alaska Native	314	0.4	2,715	0.2
Asian	24,606	34.9	537,363	38.0
Asian Indian	155	0.2	2,507	0.2
Chinese	1,058	1.5	55,366	3.9
Filipino	14,751	20.9	209,323	14.8
Japanese	6,552	9.3	181,998	12.9
Korean	262	0.4	22,924	1.6
Vietnamese	80	0.1	10,766	0.8
Other Asian	1,748	2.5	54,479	3.9
Native Hawaiian or Other Pacific Islander	6,809	9.7	143,973	10.2
Native Hawaiian	6,150	8.7	90,054	6.4
Guamanian or Chamorro	15	0.0	2,866	0.2
Samoan	126	0.2	15,472	1.1
Other Pacific Islander	518	0.7	35,581	2.5
Some other race	317	0.4	13,479	1.0
Two or more races	14,701	20.9	336,629	23.8
Hispanic or Latino and Race				
Hispanic or Latino (of any race)	7,506	10.7	141,827	10.0
Not Hispanic or Latino	62,941	89.3	1,271,846	90.0
White alone	20,949	29.7	316,285	22.4
Black or African American alone	443	0.6	23,768	1.7
American Indian and Alaska Native alone	208	0.3	1,830	0.1
Asian alone	23,329	33.1	523,697	37.0
Native Hawaiian and Other Pacific Islander alone	6,203	8.8	131,327	9.3
Some other race alone	83	0.1	1,593	0.1
Two or more races	11,726	16.6	273,346	19.3
Total housing units	30,388		530,289	

Source: Census 2018a

3.13.3.2 Demographics

Table 15 also summarizes the racial and ethnic composition of the residents of Kaua'i and Hawai'i. Based on these estimates, 49,528 of the 70,477 residents of Kaua'i (70.3 percent) are racial and/or ethnic minorities.

3.13.3.3 Housing

In 2012-2016, Kaua'i County had a total of 30,400 housing units, 26 percent of which were vacant. Of the total housing units, 74 percent were in single-unit structures, 25 percent were in multi-unit structures, and less than 0.5 percent were mobile homes. An estimated 36 percent of the housing units were built since 1990. (Census 2018b)

3.13.3.4 Employment

In Kaua'i County, 62 percent of the population 16 and over were employed; 34 percent were not currently in the labor force. An estimated 73 percent of the people employed were private wage and salary workers; 16 percent were Federal, state, or local government workers; and 11 percent were self-employed in their own (not incorporated) business (Census 2018b). Tourism continues to be a major employment generator for Kaua'i, with 22.9 percent of employed individuals working in the arts, entertainment, recreation, accommodation, and food services sector. Table 17 summarizes employment percentage by industry.

PMRF is a large contributor to employment in Kaua'i County, particularly on the western side of the island. The installation employs approximately 70 military personnel, 150 government civilian personnel, 520 operations and maintenance contractor personnel, and 180 contractors

representing over 25 companies (U.S. Department of the Navy 2016). KTF employs 14 personnel, approximately 0.02 percent of the county's population. As many as 500 additional individuals rotate through KTF during a launch campaign. These individuals are housed at PMRF or off-facility accommodations.

The February 2018, non-seasonally-adjusted unemployment rate in Kaua'i was 1.7 percent, compared with 1.9 percent for the State of Hawai'i. Seasonally adjusted unemployment rates during the same period were 2.1 percent for the State of Hawai'i. (Hawaii Department of Labor and Industrial Relations 2018)

3.14 Human Health and Safety

3.14.1 Definition of Resource

Human health and safety analysis includes consideration of any activities, occurrences, or operations that have the potential to affect the safety, well-being, or health of members of the public. The primary goal is to identify and prevent potential accidents or impacts on the general public. Site preparation activities such as construction and modification, demolition, and non-launch operational activities; pre-launch operations such as missile and ordnance assembly movements; test vehicle assembly activities such as integration and installation; and launch operations have been evaluated for potential hazards or risks to the public and KTF personnel.

3.14.2 Region of Influence

The ROI for potential impacts and risks related to human health and safety includes work areas associated with test vehicle launch operations, areas adjacent to KTF

Table 16 - Age Profile of Kaua'i County Residents, 2012-2016.

Age Group	Population	Percent
Under 20 years	17,090	24.3
20 to 34 years	12,355	17.5
35 to 54 years	18,144	25.8
55 to 74 years	17,834	25.3
75 years and over	5,024	7.1
Median age	42.0	

Source: Census 2018a

Table 17 - Employment Percentage by Industry, 2012-2016.

Industry	Percentage of Employed Individuals
Agriculture, forestry, fishing and hunting, and mining	3.5
Construction	7.4
Manufacturing	2.1
Wholesale trade	1.5
Retail trade	10.8
Transportation and warehousing, and utilities	5.7
Information	1.4
Finance and insurance, and real estate and rental and leasing	7.0
Professional, scientific, and management, and administrative and waste management services	11.0
Educational services, and health care and social assistance	15.8
Arts, entertainment, and recreation, and accommodation, and food services	22.9
Other Services, except public administration	4.5
Public administration	6.4
Total	100.0

Source: Census 2018b

including PMRF and agricultural areas, and overwater areas and beaches. The population of concern includes the workers employed at KTF/PMRF, individuals and other personnel directly involved with launch operations, and visitors to and permanent residents of Kaua'i County.

3.14.3 Affected Environment

3.14.3.1 Regulatory Setting

The primary regulation for M&O contractors is 10 CFR 851, Worker Safety and Health Program. Applicable DOE directives include DOE O 440.1B Change 2, *Worker Protection Program for DOE (Including the National Nuclear Security Administration) Federal Employees for DOE employees* as well as DOE G 440.1-1B Change 1, *Worker Protection Management for DOE Federal and Contractor Employees* for both DOE and its contractors. NNSA Policy Letter NAP-6A, Federal Employee Occupational Safety and Health Program covers the requirements for NNSA employees. These regulations establish the requirements that the M&O contractor worker safety and health program must abide by in order to ensure a safe workplace is provided to KTF personnel.

While 10 CFR 851 establishes the safety controls and standards, all explosive operations are conducted in accordance with the DoD-approved U.S. Navy Explosive Site Plans for the site/facility involved. The technical standard DOE-STD-1212-2012, Explosive Safety, provides the basic technical requirements for DOE facilities and the M&O explosive safety program necessary for operations involving explosives, explosives assemblies, propellants, and assemblies containing these materials. Further, DOE-STD-1212-2012 applies to all DOE facilities, including KTF, engaged in developing, manufacturing, handling, storing, transporting, processing, or testing explosives, pyrotechnics, and propellants, or assemblies containing these materials, and to the safe management of such operations. (DOE 2012)

DOE implements guidance and requirements to manage the exposure of Federal workers and contractors to occupational noise. DOE and NNSA occupational noise exposure and hearing conservation program standards are based on both the OSHA limits and the more stringent thresholds established by the ACGIH. The ACGIH limits are shown in Table 7 discussed in Section 3.6.3.4.

3.14.3.2 Site Preparation Activities

Facility access to KTF is carefully controlled through gates and badging, thus reducing the ability for the general public to access the site and encounter hazards or risks present at KTF. Personnel who have been granted access, whether they are M&O personnel, subcontractors, or other mission-designated individuals, are subject to 10 CFR 851 requirements, OSHA limits, and ACGIH limits, among other PMRF and M&O contractor policies, plans, and work control documentation. Potential occupational-related effects on safety and health for workers involved in the performance of the construction activity are possible. Personnel working at KTF are required to exercise good housekeeping practices, with work areas maintained to be clean, safe, and orderly at all times, and tools, supplies, and materials returned to their proper storage area when not in use. The types of hazards and risks are of the type found within typical construction activities. Additionally, personnel working at KTF have the right and the obligation to refrain from participating in any operations that they believe to be unsafe to people or to the environment. Personnel also have the authority to halt inappropriate operations.

3.14.3.3 KTF Pre-launch Operations

Two general types of operations at KTF involve explosive hazards. These explosives are categorized as: solid rockets and payload ordnance. Ordnance safety measures include those described in policies, procedures, plans, and work control documents to prevent premature, unintentional, or unauthorized detonation of ordnance. Any program using a new type of ordnance device for which proven safety procedures have not been established requires an Explosive Safety Approval before the ordnance is allowed on PMRF or used on a test range. This approval involves a detailed analysis of the explosives and of the proposed test activities, procedures, and facilities for surveillance and control, an adequacy analysis of movement and control procedures, and a design review of the facilities where the ordnance items will be handled.

In regard to rocket and ordnance operations and hazards, examples of controls addressed within the policies, procedures, plans, and work control documents established to ensure worker safety include:

- Prior to shipment to KTF by PMRF personnel, all rocket motors and associated explosives are safely inspected, commensurate with age and pedigree, by the rocket system integrator usually with input from the original motor manufacturer.
- All rocket motors and other explosive

components, except those in process, are kept stored in the explosive storage magazines under the control of PMRF.

- All explosive components are returned to PMRF storage when no longer needed to meet operational schedules.
- All explosive containers must be labeled and marked according to appropriate standards.
- All containers of explosives must be covered and the cover securely fastened before storing.
- All cranes, hoists, launchers, and launcher loading equipment required for an operation involving explosives shall be functional and load proof-tested.
- Rigging equipment shall be inspected before use.
- Testing of safety-related equipment in ordnance handling facilities shall be recorded on a KTF Ordnance Certificate and posted in a conspicuous location in the facility. The certificate shall indicate test dates, expiration dates, and the name(s) of personnel performing the tests.
- All explosive assemblies, transport dollies, handling equipment and personnel will be connected to a common ground to equalize the electrical potential between them. (SNL 2018c)

PMRF personnel are responsible for all test vehicle assembly and ordnance movement within PMRF and KTF. These individuals establish roadblocks and barricades to ensure no unauthorized access is obtained by individuals not essential to the test vehicle assembly/ordnance movement. Further, flashing yellow lights on test vehicle assembly tow vehicles indicate that assemblies or ordnance are in the process of being moved and that all unauthorized site personnel should stay outside of the designated hazard areas.

3.14.3.4 KTF Test Vehicle Assembly Activities

To ensure worker safety, integration and assembly of test vehicles occur within designated hazard areas. Since each launch is unique, hazard area restrictions for all launch pad configurations are specific to each launch and the specific hazards to be encountered during that specific launch are addressed. However, there are some common controls that are implemented that have been established to ensure the safety and health of all personnel involved in test vehicle assembly activities. Examples of these controls include:

- The specific hazard radius area for a specific launch is cleared of all non-mission-essential personnel for all operations involving transport of ordnance, power switching, the application of any signals to on-board systems, or movement of the launcher when the vehicle assembly is uploaded.
- Only mission-essential personnel are allowed within the AEB at the discretion of the Safety Officer during or after final arming of the test vehicle assembly for the following reasons:
 - To perform first stage arming functions such as resistive measurements, stray voltage measurements, and booster arming plug installation or removal
 - To switch AC power to launchers and launcher control systems through appropriate circuit breakers located within the AEB (SNL 2018c)

Further, a flashing red light at the facility indicates that hazardous work is in progress and that hazardous conditions are present. The maximum number of mission-essential personnel that are allowed into the AEB and LOB is posted at the facility entrance and is limited to those individuals necessary to perform the required operations plus official observers as designated by the Safety Officer and the Test Director. The facilities are off-limits to all non-essential personnel when test vehicle assemblies or other ordnance are present.

3.14.3.5 KTF Launch Operations

Prior to operations, all personnel who are active participants in hazardous operations are required to read and comply with the provisions set forth in M&O policies, procedures, technical documents, and work control packages that abide by all Federal and state requirements, and applicable DOE and NNSA policies, guidelines, and requirements.

During launch operations, all authorized personnel not at an assigned duty station as required by the type of operation or not authorized to be in the LOB, are evacuated to a point beyond the explosive quantity safety distance and GHA established for that specific launch. The launch pad is also off-limits to all non-essential personnel when test vehicle assemblies are present on the pad. When a rail launcher is loaded with a test vehicle assembly, the pad is cleared of all people and the Safety Officer directs the launcher remotely. Further, once test vehicle assemblies have been loaded onto the launcher, launcher control systems are placed in "Local" mode or turned off when personnel are working at the pad.

In the event of a test vehicle misfire, all systems are returned to a safe condition, and the launcher area restricted to all personnel for a minimum of 30 minutes. The M&O contractor and PMRF personnel evaluate the conditions and determine an appropriate course of action. All explosive, pyrotechnic, and propellant wastes, including those resulting from misfires, are classified as Category-L material and are evaluated by a designated Interim Hazard Classifier. PMRF is responsible for emergency disposal of explosives (SNL 2018c).

3.15 Resource Area Not Evaluated

The SNL/KTF SWEA does not evaluate any aspects of radioactive waste or mixed waste (mixed hazardous and radioactive waste), including management, transport, or disposal. KTF operations do not generate radioactive or mixed waste, and no radioactive or mixed waste is currently stored on-site.



Environmental Consequences

This chapter presents an analysis of the potential direct and indirect effects of each alternative on the affected environment. Cumulative impacts for each resource area are addressed at the end of this Section.

4.1 Proposed Action

4.1.1 Land Use

4.1.1.1 Construction and Modification

Construction and modification activities as defined in the Proposed Action are within the current designation for KTF and would have no impact to land use.

4.1.1.2 Launch Operations

If the Proposed Action were adopted, potential impacts from launch operations, larger test vehicle assembly launches, and post launch activities would be negligible to land use and remain within the current designation. Therefore, no impacts would occur.

Surrounding areas to KTF within the GHA for a specific launch would be closed off and cleared of persons before and during a launch but would remain open at all other times.

4.1.1.3 Non-Launch Operations

Non-launch operations such as maintenance activities and environmental monitoring would have no impact to land use and no impacts are anticipated.

4.1.2 Geology and Soils

4.1.2.1 Construction and Modifications

Some construction and modification activities would require ground disturbance, particularly clearing, grading, digging, and trenching. Boring depths up to 16 ft. would be needed for lightning protection poles; foundations would be installed at depths up to 12 ft. These construction activities would be performed primarily in the KTF launch field and would not affect dunes. Impacts to geology would be small.

Approximately 60,000 sq. ft. of ground would be disturbed for construction of various foundations and roads (see Section 4.1.7.1.2). Small effects to soil profiles from ground disturbance could occur through erosion and sediment transport. The potential for adverse impacts would be minimized through implementation of best management practices (BMPs), particularly erosion and sediment controls, as specified in the M&O Laboratory Policy System.

Fuel and lubricants in equipment used during construction activities present the potential for soil contamination. To minimize the potential impact to soils, equipment would be refueled on impermeable surfaces and equipment would be inspected regularly for safety, cleanliness, and leaks. Leaking equipment would be removed from service and repaired.

4.1.2.2 Launch Operations

Launch operations would cause only minimal ground-disturbance as the concrete launch pad would deflect the force of the blast during launches. No impacts to geology would be anticipated.

Launches could result in the deposition of contaminants from propellant combustion over time. The greater frequency of launches and propellant weight of rockets under the proposed action could increase the likelihood of contaminant deposition. To date, surface soil sampling and analysis for metals by Terrestrial Surveillance Program personnel have indicated no detectable environmental impacts to soil from KTF operations. Terrestrial surveillance will continue for metals in surface soil.

4.1.2.3 Non-Launch Operations

Non-launch operations would involve minimal ground-disturbance from construction or maintenance of fire breaks; clearing; mowing; off-road driving; or equipment use during small maintenance, repair, and D&D projects. No impacts to geology would be anticipated.

Maintenance operations may involve use of chemicals such as paints, lubricants, solvents, and herbicides, and equipment requiring diesel or gasoline as fuel. To avoid soil contamination, all products would be handled and/or applied in accordance with manufacturers' recommendations; applicable DOE and NNSA policies; M&O LPS; and SPCC Plan. Spills would be contained and cleaned up promptly. No impacts to soils would be anticipated.

4.1.3 Transportation and Traffic

4.1.3.1 Construction and Modifications

Construction and modification activities would lead to temporary increases in truck and worker vehicle traffic to and from KTF. Construction materials, including concrete, could be delivered from other parts of Kaua'i. Specialized components or materials may be flown to PMRF or delivered by ship to Nawiliwili Harbor for truck transport to KTF along the Kaumualii Highway. Traffic delays from trucks transporting wide loads would be rare. Transport of wide loads would be coordinated with police or local transportation officials. Effects from additional vehicles on roadways would be small and temporary.

4.1.3.2 Launch Operations

Launch operations would involve transport of launch vehicles, including rocket motors, to KTF from the PMRF airfield. This transport would take place within the boundaries of PMRF; no effects to the public would occur.

During launch campaigns, individuals would fly via commercial airlines to Lihue and drive to KTF and PMRF, individually or with multiple people per vehicle. Individuals would stay in either PMRF accommodations (restricted to DoD personnel and contractors) or off-facility Kaua'i hotels, motels, or rentals during the one- to two-week preparation and launch period, driving to PMRF and KTF each day. Launch-related traffic from off-facility accommodations would converge on Route 50 from Waimea to the PMRF Main Gate at Tartar Drive. Under the proposed action, this traffic could be a regular occurrence, with as many as 20 launches per year; however, additional traffic would represent only an incremental increase in traffic through the area, less than 10 percent of vehicles, and would not change the level of service for Route 50. Only small changes to transportation and traffic would occur.

4.1.3.3 Non-Launch Operations

During non-launch operations, typically only 14 full-time staff would be present at KTF, in addition to temporary contract staff for some maintenance projects. No effects on transportation and traffic would occur.

4.1.4 Air Quality

4.1.4.1 Construction and Modifications

Emission of pollutants from construction and modification activities would occur from combustion of fuel in equipment and machinery, increased vehicle use for workers, and the introduction of dust during ground disturbing activities. Based on the analysis presented in the Hawaii Range Complex EIS (Navy 2008), which analyzed pollutant emissions from these same types of sources for a much greater level of construction at the PMRF than is included in the proposed action, none of the emissions generated by construction and modifications at KTF would exceed the highest *de minimis* (In risk assessment, it refers to the highest level of risk that is still too small to be concerned with. Therefore, only risk levels above this *de minimis* level must be addressed and managed) or “conformity threshold” levels of 100 tons per year of criteria air pollutants. The activities at KTF would include construction BMPs to reduce production of construction dust, including frequent watering of work areas, covering truck loads, and hauling on paved roads. Asbestos derived from D&D activities is addressed in Sections 4.3.10 and 4.1.14.5.

4.1.4.2 Launch Operations

For air emission impacts, rocket launches are short-term, discrete events that would occur at widely spaced times at KTF. Because of this, the effects of individual launch operations would not be additive, and impacts would not accumulate with multiple launches. Introduction of pollutants to the air would occur intermittently over a campaign, from transport of launch vehicle assemblies to KTF, additional launch personnel traffic, equipment and generators used to support the launch, and the launch itself.

Transport of launch vehicle assemblies would include cargo plane transport of launch vehicle assemblies to the PMRF airfield and hauling this equipment by truck from the airfield to KTF. Air operations at the PMRF airfield in 2009 were estimated to number 25,486 landings and takeoffs. As demonstrated by the analysis in the Flexible Target Family EA (MDA 2007), the additional 320 flights (1.3% increase annually) required to support the 20 rocket launches annually under the proposed action would not

exceed any Federal *de minimis* quantities. The analysis also shows that increased emissions from the truck traffic used to transport the assemblies to KTF would be extremely small, well below Federal *de minimis* levels. The impact to air quality from air and ground transport of the launch vehicles would be short-term.

During the launch campaign, up to 500 individuals would rotate through KTF and PMRF, with a maximum of approximately 100 additional individuals present at any one time. Typically, these personnel would drive each day to KTF and PMRF from accommodations in Lihue. As shown in Section 4.1.3, this additional traffic on local roads would represent only an incremental increase in traffic through the area, less than 20 percent of vehicles. The additional emissions from fuel combustion would be small and temporary.

Equipment used to prepare the launch, such as cranes and trucks, would result in pollutant emissions at KTF. These emissions would be a small fraction of those that would occur from construction, and thus would be short-term.

Two 320-kW diesel engine generators would be used to provide a consistent and reliable source of power during all stages of launch operations. Generators are used full-

De Minimis

Under the existing air quality regulations, *de minimis* emission levels are listed for each criteria pollutant. In creating the *de minimis* emission levels, USEPA sought to limit the need to conduct conformity determinations for actions with minimal emission increases. When the total direct and indirect emissions from the project or action are below the *de minimis* levels, the project or action would not be subject to a conformity determination.

time during a launch countdown. Whenever KIUC goes down during a launch campaign, generators are utilized to maintain environmental control. These generators are the only stationary sources of air emissions at KTF and are permitted by the State of Hawaii for operation under a Noncovered Source Permit (NSP-0429-01-N, September 2015 to September 2020). The permit limits the operating hours of the two units combined to a maximum of 6,000 hours in any 12-month period, the sulfur content in the fuel to a maximum of 0.0015%, and the fuel's cetane index to a minimum of 40. KTF met all permit conditions for the calendar year 2017, and reported the highest total combined operating hours for a 12-month period as

3,968.30 hours. Under the proposed action, the combined number of hours of generator use would be managed to remain less than the currently permitted 6,000 hours. KTF would continue to use ultra-low sulfur content diesel fuel and meet the cetane index requirement, and operate the generators on a temporary, short-term basis.

Rocket launches are characterized by intense combusive reactions over a short period of time, which result in exhaust streams of varying sizes, depending on the size of the launch vehicle. The most common exhaust components for typical rockets include aluminum oxide, carbon dioxide, carbon monoxide, hydrogen, hydrogen chloride, nitrogen, water, ferric chloride, ferric oxide, nitric oxide, chlorine, and sulfur dioxide. To “bound” the analysis of potential air emissions from rocket launches under the proposed action, the analysis focuses on the largest rocket proposed. The largest rocket that would be launched from KTF under the proposed action would have a NEW of 55,000 pounds. A comparable rocket to this is the Flexible Target Family LV-2 vehicle, which has a NEW of 56,418 pounds and was analyzed in the Flexible Target Family EA (MDA 2007).

Analysis of the LV-2 in that document was accomplished by using previous analyses of a much larger rocket, the Peacekeeper, which has a propellant mass of over 95,000 pounds. Because the Peacekeeper was so much larger than the LV-2, with a propellant weight almost twice that of the LV-2, it was determined that the LV-2 would have less impacts than the Peacekeeper. Based on the previous analysis of the Peacekeeper, the FTF EA concludes that emissions from launch of the LV-2 would be expected to be within NAAQS standards (MDA 2007). Thus, by comparison, the air emissions from launch of the largest rocket proposed under the proposed action would also be expected to be within NAAQS standards, and to have temporary impacts in areas to which the general public would have access, i.e., outside of the GHA. Because the rocket booster is moving away from the point of launch, only a small portion of the launch exhaust would be emitted near the launch area. Any short-term exhaust emissions within the GHA would quickly dissipate through atmospheric dispersion.

The proposed Large Vehicle Class assembly would potentially release exhaust components in the atmosphere in amounts no greater than the following:

- Fused aluminum oxide (Al_2O_3) = 14,900 lbs.
- Carbon Monoxide (CO) = 12,100 lbs.
- Hydrogen chloride (HCl) = 900 lbs.
- Nitrogen (N_2) = 9,000 lbs.

- Dihydrogen monoxide (water) (H_2O) = 1,600 lbs.
- Carbon dioxide (CO_2) = 800 lbs.
- Chlorine (Cl) = 20 lbs.

4.1.4.3 Non-Launch Operations

Maintenance activities at KTF would require temporary use of equipment and machinery (e.g., backhoes, haul trucks) on a sporadic short-term basis. Generator use would also be sporadic and short-term, as most non-launch operations rely on the KIUC power distribution system. Thus, the air emissions from these sources would be less than analyzed above.

4.1.5 Airspace

4.1.5.1 Construction and Modifications

Construction and modification of infrastructure, utilities, or facilities at KTF would have no potential to impact airspace designations or airspace use in the ROI.

4.1.5.2 Launch Operations

Transportation of vehicle assemblies to KTF would include use of cargo flights to PMRF, resulting in an increase in air transportation operations. However, these discrete events would occur at widely-spaced times, with an increased annual maximum of 20 launches under the proposed action. Air transportation would be conducted in accordance with existing airspace use requirements and PMRF standard operating procedures, and require no changes to airspace designations.

Launches of test vehicles from KTF would not require changes to existing controlled and uncontrolled airspace in the ROI. Currently designated special use airspace, including Restricted Area R-3101 and Warning Areas W-188 and W-186, would remain in effect. NNSA would continue to coordinate airspace use with PMRF, which controls the restricted area and warning areas in communication with the FAA, Honolulu Control Facility, and Oakland ARTCC.

Launches would occur within the Restricted Area R-3101, from which aircraft are routinely excluded during launches. All other local flight activities occur at sufficient distance and altitude such that the KTF vehicle launches would not require changes to or create a hazard to these flight activities and associated airports or airfields. The regulations, policies, and procedures described in Section 3.5.3.1 would continue to be followed during launch activities. To ensure safe operations, PMRF would continue to request use of specific areas of airspace from

the FAA during launches. The FAA would issue a NOTAM to avoid specific areas until each launch is complete.

4.1.5.3 Non-Launch Operations

Non-launch operations would have no potential to impact airspace designations or airspace use in the ROI.

4.1.6 Noise

4.1.6.1 Construction and Modifications

Construction and modification activities would result in noise produced by equipment and machinery. Peak levels of noise at these sources would range from 93 to 108 dBA, and at 400 feet away would attenuate to 55 to 84 dBA (Navy 2008). These activities and the noise produced would be temporary. Personnel onsite during these activities would wear appropriate hearing protection devices in accordance with DOE regulation and directive as well as NNSA policy requiring compliance with applicable OSHA standards. Increased noise levels would not extend outside of PMRF boundaries. Increased equipment and worker vehicle traffic associated with construction activities would result in small temporary increases in road noise.

4.1.6.2 Launch Operations

Noise would be introduced during each launch campaign from transport of launch vehicle assemblies to KTF, traffic from launch personnel, equipment and generators used to prepare the launch, and the launch itself. At all stages of launch operations, DoD, NNSA, customer, and contractor personnel would wear appropriate hearing protection devices in accordance with DOE regulation and directive as well as NNSA policy requiring compliance with applicable OSHA standards.

Transport of launch vehicles would include cargo plane transport of launch vehicle assemblies to the PMRF airfield. Air operations at the PMRF airfield in 2009 were estimated to number 25,486 landings and takeoffs. While the landings and takeoffs could be heard outside of PMRF boundaries, the noise from an additional 320 flights (1.3% increase annually) would not be noticeable to the public. Launch vehicles and other equipment would then be transported by truck through PMRF to KTF and would not be noticeable to the offsite public.

During the launch campaign, up to 500 additional individuals would rotate through the KTF and PMRF, with a maximum of approximately 100 additional individuals present at any one time. Typically, these individuals would drive each day to KTF and PMRF from

accommodations in Lihue. As shown in Section 4.1.3, this additional traffic would represent only an incremental increase in traffic through the area, less than 20 percent of vehicles, and would result in only a small change to the noise environment.

Equipment used to prepare the launch, such as cranes and trucks, would result in the introduction of elevated, localized noise. This noise would occur as distinct events spread over a time period of four to six weeks, and as shown above for construction activities, the increased noise levels would not extend outside of PMRF boundaries. Two generators would be used to provide a consistent and reliable source of power during all stages of launch operations over the launch campaign. Noise from the generators would be 96 dBA at the source, attenuating to 58 dBA at a distance of 400 feet (Navy 2008). Thus, noticeably increased noise would not extend outside of PMRF boundaries.

Noise produced during launches stems from the interaction of the exhaust jet with the atmosphere and the combustion of the fuel, thus the sound pressure is related to the engine's net explosive weight (NEW). The largest rocket that would be launched from KTF under the proposed action would have a NEW of 55,000 pounds. A comparable rocket to this is the Flexible Target Family LV-2 vehicle, which has a NEW of 56,418 pounds. Analysis of the LV-2 (MDA 2007) shows that launch noise levels under the proposed action would not exceed DoD, NNSA, or OSHA safety requirements outside of the GHA. While personnel and the public outside of the GHA may be startled, awakened, or distracted by the launch noise, these noise events would be infrequent and noticeable for only a brief period of time. People in the nearest off-installation residential area in Kekaha (approximately 7 miles away) would notice the launch, but would experience slightly increased noise for no more than 30 seconds. As stated above, personnel within the GHA would be located within the launch operation building.

In addition to the noise of the rocket launch, sonic booms are possible. Sonic booms from KTF launches do not occur over land and would not affect the public (ASMD 2011). Offshore vessels impacted by sonic booms would be expected to experience sound resembling mild thunder (Navy 2008).

4.1.6.3 Non-Launch Operations

Maintenance activities at KTF would require temporary use of equipment and machinery on a sporadic short-term basis. Generator use would also be sporadic and short-term, as most non-launch operations rely on the KIUC power distribution system. The resulting increased

noise levels would not extend beyond the PMRF boundary, and when dictated by DOE regulation and directive as well as NNSA policy requiring compliance with applicable OSHA standards, onsite personnel would wear hearing protection devices.

4.1.7 Water Resources

4.1.7.1 Construction and Modifications

4.1.7.1.1 Surface Water Quality

Some construction and modification would require clearing, grading, digging, and trenching involving use of heavy equipment (e.g., bulldozers, backhoes, trucks). During these activities, suspended sediments could be carried in stormwater runoff from precipitation events during construction periods, impacting local drainage features if BMPs are not properly implemented. The use of heavy equipment could affect both the hydrology and water quality through increased turbidity, sedimentation, overland flow, or contamination of water bodies through accidental spills or leaks of fuel or oil.

The potential for impacts would be minimized through implementation of project controls as specified in the M&O LPS. Construction activities planned to collectively disturb one or more acres of land would require coverage under the NPDES General Permit Authorizing Discharges of Storm Water Associated with Construction Activity (Hawaii Administrative Rules Chapter 11-55, Appendix C). Following permit coverage, stormwater controls (BMPs) and pollution prevention measures detailed in the Stormwater Pollution Prevention Plan (SWPPP) would be required to be installed/implemented. Examples of these BMPs are as follows:

- Ensuring erosion and sediment controls remain in effective operating condition during the project activities.
- Refueling equipment at least 100 ft. from any storm drain or ditch.
- Inspecting equipment regularly for safety, cleanliness, and leaks, and implementing appropriate controls at staging areas. Leaking equipment would be removed from service and repaired.
- Protecting material and soil stockpiles from contact with stormwater using a perimeter sediment barrier.

4.1.7.1.2 Stormwater Runoff

Ground disturbance generally results in an increased

potential for stormwater runoff, erosion, and sediment transport. Erosion and sediment transport are addressed in Section 4.1.2.1. Construction of several project elements would increase the area of impermeable surfaces at KTF:

- Five concrete slabs, covering a total of approximately 25,000 square feet (sq. ft.)
- New auxiliary equipment building
- Road extension, covering approximately 24,000 sq. ft.
- Asphalt apron, concrete pad, and concrete foundation associated with the modified rail launch -system, covering approximately 6,000 sq. ft.

Construction of these project elements would result in an increase in the impervious surface area at KTF of approximately 60,000 sq. ft., although there would be an offset to some degree by decontamination and demolition of some existing structures. Stormwater runoff quantity (with commensurate increases in the potential for surface water contamination) is not projected to increase substantially as this project would be subject to the requirements of Section 438 of the *Energy Independence and Security Act* of 2007. Guidance on implementing the stormwater runoff requirements under the Act (USEPA 2009) would be implemented, where appropriate and feasible, to minimize increases in stormwater runoff. Further, high permeability and rapid infiltration of KTF soils would continue to limit flow of stormwater runoff. A minor increase in the quantity of stormwater runoff from the site would be anticipated as a result of the 60,000 sq. ft. increase of impervious surface area.

4.1.7.1.3 Groundwater

Section 4.1.2 addresses potential contamination of soils from fuel and lubricants in equipment used during construction activities. Contaminants from spills or leaks from equipment could migrate to groundwater, but procedures would be implemented during construction and modification activities to reduce the likelihood of uncontrolled releases and perform rapid cleanup if such releases were to occur.

4.1.7.1.4 Wetlands and Floodplains

No environmentally-sensitive habitat is located within or near the boundaries of the KTF. No construction or modification activities would occur within water bodies or essential fish habitat. There are no wetlands on the KTF or PMRF. Thus, there would be no impacts to these resources.

Most of the construction and modification activities would take place outside of the 100-year floodplain. The Missile Service Tower (MST) replacement is located in Flood Insurance Risk Zone VE, a 100-year flood zone with base flood elevations ranging from 18 to 26 feet and additional storm-wave hazards. However, the location of the MST would not change and the footprint would not increase substantially, thus the project would not change the flood hazard.

4.1.7.2 Launch Operations

4.1.7.2.1 Surface Water Quality

Section 4.1.2 addresses potential contamination of soils during launch operations from deposition of contaminants from propellant combustion over time. Contaminants in soils could be transported into surface water through stormwater runoff. Launches could result in the deposition of contaminants from propellant combustion over time. The greater frequency of launches and propellant weight of rockets under the proposed action could increase the likelihood of contaminant deposition. To date, surface soil sampling and analysis for metals by Terrestrial Surveillance Program personnel have indicated no detectable environmental impacts to soil from KTF operations. Terrestrial surveillance would continue for metals in surface soil.

4.1.7.2.2 Stormwater Runoff

Launch operations would not result in changes to the hydrology of KTF; no effects to the quantity of stormwater runoff would be anticipated.

4.1.7.2.3 Groundwater

Section 4.1.2 addresses potential contamination of soils from deposition of contaminants from propellant combustion over time. Contaminants in soils could migrate into groundwater. Launches could result in the deposition of contaminants from propellant combustion over time. The greater frequency of launches and propellant weight of rockets under the proposed action could increase the likelihood of contaminant deposition. To date, surface soil sampling and analysis for metals by Terrestrial Surveillance Program personnel have indicated no detectable environmental impacts to soil from KTF operations. Terrestrial surveillance would continue for metals in surface soil.

4.1.7.2.4 Wetlands and Floodplains

No environmentally-sensitive habitat is located within or near the boundaries of the KTF, and there are no wetlands on the KTF or PMRF. Thus, there would be no impacts to

these resources.

Many launch operation activities would take place outside of the 100-year floodplain. The MST, which would be used for launching of the larger proposed rocket, is located in the 100-year flood zone. However, the use of the MST would not change from current uses.

4.1.7.3 Non-Launch Operations

4.1.7.3.1 Surface Water Quality

Section 4.1.2 addresses potential contamination of soils during non-launch operations from use of chemicals such as paints, lubricants, solvents, and herbicides, and equipment requiring diesel or gasoline as fuel. Contaminants in soils could be transported into surface water through stormwater runoff. To avoid soil contamination, all products would be handled and/or applied in accordance with manufacturers' recommendations; applicable PMRF requirements; and SPCC Plan. Spills would be contained and cleaned up promptly. No impacts to surface water quality would be anticipated.

4.1.7.3.2 Stormwater Runoff

Non-launch operations would not result in changes to the hydrology of KTF; no effects to the quantity of stormwater runoff would be anticipated.

4.1.7.3.3 Groundwater

Section 4.1.2 addresses potential contamination of soils during non-launch operations from use of chemicals such as paints, lubricants, solvents, and herbicides, and equipment requiring diesel or gasoline as fuel. Contaminants in soils could migrate into groundwater. To avoid soil contamination, all products would be handled and/or applied in accordance with manufacturers' recommendations; applicable PMRF requirements; and SPCC Plan. Spills would be contained and cleaned up promptly. No impacts to groundwater quality would be anticipated.

4.1.7.3.4 Wetlands and Floodplains

No environmentally-sensitive habitat is located within or near the boundaries of the KTF. No non-launch operational activities would occur within water bodies or essential fish habitat. There are no wetlands on the KTF or PMRF. Thus, there would be no impacts to these resources.

Most of the non-launch activities would take place outside of the 100-year floodplain. Those occurring within the floodplain would be minor, and would not change the

location or footprint of facilities and infrastructure.

4.1.8 Biological Resources

4.1.8.1 Construction and Modifications

Construction of new facilities and infrastructure and some modifications to existing facilities and infrastructure would occur within KTF boundaries. These activities would require ground disturbance, particularly clearing, grading, digging, and trenching involving the use of heavy equipment (e.g., bull dozers, backhoes, etc.). Ground disturbance could result in increased erosion, though this would be controlled through implementation of construction BMPs. Use of equipment fuel, lubricants, paints, and solvents would present the potential for soil contamination, though the likelihood of contamination would be reduced by implementing BMPs for use, inspection, and cleanup.

Peak levels of noise produced by equipment and machinery would be temporary, range from 93 to 108 dBA, at 400 feet away would attenuate to 55 to 84 dBA (Navy 2008), and not extend outside of PMRF boundaries. Increased equipment and worker vehicle traffic associated with construction activities would result in small temporary increases in road noise.

4.1.8.1.1 Vegetation

No activities would take place along the shore or offshore in marine areas. Thus, no impacts would be anticipated to marine vegetation. Vegetation in the areas where construction and modification activities would take place (on the KTF) primarily consists of ruderal species that propagate in disturbed locations. No threatened or endangered plant species are located on the KTF. Thus, impacts to terrestrial vegetation from construction and modification activities would be minimal.

4.1.8.1.2 Wildlife

No activities would take place along the shore or offshore in marine areas. Increased noise and human activity would likely caused intermittent, temporary displacement of some terrestrial wildlife, particularly birds and small mammals that forage, feed, or nest within and adjacent to the KTF. It is expected that these individuals would return to the area and to normal activity after the noise-producing events have ended. Most wildlife is likely already habituated to people and noise associated with ongoing activities at the KTF. No construction activities would take place within the dunes or near the water sources used by water birds. Bird migration patterns would not be altered. Whenever Laysan Albatross are

located within an area on KTF slated for construction activities, BASH relocation efforts would be implemented per the Navy's INRMP (Navy 2010). These impacts to wildlife would be minimal.

All construction activities would be undertaken during daylight hours; however, night-time artificial lighting could be needed for security. Night lighting would have the potential to cause fallout of nocturnally active seabirds. Newell's Shearwater (ESA threatened and MBTA protected species), Hawai'ian Petrel (ESA endangered and MBTA protected species), and Band-rumped Storm-Petrel (ESA endangered species) would be at risk for this phenomenon from construction night lighting (Navy 2010). In accordance with the USFWS Biological Opinion (BO) (USFWS 2018; see Appendix A), measures to address the effects of construction-related night lighting would be implemented by NNSA and the Navy to reduce the occurrence of fallout and impacts. These measures would include reducing the use of night lighting as much as possible, keeping exterior lighting correctly positioned and shielded, and keeping doors and windows shielded when in use during nighttime hours. However, even with such measures in place, the potential for incidental takes of these species would remain.

4.1.8.1.3 Other Biological Resources

The entire State of Hawai'i is designated as a Coastal Zone. Even though Federal facilities and activities are not subject to the state's Coastal Zone Management Plan, Federal agencies are directed by law to be consistent to the maximum extent practicable. The proposed action requires a determination evaluating the consistency of KTF activities with the policies of the Hawai'i Coastal Act (ASMDC 2011). The activities under the proposed action are incremental increases in activities that already occur at KTF and which were previously found to be consistent to the maximum extent practicable with the Hawai'i Coastal Act in the 1998 PMRF Enhanced Capability Final EIS (Navy 1998; ASMDC 2011).

4.1.8.2 Launch Operations

Transport of launch vehicles would include cargo plane transport of launch vehicle assemblies to the PMRF airfield from the mainland. Based on previous analysis of rocket assembly transport, this would require an estimated 320 landings and takeoffs annually (MDA 2007) to accommodate the 20 rocket launches under the proposed action. Launch vehicles and other equipment would then be transported by truck through PMRF to KTF.

During a launch campaign, up to 500 individuals would rotate through KTF and PMRF, with a maximum of

approximately 100 additional individuals present at any one time. Equipment and machinery would be used to assemble, fuel, and emplace rockets on launch pads. Launches would consist of a single rocket.

Noise would be introduced during each launch campaign, from transport of launch vehicle assemblies to KTF, traffic from launch personnel, equipment and generators used to prepare the launch, and the launch itself (see Section 4.1.6). Launches would be single, distinct events that would occur during widely spaced times and would result in brief, short-term noise introduced to the environment. In addition to the noise of the rocket launch, sonic booms are possible. Sonic booms from KTF launches do not occur over land, and offshore would sound like mild thunder (Navy 2008).

Launches at KTF could result in the deposition of contaminants from propellant combustion into the soil over time. The greater frequency of launches and propellant weight of rockets under the proposed action would increase the likelihood of contaminant deposition. To date, surface soil sampling and analysis for metals by SNL Terrestrial Surveillance Program personnel have indicated no detectable environmental impacts to soil from KTF operations. Terrestrial surveillance would continue for metals in surface soil.

4.1.8.2.1 Vegetation

No launch operations would take place offshore in marine areas and there would be no impacts to marine vegetation. Vegetation in the areas where launch activities would take place (on the KTF) primarily consists of ruderal species that propagate in disturbed locations. Vegetation near the launch pads could have temporary distress from the heat generated at launch and from hydrogen chloride or aluminum oxide emissions. Vegetation is normally cleared from areas adjacent to the launch pad and the duration of high temperatures is only a few seconds. After two decades of launches at KTF, there has been no evidence of long-term adverse effect on vegetation (ASMDC 2011). No threatened or endangered plant species are located on the KTF.

4.1.8.2.2 Wildlife

No activities would take place along the shore or offshore in marine areas. No activities would take place within the dunes or near the water sources used by water birds. Bird migration patterns would not be altered.

Because transport of launch components from the mainland would occur, the risk for introduction of invasive species is present. Compliance with relevant Navy policies and procedures would limit the potential for introduction

of invasive species. Inbound flights carrying cargo from the mainland and landing at PMRF are advised to inspect and secure their cargo prior to shipment to ensure it is free of invasive species. Equipment (specifically missile defense test components) flown directly to PMRF from the mainland is primarily packaged or containerized by the manufacturer in virtually sterile conditions with regard to the potential for invasive species. When equipment is introduced from the mainland to PMRF via USAF transport, it is required to be cleaned of any soil/debris and inspected prior to loading, and it is also inspected on the PMRF airfield when the cargo arrives (ASMDC 2011). With these procedures in place, the risk for introduction of invasive species would be reduced.

Transport of launch components to PMRF would require an increased number of landings and takeoffs at the PMRF airfield, though only a 1.3% increase under the proposed action. This would increase the risk for BASH, particularly for the Laysan Albatross, an MBTA-protected species that shows a preference for nesting near the runway. With BASH management activities conducted at PMRF in accordance with the INRMP (Navy 2010), as explained above, the risk for increased bird/aircraft strikes would be reduced.

The combination of increased noise levels and human activity during launch preparations would likely displace some terrestrial wildlife, particularly birds and small mammals that forage, feed, or nest within and adjacent to the KTF. This would be a short-term, minimal impact. Relocation measures would be implemented per the Navy's INRMP (Navy 2010) whenever Laysan Albatross are located in the vicinity of launch activities.

In general, prelaunch and launch activities would be undertaken during daylight hours. However, there is the potential that some activities would occur at night, requiring lighting, and that nighttime security lighting would be required. Night lighting would have the potential to cause fallout of nocturnal seabirds during their flights between inland breeding colonies in the mountains of Kaua'i and their at-sea foraging areas (Navy 2010; ASMDC 2011). In accordance with the USFWS BO (USFWS 2018; see Appendix A), measures to address the effects of launch-related night lighting would be implemented by NNSA and the Navy to reduce the occurrence of fallout and impacts. These measures, whenever possible, would include preferentially scheduling launches for January through early September (outside of Newell's Shearwater fledgling season), scheduling launches outside of dark moon phases, reducing the use of night lighting, keeping exterior lighting correctly positioned and shielded, and

keeping doors and windows shielded when in use during nighttime hours. However, even with such measures in place, the potential for incidental takes of these species would remain.

Launch-related noise would be localized, intermittent, and short-term. Noise from launches may startle nearby wildlife and cause flushing behavior in birds, but this startle reaction would be of short duration. The increased presence of personnel, vehicles, and equipment immediately before a launch would tend to cause birds and other wildlife to temporarily leave the area that would be subject to the highest level of launch noise (ASMDC 2011). It is expected that these individuals would return to the area and to normal activity after the noise-producing activities have ended. Terrestrial species at KTF are already habituated to high levels of noise associated with ongoing activities at this facility, and the brief noise peaks produced by rocket launches would be comparable to levels produced by thunder at close range (120 to 140 db peak; Navy 2017). The offshore waters where marine wildlife reside would be subject to much lower sound pressure levels as sound attenuates with distance from the launch site.

KTF is separated from the shoreline and Green Turtle (ESA threatened) haul-out areas by Nohili Dune. Historically-observed Hawai'ian Monk Seal (ESA endangered and MMPA-protected) haul-out areas tend to be further south along the PMRF, away from the sharp limestone outcroppings of the surf zone near KTF. In addition, the Navy's Standard Operating Procedures (SOPs) for launches dictate to hold a launch if a Monk Seal is within the explosives safety quantity distance (ESQD) arc, and that launches are to be delayed if Humpback Whales (MMPA-protected), Hawai'ian Monk Seals, or Green Turtles are observed in the offshore launch safety zone. The short duration of the launch noise, combined with noise attenuation, the sheltering created by Nohili Dune, and implementation of Navy SOPs, would result in minimal impacts from noise to wildlife and ESA-protected species. (ASMSC 2011; Navy 2017)

Monitoring conducted for previous launches at the KTF for potential emissions impacts to wildlife indicated little effect on wildlife due to the low-level, short-term exhaust emissions (Navy 2017). The program included surveys of bird and mammals for both prelaunch and post-launch conditions. Birds flying through an exhaust plume could be exposed to concentrations of hydrogen chloride that could irritate eye and respiratory membranes; however, most birds would not come into contact with the plume because of their startle flight away from the initial launch noise. Deposition of aluminum oxide onto skin, fur, or

feathers would not cause injury because it is inert and not absorbed into the skin. Within offshore waters, the potential ingestion of contaminants by marine species would be remote due to atmospheric dispersion of the emission cloud and diluting effects of the ocean water. Because aluminum oxide and hydrogen chloride do not bioaccumulate, no indirect effects on the food chain would be anticipated from the exhaust emissions (Navy 2017).

A potential effect from spent boosters and missile debris falling into the waters off the coast and onto marine species from nominal launch activities would be extremely unlikely, and the potential for any impacts would only be expected to individuals at or near the surface. It is unlikely that pieces of sinking debris would have sufficient velocity to harm individuals lower in the water column. Navy SOPs state that launches are to be delayed if Humpback Whales, Hawai'ian Monk Seals, or Green Turtles are observed in the offshore launch safety zone. Debris from KTF launches would not be expected to produce any measurable impacts on offshore benthic (sea floor) resources (Navy 2017). The potential for an object dropping from the air to affect marine species would be less than 1 in a million (ASMDC 2001, 2011), resulting in limited risk.

4.1.8.2.3 Other Biological Resources

Within offshore waters, the potential ingestion of contaminants by fish would be remote because of atmospheric dispersion of the emission cloud, the diluting effects of the ocean water, and the relatively small area of EFH that would be included. By the time spent rocket motors would impact the ocean, generally all of the propellant in them would have been consumed. Any residual aluminum oxide, burnt hydrocarbons, or other propellant materials would not be expected to present toxicity concerns. (ASMDC 2011)

The proposed action requires a determination evaluating the consistency of KTF activities with the policies of the Hawai'i Coastal Act (ASMDC 2011). The launch activities under the proposed action would be incremental increases in activities that already occur at KTF and which were previously found to be consistent to the maximum extent practicable with the Hawai'i Coastal Act in the 1998 PMRF Enhanced Capability Final EIS (Navy 1998; ASMDC 2011).

4.1.8.3 Non-Launch Operations

Non-launch operations would involve minimal ground-disturbance from construction or maintenance of fire breaks; clearing; mowing; off-road driving; or equipment

use during small maintenance, repair, and D&D projects. Maintenance activities at KTF would require temporary use of equipment and machinery on a sporadic short-term basis. Generator use would also be sporadic and short-term, as most non-launch operations rely on the KIUC power distribution system.

4.1.8.3.1 Vegetation

No activities would take place along the shore or offshore in marine areas. Vegetation in the areas where non-launch operations would take place (on the KTF) primarily consists of ruderal species that propagate in disturbed locations. No threatened or endangered plant species are located on the KTF. Thus, no impacts are anticipated to terrestrial or marine vegetation from non-launch operations.

4.1.8.3.2 Wildlife

No activities would take place along the shore or offshore in marine areas. Noise and human activity would likely cause intermittent, temporary displacement of some terrestrial wildlife, particularly birds and small mammals that forage, feed, or nest within and adjacent to the KTF. It is expected that these individuals would return to the area and to normal activity after the noise-producing events have ended. Most wildlife is likely already habituated to people and noise associated with ongoing activities at the KTF. No activities would take place within the dunes or near the water sources used by water birds. Bird migration patterns would not be altered.

Relocation of Laysan Albatross adults and eggs would be conducted in accordance with the Navy's INRMP (Navy 2010) whenever the species is located within an area on the KTF slated for maintenance activities.

All non-launch operations would be undertaken during daylight hours. Night-time artificial lighting may be needed for special projects or security. Night lighting would be used in accordance with the USFWS BO (USFWS 2018; see Appendix A), and measures to address the effects of night lighting would be implemented by NNSA to reduce the occurrence of fallout and impacts to the Newell's Shearwater, Hawai'ian Petrel, and Band-rumped Storm-Petrel. These measures would include reducing the use of night lighting as much as possible, keeping exterior lighting correctly positioned and shielded, and keeping doors and windows shielded when in use during nighttime hours. However, even with such measures in place, the potential for incidental takes of these species would remain.

4.1.8.3.3 Other Biological Resources

The proposed action requires a determination evaluating the consistency of KTF activities with the policies of the Hawai'i Coastal Act (ASMDC 2011). The non-launch activities under the proposed action would be activities that already occur at KTF and which were previously found to be consistent to the maximum extent practicable with the Hawai'i Coastal Act in the 1998 PMRF Enhanced Capability Final EIS (Navy 1998; ASMDC 2011).

4.1.9 Cultural Resources

4.1.9.1 Construction and Modifications

Construction of new facilities and infrastructure and some modifications to existing facilities and infrastructure would require ground disturbance, particularly clearing, grading, digging, and trenching involving the use of heavy equipment (e.g., bull dozers, backhoes, etc.). This work would have the potential to impact subsurface archaeological deposits on KTF; there are no surface archaeological deposits on KTF. No potential for ground disturbance would occur outside the KTF boundary.

Construction and ground disturbance generally result in an increased potential for surface-water runoff, erosion, and sediment transport. This could have the potential to impact archaeological deposits. This potential would be minimized through development of appropriate drainage features as part of construction, and implementation of construction BMPs. Archaeological review of the area prior to the construction and placement of the drainage features would occur to ensure no disturbance of archaeological resources. Further, an archaeologist would be present during any ground-disturbing construction activities.

All ground disturbing work would be conducted in accordance with the Navy's ICRMP (Navy 2012). This document details procedures to be implemented by the M&O contractor to minimize or mitigate harm to archaeological resources located on the KTF, and includes procedures for monitoring ground-disturbing activities and processes for treatment of inadvertent discoveries of archaeological deposits. In the event that human remains are discovered, the Navy would be responsible for implementing the procedures in their NAGPRA CA to determine custody, treatment, and disposition of the remains and any associated funerary objects (Navy 2011).

If consultation with the State Historic Preservation Officer (SHPO) results in a determination that a facility is eligible to the National Register and would be adversely affected by proposed modifications, NNSA would continue to consult with the SHPO to develop appropriate mitigation measures.

As modifications to existing KTF facilities are proposed, NNSA would document and evaluate the facility for its National Register eligibility, and, if found eligible to the register, determine the effect of the proposed modifications on that property. Only one extant building/structure has undergone eligibility evaluation and consultation with the SHPO, the Missile Service Tower, which was found to be not eligible. NNSA would consult with the SHPO on its determinations. If consultation with the SHPO results in a determination that a facility is eligible to the National Register and would be adversely affected by proposed modifications, NNSA would continue to consult with the SHPO to develop appropriate mitigation measures .

4.1.9.2 Launch Operations

All of the launches under the proposed action, including those of the new larger rocket, would fit within the existing 10,000-foot GHA. Each launch would result in brief, short-term noise introduced to the environment, which could impact the setting of traditional cultural places in the vicinity; however, because the rocket launches are single, distinct events that would occur at widely spaced times at KTF, the impact would be temporary.

4.1.9.3 Non-Launch Operations

Non-launch operations would involve minimal ground-disturbance from construction or maintenance of fire

breaks; clearing; mowing; off-road driving; or equipment use during small maintenance, repair, and D&D projects. This work would have the potential to impact archaeological deposits on KTF. All ground disturbing activities would be conducted in accordance with the Navy's ICRMP (Navy 2012).

Maintenance activities and other non-launch operations at KTF would require use of equipment fuel, lubricants, paints, and solvents that present the potential for soil contamination and associated impacts to subsurface archaeological deposits. The likelihood of contamination would be reduced by implementing policies such as handling all products in accordance with manufacturer's recommendations; refueling on impermeable surfaces; inspecting equipment regularly for safety, cleanliness, and leaks; removing leaking equipment from service; and performing rapid cleanup if such releases were to occur.

4.1.9.4 Cultural Resources at KTF

Archaeological investigations on KTF have included surface survey, test excavations, auger tests, and monitoring. A surface survey conducted in 1990 covered most of the KTF area. The 42 extant buildings and structures at KTF were built between 1961 and 1992. Twenty-seven of them were built in the 1960s, thus they meet the regulatory age (i.e., 50 years old) to be considered for eligibility to the National Register. No systematic assessment and recording of architectural resources on

Table 18 - National Register Eligibility Evaluation Status for Buildings that Would Undergo Changes under the Proposed Action.

Bldg. No.	Year Built	Description	Activities Under the Proposed Action	Evaluation Status
619	1964	Launch Pad 19 with 7.5k Rocket Launcher	Install lightning protection towers	Recorded by SNL, recommended not eligible, awaiting DOE evaluation then consultation with SHPO
645	1988	Auxiliary Equipment Building at Launch Pad 42	Reroof building	Recorded by SNL, recommended not eligible, awaiting DOE evaluation then consultation with SHPO
646	1988	Missile Service Tower	Tower replacement	Recorded by SNL, recommended not eligible, DOE evaluation as not eligible, SHPO concurrence received
647	1988	Missile Assembly Building	Reroof building	Recorded by SNL, recommended not eligible, awaiting DOE evaluation then consultation with SHPO

SNL = Sandia National Laboratories; DOE = Department of Energy; SHPO = State Historic Preservation Officer

KTF has been conducted. As facility actions are proposed, buildings or structures that will be impacted are recorded and evaluated for National Register eligibility, and the DOE consults with the Hawai'i SHPO on their determination. Only one extant building/structure has undergone eligibility evaluation and consultation with the SHPO, the Missile Service Tower, which was found to be not eligible. Table 18 shows the status of the National Register eligibility evaluation for each of the buildings that would undergo changes under the Proposed Action.

4.1.10 Hazardous Materials and Waste Management

4.1.10.1 Construction and Modifications

4.1.10.1.1 Hazardous Materials

Construction and modifications would require the use of equipment fuel, lubricants, paints, and solvents that present the potential for soil contamination and associated impacts. The likelihood of contamination would be reduced by handling all products in accordance with manufacturer's recommendations; refueling on impermeable surfaces; inspecting equipment regularly for safety, cleanliness, and leaks; removing leaking equipment from service; and performing rapid cleanup if such releases were to occur.

Some construction and modification activities involve use of chemicals, typical of what would be found on a construction site and similar in type and quantity to chemicals currently stored and used at KTF. These chemicals include fuel for equipment, lubricants, acetylene for welding, paints and coatings, solder, and cleaning solvents. Chemicals are handled, applied, and stored in accordance with DOE and NNSA policy. No impacts related to hazardous materials would be anticipated.

4.1.10.1.2 Waste Management

Industrial waste (e.g., construction debris) would be generated by construction and modifications work under the proposed action. Existing KTF waste minimization and pollution prevention measures would be applied to control the extent of the waste increase. Concrete and asphalt would be recycled at a local facility. Waste quantities would not exceed existing waste management capacities for removal or disposal at the local landfill; however, the County of Kaua'i projects that the Kekaha Landfill will reach capacity in 2028 to 2030, and is planning a new landfill near Lihue (County of Kaua'i 2018). No increase in hazardous waste generation would be expected.

4.1.10.2 Launch Operations

4.1.10.2.1 Hazardous Materials

Only minimal increases in the current quantities and use of chemicals are expected because of the increase in the number of launch operations at KTF. Chemicals are handled, applied, and stored in accordance with DOE and NNSA policy. No impacts related to hazardous materials would be anticipated.

4.1.10.2.2 Waste Management

Additional onsite population during launch operations would increase generation of non-hazardous solid waste over current levels. Small increases in the quantity of hazardous waste (primarily used motor oil and hydraulic fluid) would be expected because of a larger number of launch operations. None of these would exceed existing waste management or recycling capacities. No impacts to waste management facilities would be anticipated.

4.1.10.3 Non-Launch Operations

4.1.10.3.1 Hazardous Materials

Type and quantities of hazardous materials used and stored would be similar to those currently at KTF, as described in Section 3.10.3.1. Current quantities and uses of chemicals are expected to be similar. No impacts related to hazardous materials would be anticipated.

4.1.10.3.2 Waste Management

Types and quantities of solid and hazardous waste would be similar to those currently generated at KTF, as described in Section 3.10.3.2. None of these would exceed existing waste management or recycling capacities. No impacts from waste generation or to waste management facilities would be anticipated.

4.1.11 Infrastructure Resilience

4.1.11.1 Construction and Modifications

New construction and existing structure modifications would meet industry standards for an area susceptible to hurricanes and flooding. Reinforced concrete and structural steel would be employed where appropriate. Structures would be designed and built to tolerate high winds and minor flooding without damage and would be situated in areas of KTF not prone to erosion. The MST is located within the 100-year floodplain as discussed in Section 3.7.3.2. No changes to infrastructure resilience would be anticipated.

4.1.11.2 Launch Operations

Facility infrastructure is designed to withstand wind and minor flooding from extreme weather events. Launches could be delayed during high wind events, but facility infrastructure should require only minor repairs after high wind or heavy rain events to become operational. No changes to infrastructure resilience would be anticipated.

4.1.11.3 Non-Launch Operations

Non-launch operations could be affected by weather events, for example, delaying maintenance because of heavy rainfall, but infrastructure should withstand these events without major damage or effect to non-launch operations.

4.1.12 Energy and Water Use

4.1.12.1 Construction and Modifications

4.1.12.1.1 Energy Use

Heavy equipment used for construction and modification activities would require gasoline or diesel fuel. Other equipment would use electricity supplied by either KIUC or on-site diesel generators. Energy demands would be temporary and met using existing infrastructure; no impacts would be anticipated.

4.1.12.1.2 Water Use

Primary water use during construction and modification activities would be for dust suppression for land-disturbing activities (e.g., grading) and exposed soil. Water trucks may be used, with water coming from the PMRF water supply system. Construction water demand would be temporary and met using existing infrastructure.

4.1.12.2 Launch Operations

4.1.12.2.1 Energy Use

During launch operations, air conditioning units on the Launch Operations Building, Missile Assembly Building, Rocket Motor Staging Area, and Missile Service Tower consume electrical power. On-site diesel generators operate to provide consistent electrical power to mission critical elements and to supplement KIUC power. Higher launch frequencies under the proposed action could substantially increase annual electric energy consumption because of a longer period of operation. Because the system delivering KIUC electricity is at approximately 10 percent of capacity, excess capacity exists to accommodate higher annual consumption and peak use. Some of the higher electrical use may also be accommodated through greater use of the on-site diesel generators.

Energy use would remain within system capacity.

4.1.12.2.2 Water Use

Launch operations would involve up to 100 individuals onsite over a 4- to 6-week period. These personnel would require water for domestic uses (e.g., drinking, sanitary purposes). Water is also used for pre-launch fire prevention by spraying water on vegetation near the launch pad. The increase in water demand would be minor and accommodated by existing infrastructure.

4.1.12.3 Non-Launch Operations

4.1.12.3.1 Energy Use

Non-launch operations would involve substantially less permanent staff (typically 14 full-time) and less electricity use (total and peak) than launch operations, described above. Air conditioning of the main building would require energy, though on-site diesel generators are generally shut down. Energy use would remain within system capacity. No impacts from energy use would be anticipated.

4.1.12.3.2 Water Use

Approximately 14 individuals would be present at KTF during non-launch operations. These personnel would require water for domestic uses (e.g., drinking, sanitary purposes). No activities associated with non-launch operations require notable quantities of water. Water demand would be minimal.

4.1.13 Socioeconomics and Environmental Justice

4.1.13.1 Construction and Modifications

4.1.13.1.1 Socioeconomics

Many, if not most, additional construction personnel would already reside on Kauaʻi. Non-Kauaʻi residents may be used for construction projects, especially specialized tasks, but effects would be small and temporary. Expenditures on construction materials would be a small net benefit to the local economy.

4.1.13.1.2 Environmental Justice

As described in Section 3.13.3, approximately 70 percent of the population of Kauaʻi County is people of color. Since this population is greater than 50 percent, adverse environmental effects could be considered as disproportionately high in affecting minority populations, therefore subject to further consideration as impacts under environmental justice (CEQ 1997).

The environmental effects of construction and modification activities under the proposed action have been described in Section 4.1 for each resource area. For some of these resource areas, ROIs are limited to KTF, which reduces the potential of environmental-justice-related impacts. For resource areas where ROIs extend beyond KTF and PMRF, effects would be small or negligible. Because none of these effects meet the criteria for “disproportionately high and adverse,” construction and modification activities under the proposed action would have no adverse impacts under environmental justice.

4.1.13.2 Launch Operations

4.1.13.2.1 Socioeconomics

KTF expenditures on Kauaʻi may increase because of a higher number of launches and up to 500 individuals during the launch campaign, with a maximum of approximately 100 additional individuals present at any one time. The Kauaʻi hospitality industry would see the greatest increase in expenditures from launch-related personnel, primarily lodging and restaurants. Because Kauaʻi’s economy is dominated by tourism, these additional individuals would represent only a small increase in economic activity within the ROI.

4.1.13.2.2 Environmental Justice

The environmental effects of launch operations under the proposed action have been described in Section 4.1

for each resource area. For some of these resource areas, ROIs are limited to KTF, which reduces the potential of environmental-justice-related impacts. For resource areas where ROIs extend beyond KTF and PMRF, effects would be small or negligible. Because none of these effects meet the criteria for “disproportionately high and adverse,” launch operations under the proposed action would have no impacts under environmental justice.

4.1.13.3 Non-Launch Operations

4.1.13.3.1 Socioeconomics

Overall employment at KTF (typically 14 full-time staff) would remain small and constant, which, in turn, would tend to maintain socioeconomic characteristics within the ROI. There would be no change in effects to existing housing and community services within the ROI. The overall socioeconomic effect would remain small.

4.1.13.3.2 Environmental Justice

The environmental effects of non-launch operations under the proposed action have been described in Section 4.1 for each resource area. For some of these resource areas, ROIs are limited to KTF, which reduces the potential of environmental-justice-related impacts. For resource areas where ROIs extend beyond KTF and PMRF, effects would be small or negligible. Because none of these effects meet the criteria for “disproportionately high and adverse,” non-launch operations under the proposed action would have no impacts under environmental justice.

4.1.14 Human Health and Safety

4.1.14.1 Construction and Modifications

Personnel from the M&O contractor and PMRF would adhere to established precautions during the planning and execution of the range operations training and test activities to prevent injury to human life or property. The potential for impacts, hazards, or risks from operational activities would be moderated by strict adherence to various KTF/PMRF site policies, procedures, work control documents, and processes established by Federal and state regulations, DOE/NNSA, DoN, PMRF, and the M&O contractor. Launch activities would not occur at the same time as other regional programs. M&O personnel and PMRF range operations management would regulate the site preparation, pre-launch and launch operations and activities to ensure that established safety procedures and protocols are followed.

Concrete pad upgrades and trenching have the potential

for construction-related accidents and injuries to the construction crew. However, no health and safety impacts would be expected to occur during construction and modification activities. A work site safety plan would be required before any project could begin to reduce potential risks to the health and safety. All employees would be notified of potential hazards associated with their work during a pre-job briefing and they would be trained in proper use of any materials they would be handling. Personnel would also be trained in the proper use of safety equipment and would conduct their activities in accordance with 10 CFR 851 and M&O policy. Construction activities associated with the proposed action would be considered routine and limited risks to health and safety would be anticipated minimal. As a result, no impacts to health and safety would be expected.

4.1.14.2 Launch Operations

The launching of test vehicle assemblies, by nature, would involve some risk. As such, the M&O contractor and PMRF personnel would implement established specific launch and range safety policies, procedures, and work controls to ensure that any potential risks to personnel, the public, and government assets are minimized. All of the policies and documents used to govern work are consistent with DoD-approved U.S. Navy Explosive Site Plans for the site/facility involved, as well as technical standard DOE-STD-1212-2012, Explosive Safety.

All missions and projects would be closely reviewed and analyzed to ensure that there are no unacceptable risks to the public, government and military personnel, and contractors. An arrangement between the County of Kaua'i, Department of Land and Natural Resources, the U.S. Navy, PMRF, and KTF for the temporary restriction of public entrance to off-base property within the established Ground Hazard Area (GHA) would be in place prior to the day of launch. The arrangement would allow security forces or county police to restrict the public from areas within the GHA.

During both the exercise and the actual launch of any test vehicle assembly that would utilize the 10,000 ft. GHA, the clearing of the proposed GHA would begin 3 hours before a launch, with the area verified clear 1 hour before launch. The proposed GHA and the overwater launch safety zone would be reopened as soon as the Range Safety Officer declares the area safe, which could be approximately 30 minutes after a launch. In the event that debris or other hazards exist in the proposed GHA after a launch, the Range Safety Office may continue to close the area until it is safe to reenter. PMRF personnel would notify the State of Hawai'i and other landowners at

least 7 days prior to launch before exercising rights under the GHA agreement.

To minimize risk to the public in these areas, security forces on the ground, in boats, and in helicopters (if necessary) would use sweep-and-search measures to ensure that all areas within the proposed GHA are verified to be clear of people (except mission-essential personnel) prior to each scheduled launch. In addition, security forces would set up control points along the road into the proposed GHA to monitor and clear traffic during launch operations. Mission-essential individuals would be located in the LOB in the GHA. Immediately after a successful launch, security forces would provide the all-clear signal, and the public would be allowed to reenter the area.

4.1.14.3 Non-Launch Operations

Potential occupational-related effects on safety and health for workers involved in the performance of non-launch operations are possible. The types of hazards and risks associated with custodial and maintenance activities are of the type found within a typical work environment. Any potential impacts or risks would be moderated with M&O policies, work control documentation, and standards that have been developed in compliance with all applicable DOE regulations and standards, including 10 CFR 851, DOE Order 450.2 Chg. 1, Integrated Safety Management, and DOE Order 231.1B Chg. 1, Environment, Safety, and Health Reporting. Personnel working at KTF would exercise good housekeeping practices. Work areas would be maintained to be clean, safe, and orderly at all times. Tools, supplies, and materials would be returned to their proper storage area when not in use. No health and safety impacts would be expected to occur during non-launch operations.

4.1.14.4 Decontamination and Demolition of Select Structures at KTF

During decontamination and demolition activities there would be the potential for exposure to asbestos fibers located in KTF structures. A work site safety plan would be required before any project could begin to reduce potential risks to the health and safety. All employees would be notified of potential hazards associated with their work during a pre-job briefing and they would be trained in proper use of any materials they would be handling. Further, all work activities would be performed in accordance with M&O policy established to comply with DOE regulations and the Environmental Protection Agency Asbestos NESHAP. No health and safety impacts would be expected to occur during decontamination and demolition activities.

4.2 No Action Alternative

Non-launch operations under the no action alternative are the same as those under the proposed action, resulting in the same types, duration, and intensity of impacts. Non-launch operations would include facility maintenance and upkeep, and materials and waste management. Maintenance activities at KTF would require temporary use of equipment and machinery on a sporadic short-term basis.

4.2.1 Land Use

4.2.1.1 KTF Land Use Agreement

NNSA and DoN are currently in negotiations to update the 1966 Agreement into a modern land use permit between the agencies. Active negotiations occurred in 2014 but were delayed due to personnel changes within the NNSA but are expected to begin again in 2019. One critical decision in the new land use permit is determining the site's legal boundaries. PMRF, NNSA and NTESS mutually agree to the boundaries set forth on the attached map. However, PMRF is interested in reducing the site's total size by about 26 acres. Due to the adverse effects a site reduction would have to NNSA's operational flexibility, NNSA will work closely with PMRF to understand how both agencies can achieve their missions within the appropriate boundary of the site.

4.2.2 Geology and Soils

4.2.2.1 Construction and Modifications

Under the no action alternative, construction and modification activities would be limited to construction of small structures, such as storage or equipment buildings, and upgrades to existing infrastructure, such as electrical, wastewater, and stormwater drainage systems. Some of these activities would require minor ground disturbance, to a lesser degree than described under the proposed action. Impacts to geology would be negligible.

Small effects to soil profiles from soil disturbance could occur. Through implementation of project controls, as described under the proposed action, impacts to soil would be negligible.

As described under the proposed action, fuel and lubricants in equipment used during construction activities present the potential for soil contamination, though these activities would be more limited under the no action alternative. To minimize the potential impact to soil, equipment would be refueled on impermeable surfaces and equipment would be inspected regularly for

safety, cleanliness, and leaks. Leaking equipment would be removed from service and repaired.

4.2.2.2 Launch Operations

Launch operations would involve only minor ground-disturbance. No impacts to geology would be anticipated.

Launches could result in the deposition of contaminants to soil from propellant combustion over time. The frequency of launches and propellant weight of rockets would be similar under the no action alternative to historic levels, and, to date, surface soil sampling and analysis for metals by Terrestrial Surveillance Program personnel have indicated no detectable environmental impacts to soil from KTF operations, making soil impacts unlikely. Terrestrial surveillance would continue for metals in surface soil.

4.2.2.3 Non-Launch Operations

Non-launch operations would be the same as under the proposed action, as described in Section 4.1.2. No impacts to geology or soils would be anticipated.

4.2.3 Transportation and Traffic

4.2.3.1 Construction and Modifications

Construction and modification activities would lead to temporary increases in truck and worker vehicle traffic to and from KTF, but at a lower level than described under the proposed action in Section 4.1.3. Construction materials could be delivered from other parts of Kaua'i. Specialized components or materials may be flown to PMRF or delivered by ship to Nawiliwili Harbor for truck transport to KTF. Traffic delays from trucks transporting wide loads would be rare. Effects from additional vehicles on roadways would be small and temporary.

4.2.3.2 Launch Operations

Effects to transportation and traffic under no action alternative launch operations would be the same as described for the proposed action in Section 4.1.3. The frequency of launches would be lower, with a maximum of 9 launches per year, resulting in fewer potential periods of extra traffic. Only small changes to transportation and traffic would occur.

4.2.3.3 Non-Launch Operations

During non-launch operations, typically only 14 full-time staff would be present at KTF, in addition to temporary contract staff for some maintenance projects. No effects

on transportation and traffic would occur.

4.2.4 Air Quality

4.2.4.1 Construction and Modifications

Air quality impacts occurring under construction and modifications conducted under the no action alternative would be the same as current operations.

Emission of pollutants from these activities would occur from combustion of fuel in equipment and machinery, increased vehicle use for workers, and the introduction of dust during ground disturbing activities. Based on the analysis presented in the Hawaii Range Complex EIS (Navy 2008), which analyzed pollutant emissions from these same types of sources for a much greater level of construction at the PMRF than is included in the proposed action, none of the emissions generated by construction and modifications at KTF would exceed the highest *de minimis* or “conformity threshold” levels of 100 tons per year. The activities at KTF would include implementation of construction BMPs to reduce production of construction dust, including frequent watering of work areas, covering truck loads, and hauling on paved roads. Asbestos derived from D&D activities is addressed in Sections 4.3.10 and 4.1.14.5.

4.2.4.2 Launch Operations

There would be half as many launches under the no action alternative (9 versus 20), and no launches of the larger vehicle. Air quality impacts occurring under the no action alternative would remain the same as current operations.

Rocket launches are short-term, discrete events that would occur at widely spaced times at KTF. Because of this, the effects of individual launch operations would not be additive, and impacts would not accumulate with multiple launches. Introduction of pollutants to the air would occur intermittently over a launch campaign, from transport of launch vehicle assemblies to KTF, additional launch personnel traffic, equipment and generators used to support the launch, and the launch itself.

Transport of launch vehicle assemblies would include cargo plane transport of launch vehicle assemblies to the PMRF airfield and hauling this equipment by truck from the airfield to KTF. Air operations at the PMRF airfield in 2009 were estimated to number 25,486 landings and takeoffs. As demonstrated by the analysis in the Flexible Target Family EA (MDA 2007), the additional 144 flights (0.5% increase annually) required to support the 9 rocket launches annually under the no action alternative would

not exceed any Federal *de minimis* quantities. The analysis also shows that increased emissions from the truck traffic used to transport the assemblies to KTF would be extremely small, well below Federal *de minimis* levels. The impact to air quality from air and ground transport of the launch vehicles would be short-term and in line with current operations.

During a launch campaign, approximately 100 additional individuals would be present at KTF and PMRF over the two-week launch pad activity. Typically, these individuals would drive each day to KTF and PMRF from accommodations in Lihue. As shown in Section 4.1.3, this additional traffic on local roads would represent only an incremental increase in traffic through the area, less than 10 percent of vehicles. The additional emissions from fuel combustion would be small and temporary and in line with current operations.

Equipment used to prepare the launch, such as cranes and trucks, would result in air emissions at KTF. These emissions would be a small fraction of those that would occur from construction.

Two 320-kW diesel engine generators would be used to provide a consistent and reliable source of power during all stages of launch operations over the two-week launch pad activity. These generators are the only stationary sources of air emissions at KTF and are permitted by the State of Hawaii for operation under a Noncovered Source Permit (NSP-0429-01-N, September 2015 to September 2020). The permit limits the operating hours of the two units combined to a maximum of 6,000 hours in any 12-month period, the sulfur content in the fuel to a maximum of 0.0015%, and the fuel’s cetane index to a minimum of 40. KTF met all permit conditions for the calendar year 2017, and reported the highest total combined operating hours for a 12-month period as 3,968.30 hours. Under the no action alternative, the combined number of hours of generator use would be expected to remain approximately the same and within the permit levels. KTF would continue to use ultra-low sulfur content diesel fuel and meet the cetane index requirement, and operation of the generators would continue to be on a temporary, short-term basis.

Rocket launches are characterized by intense combustive reactions over a short period of time, which result in exhaust streams of varying sizes, depending on the size of the launch vehicle. The most common exhaust components for typical rockets include aluminum oxide, carbon dioxide, carbon monoxide, hydrogen, hydrogen chloride, nitrogen, water, ferric chloride, ferric oxide, nitric oxide, chlorine, and sulfur dioxide. To “bound” the analysis of potential air emissions from rocket launches

under the no action alternative, the analysis focuses on the largest rocket proposed. The largest rocket that would be launched from KTF under the no action alternative would be equivalent to the STARS rocket, with a NEW of 31,000 pounds. Previous air quality analysis of the STARS rocket determined that exhaust emissions would not produce exceedances of the NAAQS in areas where the public would have access (i.e., outside the GHA) (ASMDC 2011). Because the rocket booster is moving away from the point of launch, only a small portion of the launch exhaust would be emitted near the launch area. The GHA would be evacuated of all personnel before any launch, and mission-essential personnel would be located within the LOB. Any short-term exhaust emissions within the GHA would quickly dissipate through atmospheric dispersion.

This largest test vehicle assembly under the No Action Alternative would potentially release exhaust components in the atmosphere in amounts no greater than the following:

- Fused aluminum oxide (Al_2O_3) = 4,900 lbs.
- Carbon Monoxide (CO) = 3,900 lbs.
- Hydrogen chloride (HCl) = 4,100 lbs.
- Nitrogen (N_2) = 3,200 lbs.
- Dihydrogen monoxide (water) (H_2O) = 3,700 lbs.
- Hydrogen (H_2) = 300 lbs.
- Carbon dioxide (CO_2) = 630 lbs.
- Other = 65 lbs.

Various smaller motors (among others) as described in Table 3 in Section 2.3.1.2 would also be used by KTF; however, those emissions would be within the threshold limits identified above.

4.2.4.3 Non-Launch Operations

Non-launch operations under the no action alternative would be the same as those under the proposed action, resulting in the same level of impacts. Maintenance activities at KTF would require temporary use of equipment and machinery (e.g., backhoe, haul truck) on a sporadic short-term basis. Generator use would also be sporadic and short-term, as most non-launch operations rely on the KIUC power distribution system.

4.2.5 Airspace

4.2.5.1 Construction and Modifications

Modification of infrastructure, utilities, or facilities at KTF would have no potential to impact airspace designations or airspace use in the ROI.

4.2.5.2 Launch Operations

Transportation of vehicle assemblies to KTF includes the use of cargo flights to PMRF, which results in a temporary increase in normal air transportation operations. However, these discrete events occur at widely-spaced times, with an annual maximum of 9 rockets under the no action alternative. Air transportation would be conducted in accordance with existing airspace use requirements and PMRF standard operating procedures, and require no changes to airspace designations.

Launches of vehicles from KTF would not require changes to existing controlled and uncontrolled airspace in the ROI.

Launches would occur within the Restricted Area R-3101, from which general and military aircraft are routinely excluded during launches. All other local flight activities occur at sufficient distance and altitude such that the KTF vehicle launches would not require changes to or create a hazard to these flight activities and associated airports or airfields. The regulations, policies, and procedures described in Section 3.5.3.1 would continue to be followed during launch activities. To ensure safe operations, PMRF would request use of specific areas of airspace from the FAA during launches. The FAA would issue a NOTAM to avoid specific areas until each launch is complete.

4.2.5.3 Non-Launch Operations

Non-launch operations would have no potential to impact airspace designations or airspace use in the ROI.

4.2.6 Noise

4.2.6.1 Construction and Modifications

Modification activities would result in noise produced by equipment and machinery. Peak levels of noise at these sources would range from 93 to 108 dBA, and at 400 feet away would attenuate to 55 to 84 dBA (Navy 2008). These activities and the noise produced would be temporary. Personnel onsite during these activities would wear appropriate hearing protection devices in accordance with DOE regulation and directive as well as NNSA policy requiring compliance with applicable OSHA standards.

Increased noise levels would not extend outside of PMRF boundaries. Increased equipment and worker vehicle traffic associated with construction activities would result in small temporary increases in road noise.

4.2.6.2 Launch Operations

Noise would be introduced during each launch campaign from transport of launch vehicle assemblies to KTF, traffic from launch personnel, equipment and generators used to prepare the launch, and the launch itself. At all stages of launch operations, DoD, NNSA, customer, and contractor personnel would wear appropriate hearing protection devices in accordance with DOE regulation and directive as well as NNSA policy requiring compliance with applicable OSHA standards.

Transport of launch vehicles would include cargo plane transport of launch vehicle assemblies to the PMRF airfield. Air operations at the PMRF airfield in 2009 were estimated to number 25,486 landings and takeoffs. While the landings and takeoffs could be heard outside of PMRF boundaries, the noise from an additional 144 flights (0.5% increase annually) would not be noticeable to the public. Launch vehicles and other equipment would then be transported by truck through PMRF to KTF and would not be noticeable to the offsite public.

During a launch campaign, up to 500 additional individuals would rotate through KTF and PMRF. Typically, these individuals would drive each day to KTF and PMRF from accommodations in Lihue. As shown in Section 4.1.3, this additional traffic would represent only an incremental increase in traffic through the area, less than 20 percent of vehicles, and would result in only a small change to the noise environment.

Equipment used to prepare the launch, such as cranes and trucks, would result in the introduction of elevated, localized noise. This noise would occur as distinct events spread over four to six weeks, and as shown above for construction activities, the increased noise levels would not extend outside of PMRF boundaries. Two generators would be used to provide a consistent and reliable source of power during all stages of the launch campaign. Noise from the generators would be 96 dBA at the source, attenuating to 58 dBA at a distance of 400 feet (Navy 2008). Thus, noticeably increased noise would not extend outside of PMRF boundaries.

The largest rocket that would be launched from KTF under the no action alternative would have a NEW of 31,000 pounds. A comparable rocket to this is the STARS vehicle, which has a NEW of 30,541 pounds. Analysis of the STARS rocket (MDA 2007; ASMDC 2001, 2011) shows that launch

noise levels under the no action alternative would not exceed DoD, DOE, or NNSA safety requirements outside of the GHA. Modeling of predicted noise levels for this rocket predicted a peak noise level of 91 dBA at 2 miles (ASMDC 2011). While personnel and the public outside of the GHA may be startled, awakened, or distracted by the launch noise, these noise events would be infrequent and noticeable for only a brief period of time. STARS launch noise has been measured at the nearest off-installation residential area in Kekaha (approximately 7 miles away) at 54 dBA, near ambient background levels for this location, and would not be expected to affect the residents of this town (MDA 2007; ASMDC 2001).

In addition to the noise of the rocket launch, sonic booms are possible. Sonic booms from KTF launches do not occur over land and would not affect the public (ASMDC 2011). Offshore vessels impacted by sonic booms would be expected to experience sound resembling mild thunder (Navy 2008).

4.2.6.3 Non-Launch Operations

Maintenance activities at KTF would require temporary use of equipment and machinery on a sporadic short-term basis. Generator use would also be sporadic and short-term, as most non-launch operations rely on the KIUC power distribution system. The resulting increased noise levels would not extend beyond the PMRF boundary, and when dictated by DOE regulation and directive as well as NNSA policy requiring compliance with applicable OSHA standards, onsite personnel would wear hearing protection devices.

4.2.7 Water Resources

4.2.7.1 Construction and Modifications

4.2.7.1.1 Surface Water Quality

Under the no action alternative, some construction and modification could require clearing, grading, digging, and trenching involving use of heavy equipment (e.g., bulldozers, backhoes, trucks), though these activities would occur over a smaller area than under the proposed action. During these activities, suspended sediments could be carried in stormwater runoff from precipitation events during construction periods, impacting local drainage features if BMPs are not properly implemented. The use of heavy equipment could affect both the hydrology and water quality through increased turbidity, sedimentation, overland flow, or contamination of water bodies through accidental spills or leaks of fuel or oil.

The potential for such impacts would be minimized

through implementation of project controls as specified in the M&O LPS. Construction activities planned to collectively disturb one or more acres of land would require coverage under the NPDES General Permit Authorizing Discharges of Storm Water Associated with Construction Activity (Hawaii Administrative Rules Chapter 11-55, Appendix C). Following permit coverage, stormwater controls (BMPs) and pollution prevention measures detailed in the SWPPP would be required to be installed/implemented. Examples of these BMPs are as follows:

- Ensuring erosion and sediment controls remain in effective operating condition during the project activities.
- Refueling equipment at least 100 feet from any storm drain or ditch.
- Inspecting equipment regularly for safety, cleanliness, and leaks, and implementing appropriate controls at staging areas. Leaking equipment would be removed from service and repaired.
- Protecting material and soil stockpiles from contact with stormwater using a perimeter sediment barrier.

4.2.7.1.2 Stormwater Runoff

Unlike the proposed action, construction and modifications under the no action alternative would result in no net increase of impermeable surfaces at KTF. Stormwater runoff quantity would be the same as currently exists at the facility.

4.2.7.1.3 Groundwater

Section 4.2.2 addresses potential contamination of soil from fuel and lubricants in equipment used during construction activities. Contaminants from spills or leaks from equipment could migrate to groundwater, but procedures would be implemented during construction and modification activities to reduce the likelihood of uncontrolled releases and perform rapid cleanup if such releases were to occur.

4.2.7.1.4 Wetlands and Floodplains

Most of the modification activities would take place outside of the 100-year floodplain. The MST, which would undergo some modification, is located in the 100-year flood zone; however, the location of the MST would not change and the footprint would not increase.

4.2.7.2 Launch Operations

4.2.7.2.1 Surface Water Quality

Section 4.2.2 addresses potential contamination of soil during launch operations from deposition of contaminants from propellant combustion over time. Contaminants in soils could be transported into surface water bodies through stormwater runoff. The frequency of launches and propellant weight of rockets would be in line with current levels; to date, surface soil sampling and analysis for metals by Terrestrial Surveillance Program personnel have indicated no detectable environmental impacts to soil from KTF operations, making such impacts unlikely. Terrestrial surveillance would continue for metals in surface soil.

4.2.7.2.2 Stormwater Runoff

Launch operations would not result in changes to the hydrology of KTF; no effects to the quantity of stormwater runoff would be anticipated.

4.2.7.2.3 Groundwater

Section 4.2.2 addresses potential contamination of soil from deposition of contaminants from propellant combustion over time. Contaminants in soils could migrate into groundwater. To date, surface soil sampling and analysis for metals by Terrestrial Surveillance Program personnel have indicated no detectable environmental impacts to soil from KTF operations. The frequency of launches and propellant weight of rockets would be in line with current levels. Terrestrial surveillance would continue for metals in surface soil.

4.2.7.2.4 Wetlands and Floodplains

Many launch operation activities would take place outside of the 100-year floodplain. Use of the MST, which is located in the 100-year flood zone would not change from current uses.

4.2.7.3 Non-Launch Operations

Non-launch operations would be the same as under the proposed action, as described in Section 4.1.7. Impacts of non-launch operations to surface water quality, stormwater runoff, and groundwater would be the same as current levels.

4.2.7.3.1 Wetlands and Floodplains

No environmentally-sensitive habitat is located within or near the boundaries of the KTF. No non-launch operational activities would occur within water bodies or essential fish habitat. There are no wetlands on the KTF

or PMRF.

Most of the non-launch activities would take place outside of the 100-year floodplain. Those occurring within the floodplain would be minor, and would not change the location or footprint of facilities and infrastructure.

4.2.8 Biological Resources

4.2.8.1 Construction and Modifications

4.2.8.1.1 Vegetation

No activities would take place along the shore or offshore in marine areas. Thus, no impacts would be anticipated to marine vegetation. Vegetation in the areas where modification activities would take place (on the KTF) primarily consists of ruderal species that propagate in disturbed locations. No threatened or endangered plant species are located on the KTF. Thus, impacts to terrestrial vegetation from modification activities would be minimal and in line with current operations.

4.2.8.1.2 Wildlife

No activities would take place along the shore or offshore in marine areas. The combination of increased noise levels and human activity would likely displace some terrestrial wildlife, particularly birds and small mammals that forage, feed, or nest within and adjacent to the KTF. These individuals would be expected to return once the noise ceases. No modification activities would take place within the dunes or near the water sources used by water birds. Bird migration patterns would not be altered. This would be a short-term, minimal impact. Whenever Laysan Albatross are located within an area on KTF slated for modification activities, BASH relocation efforts would be implemented per the Navy's INRMP (Navy 2010). These impacts to wildlife would be minimal and in line with current operations.

All modification activities would be undertaken during daylight hours; however, night-time artificial lighting could be needed for security. Night lighting would have the potential to cause fallout of nocturnally-active seabirds. In accordance with the USFWS BO (USFWS 2018; see Appendix A), measures to address the effects of construction-related night lighting would be implemented by NNSA and the Navy to reduce the occurrence of fallout and impacts. However, even with such measures in place, the potential for incidental takes of these species would remain.

4.2.8.1.3 Other Biological Resources

No environmentally-sensitive habitat is located within or

near the boundaries of the KTF. No modification activities would occur within water bodies or essential fish habitat. There are no wetlands on the KTF or PMRF. Thus, there would be no impacts to these resources.

The entire State of Hawai'i is designated as a Coastal Zone. The activities at KTF were previously found to be consistent to the maximum extent practicable with the Hawai'i Coastal Act in the 1998 PMRF Enhanced Capability Final EIS (Navy 1998; ASMDC 2011).

4.2.8.2 Launch Operations

Repeated sampling at KTF has shown no detectable presence of contaminants after decades of KTF operations. Ongoing terrestrial surveillance would continue to monitor for soil contamination.

4.2.8.2.1 Vegetation

No launch operations would take place offshore in marine areas and there would be no impacts to marine vegetation. Vegetation near the launch pads could have temporary distress from the heat generated at launch and from hydrogen chloride or aluminum oxide emissions. Vegetation normally would be cleared from areas adjacent to the launch pad and the duration of high temperatures would be only a few seconds. After two decades of launches at KTF, there has been no evidence of long-term adverse effect on vegetation (ASMDC 2011). No threatened or endangered plant species are located on the KTF. Thus, any impacts to terrestrial vegetation from launch activities would be minimal and in line with current operations.

4.2.8.2.2 Wildlife

No activities would take place along the shore or offshore in marine areas. No activities would take place within the dunes or near the water sources used by water birds. Bird migration patterns would not be altered. Relocation measures would be implemented per the Navy's INRMP (Navy 2010) whenever Laysan Albatross are located in the vicinity of launch activities.

Because transport of launch components from the mainland would occur, the risk for introduction of invasive species would be present. Compliance with relevant Navy policies and procedures would limit the potential for introduction of invasive species.

Transport of launch components to PMRF would require an increased number of landings and takeoffs at the PMRF airfield, though only a 0.5% increase under the no action alternative. This would increase the risk for BASH. With BASH management activities conducted at

PMRF in accordance with the Navy's INRMP (Navy 2010), as explained above, the risk for increased bird/aircraft strikes would be reduced and the impact would be less than significant.

There is the potential that some launch campaigns would occur at night, requiring lighting, and that nighttime security lighting would be required. Night lighting would have the potential to cause fallout of nocturnally-active seabirds (Navy 2010). In accordance with the USFWS BO (USFWS 2018; see Appendix A), measures to address the effects of launch-related night lighting would be implemented by NNSA and the Navy to reduce the occurrence of fallout and impacts. However, even with such measures in place, the potential for incidental takes of these species would remain.

Launch campaign noise would be localized, intermittent, and short-term, and arise from launches and increased activities. Terrestrial species are already habituated to high levels of noise associated with ongoing activities at this facility and would tend to temporarily leave the area.

The short duration of the launch noise, combined with noise attenuation, sheltering created by Nohili Dune, and implementation of Navy SOPs, would result in minor impacts from noise to wildlife. (ASMSC 2011; Navy 2017)

Monitoring conducted for previous launches at the KTF for potential emissions impacts to wildlife indicated little effect on wildlife due to the low-level, short-term exhaust emissions (Navy 2017). Within offshore waters, the potential ingestion of contaminants by marine species would be remote and no indirect effects on the food chain would be anticipated from the exhaust emissions (Navy 2017).

The potential for impacts to marine wildlife from missile debris or spent boosters would be negligible.

4.2.8.2.3 Other Biological Resources

No environmentally-sensitive habitat is located within or near the boundaries of the KTF, and there are no wetlands on the KTF or PMRF.

Within offshore waters, the potential ingestion of contaminants by fish would be remote.

The launch operations activities under the no action alternative were previously found to be consistent to the maximum extent practicable with the Hawai'i Coastal Act in the 1998 PMRF Enhanced Capability Final EIS (Navy 1998; ASMDC 2011).

4.2.8.3 Non-Launch Operations

4.2.8.3.1 Vegetation

No activities would take place along the shore or offshore in marine areas. Vegetation in the areas where non-launch operations would take place (on the KTF) primarily consists of ruderal species that propagate in disturbed locations. No threatened or endangered plant species are located on the KTF. Thus, no impacts are anticipated to terrestrial or marine vegetation from non-launch operations.

4.2.8.3.2 Wildlife

No activities would take place along the shore or offshore in marine areas. Noise and human activity would likely cause intermittent, temporary displacement of some terrestrial wildlife, particularly birds and small mammals that forage, feed, or nest within and adjacent to the KTF. It is expected that these individuals would return to the area and to normal activity after the noise-producing events have ended. Most wildlife is likely already habituated to people and noise associated with ongoing activities at the KTF. No activities would take place within the dunes or near the water sources used by water birds. Bird migration patterns would not be altered. Whenever Laysan Albatross are located within an area on KTF slated for activities, BASH relocation efforts would be implemented per the Navy's INRMP (Navy 2010). These impacts to wildlife would be short-term and minimal, and in line with current operations.

All non-launch operations would be undertaken during daylight hours. Night-time artificial lighting could be needed for special projects or security. Night lighting would be used in accordance with the USFWS BO (USFWS 2018; see Appendix A), and measures to address the effects of night lighting would be implemented by NNSA to reduce the occurrence of fallout and impacts nocturnal seabirds. However, even with such measures in place, the potential for incidental takes of these species would remain.

4.2.8.3.3 Other Biological Resources

No environmentally-sensitive habitat is located within or near the boundaries of the KTF, and there are no wetlands on the KTF or PMRF. Within offshore waters, the potential ingestion of contaminants by fish would be remote.

The launch operations activities under the no action alternative were previously found to be consistent to the maximum extent practicable with the Hawai'i Coastal Act in the 1998 PMRF Enhanced Capability Final EIS (Navy 1998; ASMDC 2011).

4.2.9 Cultural Resources

4.2.9.1 Construction and Modifications

Modifications conducted under the no action alternative would be less than under the proposed action, resulting in less ground disturbance and more limited activities.

Modifications to existing facilities and infrastructure would require ground disturbance which in turn would have the potential to increase erosion. This would have the potential to impact archaeological deposits on KTF. All ground disturbing work would be conducted in accordance with the Navy's ICRMP (Navy 2012). Archaeological review of the work area prior to modification activities would occur to ensure no disturbance of archaeological resources. Further, an archaeologist would be present during any ground disturbing activities.

Modification activities would require the use of equipment fuel, lubricants, paints, and solvents that present the potential for soil contamination and associated impacts to subsurface archaeological deposits. The likelihood of contamination would be reduced by implementing BMPs.

As modifications to existing KTF facilities are proposed, NNSA would consult with the SHPO to determine the facility's National Register eligibility and, if found eligible to the register, the effect of the proposed modifications on that property and appropriate mitigation measures. Only one extant building/structure has undergone eligibility evaluation and consultation with the SHPO, the Missile Service Tower, which was found to be not eligible.

4.2.9.2 Launch Operations

All of the launches under the no action alternative would fit within the existing 10,000-foot GHA. Each launch would result in brief, short-term noise introduced to the environment, which could impact the setting of traditional cultural places in the vicinity; however, because the rocket launches are single, distinct events that would occur at widely spaced times at KTF, the impact to these places and their use would be temporary.

Launches at KTF could result in the deposition of contaminants from propellant combustion into the soil over time, which could impact subsurface archaeological deposits. The frequency of launches and propellant weight of rockets would be similar under the no action alternative to historic levels, and to date, surface soil sampling and analysis for metals by SNL Terrestrial Surveillance Program personnel have indicated no

detectable environmental impacts to soil from KTF operations, making such impacts unlikely. Terrestrial surveillance would continue for metals in surface soil.

4.2.9.3 Non-Launch Operations

Non-launch operations would involve minimal ground disturbance from construction or maintenance of fire breaks; clearing; mowing; off-road driving; or equipment use during small maintenance, repair, and D&D projects. This work would have the potential to impact archaeological deposits on KTF. All ground disturbing activities would be conducted in accordance with the Navy's ICRMP (Navy 2012). Maintenance activities and other non-launch operations at KTF would require use of equipment fuel, lubricants, paints, and solvents that present the potential for soil contamination and associated impacts to subsurface archaeological deposits. The likelihood of contamination would be reduced by implementing BMPs.

4.2.10 Hazardous Materials and Waste Management

4.2.10.1 Construction and Modifications

4.2.10.1.1 Hazardous Materials

Some construction and modification activities involve use of chemicals, similar in type and quantity to chemicals currently stored and used at KTF, as described for the proposed action in Section 4.1.10. Chemicals are handled, applied, and stored in accordance with ES&H requirements in the SNL Laboratory Policy System. No impacts related to hazardous materials would be anticipated.

4.2.10.1.2 Waste Management

Industrial waste (e.g., construction debris) would be generated by construction and modifications work under the no action alternative, though at lower quantities than described for the proposed action in Section 4.1.10. Existing Sandia waste minimization and pollution prevention measures would be applied to control the extent of the waste increase. Waste projections would not exceed existing waste management capacities. No increase in hazardous or other solid waste generation is expected. No impacts related to waste would be anticipated.

4.2.10.2 Launch Operations

4.2.10.2.1 Hazardous Materials

Current quantities and use of chemicals at KTF are

expected to be unchanged under the no action alternative because of the similar number of launch operations projected and types of launch vehicles. Chemicals would be handled, applied, and stored in accordance with DOE and NNSA policy. No impacts related to hazardous materials would be anticipated.

4.2.10.2.2 Waste Management

Additional onsite population during launch operations would be similar to current launch-operation levels. No increases in the quantity of hazardous waste (primarily used motor oil and hydraulic fluid) would be expected. None of these would exceed existing waste management or recycling capacities. No impacts to waste management facilities would be anticipated.

4.2.10.3 Non-Launch Operations

4.2.10.3.1 Hazardous Materials

Type and quantities of hazardous materials used and stored would be similar to those currently at KTF, as described in Section 3.10.3.1. Current quantities and uses of chemicals are expected to be similar. No impacts related to hazardous materials would be anticipated.

4.2.10.3.2 Waste Management

Types and quantities of solid and hazardous waste would be similar to those currently generated at KTF, as described in Section 3.10.3.2. None of these would exceed existing waste management or recycling capacities. No impacts from waste generation or to waste management facilities would be anticipated.

4.2.11 Infrastructure Resilience

4.2.11.1 Construction and Modifications

Existing structure modifications would meet standards as described for the proposed action in Section 4.1.11. No changes to infrastructure resilience would be anticipated.

4.2.11.2 Launch Operations

Facility infrastructure is designed to withstand wind and minor flooding from extreme weather events as described for the proposed action in Section 4.1.11. No changes to infrastructure resilience would be anticipated.

4.2.11.3 Non-Launch Operations

Non-launch operations could be affected by weather events, but infrastructure should withstand these events without major damage or effect to non-launch

operations.

4.2.12 Energy and Water Use

4.2.12.1 Construction and Modifications

4.2.12.1.1 Energy Use

Heavy equipment used for modification activities would require gasoline or diesel fuel, but quantities would be in line with current modification activities. Other equipment would use electricity supplied by either KIUC or on-site diesel generators. Energy demands would be temporary and met using existing infrastructure; impacts would be negligible.

4.2.12.1.2 Water Use

Primary water use during modification activities would be for dust suppression for land-disturbing activities (e.g., grading) and exposed soil. Water trucks may be used, with water coming from the PMRF water supply system. Water demand would be temporary and met using existing infrastructure; impacts would be negligible.

4.2.12.2 Launch Operations

4.2.12.2.1 Energy Use

During launch operations, air conditioning units on the LOB, MAB, RMSA, and MST consume electrical power. On-site diesel generators operate to provide consistent electrical power to mission critical elements and to supplement KIUC power. Launch frequencies under the no action alternative would result in similar annual electric energy consumption and peak use. Energy use would remain within system capacity. No impact from energy use would be anticipated.

4.2.12.2.2 Water Use

Launch operations would involve up to 100 additional individuals onsite over a 4- to 6-week period. These personnel would require water for domestic uses (e.g., drinking, sanitary purposes). Water is also used for pre-launch fire prevention. Water demand would be consistent with current demand during launch operations and accommodated by existing infrastructure. No impacts from water use would be anticipated.

4.2.12.3 Non-Launch Operations

4.2.12.3.1 Energy Use

Energy use for non-launch operations would be as described for the proposed action in Section 4.1.12. Energy use would remain within system capacity. No

impact from energy use would be anticipated.

4.2.12.3.2 Water Use

Water use for non-launch operations would be as described for the proposed action in Section 4.1.12. No activities associated with non-launch operations require notable quantities of water. Water demand would be minimal.

4.2.13 Socioeconomics and Environmental Justice

4.2.13.1 Construction and Modifications

4.2.13.1.1 Socioeconomics

Many, if not most, additional construction personnel would already reside on Kaua'i. Non-Kaua'i residents may be used for construction projects, especially specialized tasks, but effects would be small and temporary. Expenditures on construction materials would be a small net benefit to the local economy.

4.2.13.1.2 Environmental Justice

Environmental-justice-related effects of modification activities would be as described for the proposed action in Section 4.1.13. Because none of these effects meet the criteria for "disproportionately high and adverse," modification activities under the no action alternative would have no impacts under environmental justice.

4.2.13.2 Launch Operations

4.2.13.2.1 Socioeconomics

KTF expenditures on Kaua'i may increase because of a higher number of additional personnel during a launch campaign. The Kaua'i hospitality industry would see the greatest increase in expenditures from launch-related personnel, primarily lodging and restaurants. Because the Kaua'i economy is dominated by tourism area, these additional personnel would represent a small increase in economic activity within the ROI.

4.2.13.2.2 Environmental Justice

Environmental-justice-related effects of launch operations would be as described for the proposed action in Section 4.1.13. Because none of these effects meet the criteria for "disproportionately high and adverse," launch operations under the no action alternative would have no impacts under environmental justice.

4.2.13.3 Non-Launch Operations

4.2.13.3.1 Socioeconomics

Overall employment at KTF (typically 14 full-time staff) would remain small and constant, which, in turn, would tend to maintain socioeconomic characteristics within the ROI. There would be no change in effects to existing housing and community services within the ROI. The overall socioeconomic effect would remain small.

4.2.13.3.2 Environmental Justice

Environmental-justice-related effects of non-launch operations would be as described for the proposed action in Section 4.1.13. Because none of these effects meet the criteria for "disproportionately high and adverse," non-launch operations under the no action alternative would have no impacts under environmental justice.

4.2.14 Human Health and Safety

4.2.14.1 Construction and Modifications

As described in Section 4.1.14, provided M&O personnel follow the DOE and NNSA policies and procedures, no human health and safety impacts are anticipated.

4.2.14.2 Launch Operations

As described in Section 4.1.14, provided M&O personnel follow the DOE and NNSA policies and procedures, no human health and safety impacts are anticipated.

4.2.14.3 Non-Launch Operations

As described in Section 4.1.14, provided M&O personnel follow the DOE and NNSA policies and procedures, no human health and safety impacts are anticipated.

4.3 Closeout of DOE Tenancy at KTF

4.3.1 Land Use

4.3.1.1 Transfer of KTF to another Government Agency

Under the Closeout of DOE Tenancy at KTF Alternative, transfer to another government agency is a possibility. Transfer includes the following actions:

- Intra-Agency Transfer: Reassigning a real property asset from one DOE organization to another DOE organization. From an NNSA site's perspective, a disposition transfer entails providing real property to another NNSA or DOE Program. The

execution of intra-agency transfers occurs after full negotiation and coordination by the gaining and losing Program Secretarial Officers and Field Office Managers.

- **Federal Transfer:** Transferring full control and custody of an asset from DOE to another non-DOE Federal Agency.
- **Conveyance:** Various statutes authorize Federal Agencies to convey excess real property assets to state and local governments and in some cases, to nonprofit organizations at up to 100% discount for public benefit use. Qualifying uses include public health, homeless assistance, education, park and recreation, correctional, law enforcement, and emergency management, among others.

If transfer were to occur, the land use categorizations associated with KTF would remain and be assumed by another government agency.

Outgrants can be an alternative to disposition. As mission operations in a given asset wind down, NNSA may not have a short-term need for the asset but may foresee a potential long-term use for the asset in the future. Rather than disposing of it or letting it sit un-used for many years, NNSA may opt to temporarily outgrant the asset to another Government agency or private institution.

An Outgrant transfers the right for a non-NNSA party to temporarily use an NNSA real property asset through a lease, permit, license, or easement. Once the Outgrant term ends, NNSA can choose to renovate the asset to accommodate an emerging mission requirement. This approach can reduce the need to acquire or build new assets. Outgranting real property is not a disposition method but, in some cases, may be a viable alternative to disposition. Note that different outgrant types have different characteristics. For example, easements convey a formal interest in the property, while licenses and permits do not. Also, parties can typically terminate licenses and permits with minimal notice, while easements can usually only be terminated for specific causes.

Land use categorizations are expected to remain the same after facilities at KTF have been demolished or outgranted. Land use could change between developed and undeveloped depending upon the intended use of the area after demolition.

4.3.2 Geology and Soils

4.3.2.1 Decommissioning and Demolition

Under the closeout of DOE tenancy alternative, D&D would be performed on one or more KTF structures. D&D activities would require use of heavy equipment, with activities similar to those described for construction and modifications under the proposed action in Section 4.1.2. Most D&D activities would require ground disturbance, particularly removal of subsurface infrastructure, such as foundations and utilities. These activities would take place in prior-disturbed areas of the facility. Impacts to geology would be negligible. Effects to soil profiles would be minimized through implementation of project controls, particularly erosion and sediment controls.

Fuel and lubricants in equipment used during demolition activities present the potential for soil contamination. To minimize the potential impact to soils, equipment would be refueled on impermeable surfaces and equipment would be inspected regularly for safety, cleanliness, and leaks. Leaking equipment would be removed from service and repaired.

4.3.3 Transportation and Traffic

4.3.3.1 Decommissioning and Demolition

D&D activities would lead to temporary increases in truck and worker vehicle traffic to and from KTF, such as described for construction and modifications under the proposed action in Section 4.1.3. Effects from these additional vehicles on roadways would be small and temporary. Under the discontinuation of KTF operations option, traffic flow could marginally improve on nearby roadways upon the completion of D&D because of the absence of permanent KTF staff and additional launch-operations personnel.

4.3.4 Air Quality

4.3.4.1 Decommissioning and Demolition

Under the closeout of DOE tenancy alternative, D&D would be performed on one or more KTF structures. The types and intensity of activity, and equipment and machinery used, would be similar to that for construction and modifications under the proposed action. Emission of pollutants from demolition activities would occur from combustion of fuel in equipment and machinery, increased vehicle use for workers, and the introduction of dust during demolition and ground disturbing activities. Based on the analysis presented in the Hawaii Range Complex EIS (Navy 2008), which analyzed pollutant

emissions from these same types of sources for a much greater level of activity at the PMRF than is included in the closeout of DOE tenancy alternative, none of the emissions generated by demolition at KTF would exceed the highest *de minimis* or “conformity threshold” levels of 100 tons per year. The activities at KTF would include implementation of controls to reduce production of demolition dust, including frequent watering of work areas, covering truck loads, and hauling on paved roads. These activities and the air emissions produced would be temporary. Asbestos derived from D&D activities is addressed in Sections 4.3.10 and 4.1.14.5.

4.3.5 Airspace

4.3.5.1 Decommissioning and Demolition

Under the closeout of DOE tenancy alternative, D&D would be performed on one or more KTF structures. These activities would have no potential to impact airspace designations or airspace use in the ROI because it is used and managed by PMRF which would remain in operation.

4.3.6 Noise

4.3.6.1 Decommissioning and Demolition

Under the closeout of DOE tenancy alternative, D&D would be performed on one or more KTF structures. This would require use of equipment and machinery similar to that used for construction and modifications. Peak levels of noise at these sources would range from 93 to 108 dBA, and at 400 feet away would attenuate to 55 to 84 dBA (Navy 2008). These activities and the noise produced would be temporary. Personnel onsite during these activities would wear appropriate hearing protection devices in accordance with DOE regulation and directive as well as NNSA policy requiring compliance with applicable OSHA standards. Increased noise levels would not extend outside of PMRF boundaries. Increased equipment and worker vehicle traffic associated with demolition activities would result in small temporary increases in road noise.

In the long-term, the noise environment of KTF would be changed. There would be a decrease in the number of noise events because of the lack of rocket launches, and the associated lack of activities that are needed to support rocket launches, including transport of vehicle assemblies, personnel transport, and preparation of launch campaigns.

4.3.7 Water Resources

4.3.7.1 Decommissioning and Demolition

4.3.7.1.1 Surface Water Quality

Under the closeout of DOE tenancy alternative, D&D would require use of heavy equipment (e.g., bulldozers, backhoes, trucks). During these activities, suspended sediments could be carried in stormwater runoff from precipitation events during construction periods, impacting local drainage features if BMPs are not properly implemented. The use of heavy equipment could affect both the hydrology and water quality through increased turbidity, sedimentation, overland flow, or contamination of water bodies through accidental spills or leaks of fuel or oil.

The potential for such impacts would be minimized through implementation of project controls as specified in the M&O LPS. Construction activities planned to collectively disturb one or more acres of land would require coverage under the NPDES General Permit Authorizing Discharges of Storm Water Associated with Construction Activity (Hawaii Administrative Rules Chapter 11-55, Appendix C). Following permit coverage, stormwater controls (BMPs) and pollution prevention measures detailed in the SWPPP would be required to be installed/implemented. Examples of these BMPs are as follows:

- Ensuring erosion and sediment controls remain in effective operating condition during the project activities.
- Refueling equipment at least 100 feet from any storm drain or ditch.
- Inspecting equipment regularly for safety, cleanliness, and leaks, and implementing appropriate controls at staging areas. Leaking equipment would be removed from service and repaired.
- Protecting material and soil stockpiles from contact with stormwater using a perimeter sediment barrier.

4.3.7.1.2 Stormwater Runoff

D&D under the closeout of DOE tenancy alternative would result in a decrease of impermeable surfaces by the following amounts of concrete:

- Building foundations and launch pads: 105,000 sq. ft.
- Pavement: 35,644 sq. ft.

Stormwater runoff quantity would be lower than currently exists at the facility.

4.3.7.1.3 Groundwater

Section 4.3.2 addresses potential contamination of soil from fuel and lubricants in equipment used during D&D activities. Contaminants from spills or leaks from equipment could migrate to groundwater, but procedures would be implemented during D&D activities to reduce the likelihood of uncontrolled releases and perform rapid cleanup if such releases were to occur. Long term there would be a minimal increase in infiltration from the removal of impermeable surfaces.

4.3.7.1.4 Wetlands and Floodplains

No environmentally-sensitive habitat is located within or near the boundaries of the KTF. No demolition activities would occur within water bodies or essential fish habitat. There are no wetlands on the KTF or PMRF. Thus, there would be no impacts to these resources.

Most of the demolition activities would take place outside of the 100-year floodplain. Any demolition activities within the floodplain would remove the footprint of facilities and infrastructure. Infrastructure removal would not have an impact on the flood hazard area.

4.3.8 Biological Resources

4.3.8.1 Decommissioning and Demolition

4.3.8.1.1 Vegetation

No activities would take place along the shore or offshore in marine areas. Vegetation in the areas where demolition activities would take place (on the KTF) primarily consists of ruderal species that propagate in disturbed locations. No threatened or endangered plant species are located on the KTF. Thus, no impacts would be anticipated to protected terrestrial or marine vegetation from demolition activities. Long-term vegetation recovery would occur in locations of facility and infrastructure removal.

4.3.8.1.2 Wildlife

No activities would take place along the shore or offshore in marine areas. Increased noise and human activity would likely caused intermittent, temporary displacement of some terrestrial wildlife, particularly birds and small mammals that forage, feed, or nest within and adjacent to the KTF. It is expected that these individuals would return to the area and to normal activity after the noise-producing events have ended. Most wildlife is likely

already habituated to people and noise associated with ongoing activities at the KTF. No demolition activities would take place within the dunes or near the water sources used by water birds. Bird migration patterns would not be altered. Whenever Laysan Albatross are located within an area of KTF slated for demolition activities, BASH relocation efforts would be implemented per the Navy's INRMP (Navy 2010). These would be short-term, minimal impacts.

All demolition activities would be undertaken during daylight hours; however, night-time artificial lighting could be needed for security. Night lighting would have the potential to cause fallout of nocturnal seabirds. In accordance with the USFWS BO (USFWS 2018; see Appendix A), measures to address the effects of demolition-related night lighting would be implemented by NNSA and the Navy to reduce the occurrence of fallout and impacts. However, even with such measures in place, the potential for incidental takes of these species would remain and would be a significant impact.

4.3.8.1.3 Other Biological Resources

The entire State of Hawai'i is designated as a Coastal Zone. Even though Federal facilities and activities are not subject to the state's Coastal Zone Management Plan, Federal agencies are directed by law to be consistent to the maximum extent practicable.

4.3.9 Cultural Resources

4.3.9.1 Decommissioning and Demolition

Under the closeout of DOE tenancy alternative, D&D would be performed on one or more KTF structures. This would require some level of ground disturbance, which in turn would have the potential to increase erosion. While this work would largely be undertaken on previously disturbed ground, there would still be the potential to impact archaeological deposits on KTF. All ground-disturbing work would be conducted in accordance with the Navy's ICRMP (Navy 2012). Archaeological review of the work area would occur to ensure no disturbance of archaeological resources, and an archaeologist would be present during any ground disturbing activities.

Demolition would require the use of equipment fuel and lubricants that present the potential for soil contamination and associated impacts to archaeological deposits. The likelihood of contamination would be reduced by implementing BMPs.

As demolition of existing KTF facilities is proposed, NNSA would consult with the SHPO to determine the facility's

National Register eligibility.

If consultation with the SHPO results in a determination that a facility is eligible to the National Register and would be adversely affected by proposed demolition, NNSA would continue to consult with the SHPO to develop appropriate mitigation measures to address the adverse effect.

4.3.10 Hazardous Materials and Waste Management

D&D activities would require temporary increases in fuel use for heavy equipment used in demolition. Generation of industrial waste would increase temporarily from building demolition. Quantities are estimated as follows:

- Concrete: 9,500 cubic yards
- Steel: 600 tons
- Aluminum: 26 tons
- Asbestos: 110 cubic yards
- Debris: 4,700 cubic yards

Existing KTF waste minimization and pollution prevention measures would be applied to control the extent of the waste increase. Concrete, steel, and aluminum would be recycled at local facilities. In the absence of local recycling options, NNSA would evaluate options to avoid using the local landfill, particularly for uncategorized debris. The County of Kaua'i projects that the Kekaha Landfill will reach capacity in 2028 to 2030, and is planning a new landfill near Lihue (County of Kaua'i 2018). Waste projections would not exceed existing waste management capacities, but could slightly shorten the functional life of the Kekaha Landfill (the facility currently receives approximately 75,000 tons of solid waste annually). During D&D there would be an increase in hazardous or other solid waste generation, but post-D&D there would be minimal to no impact.

4.3.11 Infrastructure Resilience

4.3.11.1 Decommissioning and Demolition

Partial D&D of facility infrastructure would take place in a manner that would not reduce the structural integrity of remaining infrastructure elements. Complete D&D of KTF infrastructure would render moot a discussion of infrastructure resilience.

4.3.12 Energy and Water Use

4.3.12.1 Decommissioning and Demolition

Energy use during D&D activities would be primarily gasoline and diesel fuel for heavy equipment used in demolition. Smaller equipment could use electricity supplied by KIUC or from on-site diesel generators. Energy use would be temporary and accommodated with existing infrastructure. No impacts related to energy use would be anticipated.

D&D activities would increase demands on water supplies for short periods. Water would be needed for D&D activities such as wetting D&D sites for dust suppression and drinking water supply for construction crews. This increase in water demand would be temporary and minimal.

4.3.13 Socioeconomics and Environmental Justice

4.3.13.1 Decommissioning and Demolition

Many, if not most, additional personnel involved in D&D activities would already reside on Kaua'i. Non-Kaua'i residents could be used for D&D, especially in specialized tasks, but effects from additional personnel would be small and temporary. Under the discontinuation of KTF operations option, long-term socioeconomic effects from the absence of up to 200 temporary personnel associated with each launch operation could have a small, negative effect on the local hospitality industry. This effect would be likely to be unmeasurable, as KTF is a small contributor to the Kaua'i tourist industry. The loss of the 14 full-time KTF staff positions would likely result in an unmeasurable change to the total employment in the area, with more than 900 staff employed at PMRF alone. The socioeconomic effect from the loss of temporary launch personnel and permanent KTF staff would be small.

The environmental effects of D&D activities would be similar to construction activities described in Section 4.1 for each resource area under the proposed action. For some of these resource areas, ROIs are limited to KTF, which reduces the potential of environmental-justice-related impacts. For resource areas where ROIs extend beyond KTF and PMRF, effects would be small or negligible. Because none of these effects meet the criteria for "disproportionately high and adverse," D&D activities under the proposed action would have no impacts under environmental justice.

4.3.14 Human Health and Safety

During decontamination and demolition activities there would be the potential for exposure to asbestos fibers located in KTF structures. A work site safety plan would

be required before any project could begin to reduce potential risks to the health and safety. All employees would be notified of potential hazards associated with their work during a pre-job briefing and they would be trained in proper use of any materials they would be handling. Further, all work activities would be performed in accordance with M&O policy established to comply with DOE regulations and the Environmental Protection Agency Asbestos NESHAP. No health and safety impacts would be expected to occur during decontamination and demolition activities.

4.4 Cumulative Impacts

Council on Environmental Quality regulations define a cumulative impact 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). Cumulative impacts can be viewed as the total combined impacts on the environment of the proposed action or alternative(s) and other known or reasonably foreseeable actions.

Potential cumulative impacts of KTF operations are limited by KTF’s remote location and the types of activities performed:

- KTF is located in a sparsely-populated, largely rural area, at the northern end of PMRF. Few activities take place outside of those already evaluated, above, that would contribute to environmental effects of KTF activities.
- Rocket launches are short-term, discrete events that would occur at widely spaced times. Because of this, the effects of individual launches would not be additive to those at PMRF, but rather, impacts would be equivalent to any one launch.

This section assesses cumulative impacts by combining the potential effects of the proposed action with the effects of other past, present and reasonably foreseeable activities in the ROI. The ROIs vary by resource area and are generally the same as those presented in Chapter 3. The proposed action was selected to assess a bounding scenario of potential cumulative effects. This approach results in a conservative analysis of the maximum cumulative impacts. Note that under the closeout of DOE tenancy at KTF alternative, more D&D activities could take place over a shorter time than under the proposed action, including potential D&D of the entire facility. These additional D&D activities are considered in the relevant resource area evaluations, below.

4.4.1 Land Use

Site preparation, operational, launch and post-launch activities associated with the Proposed Action would not change any existing land use classifications. No cumulative impacts are expected.

There is the potentiality for impacts to KTF operations in the future from redevelopments to PMRF operations. The PMRF Installation Development Plan has delineated areas to the south of Nohili Road and to the west of KTF as areas for future operations development. The area to the south of Nohili Road totals approximately 23.7 acres, while the area west of the KTF totals approximately 5.3 acres. NNSA, DOE, and NTESS would have to discuss potential impacts to KTF and address within the Land Use Agreement still in development. Potential impacts include:

- Reduced footprint to the KTF boundaries
- Limited launch capabilities
- Renegotiation and redesign of KTF ESQD
- Renegotiation of GHA

4.4.2 Geology and Soils

The ROI for geology and soils is limited to KTF. Activities outside KTF would not contribute to ground disturbance, soil contamination, or soil erosion. Environmental effects would be limited to those already described in Section 4.1.2.

4.4.3 Transportation and Traffic

Construction and launch-operation vehicle traffic from PMRF during high-activity periods (e.g., major PMRF construction projects, launch operations) could combine with KTF vehicle traffic to potentially increase traffic delays on Route 50, particularly in higher-traffic areas such as Waimea and Kekaha. Delays would likely be greatest during periods of high-tourist traffic. Cumulative impacts to traffic could be noticeable, but small and temporary.

4.4.4 Air Quality

Implementation of the proposed action in conjunction with operation of the PMRF would not incrementally affect air quality within the ROI. Air quality is inherently localized because emissions disperse relatively quickly with increasing distance from the source. Cumulative impacts would occur when multiple activities affect the same geographic areas simultaneously or when sequential projects extend the duration of air impacts within a given area over a longer period of time. The

emissions produced by the proposed action and nominal PMRF operations would be intermittent, short-term, and occur over a long period of time, which would minimize or preclude cumulative air impacts.

4.4.5 Airspace

Under the proposed action, the only potential for impacts to airspace would arise from air transportation of vehicle assemblies and vehicle launches. Based on previous analysis of the rocket most similar to the bounding vehicle analyzed for the proposed action (MDA 2007), it is estimated that 320 flights annually (landings and takeoffs) would be needed for air transportation of the assemblies for 20 vehicles, and each vehicle would undergo one launch, for a total of 340 air operations. Air operations at the PMRF airfield in 2009 were estimated to number 25,486 landings and takeoffs. The air transport and launch of the 20 vehicles would result in a minor 1.3% increase in air operations.

4.4.6 Noise

Implementation of the proposed action in conjunction with operation of the PMRF would not incrementally affect noise within the ROI. Noise levels are inherently localized because sound levels decrease relatively quickly with increasing distance from the source. Cumulative impacts would occur when multiple activities affect the same geographic areas simultaneously or when sequential projects extend the duration of noise impacts within a given area over a longer period of time. The noise produced by the proposed action and nominal PMRF operations would be intermittent, short-term, occur over a long period of time, and have spatial distribution throughout the PMRF.

4.4.7 Water Resources

Cumulative effects to water resources could occur in two ways:

- Additive or compounding effects of contamination from KTF activities with other contamination sources affecting groundwater or surface water.
- Increased runoff from KTF combined with other sources causing flooding.

To date, surface soil sampling and analysis for metals by Terrestrial Surveillance Program personnel have indicated no detectable environmental impacts to soil from KTF operations. Terrestrial surveillance would continue for metals in surface soil. Activities at PMRF that could result in contamination of nearby water bodies (Nohili Ditch and

the Pacific Ocean) are conducted under procedures similar to those at KTF, limiting the potential for contamination; these operations have been analyzed in other NEPA documents (e.g., U.S. Department of the Navy 2008, U.S. Department of the Navy 2017). No contamination-related cumulative effects to groundwater or surface water are anticipated.

Under the proposed action, construction of project elements would increase impervious surface area at KTF by approximately 60,000 square feet. Drainage features combined with the high permeability and rapid infiltration of KTF soils would limit flow of stormwater runoff. No planned expansion of PMRF or new development of other structures near KTF are anticipated. Any future increase in impermeable surfaces of non-KTF PMRF structures would have to meet stormwater runoff requirements of Section 438 of the *Energy Independence and Security Act* of 2007, as described in Section 4.1.7. A minor increase in the quantity of stormwater runoff or resulting cumulative effects would be anticipated.

4.4.8 Biological Resources

Cumulative impacts to biological resources would occur when multiple activities affect the same geographic areas simultaneously or when sequential projects extend the duration of impacts within a given area over a longer period of time.

Similar impacts are expected to occur to these species from PMRF activities. The biological opinion issued by the USFWS (USFWS 2018; see Appendix A) considered cumulative effects of continued operation of PMRF and KTF in concert with State, local, and private actions, and determined that the cumulative effects are not likely to jeopardize the continued existence of the Newell's Shearwater. The biological opinion further found that the beneficial effects of the conservation mitigation measures that would be implemented by the Navy and NNSA would offset the anticipated losses as well as any additional decline of the population in the action area. Overall, it is the USFWS "Biological Opinion that the proposed action discussed herein is not likely to jeopardize the continued existence of the Newell's shearwater" (USFWS 2018.).

4.4.9 Cultural Resources

No cumulative effects would occur to cultural resources. The potential for erosion and soil contamination has been and would continue to be controlled under BMPs. Noise from KTF rocket launches and air transport of rocket assemblies would occur as distinct, single events over a very brief amount of time, and would be few in number. Ground disturbance and modifications to

existing facilities would be conducted in accordance with procedures found in the Navy's ICRMP to identify cultural resources, monitor ground disturbing activities, evaluate resources for National Register eligibility, and design and implement appropriate mitigation measures when avoidance of such resources is not possible.

4.4.10 Hazardous Materials and Waste Management

No cumulative effects would occur from onsite storage or use of hazardous materials. Under the proposed action, hazardous waste generation would be similar in magnitude to current operations; no cumulative effects would be anticipated. Under the closeout of DOE tenancy at KTF alternative, quantities of industrial waste generated over the short-term by D&D of KTF would be substantially larger than current waste generation. Waste minimization, especially concrete and scrap metal recycling, would be used to minimize potential impacts on waste disposal facilities, including cumulative impacts from waste generation at PMRF or other locations.

4.4.11 Infrastructure Resilience

The ROI for infrastructure resilience is limited to KTF. Activities outside KTF would not contribute to changes in infrastructure resilience. Environmental effects would be limited to those already described in Section 4.1.11.

4.4.12 Energy and Water Use

Cumulative impacts from energy and water use could occur if KTF use combined with non-KTF use were to exceed system capacities or substantially reduce capacity margins, either electricity generation/water supply or transmission/supply infrastructure. Under the proposed action, KTF energy and water use would be minor compared to PMRF. Increased KTF energy and water use would not impact existing KIUC's ability to provide to their customers, and PMRF water supply and infrastructure are adequate for future PMRF and KTF needs. Environmental effects would be limited to those already described in Section 4.1.12.

4.4.13 Socioeconomics and Environmental Justice

Cumulative impacts to socioeconomics could result from KTF activities and operations combined with PMRF or other activities to affect housing cost or availability, community services, or the economy. Under the proposed action, the socioeconomic effect of KTF would be minor compared to PMRF and the overall size of the economy in Kaua'i. Environmental effects would be limited to those

already described in Section 4.1.13.

Environmental-justice-related cumulative impacts could occur from resource-specific cumulative environmental impacts, as described in this section. The resource-by-resource evaluation did not identify any cumulative impacts of the proposed action; therefore, no environmental-justice cumulative impacts are identified.

4.4.14 Human Health and Safety

There have never been any launches or operations that caused bodily harm, injury, or casualties, damage to any facility, or damage to the environment. Provided that DOE and NNSA policies and procedures are followed, no cumulative impacts to human health and safety associated with operational activities are anticipated.

4.5 Accidents Risks, Hazards, and Intentionally Destructive Acts

The activities that NNSA would continue to perform include operational support and launch activities for defense missions and flight tests. The Proposed Action considers the total launch support for approximately 20 launches within a calendar year. While planned launches could occur during the months of September to December, this period is considered a protected period for threatened and endangered species; any proposed launches during this timeframe would follow requirements set forth by PMRF and the USFWS biological opinion (USFWS 2018).

As described in Section 2, the Proposed Action increases the overall number of launches for test vehicle assemblies in the following categories:

- Small Rail Class
- Large Rail Class
- Medium Vertical Class

The types of test vehicle assemblies within these vehicle categories are also defined in the No Action Alternative have been reviewed and analyzed in previous NEPA documentation and would be considered bound by the analysis of the Proposed Action.

In addition to an increase in previously analyzed test vehicle assemblies, the Proposed Action proposes the launch of a larger test vehicle assembly in the Large Vehicle Class category. For this proposed new test vehicle assembly, the total estimated NEW for the entire system (first stage, second stage, and any other ordnance on the system) would be bound by 55,000 lbs. of Class 1.1. A test

vehicle assembly of a size similar to the proposed Large Vehicle Class assembly was analyzed in the 2007 MDA FTF EA. Within the MDA FTF EA, the “target” that closely matches the proposed test vehicle assembly is the LV-2, a Class 1.1 rocket motor with a total propellant quantity of 56,418 lbs. As such, a comparative assessment of the potential accident risks and hazards posited for the LV-2 rocket motor in that analysis is used here to analyze the proposed Large Vehicle Class test vehicle assembly in the Proposed Action.

The MDA FTF EA analyzed accident risks and hazards for Pre-Launch, Launch and Post-Launch activities which are included within the Launch Operations analyzed in this SWEA:

- Pre-Launch activities for the launch of solid propellant target would include short term storage at the launch location, pad setup, final integration/functional testing/target propellant loading, range clearing and other safety requirements. Launches of the LV-2 would require the fueling of the avionics control module attitude control section with a small quantity of hydrazine for the attitude control system. The hydrazine loading would be accomplished using specific propellant loading equipment and standard operating procedures developed for those activities. The target would then be erected on the launch pad. (MDA 2007)
- Launch activities for both liquid and solid propellant targets would include the launch and flight of the target, beginning with the first stage motor ignition, nominal ascent and mission events, possible abort, target scene presentation,...debris generation. (MDA 2007)
- Following vehicle liftoff from the launch pad, the pad would be checked for safe access. Post-launch activities for solid and liquid propellant targets would include inspection of the launch pad facilities, launch pad/platform, and equipment for damage, as well as general cleanup and performance of maintenance and repairs necessary to accommodate the next launch cycle. Post-launch refurbishment could include the replacement of cables and other damaged components, and the painting of components (e.g., launch vehicle suspension system) for corrosion control and cleanup of any residues that would be disposed of as hazardous waste. There are no plans or requirements to recover targets or payloads. If a recovery is required due to a mission failure investigation it would be performed on an

emergency basis. If a malfunction occurs during the target’s flight, the Range Safety Officer might terminate the flight, resulting in debris being deposited along the flight path. (MDA 2007)

The risk of potential accidents or hazards could be encountered at any time during this launch campaign.

4.5.1 Accident Risks and Hazards

In 2015, the M&O contractor performed a Hazard Evaluation (HE) for KTF using the What-If/Checklist technique. The accidents and hazards identified were screened from a list of accidents and hazards noted in a Hazard Identification (HI) of M&O Preliminary Hazard Screening (PHS) documentation. The HE used the hazards carried forward from the HI to identify potentially hazardous conditions/scenarios, as well as the corresponding preventive and mitigative controls (FMA 2017).

To perform the HE and HI process, the M&O contractor gathered personnel from the following disciplines to serve as team members:

- Environmental Safety and Health
- Industrial Hygiene
- Explosive Safety
- Safety Engineering

Fire Protection

What-If Technique

The What-If technique is a brainstorming approach, in which Subject Matter Experts ask questions or voice concerns about possible undesired event scenarios. The What-If/Checklist technique combines the creative brainstorming features of the What-If approach with the systematic features of the Checklist method. Further information on the What-If, Checklist, and What-If/Checklist Hazard Evaluation techniques can be found in *Guidelines for Hazard Evaluation Procedures* 3rd Edition, (i.e., “the Red Book”) published by the Center for Chemical Process Safety. (FMA 2017)

- Pressure Safety
- Electrical
- Mission Representatives

Table 19 - Accident Risks/Hazards Identified for Analysis

Hazard/Energy Source	Hazard Description	Location
Explosives	<ul style="list-style-type: none"> • Rocket Motors – 1.1 and 1.3C (up to 35,000 lbs. of 1.1 or up to 100,000 lbs. of 1.3C) • Ignitors – 1.3C • Initiators – 1.4S • Pressure Cartridges – 1.4S • FLSC – 1.1D • MDF – 1.1D 	KTF MAB, RMSA, AB3, Launch Pad
Mechanical and Material Movement Hazards	<ul style="list-style-type: none"> • Power tools • Pinch and Crush Hazards • Falling Objects • Forklifts • Cranes and Hoists • Stored Energy (Ejector Springs ~570 ft. lbs.) • Loader • Launcher 	Launch Pad, KTF MAB
Elevated Work	<ul style="list-style-type: none"> • Falls from Height • Dropped Items 	KTF
High Pressure	<ul style="list-style-type: none"> • ACS Cart contains nitrogen gas with a maximum pressure of 3600 psi • Hydraulic Systems • Compressed Gases – up to 6000 psi 	KTF MAB, Launch Pad
Fire	Rocket Launch Initiates Wildland Fire	Launch Pad
Confined Space	<ul style="list-style-type: none"> • Launchers are considered non-permitted confined spaces • Antennae masts are considered non-permitted confined spaces • Septic Tanks are considered Permitted Confined Spaces 	KTF, Launcher, Antenna Masts, Septic Tanks
Toxic Materials	<ul style="list-style-type: none"> • Hydrazine (100 lbs.) 	Sealed Tanks
Asphyxiant Materials	<ul style="list-style-type: none"> • Nitrogen Gas 	KTF

The M&O team postulated and evaluated credible scenarios based upon accidents and hazards identified in a preliminary HI. The accidents and hazards identified in the primary hazard screening (PHS) were evaluated to determine which, if any, represent the potential to rise up to an event that cannot be tolerated (e.g., worker death). This type of accident risk/hazard event is called an “Unacceptable Consequence”. Accident Risk/Hazard events that do not meet the definition of an Unacceptable Consequence, but are still undesirable are considered “Undesirable Consequences”; these types of events and the potential impacts from their occurrence represent those accident risks/hazards that are adequately controlled by M&O safety management programs, administrative controls, and training. (FMA 2017)

Accident Risks/Hazards that were deemed Unacceptable Consequence during the HI were elevated, scrutinized and analyzed for further study during the HE. Table 19 captures the hazard sources and a brief description of associated accident risk/hazards identified by the M&O team through the PHS screening that would require

further analysis. Appendix B-1 provides a more detailed look at the individual hazards evaluated, the postulated consequences, and the engineered and administrative controls associated with each.

The guidelines for consequences analysis of the elevated accident risks/hazards that were analyzed during the HE are shown in Table 20.

The M&O evaluation team considered consequences unmitigated from the identified hazards and derived a set of credited controls. Table 21 below captures a snapshot of the credited controls that were identified during the accident and hazard evaluation; Appendix B-2 presents the entire list of credited controls.

4.5.1.1 Results of Accident Risk and Hazard Analysis

Appendix B provides the detailed specifics on the elevated accidents and hazards that were evaluated by the M&O team. The analysis of the hazards and risks found that no

Table 20 - Accident Risk/Hazard Consequence Guidelines

Abbreviation	Consequence Level	Worker Impact	Environmental Impact	Mission Impact
H	High (Unacceptable)	Death, Life Threatening – Permanent total disability requiring hospitalization	Irreversible significant, reportable, environmental impact; Permit NOV with fines and required facility shutdown	Monetary loss equal to or exceeding \$1M Loss of mission requiring restart
M	Moderate (Unacceptable)	Near Life Threatening – Permanent partial disability, injuries or occupational illness that results in hospitalization	Reversible significant reportable environmental impact; Permit NOV with fines	Monetary loss equal to or exceeding \$100K, but less than \$1M
L	Low (Undesirable)	Less than Life Threatening – injury or occupational illness that may require medical treatment beyond first aid	Reversible moderate reportable environmental impact; permit NOV without fines	Monetary loss equal to or exceeding \$10K, but less than \$100K Delay of mission, not requiring restart
N	Negligible (Undesirable)	Minor Injury – injury or occupational illness that may require first aid	Minimal non-reportable environmental impact; no permit NOV	Monetary loss less than \$10K No mission impact

Table 21 - Sample of Credited Controls Identified for KTF Potential Accidents/Hazards

Control	Description	Category
Access Control	KTF has limited access to authorized personnel only	Engineered
Grounding and Bonding	The KTF Assembly Buildings and Launch Pads are grounded and bonded. Ordnance Operations require all electrical equipment above 110 V to have a GFCI	Engineered
Flight Termination System (FTS)	Flight Termination System serves as an "initial condition" to help prevent a catastrophic event. Note: The FTS is managed by PMRF.	Engineered
Safe Plug	Safe Plug is used to inhibit the fireset and is also used to prevent inadvertent powering up during arming	Engineered
PGRADS	Potential Gradient is monitored at the site. Work on explosive devices is suspended when +/- 2000V/m has been reached	Engineered
Explosive Safety Program (Safety Management Program – SMP)	The explosives safety program provides programmatic and technical support to assist employees on the safe handling of explosives	Administrative
Pressure Safety Program (SMP)	Safety Engineering provides the safety programs and technical support to assist employees to perform work on pressure systems in a safe manner	Administrative

items were uniquely new or outside the experience base and existing safety controls of normal standard operating procedures, and engineering and administrative controls. All hazards and accidents and controls are within the test lab and launch site and are in place for each launch campaign. Single Point Failures have not been identified during this process. There is defense in depth within the Control Set. (FMA 2017)

4.5.2 Mitigation of Potential Accident and Hazards during KTF Launch Operations

All hazardous operations at SNL/KTF are performed

under strict adherence to existing policies in the M&O LPS. A site procedure provides general requirements and guidance for all range operations at SNL/KTF, including ordnance safety, pre-launch and hazardous operations control, ordnance handling and storage facilities, liquid fuels storage and handling, and launch pad operations. (Navy 2017)

KTF rocket motors and other ordnance components would be stored in explosive storage magazines by PMRF, except when needed by the M&O contractor for processing, assembly, and launch. The movement of explosives and other hazardous materials between PMRF and SNL/KTF would be conducted in accordance with

PMRF procedures and DoD Explosives Safety Standards. PMRF would provide fire protection and firefighting services to SNL/KTF, and enforces base safety regulations and programs on SNL/KTF. (Navy 2017)

For the launching (flight test) of test vehicle assemblies out of PMRF/KTF, flight safety analysis would be performed by PMRF as the primary, responsible authority; KTF M&O personnel; and MDA personnel. MDA flight test safety analysis has determined that a maximum ground hazard area GHA with a radius of 10,000 ft. centered at Pad 42 within the KTF would be strictly adhered to. Containment within the GHA would be determined by the PMRF Flight Safety Officer. As stated previously, the GHA is an area that must be cleared of nonparticipants (workers or the public) prior to a launch.

The PMRF Range Safety Office would be responsible for establishing Ground Hazard Areas and Launch Hazard Areas over water beyond which no debris from early flight termination is expected to fall (Navy 2017). The PMRF Range Safety Officer considers the following when establishing a GHA:

- Size and flight characteristics of the test vehicle assembly
- Individual flight profiles of each test vehicle assembly flight launch
- FTS operations and reaction times should a flight malfunction occur
- Data processed by ground-based or onboard missile computer systems may be used to recognize malfunctions and terminate missile flight (Navy 2017)

Preliminary analysis of the Large Vehicle Class test vehicle assembly by MDA considered the following assumptions and inputs based upon the LV-2:

- Flight termination debris catalog
- Malfunction flight modeling
- Risk reduction options

MDA analysis determined that any potential target missile debris would be expected to fall within the 10,000 ft. radius GHA. MDA anticipates that refined analysis would result in a smaller GHA footprint.

4.5.2.1.1 Range Safety

Range Safety at PMRF would be controlled by Range Control, which is responsible for hazard area surveillance and clearance and control of all PMRF operational areas. Range Control would maintain real time surveillance,

clearance, and safety at all PMRF areas including SNL/KTF. PMRF would set requirements for minimally acceptable risk criteria to occupational and non-occupational personnel, test facilities, and nonmilitary assets during range operations. For all range operations at PMRF, the Range Control Officer requires a safety plan. A Range Safety Operation Plan would be generated by PMRF Range Safety personnel prior to range operations. (Navy 2017)

The Range Safety Operation Plan would be approved by the Commanding Office prior to any launch. Launch would only be allowed when the risk levels are less than the acceptable risk criteria in PMRF Instruction 8020.16, which are equivalent to the criteria developed by the Range Commanders Council (RCC) (e.g., RCC 321). Information provided in the safety plan would include: (1) a list of project materials, items, or test conditions that could present hazards to personnel or material through toxicity, combustion, blast, acoustics, fragmentation, electromagnetic radiation, radioactivity, ionization, or other means; (2) descriptions of radiation, toxic, explosive, or ionization problems that could accumulate as a result of the tests; (3) aerodynamic and flight control information, and destruct system information and parameters; (4) plans, specifications, and procedural or functional steps for events and activities involving explosives to conform to criteria in the PMRF instruction; and (5) complete operational specifications of any laser to be used and a detailed description of its planned use. (Navy 1998; 2008; 2017)

Missile Flight Analysis

PMRF would conduct missile flight safety in accordance with Naval Air Warfare Center Weapons Division Instruction. Missile flight safety includes analysis of missile performance capabilities and limitations, of hazards inherent in missile operations and destruct systems, and of the electronic characteristics of missiles and instrumentation. It also includes computation and review of missile trajectories, launch azimuths, kinetic energy intercept debris impact areas, and hazard area dimensions, review and approval of destruct systems proposals, and preparation of the Range Safety Operation Plan required of all programs at PMRF (described above). (Navy 2017)

4.5.2.1.2 **Ground Safety**

The Range Control Officer using PMRF assets would be solely responsible for determining range status and setting RED (no firing – unsafe condition due to a fouled firing area) and GREEN (range is clear and support units are ready to begin the event) range firing conditions. The

Range Safety Approval and the Range Safety Operation Plan documents are required for all test vehicle assembly systems using PMRF (Navy 1998). PMRF uses RCC 321, Common Risk Criteria for National Test Ranges. RCC 321 sets requirements for minimally acceptable risk criteria to occupational and non-occupational personnel, test facilities, and nonmilitary assets during range operations. (Navy 2017)

4.5.2.1.3 *Ordnance Management and Safety*

Ordnance safety includes procedures to prevent premature, unintentional, or unauthorized detonation of ordnance. Any program using a new type of ordnance device for which proven safety procedures have not been established requires an Explosive Safety Approval before the ordnance is allowed on PMRF or used on a test range. This approval involves a detailed analysis of the explosives and of the proposed test activities, procedures, and facilities for surveillance and control, an adequacy analysis of movement and control procedures, and a design review of the facilities where the ordnance items will be handled. (Navy 2017)

The M&O contractor has provided an Explosive Site Plan to PMRF for approval for the proposed Large Vehicle Class test vehicle assembly launch.

4.5.2.1.4 *Ocean Area Clearance*

Range Safety officials would manage operational safety for projectiles, targets, missiles, and other hazardous activities into PMRF operational areas. The operational areas would consist of two Warning Areas (W-186 and W-188) and one Restricted Area (R-3101) under the local control of PMRF. The Warning Areas are in international waters and are not restricted; however, the surface area of the Warning Areas is listed as “HOT” (actively in use) 24 hours a day. PMRF would publish dedicated warning Notice to Mariners (NOTMARs) and NOTAMs 1 week before hazardous operations. In addition, a 24-hour recorded message would be updated on the hotline daily by Range Operations to inform the public when and where hazardous operations would take place. (Navy 2017)

Prior to a hazardous operation proceeding, the range is determined to be cleared using inputs from ship sensors, visual surveillance of the range from aircraft and range safety boats, radar data, and acoustic information from a comprehensive system of sensors and surveillance from shore. (Navy 2017)

Figure 10 depicts the airspace use surrounding PMRF

including the warning areas.

Fire and Crash Safety

Personnel would be trained to respond to activities such as aircraft fire fighting and rescue in support of airfield operations, hazardous material incidents, confined space rescue, and fuel releases, plus structure and brush fire fighting, fire prevention instruction, and fire inspections. (Navy 2017)

4.5.2.1 Potential Accidents Associated with the Large Vehicle Class Test Assembly

As stated, the proposed launch of a test vehicle assembly in the Large Vehicle Class category is comparable to the launch of the LV-2 as described in the MDA FTF EA. Analysis of the LV-2 launch within the MDA FTF EA compares the launch of the LV-2 to the launch of the Peacekeeper target described in the July 2003 Ground-Based Midcourse Defense (GMD) Extended Test Range (ETR) Final EIS. Potential accident probabilities associated with the Peacekeeper involve an accident involving the transport vehicle (GMD 2003). Only a small fraction of such accidents would affect missile propellants or explosives being transported due to the use of specialized shipping containers that protect the shipment (GMD 2003). The potential for these types of accidents to occur are mitigated through procedures (GMD 2003).

4.5.3 Natural Phenomena Events

The island of Kauaʻi is located in the Pacific Ocean and is subject to several types of natural hazards including floods, hurricanes and high winds, tidal waves and tsunamis, volcanic eruptions, earthquakes, lightning, and fire.

In August 2018, Hurricane Lane was only the second Category 5 hurricane to pass within 350 miles of Hawaiʻi. The hurricane prompted the issuance of hurricane watches and warnings for every island in the Hawaiʻian chain. Heavy rainfall caused flash flooding and mudslides with wind gusts reaching up to 55 mph. Little to no damage was reported at KTF as a result of the hurricane.

Potential accidents induced by natural phenomena and their effects were identified as having a low to negligible impact during the HI and were not analyzed further.

4.5.4 Intentionally Destructive Acts

In identifying the reasonably foreseeable impacts of

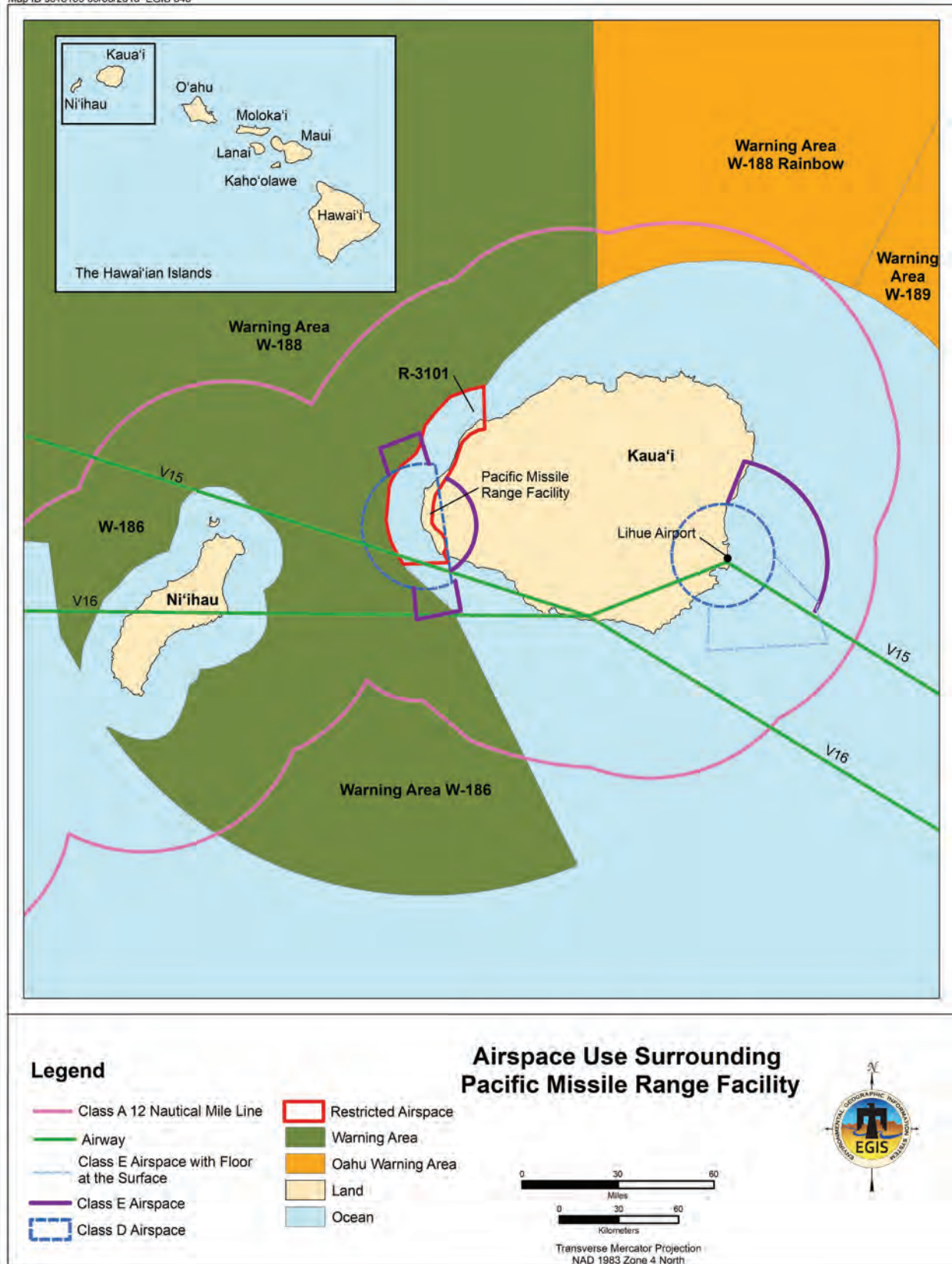


Figure 10: Airspace Use Surrounding PMRF

potential accidents and hazards under the proposed action and alternatives, it is reasonable to consider the possibility of intentionally destructive acts being committed at KTF. Intentionally destructive acts are not accidents; however, the physical effects of a destructive act – whether caused by a fire, explosion, missile, or other impact force – may be compared with the effects of accidents. That is, the consequences of an act of sabotage or terrorism could be discussed by a comparison to the consequences of a severe accident because the forces that could result would be similar to those considered in accident analysis. (NEPA 2002)

While the effects of destructive acts can be considered comparable to accidents, the process of analyzing such acts poses a challenge because the potential number of scenarios is limitless and the likelihood of attack is unknowable (NEPA 2002). The scope of destructive acts can include a variety of impacts from the following intentionally inflicted acts:

- Sabotage
- Terrorism
- Treachery
- Treason
- Subversion
- Disruption
- Vandalism

For the purpose of this SWEA, the analysis of intentionally destructive acts is bounded by the impacts analyzed in Appendix B for Unacceptable accidents and hazards. Comparable analysis between intentionally destructive acts and Unacceptable accidents and hazards is possible because the effects of the incident will be the same, regardless of the intent, or lack thereof, as evidenced in an accident.

The types of accidents that bound intentionally destructive acts include accidents and hazards that would result in worker death and/or permanent (partial) disability. Examples of these types of hazards analyzed in Appendix B include:

- Damage or leaking to toxic and corrosive material containers (hydrazine)
- Accident during the transport of materials between the airstrip to buildings, storage magazines, and launch pads
- Detonation of test vehicle assembly while performing assembly operations

- Motors are influenced by Heat or Flame
- Equipment failure as a result of exposure/subject to Shock (dropped or handled roughly)
- Motors are affected by Electrical sources
- Detonation of test vehicle assembly is affected by Electrical sources, the Physical Environment, Shock, Impact, and/or Friction
- Unintentional Initiator fires
- Injury while performing test vehicle assembly stage stackup
- Hydraulic failure

As described in Appendix B, various engineered and administrative controls would be enacted in addition to DOE and NNSA guidance and policies, safety management programs, and site procedures to address the potential impacts. Further, access to KTF would be controlled, select buildings require key control, and mission interaction with the public would generally be conducted through approved suppliers. It should be noted that absent from these controls, guidance, policies, and procedures is the ability to detect or plan for the intent of an individual to commit the destructive act.

The Proposed Action and the alternatives as discussed would include physical and administrative safeguards to protect the public and the employee from harm that could result from a destructive act. DOE, NNSA, PMRF, and the M&O contractor would continue to adjust methods and systems as appropriate based upon review, evaluation and analysis of each launch campaign.



Laysan Albatross

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Appendix A

**Biological Opinion of the U.S. Fish and
Wildlife Service for the Proposed Base-Wide Infrastructure,
Operations, and Maintenance Activities at the Pacific
Missile Range Facility, Island of Kauai, Hawaii.**



Polihale State Park

Biological Opinion of the U.S. Fish and Wildlife Service for the Proposed Base-wide Infrastructure, Operations, and Maintenance Activities at the Pacific Missile Range Facility, Island of Kauai, Hawaii



Photo Credits: Rocket launch at Barking Sands, COMNAVREGHI 2010; Newell's shearwater, Tracy Anderson, Save Our Shearwaters Program.



**August 20, 2018
(01EPIF00-2015-F-0227)**

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

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In Reply Refer To:
01EPIF00-2014-F-0066
01EPIF00-2015-F-0227

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Subject: Reinitiation of Formal Consultation on Proposed Base-wide Infrastructure,
Operations, and Maintenance Activities at the Pacific Missile Range Facility
(PMRF) on Kauai, Hawaii

Dear Mr. Johnson and Ms. Lacy:

This document transmits the U.S. Fish and Wildlife Service's (Service or USFWS) biological opinion addressing the subject action, as revised, and its effects on the threatened Newell's shearwater (*Puffinus auricularis newelli*). The U.S. Department of the Navy (Navy) and the U.S. Department of Energy (DOE), National Nuclear Security Administration (NNSA) formally requested reinitiation of formal consultation on the subject action on April 9, 2015 in light of changes to the project description and higher than anticipated take levels of the shearwater that were addressed in the original biological opinion, dated September 9, 2014, for this action. Your request for reinitiation of formal consultation was received on April 9, 2015. This biological opinion was prepared in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C 1531 et seq.).

This biological opinion is based on: (1) information the Service received on May 1, 2018 in the April 2018 Navy and NNSA revised biological assessment (BA) prepared for the reinitiation of formal consultation on the subject action; (2) information cited in the Service's 2014 biological opinion (Service file no. 01EPIF00-2014-F-0066) on the original project description; (3) email and letter correspondence between the Service, Navy and the NNSA regarding changes to the project

description; (4) site visits conducted by the Service on September 15, 2015 to Kokee Sites, and on November 23, 2015 to Barking Sands and Makaha Ridge; (5) the *Hawaiian Dark-rumped Petrel and Newell's Manx Shearwater Recovery Plan* (USFWS 1983); and (6) other literature cited herein (see the Literature Cited section below). A complete decision record of this consultation is on file at the Service's Pacific Islands Fish and Wildlife Office in Honolulu, Hawaii.

Consultation History

September 9, 2014: The Service issued a biological opinion (Service file no. 01EPIF00-2014-F-0066) addressing PMRF Base-wide Infrastructure, Operations, and Maintenance Activities. The Consultation History section of that biological opinion is herein incorporated by reference.

October 23, 2014: The Service received an email from the Navy indicating take of 10 Newell's shearwaters at PMRF Barking Sands between the nights of October 16 and October 22, 2014. The Incidental Take Statement accompanying the biological opinion anticipated an average take of three fledgling shearwaters per year with a maximum take per year of nine fledgling shearwaters.

November 12, 2014: The Service formally advised the Navy and the NNSA of the need to: reinstitute formal consultation to revise analyses of take impacts to the Newell's shearwater based on higher than anticipated take levels; update measures under the proposed action to further avoid and minimize take impacts; develop protocols to insure preparedness for the seabird fledgling season; and develop additional conservation measures under the proposed action to provide conservation benefits to the Newell's shearwater commensurate with increased take impacts.

April 9, 2015: The Service received a letter from the Navy requesting reinstitution of formal consultation on PMRF Base-wide Infrastructure, Operations, and Maintenance Activities for purposes of addressing higher than anticipated take of the Newell's shearwater and revision of conservation measures under the proposed action for the Newell's shearwater.

April 16, 2015: Formal consultation was reinstituted effective this date.

July 23, 2015: The Service sent a letter to the Navy indicating that, although additional details were forthcoming, there was sufficient information to reinstitute formal consultation as of April 16, 2015. The letter also estimated the issuance date for a new biological opinion as August 31, 2015. In addition, the Service informed the Navy that it was necessary to update the status of the species and environmental baseline analyses in the opinion for the Newell's shearwater due to new information regarding increased impacts to the species caused by collisions with utility structures.

August 14, 2015: The Service received a letter and enclosure from the Navy describing proposed conservation measures for the Newell's shearwater; and draft guidelines for implementing those conservation measures at the PMRF.

August 20, 2015: Adam Griesemer of the Service met with Cory Compura, April Teekell, and John Nelson of the Navy (via a conference call) to discuss the Navy's August 14, 2015 letter. The Service informed the Navy that we were preparing a letter regarding the change in project description and updating the schedule for completion of the reinstituted consultation.

September 23, 2015: The Service sent a letter notifying the Navy that removal of conservation measures from the project description that provide reproductive benefits to the Newell's shearwater population is a change in the project description. The Service requested a joint meeting to discuss this change, the information needs arising from the change, and to identify collaboratively an updated schedule for addressing information needs for completing the consultation.

October 2, 2015: Adam Griesemer of the Service was notified via telephone by Zena Wetzel (a contract biologist for the Navy) that a dead Newell's shearwater was found near the Kokee Site C communication tower during monitoring surveys.

December 15, 2015: Mary Abrams, David Tessler, Aaron Nadig, and Adam Griesemer of the Service met with Aaron Poentis, Tamara Conkle, Cory Compura, Cynthia Nojima, April Teekell, and John Nelson of the Navy to discuss changes to the project description, information needs arising from this change, and to identify collaboratively an updated schedule for addressing information needs for completing the consultation.

March 25, 2016: The Service initiated a new evaluation addressing the effects of the proposed action on the Newell's shearwater based on the Navy's letter to the Service addressing additional information on the project description, including revised conservation measures that avoid and minimize impacts to the Newell's shearwater from project night lighting, and follow-up on the Service's suggestions regarding appropriate conservation measures for the Newell's shearwater.

August 29, 2016: Cory Campora of the Navy met with Aaron Nadig of the Service via telephone to discuss the schedule for completion of the reinitiated consultation. The Service and Navy agreed that once the draft biological opinion was completed, they would meet again to discuss the proposed action and updating the schedule.

July 26-27, 2017: Adam Griesemer, Aaron Nadig, Mary Abrams, Larry Salata, and Eric Hein of the Service met with Kelly Ebert, Tamara Conkle, Cory Campora, Frans Juola, and April Teekell of the Navy to discuss the Service's analyses informing the draft biological opinion such as the Service's deterministic population model, changes to the PMRF project description and conservation measures, interagency coordination, and action items necessary to complete the consultation.

August 28, 2017: Kelly Ebert of the Navy emailed the Service to provide notification of the Navy's intent to revise their biological assessment to include contributions to the Hawaiian Seabird Conservation Account managed by the Service and administered by the National Fish and Wildlife Foundation.

May 1, 2018: The Service received from the Navy a revised biological assessment for inclusion in the Navy and NNSA's reinitiation of formal consultation on the subject action.

July 26, 2018: The Service sent the Navy the draft biological opinion and requested comments.

August 3, 2018: Kelly Ebert of the Navy emailed the Service that the Navy would not finish comments on the draft BO until an unknown time the following week.

August 8, 2018: The Navy sent the Service their comments on the draft BO.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The Navy's PMRF provides integrated range services for multiple Department of Defense (DoD) and NNSA activities. PMRF is the largest instrumented multi-environment weapons test range in the U.S. and includes land, sea, and air zones. The range services accommodate training, tactics development, and evaluation for air, surface, and subsurface weapons systems for DoD and other U.S. departments and agencies, foreign military forces, and private industry. PMRF maintains facilities and provides services to support Pacific Fleet underwater, surface, and air training exercises and other activities designed by the Chief of Naval Operations. The scope of the proposed action considered in this biological opinion includes all current and ongoing base infrastructure, operations, and maintenance activities at all terrestrial PMRF sites on the island of Kauai, including activities of tenant and customer DoD commands and other Federal agencies. The PMRF Main Base is located at Barking Sands, which has training and Research, Development, Test, & Evaluation (RDT&E) activity areas for tracing and surveillance radars, data processing, communications networks, and an airfield. In addition to the main base at Barking Sands, PMRF is comprised of support facilities on Kauai at Makaha Ridge (secondary range), Kokee (tracking radars, telemetry, communications, command, and control), Kamokala Ridge (munitions storage), Port Allen (pier for weapons recovery and Navy Seaborne Powered Targets (SEPTAR) boats), and Milolii Ridge (reflectors) (COMNAVREGHI 2010).

Although the Kauai Test Facility (KTF) previously included an area on Mount Kahili as a communications repeater site, the site is no longer used by KTF and all NNSA-owned telemetry and data acquisition equipment was removed. Mount Kahili will not be addressed further in this document.

The term of the proposed action is 50 years.

Components of the Proposed Action

i. PMRF Main Base – Barking Sands

Barking Sands is the principal operations area for PMRF and supports surface, subsurface, air, and space activities (COMNAVREGHI 2010). Tracking and surveillance radars, data processing, and other communications networks are contained within RDT&E activity areas. Nohili Ditch and Kinikini Ditch separate Barking Sands into three zones: north, central, and south (Figure 1).

The northern third of Barking Sands, north of Nohili Ditch, comprises KTF, an area managed and operated by NNSA's Sandia National Lab (SNL) for missile assembly and launch operations and associated support activities, administration, and services. SNL operates Sandia's Strategic Target System (STARS) and rail-launched sounding rocket launches from KTF. Within the NNSA *Work For Others* program, SNL also conducts missile launches for DoD components, including the Missile Defense Agency (MDA). KTF personnel conduct test operations to support materials research, components development, advanced re-entry vehicle technologies, water entry and recovery systems, and missile defense testing (www.sandia.gov/locations/ktf). Access to KTF, including the Nohili Dune area (the western boundary of KTF), is controlled and limited at all times. Polihale State Park, to the north of KTF, provides beach dune, camping, and surfing

activities to the public. Temporary closures of State of Hawaii access roads and beach areas at Polihale occur during missile launches from KTF.

In addition to housing KTF, the northern third of Barking Sands contains U.S. Army/MDA Terminal High Altitude Area Defense (THAAD) missile launch facilities, a 50K launch pad (capable of supporting a 50,000 pound maximum design load launcher), and the Aegis Ashore Test Center. As at KTF, beach and dune areas to the west of the THAAD, 50K, and Aegis launch facilities are off-limits to all PMRF personnel and visitors except for security personnel conducting patrols. Prior to missile launches from any launch pad, the Navy carries out security patrols to ensure no human presence in the Ground Hazard Area during launch activities (COMNAVREGHI 2010). During pre-launch and other patrols, security all-terrain vehicles (ATVs) are driven in non-vegetated areas between the high tide line and beach berm, and pickup trucks are driven only on existing dirt roads. Any security ATV entering the beach area is required to cross the berm only on designated permanent paths indicated by signage.

The central third of Barking Sands, delineated by Nohili Ditch on the north and Kinikini Ditch on the south (Figure 1), contains a 6,000-foot runway and associated air operations facilities. In addition to the runway, these facilities include a helicopter landing pad, main hangar, and administrative buildings. The airfield supports C-5 and C-17-type cargo aircraft, tactical aircraft, and helicopters. Operations support aircraft consist primarily of C-26 airplanes, which are used for logistics and range surveillance, and S-61 helicopters used for personnel transfer, logistics, surveillance, and target recovery. Daily touch-and-go practices of cargo airplanes also occur at the airfield. In addition to air operations facilities, the central third of Barking Sands supports base administration, base services, range operations, ordnance maintenance, and fuel supply facilities. The U.S. Army and Hawaii Air National Guard (HIANG) also maintain facilities and carry out missions in this section of the installation.

The southern third of Barking Sands, south of Kinikini Ditch (Figure 1), contains a housing area, personnel support facilities, and additional base operations facilities. Just to the south of Kinikini Ditch lies a recreational beach cottage area consisting of 19 cottages. The cottages are available for short-term rentals to active duty and retired military and their families and to DoD employees and contractors working on the installation. The cottages are adjacent to the beach, and the beach on this section of Barking Sands is open to use by military personnel and their families and beach cottage visitors. A breeding colony of Wedge-tailed Shearwaters (*Ardenna pacifica*) occurs in and adjacent to the beach cottage area. The southern third of the base also contains a housing area consisting of approximately 70 units (primarily single-family homes and duplexes), and personnel support facilities that include a Navy Exchange, fitness center, youth center, soccer field, movie theater, and all-hands club. A man-made oxidation pond is located in this section of the base, providing the only surface water on Barking Sands outside of the agricultural drainage ditches. Finally, this southern section of Barking Sands contains communications facilities, an antenna array, and launch facilities, although on a small spatial scale relative to the northern third of the base (COMNAVREGHI 2010). Barking Sands is surrounded by or contains a total of 6.3 miles of barbed wire fencing, consisting of 3-strand barbed wire atop chain link fence.

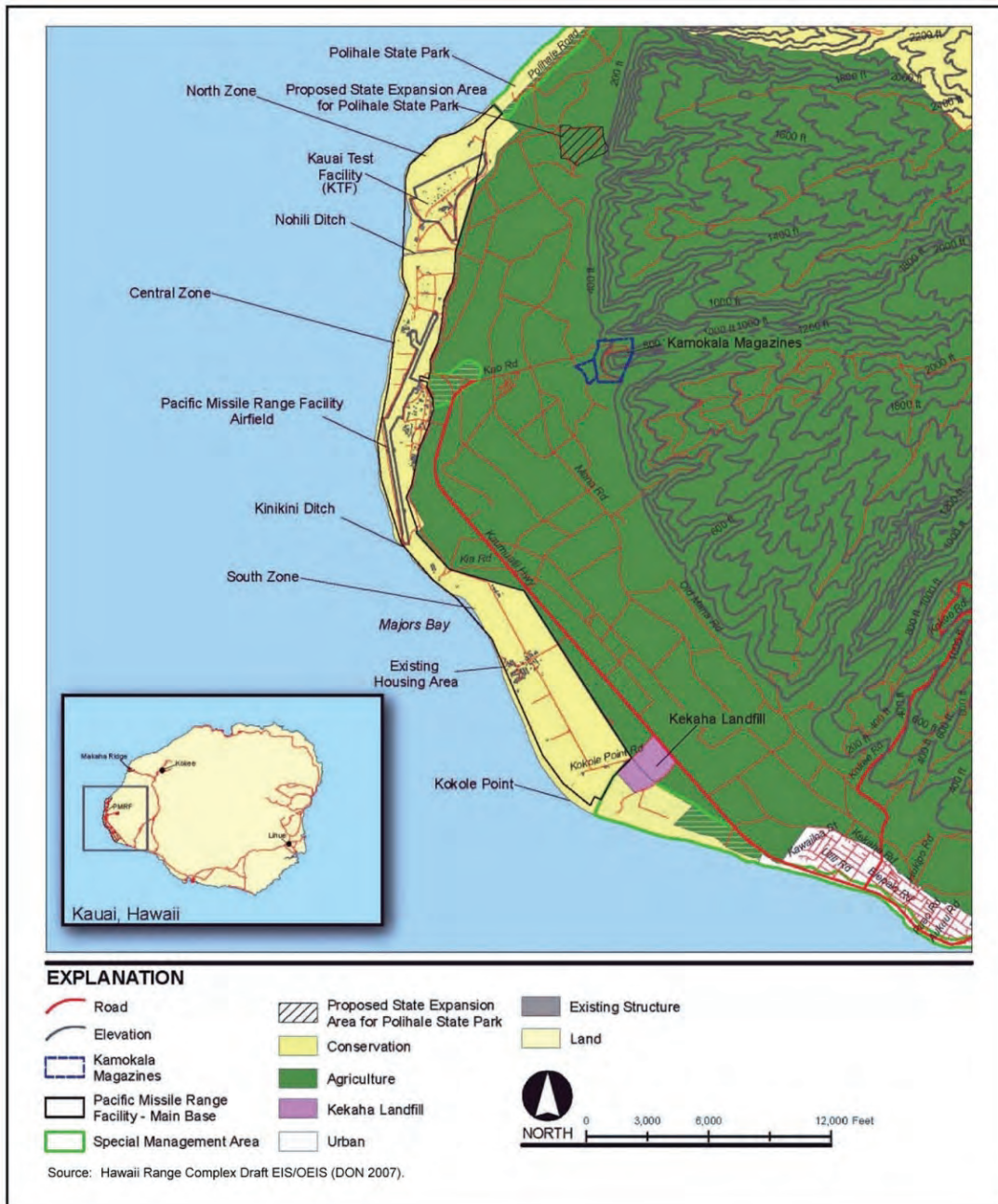


Figure 1. Map of the PMRF on Kauai (Source: COMNAVREGHI 2010).

a) Barking Sands Lighting

Night-lighting at Barking Sands is associated with base administration, maintenance, personnel support infrastructure, and missile assembly and launch facilities. Anti-Terrorism/Force Protection-lighting is used intermittently at Barking Sands missile assembly and launch facilities to protect personnel and assets prior to launch activities. Currently, three missile assembly areas and five launch pads are located in the northern section of Barking Sands, and a launch pad is located in the southern section of Barking Sands at Kokole Point. The total number of nights per year during which Force Protection lighting is required on these launch pads for all missile launch activities by all supported DoD commands and other Federal agencies is currently approximately 90-120 nights.

Duration of each event ranges from approximately three days to four weeks, and event schedules are spread out throughout the calendar year. Thus, the number of nights during the three-month nocturnal seabird fledging period (mid-September through mid-December) that require lighting at launch pads is not likely to exceed a total of 30 days.

b) Barking Sands Communication Towers and Transmission Lines

Fourteen communication towers are located at Barking Sands (Figure 2). In compliance with Federal Aviation Administration (FAA) and Commander, Naval Air Systems Command requirements regarding airfield obstruction-lighting, a subset of the communication towers at Barking Sands have aircraft obstruction-lighting at the top of the structure; this lighting consists of two steady-burning, unshielded red bulbs (DON 2018). The height and lighting of all communication towers at Barking Sands are presented in Table 1.

Table 1. General locations, heights, and lighting conditions of communication towers at Barking Sands, PMRF, as of September 2008.

Building/Site	Type of Tower or Antenna	Tower Height	Aircraft Obstruction-Lighting
Bldg 564	Metro tower	96 ft	2 red bulbs
Bldg. 515	Calibration lab antennas (2)	80 ft	2 red bulbs
Bldg. 556	Pyramid spiral antenna	40 ft	2 red bulbs
Bldg. 396	Aircraft beacon tower	66 ft	none
North Gate	HI Telephone microwave tower	165 ft	2 red bulbs
Bldg. 1100	Boresight tower	150 ft	2 red bulbs
North of Kokole Point	WWVH/U.S. National Institute of Standards and Technology radio antennas (2)	90 ft	none
North of Kokole Point	WWVH/U.S. National Institute of Standards and Technology radio tower	45 ft	none
Bldg. 851	Radial curtain antenna tower	110 ft	none
Bldg. 852	Radial curtain antenna tower	110 ft	none
Bldg. 853	Radial curtain antenna tower	110 ft	none
Bldg. 854	Radial curtain antenna tower	110 ft	none
Bldg. 822	Communications tower	110 ft	2 red bulbs
Bldg. 850	U.S. Coast Guard/Differential Global Positioning System tower	200 ft	2 red bulbs

In addition to communication towers, structures with narrow profiles exceeding 26 feet in height at Barking Sands include 121 electrical distribution line poles spread over a distance of approximately 7 miles. Unlike poles supporting 69 kilovolt (kV) transmission lines that run along the main roads of Kauai and stand 70 to 85 feet tall, the poles on Barking Sands support 12 kV distribution lines and are 45 feet in height. This height is within the range of heights of the kiawe trees (*Prosopis*

pallida) that dominate the non-native habitat on the base, including roadside habitat, that grow from 30 to 60 feet tall (COMNAVREGHI 2010 p. 3-51, http://www.ctahr.hawaii.edu/forestry/trees/CommonTreesHI/CFT_Protopsis_pallida.pdf). In addition, distribution lines on 45-ft poles throughout Barking Sands are configured in a horizontal plane, rather than stacked vertically, such that the vertical profile is equivalent to that of a single line. All existing communication towers and power lines at Barking Sands are in use, and there is no plan for removal of any towers or lines at this time.

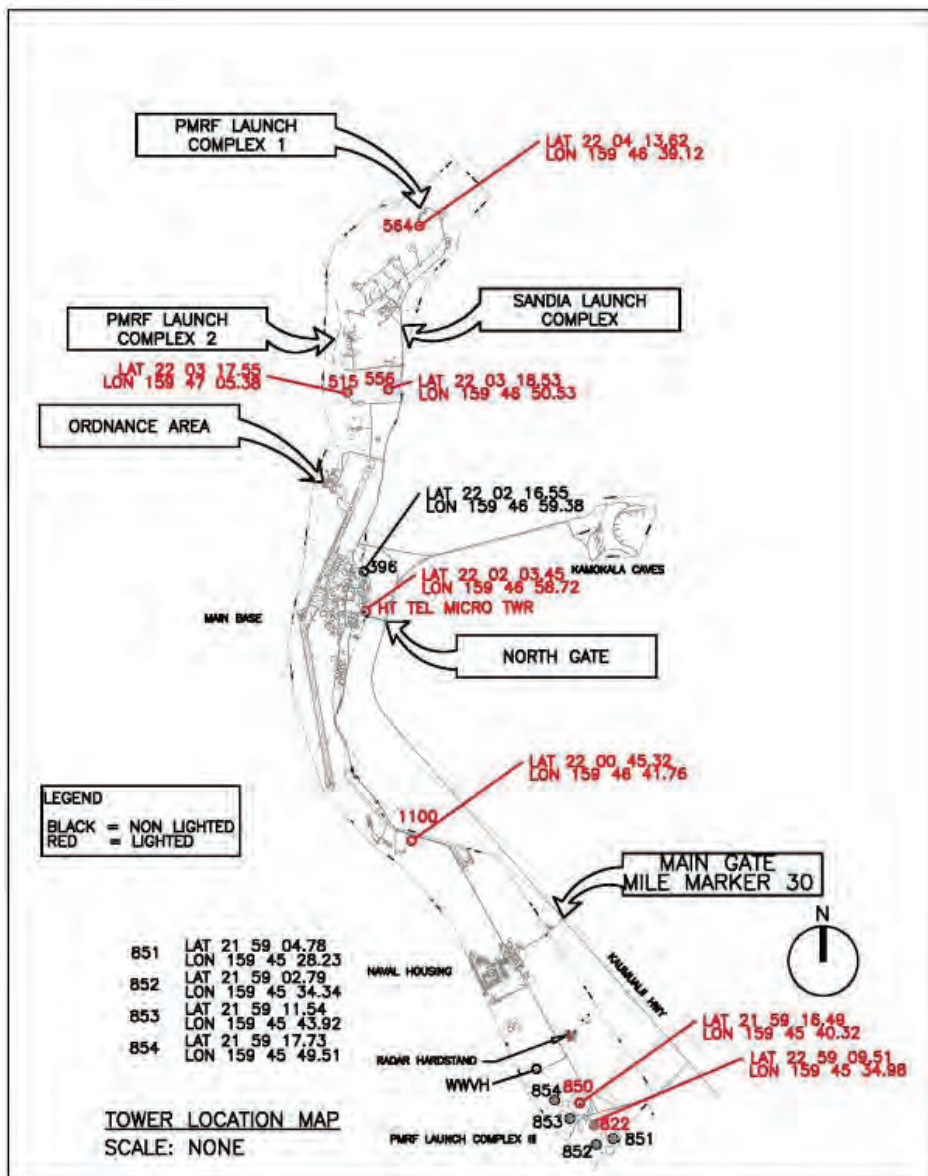


Figure 2. Locations of communication towers at Barking Sands, PMRF. Towers indicated by red font contain aircraft obstruction-lighting, consisting of two steady-burning unshielded red bulbs. Towers indicated by black font do not have lighting.

c) *Barking Sands Air Operations and Bird-Aircraft Strike Hazard Program*

Barking Sands air operations facilities in the central portion of the installation include a 6,000-foot runway, four helicopter landing pads, main hangar, and administrative facilities. The airfield supports military aircraft including, but not limited to, large cargo aircraft, tactical aircraft, and helicopters. Operations support aircraft consist of C-26 airplanes used for logistics and range surveillance, and S-61 helicopters used for personnel transfer, logistics, surveillance, and target recovery. Daily touch-and-go practices of cargo airplanes also occur at the airfield. Although field carrier landing practices (FCLPs) have not been conducted at the Barking Sands airfield, the potential exists for this training to occur. FCLPs are practices and tests of landing tactical aircraft at a land-based airfield for pilots who will land tactical aircraft on aircraft carriers. Pilots who are in the process of being assigned to aircraft carriers forward-deployed in the western Pacific normally conduct FCLP training on the west coast of the mainland U.S. The airfield at Barking Sands would be used for FCLP training and testing only if a pilot were unable to test on the mainland U.S. prior to travel to the western Pacific due to scheduling reasons.

To minimize the risk of aircraft collisions with birds and other wildlife, the Commander, Naval Installations Command (CNIC) contracts United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) Wildlife Services (WS) to implement an integrated wildlife control operation within the Bird Aircraft Strike Hazard (BASH) zone at Barking Sands. Control methods include lethal techniques for introduced species such as zebra doves (*Geopelia striata*), spotted doves (*Spilopelia chinensis*), mynas (*Acridotheres tristis*), bulbuls (*Pycnonotus* spp.), and manakins (*Lonchura* spp.). Lethal control is conducted via shooting in high probability bird-strike zones along the runways and taxiways. With non-listed species that are federally protected under the Migratory Bird Treaty Act (MBTA), USDA-WS conducts non-lethal control, including non-lethal trapping/relocation and hazing by personnel on foot or in vehicles. MBTA-protected species managed at Barking Sands include, but are not limited to, Laysan albatrosses (*Phoebastria immutabilis*), great frigatebirds (*Fregata minor*), and Pacific golden plovers (*Pluvialis fulva*). PMRF Air Operations maintains a Migratory Bird Permit for management of MBTA-protected species within the BASH zone. Newell's shearwaters are not hazed and personnel authorized to conduct BASH operations are trained in seabird preparedness in the event staff discover grounded seabirds.

d) *Makaha Ridge Tracking Station*

The Makaha Ridge Tracking Station serves as PMRF's secondary missile tracking and surveillance station (COMNAVREGHI 2010, pp. 4-1 – 4-2). Structures at the site consist of eight buildings and two antennas attached to telephone poles (Kleidosty Pacific 2016, p.30-31) (Figure 3). Tracking and surveillance activities occur inside the buildings at Makaha Ridge, including a Frequency Interference Control building, telemetry building, communications building, laboratory, power plant, maintenance facility, and guard shack. Access to Makaha Ridge Tracking Station is limited to assigned personnel and visitors on official business (COMNAVREGHI 2010, pp. 4-1 – 4-4).

Exterior security lights on buildings at Makaha Ridge are currently unshielded or partially shielded by roof overhangs. In compliance with FAA and Commander, Naval Air Systems Command requirements, the two antennas at this site each have steady-burning, unshielded red bulbs (DON 2018). Transmission lines at the Makaha Ridge site consist of 12 kV distribution lines at a height

of 45 feet along a total distance of 0.6 miles. Makaha Ridge contains 0.17 miles of barbed wire fencing, consisting of three-strand barbed wire atop a chain link fence.

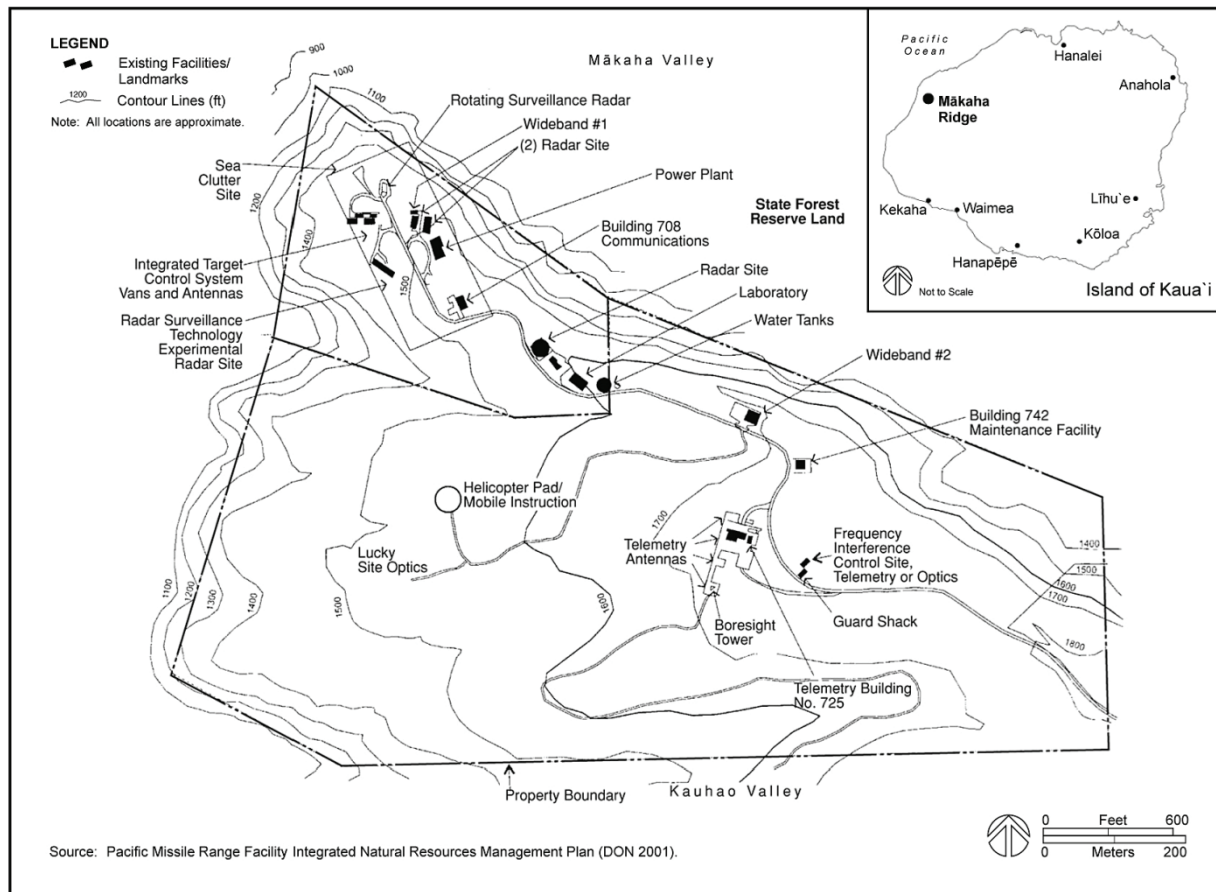


Figure 3. Map of Makaha Ridge site, PMRF, Kauai (Source: COMNAVREGHI 2010).

e) Kokee Sites

The PMRF Kokee sites contain four Navy-operated and maintained buildings in which telemetry, tracking, communications, and command and control operations occur (Kokee Sites A through D, Figure 4). A Geophysical Observatory operated by the National Aeronautics and Space Administration (NASA) is also located at the Kokee sites (Site E, Figure 4). Kokee Site A accommodates tracking and command, training and administration, and logistics support. Site B contains a power plant and fuel storage facility. Site C consists of boresight equipment, operations and maintenance support, a microwave antenna, and radar, and site D contains a transmitter building and antenna support facilities (COMNAVREGHI 2010, pp. 5-1 – 5-3). Although the US Air Force Station (USAF) and the PMRF Kokee sites are both located in northwestern Kauai in Kokee State Park (Figure 5), the sites are not the same and the USAF is responsible for compliance for their operations at the Kokee Air Force station as described in the USAF Biological Assessment (USAF 2016).

Kokee Site A contains only two exterior security lights operated via motion sensors; lights are off unless motion is detected. Site B has no exterior lights. Site C contains a guard shack with an unshielded exterior security that was turned off beginning in October 2015, and site D has no

exterior lights. The NASA site (Site E) has four facility lights: two low wattage lights that remain on and two unshielded lights turned on by personnel as needed on infrequent occasions where they must be present at night. No above-ground transmission lines occur on the PMRF Kokee sites. The sites contain a total of 0.03 miles of barbed wire fence, consisting of three-strand barbed wire atop a chain link fence.

Two lattice-support communication towers are at Kokee Site C. Each tower has an unshielded steady-burning red light as per FAA and Commander, Naval Air Systems Command requirements. The communication towers are each 110 feet in height. Approximately 100 feet of each tower is exposed above the surrounding vegetation level. Communication Tower 764 has 28 guy wires.

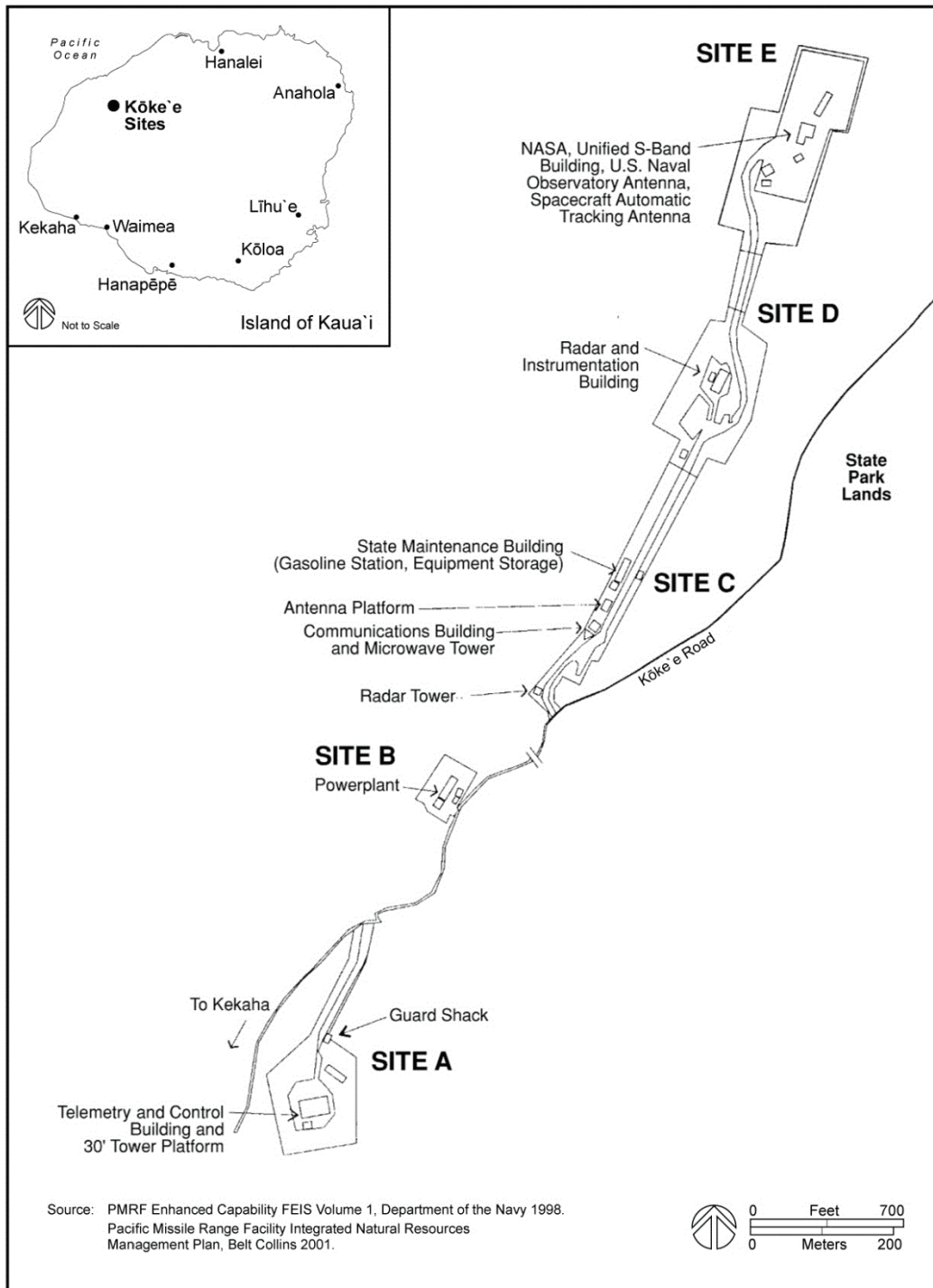


Figure 4. Map of PMRF Kokee Sites on Kauai (Source: COMNAVREGHI 2010).

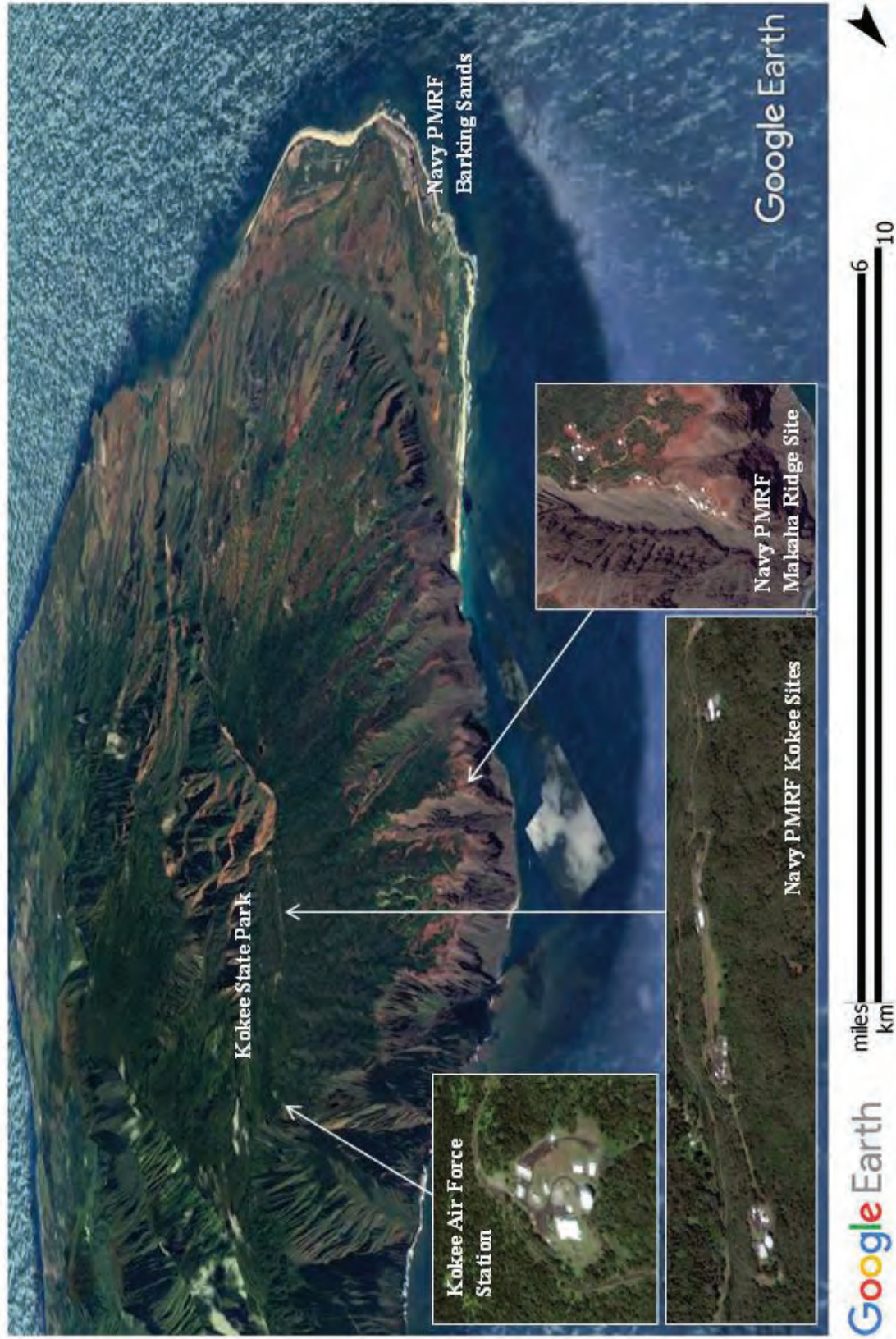


Figure 5. Three-dimensional view of Kauai with approximate locations of PMRF Kokee Sites and Kokee Air Force Station in Kokee State Park, PMRF Makaha Ridge Site, and PMRF Barking Sands. White shapes in zoomed views are buildings. Imagery from Google Earth, data SOEST/UHM and USGS, 2016 Digital Globe.

f) Kamokala Ridge Magazines

The Kamokala Ridge Magazines are located east of Barking Sands (Figure 1). Facilities at the site consist of two earth-covered magazines, 10 ordnance storage magazines excavated into the cliff face, and a missile assembly building. Ordnance is stored for the Navy, HIANG, DOE, and intermittently for other military commands with training and ordnance storage requirements (COMNAVREGHI 2010, pp. 6-1 – 6-2).

Per Navy instruction regarding security lighting for conventional arms, ammunition, and explosives (DON 2003), exterior lighting includes three floodlights on each of the two earth-covered magazines and a single incandescent bulb over the doorway of each of the 10 excavated magazines. This site includes 0.33 miles of barbed wire fencing, consisting of three-strand barbed wire atop a chain link fence.

g) Port Allen

At Port Allen Boat Harbor, the Navy leases the west side of the pier and pier building from the State of Hawaii. This site provides berthing facilities for three weapons recovery boats and a building for warehousing and support facilities including communications, maintenance/repair, and engineering.

Exterior lighting is required at the pier at Port Allen for Anti-Terrorism/Force Protection purposes (DON 2007) and to minimize nighttime trip and fall hazards near the water. Eleven lights are mounted under the roof overhang on the west side of the building, and one light is mounted on the front of the building (the northwest corner). The light on the front of the pier building is owned and operated by the Navy. The eleven lights along the west side of the building are operated by Navy, but the light fixtures are State property. These lights are turned on each night for security camera lighting and safety purposes. Six higher-intensity lights are turned on only during rare/infrequent occasions when personnel are working on docked boats on nights when fueling or upload/offload of equipment occurs. The site contains 0.05 miles of barbed wire fencing, consisting of three-strand barbed wire atop a chain link fence.

h) Miolii Ridge

The Miolii Ridge site is comprised of three, small 10-foot 2 reflector areas. No facilities are located at the site.

ii. Conservation Measures to Minimize Impacts of the Proposed Action

The following mitigation measures were developed by the Navy through consultation with the Service, are considered part of the proposed action, and are intended by the Navy to minimize adverse impacts to the Newell's shearwater that are directly related to the proposed action. These include measures that have been implemented at PMRF prior to initiation of this consultation.

a) Nocturnal Seabird Protection Program. The following measures are described as the nocturnal seabird protection program:

- All unnecessary exterior lighting will be turned off during moonless nights and shoulder nights during the seabird fledgling season. For example, in the 2016 seabird fledgling season, this measure was implemented during the seven nights prior to and eight nights following the September 30th new moon, the 10 nights prior to and eight nights following the October 30th new moon, and the eight nights prior to and two nights following the November 29th new moon;
- Full cut-off fixtures will be used where security or safety concerns require night lighting;
- Staff will patrol to confirm any exposed lights during the night are truly required and meet the shielding requirements;
- Base-wide predator control will be implemented to enhance survival and minimize the risk of predation to any downed seabirds on the installation;
- Monitoring will be implemented for downed seabirds on the installation during the seabird fledgling season;
- Support will continue for a seabird collection station at the Main Gate entrance to Barking Sands for the SOS program;
- Recovered downed seabirds found at PMRF and will be placed in the seabird collection station at Barking Sands or transported to Kauai Humane Society, where the SOS program is housed; and
- Brochures will be distributed at Barking Sands to further increase personnel and visitor awareness of on-base seabird protection measures.

b) Early Planning and Scheduling

The installation commander has issued a notice (PACMISRANFAC NOTICE 10570 dated September 15, 2017) that gave guidance on measures to be implemented to reduce/eliminate risk to protected seabirds during the fledgling season. Over the past 8 years, 93 percent of Newell's shearwater fallout has occurred between 12 October and 8 November (DON 2018). A calendar has been developed to overlay the moon phases with the shearwater fledgling season to identify potential periods of higher risk such as nights of dark moon phases within the historical peak fallout period during previous fledgling seasons. The Navy will minimize risk by scheduling non-time sensitive night operations outside the peak of the seabird fledgling season to the extent practicable. It is estimated that operations would not be able to avoid the dark moon phases during the fledgling season an average of once per year. In the future, there may be more flexibility in scheduling operations outside the dark moon phases as planning for operations can occur more than two years in advance.

c) Night-time Lighting Inspection

The Navy will conduct a night-time lighting inspection prior to the start of the seabird fledgling season to confirm that the minimization measures regarding lighting are being followed and to identify potential risks that may not have been previously identified and addressed.

d) Parking Lot Lighting

During the seabird fledgling season, lighting in the Aegis Ashore parking lot and other parking lots will be turned off with the exception of the shielded light at the Public Works parking lot,

and would only be temporarily lit for safety or special uses. Back-in parking will be required in parking lot stalls facing the ocean.

e) Interior Lighting

The Crash Fire Garage door is usually kept open to minimize response times in case of emergency. The Navy will reduce the interior garage lighting to the minimum required for fire crews to perform their work during the seabird fledging season. For other facilities such as hangars, exterior lighting will be minimized and bay doors will be kept closed as much as possible during the seabird fledging season.

f) Guideline for Implementation of Conservation Measures

Based on an analysis of seabird fallout trends over the past few years, the Navy has identified the change in personnel involved in implementing conservation actions as a contributing factor to the unexpectedly high fallout during the 2014 fledging season. The Navy has prepared draft guidelines to provide clarity and continuity in implementing biological opinion-associated conservation measures. These guidelines will clarify roles and responsibilities, point of contact information, minimum coordination and communication strategies, and documentation and reporting procedures for successful implementation of the biological opinion-associated conservation measures. In addition, a schedule describing the type of training and coordination planned, the target audience, and sample training materials will be maintained in the appendices of the guideline document. The document is a guideline instead of a traditional Standard Operation Procedure because it is intended to be a living document that can be adapted to maximize effectiveness as the program evolves.

g) Command Duty Officer Smartbook for Environmental Response

Additional guidance materials have been added to the Command Duty Officer (CDO) binder to provide immediate guidance to the CDO on duty.

h) Conservation Measures Pursuant to ESA Section 7(a)(1).

The following conservation measures were developed by the Navy through consultation with the Service to fulfill the Navy's ESA Section 7(a)(1) responsibilities for having an impact on Newell's shearwater.

The Remotely Piloted Air Vehicle (RPAV) Project

Navy has funded a project, in collaboration with the Hawaii Department of Land and Natural Resources (DLNR) Kauai Endangered Species Recovery Project (KESRP), to use a RPAV and ornithological radar to map flight paths and document nesting locations of Hawaiian Petrels (*Pterodroma sandwichensis*) and Newell's shearwaters on Kauai. As part of this project, KESRP has been subcontracted to ground-truth colony locations based upon RPAV data. If the RPAV does not successfully identify colony locations, KESRP will undertake nest monitoring in currently-known colonies as part of this project. This work was funded by the Navy in FY13 at \$250,000.

KESRP Field Assistant

The Navy provided a full-time Endangered Seabird Field Assistant to the Hawaii DLNR KESRP for four months in 2012 (15 May through 15 September). This position was funded by the Navy at a total of \$28,000. The Navy also funded KESRP in the summer of 2013 to conduct nest monitoring in currently-known Newell's shearwater colonies on Kauai at a funding level of approximately \$40,000.

Seabird Conservation Account

The Navy proposes to contribute to the Hawaiian Seabird Conservation Account managed by the Service and administered by the National Fish and Wildlife Foundation in exchange for transfer of liability of further compensatory mitigation actions and to receive credits to offset the anticipated impacts to Newell's shearwater from the proposed action. Funds will be used to contribute to conservation of the species through management of seabird breeding colonies. Management may include removal of non-native predators, such as rats (*Rattus spp.*), feral cats (*Felis catus*), pigs (*Sus scrofa*), and barn-owls (*Tyto alba*), and restoration of occupied seabird breeding habitat. Partners implementing the management will demonstrate effectiveness through monitoring to detect the number of predators present and the number removed at the seabird breeding colony(ies) receiving the management.

In 2022, the Navy will coordinate with the Service to reevaluate their action of contributing to the Hawaiian Seabird Conservation Account and the effectiveness of the management implemented at the seabird breeding colony(ies). The Navy's contributions are anticipated to support, annually, management for 30 breeding pairs in 2018 and expanding management to affect 50 breeding pairs by 2022. Unless the Navy and Service reinitiate consultation based on the 2022 evaluation, the Navy's funding contributions to the Hawaiian Seabird Conservation Account will continue in years after 2022 at a level supporting, annually, the management of 50 breeding pairs.

iii. Annual Reporting on Conservation Measures

The Navy will submit annual reports detailing the implementation of the above Conservation Measures used to minimize the effects of the action. Annual reports will also summarize survey and monitoring results and levels of take of all ESA-listed species. The first report will be submitted at the end of the first fiscal year following BO issuance.

Action Area

The action area of a project is defined by regulation as all areas [likely] to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR §402.02). The action area for this action (Figure 6) includes the main base of PMRF, known as Barking Sands, and all of Mana Plain, which surrounds Barking Sands, because this area is likely to be subject to above ambient light and noise levels associated with launches and aircraft operations. In addition to Barking Sands and the surrounding Mana Plain, the action area (Figure 6) is also comprised of several smaller sites located at Makaha Ridge, Kokee, Kamokala Ridge, and Port Allen that will also be subject to above ambient noise and light levels caused by Navy operations. Lastly, the action area also includes the western region of the island, from

Waimea Canyon through the Na Pali coast (Haena, Kokee, and Polihale State Parks), which constitutes the areas affected by the action. Air operations and missile launch operations produce noise and/or are visible within the action area. The action area, encompassing the region west of Haena to Port Allen, constitutes approximately 40% of Kauai.

Details of the sites which encompass the action area are provided below, in part, based on descriptions found in the draft BA, current conditions sections of the 2010 PMRF INRMP (COMNAVREGHI 2010). Additional details including maps and pictures of each PMRF site are provided in the 2010 PMRF INRMP.

Barking Sands is located along the Mana Plain on the western coastline of Kauai (Figure 6). The base is approximately 7 miles long and 0.5 miles wide, encompassing approximately 2,060 acres. Barking Sands is bordered to the north by Polihale State Park and to the south by Kokole Point. Barking Sands is bordered to the east by agricultural lands, which continue across the Mana Plain to the mountains of central Kauai. Barking Sands is bordered to the west by the Pacific Ocean, with a coastline dominated by sand beaches, beach barrier dunes, and beach strand vegetation. The Nohili Dunes provide the highest elevation at Barking Sands, approximately 100 feet. The drainage ditches constitute most of the surface water within Barking Sands.

Mana Plain extends across coastal leeward Kauai (Figure 6) and is bordered by Puu Ka Pele Uplands to the east, including Makaha Ridge, Na Pali coastline to the north, and Pacific Ocean to the west and south. Mana Plain once contained expansive wetland habitats that supported a variety of native plant and wildlife species. Prior to its drainage and conversion to agricultural lands during the 1900s, approximately 1,700 acres of permanent, semi-permanent, and seasonal wetlands were present on Mana Plain.

Makaha Ridge is a finger ridge of the Na Pali coast which occurs on the west-northwest side of Kauai to the northeast of Barking Sands (Figure 6). The elevation at Makaha Ridge ranges from 1,460 feet at the cliff faces to 1,850 feet at the eastern perimeter. The site covers 244 acres and lies approximately 7 miles north of Barking Sands within State of Hawaii forest reserve areas. Steep slopes surround the station to the south, west, and north. Water drainage paths exist at the site; however, there are no perennial surface water features.

The Kokee sites of PMRF (Figure 6) occur along Kaunuohua Ridge near the northwestern terminus of Waimea Canyon. Kokee State Park borders the sites on all sides, and forested areas extend within the property boundaries. The Kokee sites are located on five small parcels that total 16 acres of land, which range in elevation from 3,710 to 3,800 feet. No surface water resources occur at the sites.

The Kamokala Ridge Magazines is located approximately 1.5 miles east of Barking Sands covering 89 acres on the western side of the ridge (Figure 6). Elevation of the site ranges from 240 to 320 feet. The ridge is located on the western edge of the Puu Ka Pele, an upland area with numerous valleys that are characterized by rock outcrops and lowland dry vegetation. The Mana plain extends to the west of Kamokala Ridge. There are no perennial surface water features at the site.

The PMRF Port Allen site is located in the town of Port Allen (Figure 6) on the southern shore of Kauai. At this site, the Navy leases the west side of the pier and west side of the pier building from the State of Hawaii. The total area of the leased site is 1.0 acre. Because the Navy does not have jurisdiction over the lighting conditions on the east side of the pier, owned and operated by the State of Hawaii, the action area is restricted to the Navy-leased property on the west side of the building and pier.

The Na Pali Coast in northwestern Kauai extends from Haena to Polihale State Park (Figure 6). The elevation along the coast ranges from sea level to 3,700 feet in Kokee. The Na Pali region is characterized as a coastal cliff formation with numerous upland finger ridges, precipitous cliffs, and deeply incised valleys. The elevation in the rim areas ranges from approximately 2,700 to 3,600 feet.

Waimea Canyon is located in the western region of Kauai (Figure 6) and is bordered by Puu Ka Pele uplands and Na Pali Coast to the west, Makaweli uplands to the south, and the Alakai High Plateau to the north. The elevation in Waimea Canyon ranges from approximately 100 feet up to 3,700 feet at the canyon rim. The Waimea Canyon is characterized by near vertical cliffs and dramatic valleys. Several streams flow into the Waimea River in the Waimea Canyon, including Poomau, Waiahulu, Koaie, and Waialae streams.

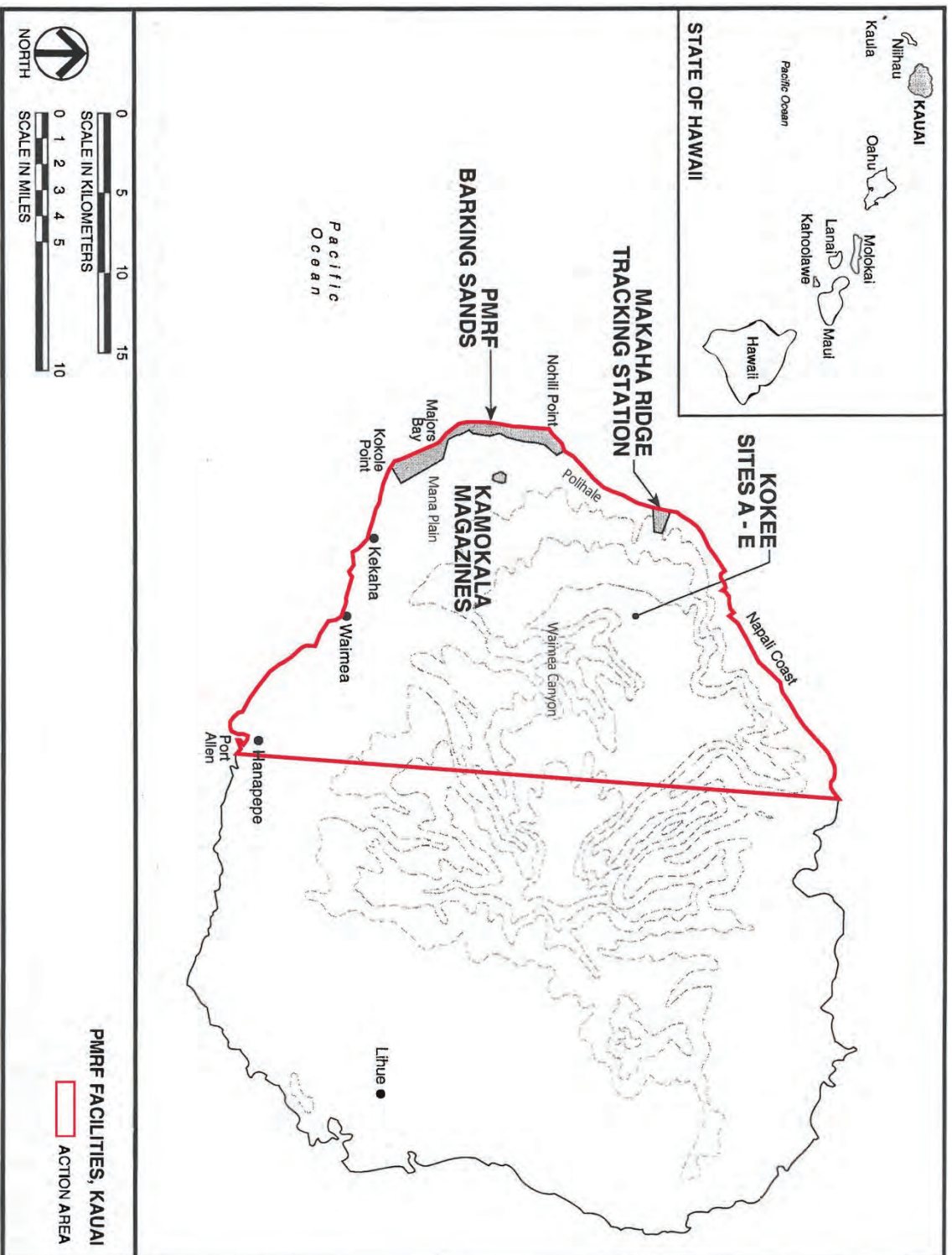


Figure 6. Map of action area for the proposed action on Kauai. Action area encompasses the area within the red border. (Source: COMNAVREGHI 2001).

ANALYTICAL FRAMEWORK FOR THE JEOPARDY DETERMINATION

In accordance with policy and regulation, the jeopardy analysis in this biological opinion relies on four components: (1) the *Status of the Species*, which evaluates the Newell's shearwater range-wide condition, the factors responsible for that condition, and its survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the Newell's shearwater in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the Newell's shearwater; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the Newell's shearwater; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the Newell's shearwater.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the Newell's shearwater's current status, taking into account cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the Newell's shearwater in the wild.

The jeopardy analysis in this biological opinion places an emphasis on consideration of the range-wide survival and recovery needs of the Newell's shearwater and the role of the action area in the survival and recovery of the Newell's shearwater as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

STATUS OF THE NEWELL'S SHEARWATER

i. Listing Status, Taxonomy, and Species Description

The Newell's shearwater was listed as a threatened species in 1975 (USFWS 1983), pursuant to the Endangered Species Preservation Act of 1966. *The Hawaiian Dark-rumped Petrel and Newell's Manx Shearwater Recovery Plan* was published in 1983 (USFWS 1983). Species five-year reviews on Newell's shearwater were completed in 2011 and 2017. Each of the reviews recommended up-listing the Newell's shearwater to endangered status primarily due to precipitous declines in the global population over the last two decades. Critical habitat has not been designated for the Newell's shearwater (USFWS 1983).

The Newell's shearwater taxonomically belongs to the *Puffinus* genus, in the *Procellariidae* family and *Procellariiformes* order, along with 20 other extant shearwaters ranging throughout the Indian, Atlantic, and Pacific oceans (Gill and Donsker 2016). Shearwaters are characterized by exhibiting a "shearing" flight pattern, dipping from side to side on stiff, straight wings with few wing beats. Genetic analyses conducted by Martínez-Gómez *et al.* (2015) confirmed the taxonomic status of Newell's shearwaters (*P. auricularis newelli*) as a subspecies alongside the Townsend's shearwater (*P. auricularis auricularis*). These two subspecies comprise *P.*

auricularis. The two subspecies exhibit minor differences in plumage patterns and breeding chronology (Martínez-Gómez *et al.* 2015, p. 1026). The Townsend's shearwater is endemic to the Revillagigedo Archipelago located off the coast of Mexico and south of Baja California Peninsula. The Townsend's shearwater's range and distribution has been significantly contracted to a single island with less than 100 breeding pairs remaining (Martínez-Gómez *et al.* 2015, p. 1032; and BirdLife International 2016a).

The Newell's shearwater is approximately 12 to 14 inches long, with a wingspan of 30 to 35 inches (Berger 1972, p. 46), and weighs approximately 14 ounces (Ainley *et al.* 1997, p. 15). Its plumage is glossy black above, and white below (Ainley *et al.* 1997, p. 15). The Newell's shearwaters' maneuverability is characterized by fast, directional, and a low-to-water flight pattern, due to high wing-loading. A Newell's shearwater wing-loading averages about 60 N [newtons]/m² (± 5.3 SD) with a low aspect ratio (10.3 ± 0.45 SD); significantly different from other shearwaters or petrels (Spear *et al.* 1995; Warham 1977). Observations of Newell's shearwaters transiting over land show a distinct flight pattern characterized by an almost frantic flapping style with the wings held straight (KESRP 2017). It has a dark gray to brown bill that is sharply hooked at the tip (Ainley *et al.* 1997, p. 15). Its claws are well adapted for burrow excavation and climbing.

ii. Historic and Current Distribution

The Newell's shearwater is believed to have colonized, historically, many of the southeastern Hawaiian Islands, including Hawaii, Maui, Molokai, Oahu, and Kauai (USFWS 1983, p. 2; Pyle and Pyle 2009, p.3). Newell's shearwaters were thought to be extinct after 1908, due largely to habitat loss and predation, but in 1954 a specimen was collected on the island of Oahu (King and Gould 1967) and in 1967 a breeding colony was found on Kauai (Sincock and Swedberg 1969). Although no Newell's shearwater breeding colonies have been identified on the island of Oahu, downed Newell's shearwaters have been recovered throughout the island since the 1950s (Pyle and Pyle 2009, p.3). Three fragmented breeding areas were identified in the Puna District on the southeast island of Hawaii in 1993, based on nocturnal calling, visual detections of birds in flight, and two Newell's shearwater carcasses found along the highway; however no active burrows were found (Reynolds and Ritchotte 1997, p. 31). Currently, research staff at Haleakala National Park on Maui Island consistently report Newell's shearwater ground calling within Kipahulu Valley and along the northern slope of Mount Haleakala near Koolau Gap, indicating a breeding site (NPS 2012, p. 18). However, due to sensitive resources in the area and the difficult terrain, no ground surveys have been conducted in these locations (NPS 2012, p. 19). In 2015, acoustic song meters were placed at 41 sites in remote areas of Haleakala National Park to detect potential new seabird breeding colonies (McKown and Savage 2015, p. 1). Song meters detected Newell's shearwater ground calls in low numbers (averaging 2 ground calls per survey night) at five of the 41 sites, with only one site recording regular activity during the 30-day study period (McKown and Savage 2015, p. 15). The song meters in this study were programmed to record 1 out of every 5 minutes, for 5 hours starting at sunset, then record 1 out of every 10 minutes for the 5 hours preceding sunrise (McKown and Savage 2015, p. 3). This schedule amounted to an hour and a half of data each night. Additional longer-term acoustic and ground surveys are needed to evaluate the extent, distribution, and viability of Newell's shearwater on Maui and Hawaii islands.

While some knowledge gaps remain concerning its distribution, the Newell's shearwater has experienced a significant breeding range contraction and currently, all known extant breeding colonies with documented burrows are located on the island of Kauai (Figure 7). Estimates indicate 90 percent of the global population resides on Kauai (Ainley *et al.* 1997; Griesemer and Holmes 2011).

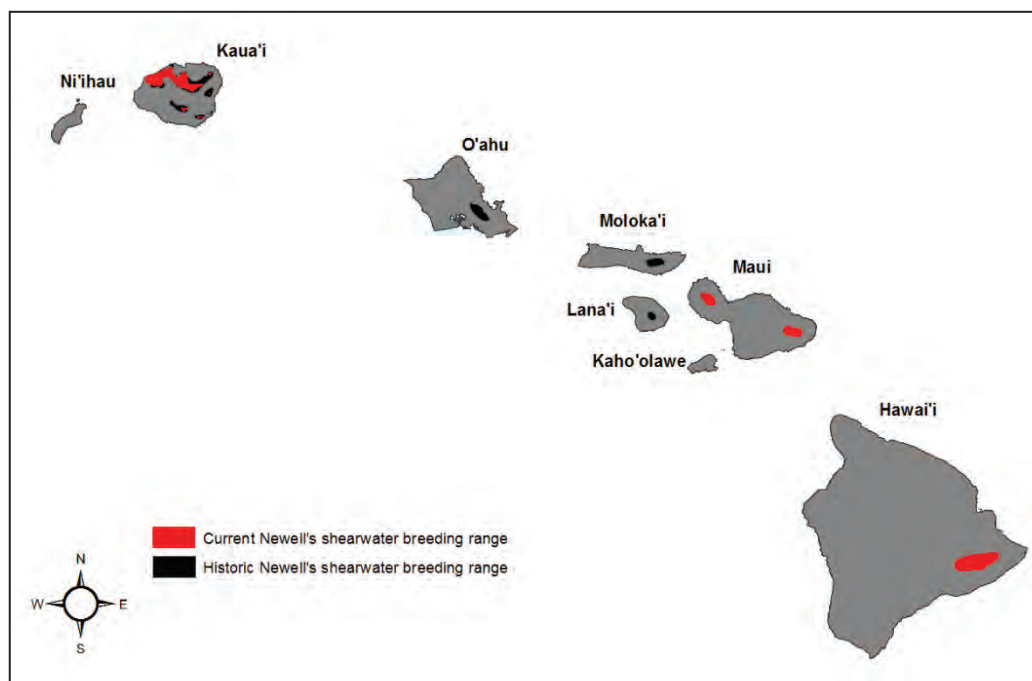


Figure 7. A comparison of the historic and current breeding range for the Newell's shearwater. Map shows current breeding range contraction from the historic breeding range for the Newell's shearwater within the Hawaiian Archipelago. While the Newell's shearwater may breed on Hawaii and Maui islands, the only known extant breeding colonies with documented burrows of Newell's are located on the island of Kauai.

Of the Newell's shearwater breeding on the island of Kauai, 104 breeding pairs were being monitored and an additional 64 burrows in Upper Limahuli Preserve were monitored in 2015 but could not be identified to species (i.e., burrows were either Newell's or petrels) (Raine *et al.* 2016a, 2016c). The majority of the monitored shearwaters (82 breeding pairs) in 2015 were concentrated within the Upper Limahuli Preserve (ULP), enclosed by an ungulate exclusion fence. Auditory surveys documented several additional areas of concentrated shearwater ground-calls indicating breeding activity within Lumahai Valley and Laau Mountain in montane habitat and within Honopu Valley along the Na Pali coast (Banfield *et al.* 2013). However, due to inaccessible and difficult terrain, no numbers or estimates exist for shearwaters breeding in these locations.

Based on historic and current distribution of breeding sites, Newell's shearwaters prefer breeding habitat in montane wet (e.g., Hono o Na Pali colony) to lowland wet and wet cliff (e.g., Upper Limahuli colony) habitat of 200m to 1,000m in elevation, steep to moderate slopes with thick native understory of uluhe fern (*Dicranopteris linearis*) and open canopy of dispersed ohia trees (*Metrosideros polymorpha*) (Troy *et al.* 2014, p. 325). The preference for montane forested

habitat beneath dense uluhe fern helps to conceal shearwater burrows from predators while dispersed ohia trees may provide a take-off point for shearwaters to regain flight (Troy *et al.* 2014, p. 318). The Newell's substrate preference includes rocky volcanic soils with a moderate amount of fine soil particles and suitable drainage to prevent burrow flooding (Troy *et al.* 2014, p. 324). Recent seabird surveys have resulted in the first confirmed Newell's shearwater burrows (n=3) along the Na Pali coast, in dry cliff habitat (Raine and Banfield 2015a, p. 11).

iii. Life History

Newell's shearwaters have a long lifespan (up to 36 years), do not reproduce until 6 years of age, lay one egg per year, and offspring require significant parental investment (Ainley *et al.* 2001). As with other k-selected species¹, these traits of long lifespans and low reproduction at high energetic cost define the life strategy of a species that has evolved in a stable, predictable environment, i.e. the succession of ecosystem development in the Hawaiian Islands following a period of volcanic eruptions.

Newell's shearwater breeding season begins in late March/early April when adults and sub-adults arrive to inland breeding colonies, followed by a 2-4 week exodus when breeding adults forage to build-up reserves (Raine and McFarland 2013a, p. 2; Raine and Banfield 2015a, p. 2). The incubation period begins in May and continues through July, and the chick provisioning stage occurs in late July through September (Raine and McFarland 2013a, p. 2). Both sexes equally incubate the egg (Ainley *et al.* 1997, p. 10). The fledging or late chick rearing stage, when young leave the nest for the first time occurs in September through December (DOFAW 2018; Raine and McFarland 2013a, p. 2). Adults travel from breeding to feeding areas and return to feed their chicks irregularly every one to three nights throughout the chick rearing stage (Ainley *et al.* 1997). Newell's shearwaters, similar to other birds in the Order Procellariiformes, exhibit strong natal philopatry, with breeding pairs returning to the same burrow to breed each year (Bried *et al.* 2003, p. 242).

Ainley *et al.* (2001, p. 117) documented higher than expected numbers of active shearwater burrows with no egg or nestling signs present (11%-22%), indicating no breeding attempt was made. Monitoring data of shearwater colonies indicate at least 10% or more of activity within breeding colonies is comprised of non-breeding birds or sub-adults (<6 years old) prospecting for mates or excavating burrows during the breeding season (Raine *et al.* 2016a, 2016c). Ainley *et al.* (1997, p. 11) suggested shearwaters on Kauai begin returning to their breeding habitat as sub-adults at 2-3 years of age. The full shearwater breeding season is treated as March 1 to January 1 to cover the entire period when shearwaters may transit to and from the ocean and inland breeding sites (Travers *et al.* 2016, p. 5). All transit over land occurs in darkness, with a peak over land passage during the year coinciding with the late incubation and chick rearing stages (Travers *et al.* 2013, p. 35). Fledglings leaving the nest for the first time exhibit strong phototropic behavior and rely on ambient light from the moon to navigate to open ocean (Telfer *et al.* 1987, p. 410).

¹ K-selected species are those characterized by long lifespans and low reproduction at high energetic cost due to their evolution in stable environments.

Newell's shearwaters are pelagic, spending much of their time foraging over deep waters where 96 percent of their diet consists of cephalopods, primarily the Ommastrephidae family of flying squid with the remaining 4 percent consisting of flying fish (*Exocoetus* sp.) (Ainley *et al.* 2014, p. 70). Newell's shearwaters likely specialize in feeding over yellowfin tuna (*Thunnus albacares*), as both flying squid and flying fish are important in the diet of yellowfin tuna.

iv. Current Population Demographics

At-sea surveys conducted in the central and eastern tropical Pacific between 1980 and 1994 (Spear *et al.* 1995) estimated the total Newell's shearwater population at 84,000 (95% CI = 57,000-115,000) including juveniles and sub-adults. An updated assessment based on survey data collected by the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA-NMFS) Southwest and Pacific Islands Fisheries Science Centers from 1998 to 2011, estimated the total Newell's shearwater population at 27,011 (95% CI = 18,254-37,125) including juveniles and sub-adults (Joyce 2013). Given 90 percent of the global population resides on Kauai (Ainley *et al.* 1997; Griesemer and Holmes 2011), the estimated population of Kauai is 24,310 individuals (USFWS 2017b, p. 113). The percentage of the population that is breeding age (6 years of age or older) is estimated at 0.637 (Ainley *et al.* 2001, p.115), equaling an adult population size of 15,485 (approximately 7,500 pairs).

Annual survivorship and juvenile/sub-adult survivorship of the Newell's shearwater has not been studied in the field (i.e., estimated from banding efforts and recapture). Population viability modeling efforts estimate Newell's shearwater adult survivorship at 0.905 (Ainley *et al.* 2001, p. 116) to 0.920 (Griesemer and Holmes 2011, p. 20; USFWS 2017b) and juvenile/sub-adult survivorship at 0.333 (Ainley *et al.* 2001, p. 116) based on long-term survivorship data of related species. The likelihood of Newell's shearwater adults (≥ 6 years of age) to breed in any one year was estimated to vary between 0.60 and 0.50 (Ainley *et al.* 2001, p. 118), which is markedly lower than the breeding probability (0.82) of other Procellariidae species. Based on a five-year monitoring study of a single Newell's shearwater colony on Kauai the annual reproductive success of shearwaters was estimated at 0.66 fledglings per breeding pair (Ainley *et al.* 2001, p. 117).² In comparison, the Manx shearwater, a closely related species with an extensive range and a stable global population has a reproductive success of 0.70 (Brooke 1990; and Ainley *et al.* 2001, p. 117).

Based on Newell's shearwater population parameters, SOS data, and carcass searches under power lines, Ainley *et al.* (2001) estimated the global population of Newell's shearwaters are declining at least 5.9 percent per year ($\lambda=0.941$). Ainley *et al.* (2001, p. 118) found that the main factor limiting the population growth rate of the Newell's shearwater was the extremely low breeding probability (0.547), which is associated with individual fitness and habitat quality. Ainley *et al.* (2001) suggested that the low breeding probability could be the result of high mate loss due to predation or other threats affecting individual fitness. Indeed, adults that lose a mate due to predation cannot obtain a new one quickly and have been observed not to breed the

² Reproductive success is defined as the number of chicks fledged from active burrows (Ainley *et al.* 2001).

following season (Ainley *et al.* 2001, p. 118). The purpose of the Ainley *et al.* (2001) population demographic study was to evaluate the status of Newell's on Kauai. The study sampled an average of 65 burrows for seven seabird seasons, 1981–1985 and 1993–1994. The colony sampled was in a natural state (i.e., receiving no conservation management actions) and the sample was not constrained to only experienced breeders, but rather sought to maximize the total number of burrows monitored each season (Ainley *et al.* 2001, p. 112).

Ornithological radar data was first used to monitor populations of Newell's shearwaters and Hawaiian petrels on Kauai in 1992–1993 (Day *et al.* 2003, p. 670), based on methods developed to monitor marbled murrelet (*Brachyramphus marmoratus*) populations in the Pacific Northwest (Cooper *et al.* 2001). Radar has been used to monitor the summer movement patterns of Newell's shearwaters and provide an accurate estimate of birds as they transit through the detection area at 13 sites throughout the island (Day and Cooper 1995; Raine *et al.* 2017). Day *et al.* (2003) reported a mean annual rate of 11.2 percent decline in the Newell's shearwater population between 1993 and 2001, based on the analyses of ornithological radar data.

A subsequent study using visual observations, species-specific timing of petrel and shearwater movements, and radar data analysis showed an appreciable reduction in the number of shearwaters transiting to and from montane breeding colonies from 1993 to 2013 (Raine *et al.* 2017), updating the analyses presented in Day *et al.* (2003). Radar surveys were conducted in coastal areas of known seabird flyways in May through mid-July, during the incubation and early chick-rearing stage. Therefore, these radar data are a conservative index of breeding activity. The overall mean for shearwaters across all 13 radar sites surveyed in 1993 was 524 ± 207 targets/h and in 2013 was 34 ± 9 targets/h, representing a mean decrease of 94% between the two periods ($t = 2.37$, $P = 0.03$; Raine *et al.* 2017). All of the 13 sites showed a large decrease in movement rates over the entire period, with movement rates at 12 (92%) out of 13 sites showing statistically significant declines (Raine *et al.* 2017). Based on the radar data (Raine *et al.* 2017) as a proxy for the breeding population, the Newell's shearwater population on the island of Kauai declined, annually, at a mean rate of 12.5 percent over the 20-year period. This updated rate of decline of the Newell's shearwater population is comparable to the mean annual rate of - 11.2 percent between 1993 and 2001 reported by Day *et al.* (2003, p. 673).

Ainley *et al.* (2001) had documented 14 shearwater breeding colonies distributed across Kauai (Figure 8). Several of these formerly large Newell's shearwater colonies in Kalaheo, Kaluahonu, and Makaleha on the island of Kauai have declined dramatically in recent decades to near extirpation (Raine *et al.* 2017). No population data exists for Newell's breeding on other islands.

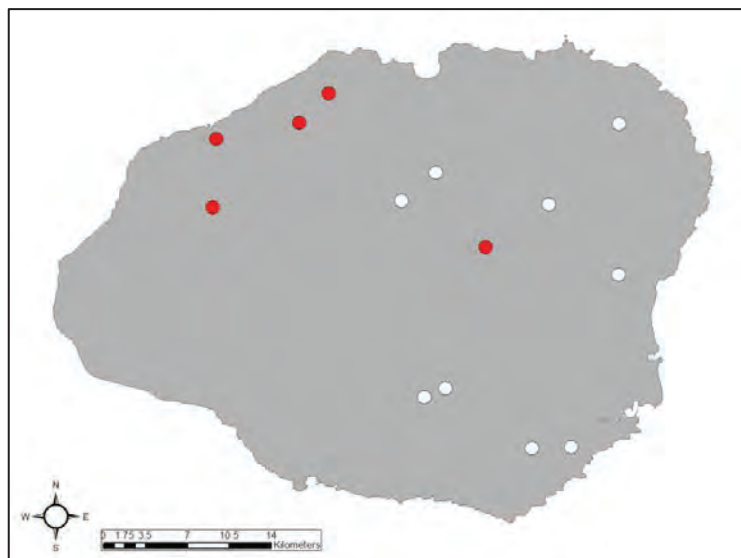


Figure 8. Map of Kauai showing Newell's shearwater breeding colony locations ($n=14$) (Ainley *et al.* 2001); unfilled circles ($n=9$) represent colonies near extirpation (<5 burrows).

In two breeding colonies on Kauai, ULP and Hono o Na Pali Natural Area Reserve (NAR), efforts are currently underway to curtail the population decline through the removal of predators. The reproduction output of the 104 monitored Newell's shearwater pairs breeding within these areas are measured in terms of their reproductive success.³ Since 2011, the reproductive success of Newell's shearwater pairs within ULP has increased by 27 percent, from 0.692 to 0.882 in 2011 and 2015, respectively (Raine *et al.* 2016a, p. 16). This increase appears to be a direct result of the ungulate exclusion fence completed in 2010 and intensive predator control that began in 2011. Indeed prior to these conservation efforts, surveys at ULP documented a 0.545 reproductive success rate (Table 2). Newell's are less prevalent than petrels within Hono o Na Pali Natural Area Reserve (NAR) and have not been as successful in reproducing (Table 2) due primarily to predation by cats, rats and feral pigs, despite the ungulate exclusion fencing and predator control. In addition to the reproductive success rates from Newell's burrows listed in Table 2, there were an additional 162 burrows at ULP and Hono o Na Pali NAR monitored in 2015 that could not be identified to species (i.e., burrows were either used by Newell's shearwaters or petrels).

Table 2. Reproductive success rates for Newell's shearwater breeding pairs (n) monitored each year (2010–2015) at Upper Limahuli Preserve and Hono o Na Pali Natural Area Reserve's Pohakea site.

Year	2010 (n)	2011 (n)	2012 (n)	2013 (n)	2014 (n)	2015 (n)
ULP	0.545 (11)	0.692 (15)	0.682 (34)	0.784 (46)	0.840 (59)	0.882 (82)
Hono o Na Pali NAR-Pohakea	no data	no data	no data	0.571 (8)	0.375 (20)	0.667 (22)

³ Reproductive success in Procellariiformes, also commonly referred to in scientific literature as breeding success, is the percentage of eggs laid that result in young fledged (Warham 1996).

v. Threats

Primary threats to the Newell's shearwater include artificial nighttime lighting (Reed *et al.* 1985; Cooper and Day 1998), collisions with power infrastructure (Cooper and Day 1998; Podolsky *et al.* 1998), predation by introduced predators (Raine and Banfield 2015b, 2015c), and changes to breeding habitat due to introduced invasive plants (Troy *et al.* 2014). These threats to the Newell's shearwater have been steadily increasing.

Artificial light sources collectively are a significant mortality factor associated with Newell's shearwaters (Ainley *et al.* 2001; Troy *et al.* 2011). Upward projecting nighttime lighting interferes with the shearwaters ability to navigate to and from their breeding sites. Shearwaters, primarily fledglings and sub-adults are disoriented by nighttime lighting and will circle light sources until they become exhausted and fall to the ground, where these birds are vulnerable to being killed by feral cats, dogs, or vehicles (Travers *et al.* 2013, p. 81). They often fly into utility wires, poles, trees, and buildings and fall to the ground; this phenomenon is referred to as "fallout". Once these seabirds fall to the ground, they are unable to regain flight unless they have access to an area with sufficient take-off conditions to allow enough air to move under their wing to provide lift (Ainley *et al.* 2015, p.32). Since 1979, the State's Division of Forestry and Wildlife (DOFAW) on Kauai with financial assistance from the Kauai Island Utility Cooperative (KIUC) (beginning in 2003) has supported the Save our Shearwaters (SOS) program to collect "downed" Newell's shearwaters and Hawaiian petrels (*i.e.*, birds that have either collided with structures or fallen out, or have been injured or killed due to exhaustion caused by light attraction). Over a 37-year period (1979-2016), the SOS program documented a total of 30,552 Newell's shearwaters recovered, injured or killed due to artificial nighttime lighting (DOFAW 2018). In the 1980s through 1990s, an average of 1,247 Newell's shearwaters were processed by the SOS program each year, where carcasses were documented or injured birds were rehabilitated and released (DOFAW 2018).

Adults and sub-adults are subject to collisions with power lines while flying between their nesting colonies and at-sea foraging areas (Cooper and Day 1998, p. 18; Podolsky *et al.* 1998, p. 21). Nestlings are indirectly affected as they rely on provisioning from both parents in order to survive, thus the loss of either parent results in nestling fatality. In 1993, in a single breeding season Podolsky *et al.* (1998, p. 30) documented deaths of at least 70 breeding adults and 280 sub-adult shearwaters over the summer months, in addition to 340 fledgling deaths in the autumn months, all as a result of collisions with power lines on Kauai. However, this study covered only the eastern and southern portions of the island (Podolsky *et al.* 1998, p. 30).

Based upon recent information collected from passive acoustic song meters (n=51) by KIUC Underline Monitoring Program, the Service has conducted modeling to extrapolate the amount of documented take (*i.e.*, collisions with power lines) to the entire power system on Kauai (USFWS 2017b). The Service estimates that 1,800 Newell's shearwater mortalities are occurring per year as a direct result of power line strikes under the KIUC Short-Term Habitat Conservation Plan (STHCP) and Incidental Take Permit (ITP), using the rounded average of 2014 and 2015 strikes from scenarios IV, VB, and VIA selected in the USFWS Newell's Shearwater Landscape

Strategy Appendix 2 (2017b, p. 123)⁴ This number is substantially greater than what was anticipated at the time the ITP was issued. The KIUC Short-Term Habitat Conservation Plan and Incidental Take Permit authorized the annual take of up to 162 Newell's shearwaters and 2 Hawaiian petrels (adults and sub-adults) from 2011 to 2016.

Introduced predators, particularly cats, rats, feral pigs, mongoose (*Herpestes auropunctatus*), and barn owls, are a severe threat to the continued existence of the Newell's shearwater. Adults, sub-adults, and young are susceptible to predation by these introduced predators (Raine and McFarland 2013b; Raine and Banfield 2015a, p. 38). These non-native predators occur throughout the Hawaiian Islands, with the exception of the mongoose, which has not established a breeding or viable population on Kauai (KISC 2018).

Another threat to the Newell's shearwater is habitat loss due to invasive vegetation. Invasive plants alter the three-dimensional structure of Hawaiian forests (Asner *et al.* 2008) as well as disrupt other ecological processes. A vegetation shift in areas of Kauai away from native understory to invasive vegetation, including but not limited to strawberry guava (*Psidium cattleianum*) and ginger (*Hedychium gardnerianum*) has been associated with at least one abandoned Newell's shearwater colony on Kauai (Troy *et al.* 2014). Extreme weather events such as hurricanes Iniki (1992) and Iwa (1982) have caused significant disruptions in forest habitat and, coupled with colonization of invasive plants, have resulted in permanent habitat loss for forest birds (Pratt 1994). In addition, areas of degraded habitat have facilitated the spread of invasive mammalian predators (Raine *et al.* 2016b, 2016c, 2016d). For example, in a heavily degraded habitat Ainley *et al.* (2001) counted 30 dead Newell's shearwater sub-adults and adults due to predation in one season (Ainley *et al.* 2001, p. 121).

Other threats include climate change and its affects to both seabird adult survivorship and recruitment (Sandvik *et al.* 2012) by generally affecting food availability (Oro 2014). Research by Spear *et al.* (2007) and Ainley *et al.* (2014) also indicate that Newell's shearwaters forage readily with yellowfin tuna and may be vulnerable to fishery interactions.

vi. Survival and Recovery Needs

For purposes of this biological opinion, the "survival condition" of the Newell's shearwater in the wild represents the level of reproduction, numbers, and distribution necessary to support a persistent population in the Hawaiian Archipelago that is fully protected by the ESA. For purposes of this biological opinion, the "recovery condition" of the Newell's shearwater is that where the threats to the species have been addressed such that the protections of the ESA are no longer necessary to insure the survival condition of the Newell's shearwater in the wild.

The recovery plan (USFWS 1983) for the Newell's shearwater does not contain recovery criteria; rather general goals are listed that require revision due to a substantial amount of new information. For example, the recovery plan (USFWS 1983, p. 22) calls generically for reducing

⁴ KIUC activities are also likely to cause take of Hawaiian petrels; however, updated estimates of annual petrel take levels are not described in this biological opinion.

annual SOS collected, lighting related fallout of Newell's shearwaters to less than 100 birds, and for developing efficient predator control methods to protect nesting sites.

In 2017, the Service finalized the *Newell's Shearwater Landscape Strategy* (USFWS 2017a). The Newell's Shearwater Landscape Strategy (USFWS 2017a) focuses on managing and enhancing extant colonies in areas with minimal light impacts, mitigating threats at the colony, and those encountered while in transit to the colony, and creating new colonies through social attraction and translocation (USFWS 2017a).

This strategy expands on actions completed by KIUC under the STHCP, including a predator-exclusion fencing feasibility study (Young and VanderWerf 2014) and the 2013–2014 Kauai island-wide auditory surveys to locate new shearwater and petrel colonies (Banfield *et al.* 2013; Raine and Banfield 2015b). The strategy describes general tools (i.e., manual predator control, ungulate and predator-exclusion fences) as well as translocation and social attraction activities to protect or augment existing breeding colonies and/or create new breeding colonies. Removing terrestrial predators (e.g. feral cats) that depress shearwater survival and establishing predator-free breeding habitat is required to successfully restore seabird colonies (Buxton *et al.* 2014; Jones and Kress 2012). On Kauai, repeated access into the colony to conduct intensive predator control in open systems can degrade sensitive vegetation, while predator ingress and predation remains constant. In montane habitat, manual predator control should be conducted as an incremental step towards the goal of constructing a predator exclusion fence culminating with predator removal or eradication.

Predator fencing is the most effective tool against mammalian depredation at the colony, particularly for indigenous species that are highly sensitive to predation (Young *et al.* 2013; Norbury *et al.* 2014). Within the current range of Newell's shearwater, topography, streams, and remoteness limit the number of sites and size of areas that can be protected with predator exclusion fences. Preliminary surveys of eight sites known to have Newell's shearwater populations identified three as suitable for predator fencing; the other five were eliminated because of topography or streams (Young and VanderWerf 2014). The KESRP continues to survey areas for Newell's shearwater activity so active sites suitable for predator fencing, in addition to those identified in the Newell's Shearwater Landscape Strategy, could be identified in the coming years. At a minimum, the two sites recommended by Young and VanderWerf (2014) with identified Newell's shearwater burrows should be fenced. The third site identified in this study was found to have only Hawaiian petrel burrows. Other sites located independently by KESRP and verified as occupied and suitable for fencing should be fenced. These sites should be protected using manual predator control until the fences are complete. To increase recruitment once fences are complete, social attraction should be a component of the project (see below).

The strategy prioritizes management efforts to occur in colonies already receiving conservation management actions under the existing KIUC STHCP, by relying on the concept of a 'no light conservation zone' or NLCZ to define an area which contains very little artificial nighttime lighting or light impingement. The NLCZ is based on the belief that artificial nighttime lighting is the primary factor constraining the distribution of Newell's shearwater breeding colonies and therefore colonies located in the NLCZ are more viable and should receive conservation actions.

The NLCZ encompasses the northwest corner of Kauai and includes coastal areas as well as mountainous steep terrain with a relatively small human population, resulting in minimal artificial nighttime lighting in the area. The NLCZ contains very little nighttime lighting currently, unfortunately there are no county ordinances or other mechanisms to support or require the continued existence of an NLCZ into the future. The strategy also calls for generally minimizing the effects from artificial nighttime lights and power lines.

In addition to this isolated area there is a need to generally address light attraction. Many sources of lights have already been modified to minimize attraction of fledging Newell's shearwaters, but a standard island-wide study is needed at regular intervals to identify new locations of concern for light attraction and those that might be out of compliance. A study is also needed to test the various types of LED bulbs available against the existing low pressure sodium bulbs to assess which is most suitable for seabirds. The results of this study should be used to determine which lighting configuration has the least impact on Newell's shearwaters and inform future recommendations on retrofitting lights, targeting the highest impact lights first. In the interim, problematic lights should be removed, turned off during the fledging season, reduced in intensity, or fitted with shields to direct the light toward the ground to minimize impacts.

The strategy does not comment on any elements (e.g., habitat requirements, genetic representation, and population resiliency) that would contribute to and define the long-term health needs of the Newell's shearwater population.

Population viability modeling efforts conducted by the Service defined Newell's shearwater adult survivorship at 0.92, based on a boxplot assessment and linear regression of adult survivorship data from proxy Procellariiformes (USFWS 2017b, p. 122). Because the Newell's reproductive strategy has evolved to have a high adult survivorship, adult mortality is particularly harmful to the population. Left unchecked low adult survivorship (or conversely high adult mortality) will serve to depress the colony population to unsustainable numbers thereby increasing the vulnerability of these populations to invasive predators and other stochastic events (e.g., hurricanes damaging breeding habitat or climate shifts altering food availability).

The survival and recovery needs of the Newell's shearwater are described in the succeeding paragraphs based on components from the recovery plan and landscape strategy documents highlighted above, as well as the best currently available scientific information. The survival condition of the Newell's shearwater is the biological factors necessary for a persistent population. The survival condition of the Newell's shearwater will need to include over a generation time (i.e., 7-8 years), an annual and stable breeding probability of 0.80 and consistently high reproductive success levels of at least 0.85 fledglings per breeding pair, per season. In order to achieve these biological factors, immediate actions need to be taken to protect occupied breeding habitat from invasive predators by constructing predator-exclusion fences and concurrently increasing predator removal efforts around the two extant and accessible breeding colonies on Kauai (Upper Limahuli and within Hono o Na Pali). Once a predator exclusion fence is constructed and predators are eliminated within the fence, management efforts should incorporate social attraction techniques using acoustic and visual/olfactory cues (Buxton and Jones 2012) to lure prospecting non-breeders and sub-adults into the protected breeding

habitat. Current telemetry data shows that the Hono o Na Pali and Upper Limahuli colonies are minimally affected by power line collisions and artificial nighttime lighting based on actual flight paths ($n = 9$) to and from foraging areas and breeding habitat (Raine *et al.* 2016e, p. 24). The main land-based threats to the Hono o Na Pali and Upper Limahuli colonies are introduced predators and invasive vegetation.

Maintaining the ecological life-support systems (i.e., habitat requirements) for the two largest Newell's shearwater breeding colonies is critical to the long-term survival. Management of breeding habitat within predator exclusion fences should include invasive vegetation control during the non-breeding season to support a native understory and canopy and biosecurity measures to prevent introductions of invasive flora and fauna. The size of the predator exclusion fences in montane forested habitat will be dictated to some extent by the terrain, however each exclusion fence should contain the extant colony, anticipate and minimize erosion, and be large enough (≥ 10 ha) to encompass enough breeding habitat to sustain at least 1,500 active breeding pairs and small enough to be adequately maintained in perpetuity. Given these habitat requirements, the minimum "range-restricted" population necessary to retain the species potential for recovery is 3,000 breeding pairs (two colonies with 1,500 pairs each).

Survival of the Newell's shearwater cannot be predicated solely on the existence of two neighboring breeding colonies on a single island. The survival needs of the Newell's shearwater include reducing adult mortality occurring range wide due to the attraction to artificial lights and collisions with power lines. The data gathered from Travers *et al.* (2014) and Travers *et al.* (2015) have vastly improved our knowledge of the scope of the impact of power line collisions and have identified the power line segments, of those surveyed, that have the greatest impact on seabirds. Lines along Power Line Trail in the north central region of the island were responsible for 75 percent of the documented strikes in 2014 (Travers *et al.* 2015). This stretch of lines should be prioritized to be buried, lowered in height, modified such that the top lines are removed, re-directed after appropriate studies to assess minimization effectiveness, or made visible in some manner (e.g., through the use of lasers or bird diverters, both of which are being tested by KESRP). As additional stretches of lines are monitored each year, other high-impact zones will be identified and appropriate avoidance or minimization methods should be implemented. Reducing the impact of power lines is critically important to ensuring the continued existence of Newell's shearwater on Kauai.

The SOS program on Kauai is designed to reduce mortality of fledglings and adults that have been grounded (i.e., unable to regain flight) due to the attraction to artificial lights or collisions with power lines. The continuation of the SOS program is a clear step to reduce adult mortality.

In summary, the recovery condition of the Newell's shearwater is the necessary survival condition plus specific measures to adequately address the specific threats contributing to the species range-wide endangerment. Specific measures needed to achieve a recovery condition include the elimination or minimization of all three high collision-risk power lines (the Power Line Trail, Kilauea, and the Central Region segments) on the island of Kauai. The recovery condition will need to include the creation or active management of at least two additional healthy shearwater colonies on Kauai and two healthy shearwater colonies on Maui. For example, the two additional colonies on Kauai could be any of those identified by Young and

VanderWerf (2014), or other colonies located independently by KESRP. For the purposes of this biological opinion, a healthy Newell's shearwater breeding colony is defined as containing a: (1) minimum of 1,500 breeding pairs or active burrows, based on long-term monitoring data on the Manx shearwater (Fraser *et al.* 2013; Brooke 1990; BirdLife International 2016b); (2) suitable breeding habitat, including predator-free or low levels of predator presence adequate to sustain in perpetuity a minimum of 1,500 breeding pairs; (3) flyway corridors to and from the colony where there are none or minimal artificial lighting and power line threats; and (4) a colony-population growth rate, λ equal to or greater than one, sustained over at least a generation. Protecting and augmenting any existing Newell's shearwater colonies on Maui will ensure genetic representation and redundancy, allowing the Newell's shearwater to maintain an adaptability and evolutionary capacity over time.

New management actions that have occurred in the last five years include:

- Completion of the 3-hectare predator exclusion fence in 2015, at the Nihoku conservation unit within Kilauea Point National Wildlife Refuge. Newell's shearwater nestling translocations began in 2016 and will continue over four years with the goal of establishing a new Newell's shearwater breeding colony within a fully protected predator-free area on Kauai;
- Predator control efforts to benefit Newell's shearwaters that began in June 2016 and are expected to continue for 2-4 years, within a discrete area (≤ 1 hectare) in Hono o Na Pali Natural Area Reserve, funded by the American Bird Conservancy; and
- Construction of two 1.8-hectare predator-exclusion fences (one each for Newell's shearwater and Hawaiian petrels) in West Maui to protect unoccupied Newell's shearwater breeding habitat. Upon completion of the fence in 2013, social attraction techniques including installation of artificial burrows, decoys, and auditory broadcasts calls have been implemented at the site, along with native vegetation restoration efforts. In June 2016, two prospecting Newell's shearwater adults were recorded on remote cameras (Craig 2016, p. 28).

Recommendations for Future Actions:

- Maintain support and oversight of the two 1.8-hectare Makamakaole Seabird Predator-Proof Fences in West Maui, constructed by First Wind, Inc. and maintained by Kaheawa Wind Power LLC, specifically to create a new Newell's shearwater breeding colony within a predator-free area on Maui. Efforts at this site should be focused on restoring native montane habitat, since this site was previously used for agricultural purposes;
- Conduct additional acoustic surveys within remote areas of Haleakala National Park in southeast Maui, to identify the areas of Newell's breeding habitat and the relative colony population size;
- Construct a predator exclusion fence to fully enclose the entirety of Upper Limahuli colony, followed by efforts to eradicate terrestrial predators and control barn owls;
- Construct a predator exclusion fence to protect the Pohakea colony within Hono o Na Pali NAR; followed by eradication of terrestrial predators within the fence, efforts to reduce barn owl predation, and social attraction techniques to expand the colony;

- Construct a predator exclusion fence along the ridgeline surrounding the Upper Manoa Valley colony, followed by eradication of terrestrial predators within the fence, efforts to reduce barn owl predation, and social attraction techniques to expand the colony;
- Construct an ungulate exclusion fence to protect the Honopu seabird colony to manage depredation by pigs and habitat damage from pigs and goats. The area of Honopu where the ungulate fence would be installed is located within the DLNR State Parks in northwestern Kauai;
- Construct a predator exclusion fence along the edge of the Kalalau Valley, followed by eradication of terrestrial predators within the fence, efforts to reduce barn owl predation, and social attraction techniques;
- Implement erosion control measures, best management practices (e.g., area closures) and native vegetation restoration to prevent damage to sensitive montane habitat, caused by continual access into seabird colonies; and
- Reduce impacts of high collision rate power line segments at the Power Line Trail, the Waimea Canyon, the Kilauea area, and line segments within the Central region including Lihue to Kilohana Crater to Power Line Trail.

ENVIRONMENTAL BASELINE FOR THE NEWELL'S SHEARWATER

This section describes the following: the relationship of the Newell's shearwater population in the action area to the range-wide population; current status of the Newell's shearwater in the action area and the factors influencing that condition; and the role of the action area in its survival and recovery. The recovery plan (USFWS 1983) for the Newell's shearwater does not contain recovery units; therefore, this section provides the Service's characterization of the role of the action area to the survival and recovery of the species.

i. Relationship of the Shearwater Population in the Action Area to the Range-wide Population

Adult Newell's shearwaters do not nest at Barking Sands, but do use the area to transit between their ocean foraging areas and their high elevation, montane nesting sites. Newell's shearwaters transit over the Makaha Ridge and Kokee PMRF sites and Newell's shearwater colonies occur nearby these sites in the northwestern fork of Waimea Canyon and along the Na Pali Coast (DON 2018, KESRP unpublished data) (Figure 9).

Based on statistical analyses of Newell's shearwater calling data from KESRP auditory surveys (Appendix 2), Newell's shearwater population size in the action area was estimated at 35% (8,508 individuals) of the Kauai population. Of these individuals, 5,420 (63.7%) are assumed to be adults (Ainley *et al.* 2001). An estimated 90 percent of the Newell's shearwater population is thought to nest on Kauai (24,310 individuals). Thus, the population in the action area comprises approximately 31.5% of the Newell's shearwater range-wide population.

ii. Current Condition of the Newell's Shearwater Population in the Action Area

The primary threats to the entire population of Newell's shearwater are also factors which effect the condition of the population in the action area: artificial nighttime lighting, collisions with power lines, predation by introduced predators, and changes to breeding habitat due to introduced invasive plants. Fledgling Newell's shearwaters fly through the PMRF sites on their first trip to the sea. As described above, fledgling Newell's shearwaters are attracted to brightly lit areas and become disoriented by them. A total of 48 downed Newell's shearwaters were recovered at Barking Sands over the period of 2007 to 2017. Power lines are present in the lowland coastal areas of the action area. The power lines obstruct seabird flyway corridors to and from montane breeding colonies, presenting a risk of collision to transiting seabirds. Predation by non-native predators such as feral cats, barn owls, and rats has been regularly observed in extant breeding colonies in the action area, even in the most remote locations, including the Na Pali Coast (Banfield *et al.* 2013).

Surveys using ornithological radar have not been conducted specifically at PMRF Barking Sands, but surveys have been conducted in Kekaha, approximately five miles south (Raine *et al.* 2017, Day *et al.* 2003). The mean movement in the Kekaha area in 1993 was 54.0 targets/h and in 2013 was 3.6 targets/h (KESRP 2013). As a proxy for the breeding population, the radar data indicates the Newell's shearwater population transiting through the Kekaha area declined at a mean annual rate of 12.7 percent over the 20-year period, similar to the decline of the Kauai population.

In the town of Waimea, ornithological radar surveys have also been conducted, and are considered the best estimate of movement rates of breeding Newell's shearwaters in the Waimea Canyon and Na Pali coast areas. Based on the analyses of ornithological radar data, Day *et al.* (2003) estimated a mean decrease in shearwater movement of 72.4% between 1993 and 2001 in the Waimea area. In 2015, an average of 386.7 seabird targets per hour was detected during three radar surveys in the Waimea area (KESRP 2015). Each survey consisted of four, 30-minute sampling sessions (Raine, pers.comm. 2016). Hawaiian petrels were not visually detected flying over the monitoring site by observers positioned outside radar trucks during the radar surveys (Raine, pers.comm. 2016). The seabird nesting colonies in Waimea Canyon in the northern forks of the Canyon nearest the PMRF communication towers are exclusively occupied by Newell's shearwaters. Based on these observations, the movement rate detected in Session II of the radar survey is composed almost entirely of Newell's shearwaters and represents an accurate reflection of Newell's shearwater movement in the area near the Navy's communication towers at the PMRF Kokee Site. This situation is unique from other radar sites on Kauai, where Session II represents predominately Hawaiian petrel movement and Sessions III & IV reflect Newell's shearwater movement (Raine, pers.comm. 2016).

The Service conducted population modeling to estimate the decline of the Newell's shearwater population in the action area caused by past and ongoing light attraction/fallout, predation, and power line mortalities (Appendix 2). Deterministic matrix modeling followed methodologies in Griesemer and Holmes (2011) and Ainley *et al.* (2001). The model outputs indicate the population of the Newell's shearwater in the action area is declining at a rate of 10.3% per year. This decline in the Newell's shearwater population in the action area is comparable to the mean annual rates of decline indicated by ornithological radar data for the Kekaha area (-12.7%). This

rate of decline is also within the range of annual declines reported in stochastic Newell's shearwater population models which incorporated variability in mortality and climate change (USFWS 2017b, p 159).

iii. *Role of the Action Area in the Survival and Recovery of the Newell's Shearwater*

The population of Newell's shearwaters using the action area is demographically significant. As discussed above, the Newell's shearwater population transiting the action area comprises approximately 31.5% of the range-wide population. Safe passage of shearwaters across the action area as they transit to and from breeding areas is essential to the survival and recovery of the Newell's shearwater.

Newell's shearwater colonies in the Na Pali coast portion of the action area are high priority endangered seabird colonies for implementation of conservation actions: in particular, the Hono o Na Pali NAR, Upper Limahuli Preserve, and Honopu seabird colonies (Banfield *et al.* 2013; Raine and Banfield 2015d). Due to the low threat of seabird/power line collisions to shearwater breeding sites along the Na Pali coast (USFWS 2017b), these breeding sites represent an important refuge for this species. Maintaining or enhancing the capability of these breeding areas to successfully support breeding Newell's shearwaters is essential to the conservation of this species.

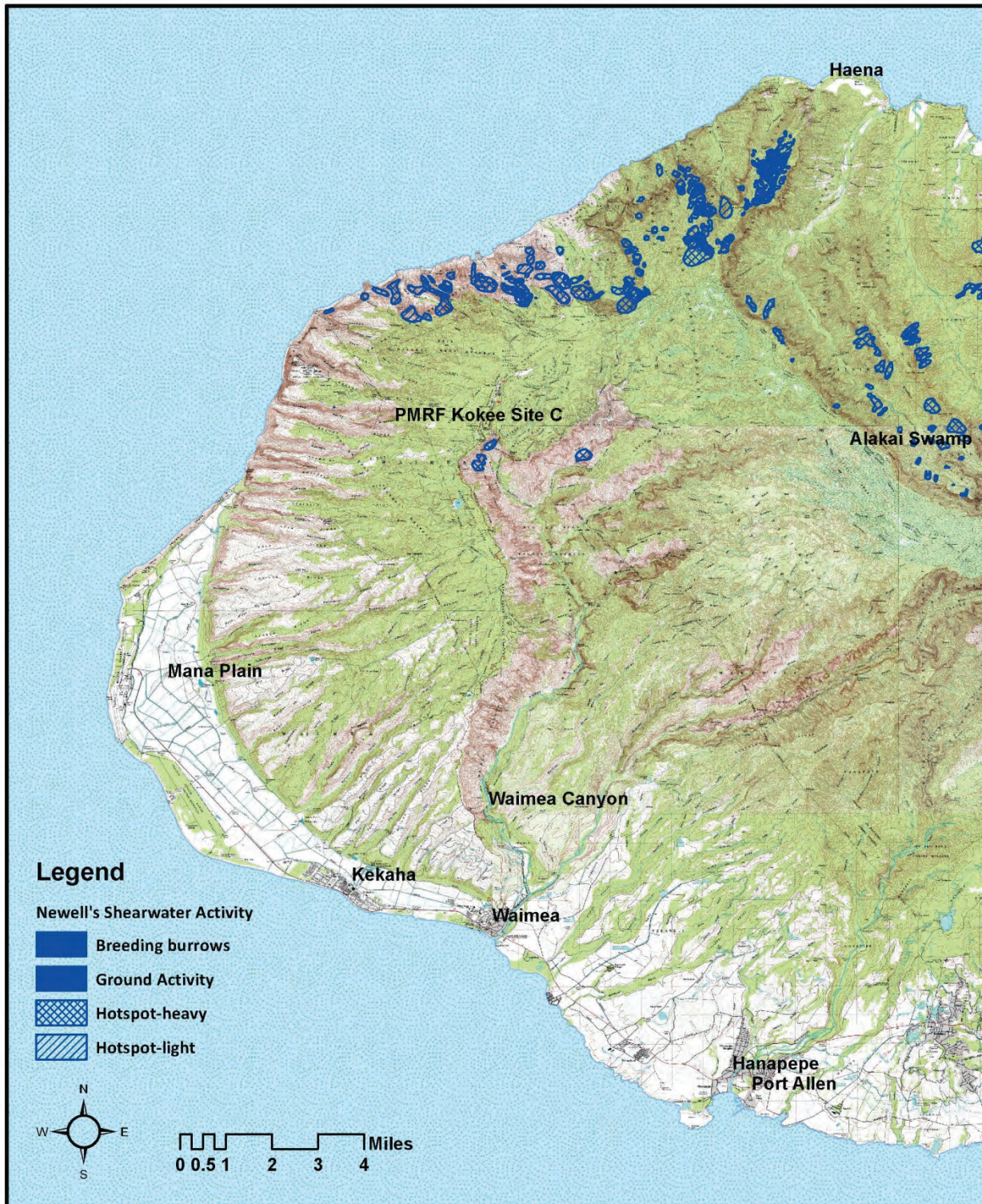


Figure 9. Newell's shearwater breeding distribution in the action area (KESRP 2016, unpublished data). *Hotspot light* defined by KESRP as localized aerial activity – sporadic calling and/or aerial activity. *Hotspot heavy* defined by KESRP as localized aerial activity – continuous calling and/or aerial activity.

iv. Previous Consultations in the Action Area

In March of 2011, the Service issued a non-jeopardy biological opinion (Service file no. 01EPIF00-2010-F-0430 and 01EPIF00-2010-F-0460) for the PMRF Intercept Test Support action, which addressed the effects of Aegis Ashore Intercept Test Support construction and operation activities at Barking Sands on the Newell's shearwater, Hawaiian petrel, and the band-rumped storm petrel for a period of three years; that biological opinion was amended in October of 2011. The incidental take statement accompanying the amended biological opinion authorized the take of up to ten Newell's shearwaters, one Hawaiian petrel, and one band-rumped storm-petrel over the 3-year term of the action as a result of collision with the boresight towers or due to attraction and fallout from lighting associated with the project. The incidental take statement accompanying the amended biological opinion also authorized the take of up to five Newell's shearwater eggs and/or chicks, one Hawaiian petrel egg and/or chick, and one band-rumped storm-petrel egg and/or chick over the 3-year term of the action as a result of predator control activities at shearwater breeding sites. The no-jeopardy conclusion relied in large part on provisions in the proposed action for minimization and mitigation of take impacts, including predator control within existing seabird breeding colonies and radar surveys to help assess seabird population trends on Kauai.

In April of 2011, the Service issued a non-jeopardy biological opinion for the Kauai Island Utility Cooperative Short-term Seabird Habitat Conservation Plan (STHCP) and Incidental Take Permit (Service file no. 01EPIF00-2011-F-0113, Permit No. TE234201-0), that addressed effects from the operation of existing and new electrical utility facilities on the Newell's shearwater and Hawaiian petrel, until 2016 for the entire island of Kauai. The Incidental Take Permit authorized the take of up to 162 adult, sub-adult, or fledgling Newell's shearwaters annually over the 5-year permit term as a result of attraction to, or collision with, KIUC facilities, as well as the take of up to 18 eggs and/or chicks as a result of the mortality of breeding adults. The annual take of up to two adult, sub-adult, or fledgling Hawaiian petrels was also authorized. Because of the minimization and mitigation measures implemented through the HCP; anticipated reduction in ongoing take from these measures; and implementation of conservation projects to offset unavoidable take (i.e. predator control within existing seabird breeding colonies), the Service concluded that the issuance of the Incidental Take Permit was not likely to jeopardize the continued existence of the Newell's shearwater and the Hawaiian petrel in the wild.

In October of 2011, the Service issued a non-jeopardy biological opinion for the PMRF Advanced Hypersonic Weapons System (Service file no. 01EPIF00-2011-F-0385), which addressed the effects from one-time operation of existing launch facilities at the Kauai Test Facility on the Newell's shearwater and the Hawaiian petrel from October through mid-November of 2011. The incidental take statement accompanying the biological opinion authorized the take of up to four Newell's shearwaters and one Hawaiian petrel over the two-month term of the action caused by seabird attraction and fallout from lighting associated with the project. Because of the minimization and mitigation measures implemented under the proposed action, an anticipated reduction in ongoing seabird take as a result of these measures, and implementation of conservation projects to offset unavoidable take, the Service concluded that the proposed action was not likely to jeopardize the continued existence of the Newell's shearwater and the Hawaiian petrel in the wild.

In September of 2014, the Service issued a non-jeopardy biological opinion (Service file no. 01EPIF00-2014-F-0066) for the PMRF Base-wide Infrastructure, Operations, and Maintenance Activities and their effects on the Hawaiian stilt (*Himantopus mexicanus knudseni*), Hawaiian moorhen (*Gallinula chloropus sandvicensis*), Hawaiian coot (*Fulica alai*), Hawaiian duck (*Anas wyvilliana*), Hawaiian goose (*Branta sandvicensis*), Hawaiian hoary bat (*Lasiurus cinereus semotus*), band-rumped storm-petrel, Hawaiian petrel, and the Newell's shearwater. The incidental take statement accompanying the biological opinion authorized the take of up to an average of three Newell's shearwater per year through the foreseeable future. The no-jeopardy conclusion for the Newell's shearwater relied in large part on provisions in the proposed action for lighting minimization and predator control measures at seabird breeding colonies to offset the impacts of incidental take and to provide a net conservation benefit to the species as a whole.

In February of 2017, the Service issued a non-jeopardy biological opinion (Service file no. 01EPIF00-2016-F-0497) for the USAF Pacific Air Forces Regional Support Center Proposed Continuing Operations at Kokee Air Force Station and Microwave Antenna Site and their effects on the Newell's shearwater, Hawaiian petrel, and band-rumped storm petrel. The incidental take statement accompanying the biological opinion authorized the take of up three Newell's shearwaters per year, two Hawaiian petrels per year, and two band-rumped storm petrels every 10 years over the life of the project. The no-jeopardy conclusion for the Newell's shearwater, Hawaiian petrel, and band-rumped storm petrel relied in large part on provisions in the proposed action for barn owl control within seabird breeding colonies to offset the impacts of the incidental take.

EFFECTS OF THE ACTION

i. Exposure Analysis Approach

The Service has developed an analysis framework for section 7 consultations that incorporates the general structure, primary concepts, and nomenclature of the U.S. Environmental Protection Agency's ecological risk assessment framework (USFWS 2005). Factors causing adverse effects are referred to as "stressors" and factors causing beneficial effects are referred to as "benefits". Under this approach, the Service determines the effects of the action on listed species and critical habitat by evaluating the location, timing, duration, frequency, and intensity of listed species or critical habitat exposure to each stressor and benefit, and the likely effects of such exposure on the reproduction, numbers, and distribution of the listed species and on the recovery support function of critical habitat.

Using this framework, the proposed action is likely to involve the following stressors: seabird light attraction, seabird collisions with communication towers, and seabird collisions with electrical distribution lines and poles. The proposed action also includes benefits in the form of conservation measures to reduce seabird exposure to artificial lighting during the Newell's shearwater fledging season, reduce predation in nesting colonies during Newell's shearwater breeding season, and restore breeding habitat.

ii. PMRF Lighting

As noted above, listed seabirds are negatively affected by increasing urbanization and the accompanying artificial lights, especially fledglings during their first flight to the ocean from the breeding colony site. When attracted to artificial lights, fledgling seabirds become confused and may suffer temporary night blindness. They often fly into utility wires, poles, trees, and buildings and fall to the ground. The timing of this impact on Kauai is primarily between September 15 and December 15. Adult Newell's shearwaters can also be attracted to lights located near their breeding grounds and affected in a similar manner; however, most shearwater groundings due to lighting involve fledglings (DOFAW 2018). The timing of this impact on Kauai is just prior to breeding (late March /early April) until the chicks fledge (early November).

At PMRF a total of 49 downed Newell's shearwaters were recovered over the 9-year period from 2007 to 2017 (DOFAW 2018, DON 2018).⁵ The only incidents of Newell's shearwater fallout at or near PMRF facilities in the action area other than Barking Sands were as follows: the recovery of one bird at Port Allen on the State-operated side of the pier near a light; and the recovery of another shearwater at the Kokee PMRF Site C communications building. There have been no observations of seabird disorientation or fallout at PMRF facilities at Makaha Ridge and Kamokala where there are lower wattage lamps used and a daily presence of Navy personnel.

The Navy has been implementing an array of lighting practices to minimize the risk of seabird light attraction at all PMRF facilities. Although the lights in several key areas at Barking Sands are turned off (the most effective practice to avoid attracting seabirds to facilities) some of the facilities at PMRF require lighting for safety or operations. Lights that cannot be turned off due to safety and/or operational purposes have been shielded, realigned, or replaced with full cutoff fixtures. Such lighting modifications may reduce impacts to listed seabirds by approximately 40 percent (Reed *et al.* 1985, p. 380), but do not completely eliminate the threat.

Since 2010, following modifications of exterior lighting such as realignment, replacement with full cut-off fixtures, and operational changes (DON 2014), a total of 32 Newell's shearwaters were downed at Barking Sands (DOFAW 2018, DON 2018). This includes two larger fallout events: 12 Newell's shearwaters were downed in 2010 and 11 Newell's shearwaters were downed in 2014. Of those downed recently in 2014, six were downed and recovered near the hangar building and five of the 11 died before SOS personnel arrived to pick up the birds. Incorrect positioning of two of four exterior floodlights at the hangar building may have attracted the shearwaters to the building. However, one of the six birds downed at the hanger in 2014 had struck the side of the building when no exterior lights were on, suggesting interior lighting likely attracted the bird.

Under the proposed action, the Navy will implement several conservation measures to reduce adverse lighting impacts to listed seabirds. The Navy will continue to annually inspect night-

⁵ Two additional Newell's shearwaters were found grounded and dead under a communication tower at Kokee Site C at PMRF likely due to collision with the tower. The Navy's biological assessment included these two Newell's shearwaters in the fallout summary (DON 2018, p. 21).

time lighting prior to the start of the seabird fledgling season to confirm implementation of light minimization measures and identify any potential lighting risk that was not previously identified or addressed. The Navy's written *Guideline for Implementation of Conservation Measures* (DON 2015) should increase and maximize the capability of base personnel to salvage and transfer downed seabirds to the SOS program in a timely and appropriate manner throughout the seabird fledgling season. In addition, the Navy will, to the extent practicable, minimize seabird fallout risk by scheduling non-time sensitive night operations outside of the peak seabird fledgling season.

The Service anticipates that the proposed project is likely to result in a low amount of seabird attraction to artificial night lighting from the use of interior and exterior lighting for operations and safety, particularly the use of exterior Anti-Terrorism/Force Protection lighting associated with the launch areas. The number of night-time operations that the Navy will not be able to avoid during the dark moon phase of the seabird fledgling season is estimated to average one per year. While the Navy has renewed their commitment to lighting minimization measures at the PMRF, such as keeping exterior lighting correctly positioned and shielded and the bay doors of the hangar closed as much as possible, the operational use of facilities and launches at Barking Sands during dark moon phases are likely to continue to cause take of seabirds. Historical fallout patterns at PMRF indicate a single fallout event can produce over 10 birds downed (e.g., 2010 and 2014). For these reasons, the Service presumed the lighting conditions during the period from 2014 to 2015 (when night-time operation of lighting resulted in one year with low fallout and one year with a larger fallout event) is representative of lighting conditions over the 50 year period. Therefore, the Service estimates up to 7 fledgling Newell's shearwaters per year are likely to be downed due to attraction to artificial light at Barking Sands.

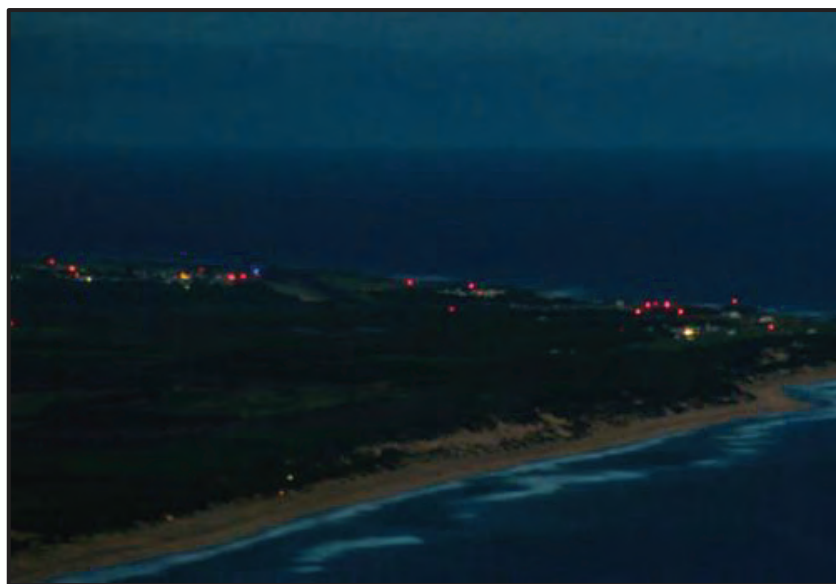


Photo 1. PMRF Barking Sands at night-time as viewed from PMRF Makaha Ridge site on November 23, 2015. Photo by Adam Griesemer, USFWS.

iii. PMRF Communication Towers and Electrical Distribution Lines

As discussed above, seabird collision with narrow-profile structures such as transmission lines and towers is well-documented for Hawaii's listed seabirds, particularly on Kauai. Listed seabirds are nocturnal and fly over 30 miles per hour, making it difficult for them to detect and avoid wires and antennas (Cooper and Day 2003, p. 64). Transmission lines and towers are a stressor source to Newell's shearwaters by obstructing their flyway corridors to and from montane breeding areas. Recent surveys using vertical radar and visual observation to estimate seabird flight altitude show site-specific variation in altitude. In low elevation non-mountainous areas shearwater flight height averages 49.5 ± 25.8 meters above ground (Travers *et al.* 2014, p. 22). In contrast, during an eight-day study at a high elevation mountainous area (along a Power Line Trail segment), a total of 323 shearwaters and Hawaiian petrels were observed transiting with 43.2% observed flying through or colliding with a power line segment at a height of approximately 88 meters above ground [78 m above the surrounding 10 m high vegetation) (Travers *et al.* 2013, p. 73; Travers *et al.* 2014, p. 26)].

The facilities at Barking Sands include approximately 7 miles of 12 kV electrical distribution lines and poles. Line heights that are at or below vegetation levels have been shown to significantly reduce the potential for seabird collisions with power lines (Ainley *et al.* 1995, Travers *et al.* 2013, Travers *et al.* 2014). No downed seabirds found by Navy personnel or recovered by the SOS program (DOFAW 2018) have been associated with the electrical distribution structures at PMRF, and vegetation at PMRF is within the range of height of distribution lines. For those reasons, the Service anticipates that vegetation cover is likely to shield seabirds from collision with electrical distribution facilities on the PMRF.

Under the proposed action, existing communication towers on the PMRF will continue to be maintained and operated. These towers create a potential for Newell's shearwaters to collide with the towers while flying between their nesting grounds in the mountains and feeding grounds at sea. The timing of this threat extends from late March / early April when Newell's shearwaters occupy their nesting grounds, just prior to breeding, until early December when the last shearwater chicks of the season fledge and fly to the sea. During the non-breeding season, Newell's shearwaters remain at sea the entire time, therefore, they are not likely to collide with a communication tower or antennae, or any other structure on land during this time.

In 2008, the Service provided the Navy with a search protocol for conducting carcass searches for downed seabirds to estimate the number of avian fatalities attributable to collisions with communication towers at PMRF. Surveys were then conducted using this search protocol. From October to December of 2008, searches for downed seabirds were performed every three to four days under each communication tower at Barking Sands, and a search efficiency trial was conducted to assess the potential for searchers to miss carcasses or live birds during searches following the Service's protocol. In 2010, the 2008 protocol surveys were expanded to the two antennas at Makaha Ridge and two communication towers at the Kokee sites in addition to the 14 towers at Barking Sands. A scavenger trail was conducted to estimate the number of carcasses or downed seabirds that may have been missed in 2008 due to removal of birds by scavengers (e.g., cats). In 2015, the surveys were repeated for all the towers. Searches of the communication towers at Kokee Site C in both 2010 and 2015 were conducted in open space within accessible search areas (Kleidosty Pacific 2011, p.2; Kleidosty Pacific 2016, p. 33). At

Barking Sands, to date, no mortality of listed seabirds due to collision with communication towers have been observed. However, at Kokee Site C, two adult Newell's shearwaters were found grounded and dead under Tower 764: one during the 2015 surveys (Kleidosty Pacific 2016) and one during a Navy site visit to the communication tower in 2017 (DON 2017).

In addition to the above, the Service considered the following information to assess seabird collision risk for purposes of this analysis: (1) the location of communication towers in relation to Newell's shearwater breeding colonies, including proximity and elevation; (2) the area of the tower exposed and height above the vegetation level; and (3) the results of studies of seabird collisions with utility structures conducted on Kauai. In considering the study results, we also evaluated the sufficiency of carcass searching in relation to the vegetation and topography of the area surrounding towers.

Information pertaining to seabird collision risk suggests a very low likelihood of collision with communication towers located at Barking Sands. The communication towers are located near sea level and approximately 10 miles from the nearest known Newell's shearwater breeding colony (Figure 9). The towers are exposed approximately 140-170 feet in height (~43 to 52 meters⁶) above the vegetation level. Studies conducted at power lines located along Kaumualii Highway to the north of Barking Sands suggest that Newell's shearwaters are less likely to fly at power line height (Travers *et al.* 2016). In addition, low numbers of Newell's shearwaters were observed transiting in this area (Travers *et al.* 2016). The towers at Barking Sands are positioned in open grass fields in a relatively flat coastal plain which facilitates carcass detection.

Information regarding seabird collision risk for towers at Kokee Site C suggests a high likelihood of collision. The site is located at an elevation of 3,700 feet, near multiple Newell's shearwater breeding colonies, the nearest located less than 1 mile away in the north fork of the Waimea Canyon. The two communication towers at the PMRF Kokee C site are 110 feet in height (~33 meters). Approximately 100 feet (~30 meters) of the tower is exposed above the surrounding vegetation level (~10-16 feet, 3-5 meters). Tower 764 has 21 guy wires which greatly increases the exposure area of the tower. Utility collision monitoring studies on Kauai have found that strike rate increases with exposure height at high elevation utility structures (e.g., Power Line Trail) as evidenced by a significant positive relationship between strike rate and power line exposure height ($n=20$, Spearman's ρ (r_s)=0.577, $p=0.015$) (Travers *et al.* 2014). The dense vegetation and topography surrounding the towers at Kokee Site C limits the accessible searchable area around towers and severely reduces the effectiveness of discovering seabirds that collide with the tower or guy wires and descend into the vegetation. During collision-passage studies conducted at the Power Line Trail on Kauai in forested areas with vegetation similar to that found surrounding the PMRF Kokee site, researchers have detected hundreds of seabird strikes with power lines using song meters, yet as of 2016 had recovered only three grounded and dead seabirds (Hawaiian petrels) on the Trail (Travers *et al.* 2013, Travers *et al.* 2014, Travers *et al.* 2015). These results indicate that carcass recovery alone is not a good predictor of seabird line collisions in this type of terrain and vegetation.

⁶ Units are expressed in feet as well as meters in the Effects of the Action, Section D for the purpose of describing units consistently between the Service's assessment of seabird collision risk and tower fatality model.

a) *Kokee Communication Tower Fatality Model*

Due to the seabird collision risk associated with communication towers at Kokee Site C, the Service developed a collision model to estimate Newell's shearwater fatalities at this site. The collision model (Appendix 1) is based on a template modified from Sanzenbacher and Cooper 2013, incorporating updated seabird movement rates for Waimea (as described in the Environmental Baseline, section *ii*) and tower characteristics. For purposes of this analysis, these estimates are considered as effects that are reasonably certain to occur because information regarding seabird collision risk for towers at Kokee Site C suggests a high likelihood of collision which cannot be detected through current ground survey monitoring methods.

Movement rates were defined as the average of Newell's shearwater movement rates as measured by radar surveys conducted in the summer of 2015. We were not able to account for seasonal variation in movement patterns in our fatality estimates due to the limited information available.

Information on collision-avoidance behavior exhibited by Newell's shearwaters (i.e., birds that completely alter their flight paths horizontally and/or vertically to avoid flying through the space occupied by a structure) suggests that avoidance responses are high based on observations of seabird interactions with power lines on Kauai (Travers *et al.* 2014, Travers *et al.* 2015, Cooper and Day 1998). Based on this information, for purposes of the model, the Service considered 99% of seabirds flying through the airspace near communication towers (including airspace above and around the tower) avoid a collision fatality (i.e., 99% avoidance rate).⁷ Using this information, the Service model estimated between 50 adult Newell's shearwater fatalities per year are likely to occur due to their collisions with the communication towers at the Kokee Site (Table 3 and Appendix 1). Including the presence of guy wires at Tower 764 increased the exposure area of the tower, resulting in a fatality estimate higher than at Tower 763.

In addition, using information on population demographics, the Service estimated the number of Newell's shearwater chicks or eggs that are likely to be killed per year as a result of its parent colliding with a communication tower. This results in up to seven Newell's shearwaters chicks or eggs that are likely to be killed per year, assuming that 60% of adults killed in the action area would have been breeding and 46% of breeding attempts would have resulted in a chick fledgling in the nest (i.e., breeding probability of 60% and reproductive success of 46%; Appendix 2).

Table 3. Fatality Model Estimates for the Kokee Towers Site based on 99% avoidance

Movement Rate	Tower 764	Tower 763	Total
2015 Average	42.89	7.14	50.03

⁷ See Appendix 1 for full description of tower collision model. The 99% avoidance described in this section refers to the annual fatality probability which is applied as a percentage to the product of exposure rate, vertical interaction probability, and horizontal interaction probability.

iv. Population Modeling of Impacts from PMRF Lighting and Communication Towers

For purposes of this analysis, the Service relied on deterministic modeling to calculate Newell's shearwater population assessment metrics for growth rate and population loss (Appendix 2). This population model provided an estimate of decline that would be associated with additional seabird fallout and additional seabird/tower collision mortalities due to PMRF activities, absent any mitigation of these impacts given the current condition of the species in the action area. In other words, this population model teases out the additional decline and population loss that would be caused by the proposed action in the absence of beneficial effects of predator management funded by proposed Navy contributions to NFWF (*See Effects of Action*, section vi for description of beneficial effects). Because the proposed action duration is a 50 year period, impacts were modeled over that time period. For purposes of this analysis, these estimates constitute the best available scientific information and are considered effects that are reasonably certain to occur, absent mitigation of these effects, because of factors delineated in: (1) the Status of the Species section; (2) the Environmental Baseline section; and (3) information contained in this section regarding past and ongoing fallout at PMRF facilities and seabird collision fatalities at Kokee Site C.

The "Environmental Baseline with PMRF Activities" model projected the additional decline due to the effects of (a) additional seabird fallout due to light attraction and (b) additional seabird/tower collision mortalities likely to be caused by PMRF activities over the 50-year term of the proposed action on the Newell's shearwater population occurring in the action area (approximately 8,500 individuals). The baseline rate of decline in the population in the action area was also projected over the 50-year period in the "Environmental Baseline" model.

To model the per year estimate of additional seabird fallout and seabird/tower collision mortalities caused by PMRF activities, the Service followed deterministic modeling methodologies described in Griesemer and Holmes (2011) and Ainley *et al.* (2001). Per year estimates were expressed as a proportion of the number of individuals in the respective age class in the current action area population. The fledgling loss due to fallout equaled 1% (7 fledglings of 750 total fledglings from breeding colonies). The mortality of 50 adults due to tower collisions equaled 0.92% of the adult population as estimated in the Environmental Baseline section in this biological opinion, section i (5,420). The additional fledgling fallout losses reduced reproductive success by a rate of 0.44% per year (approximately 1% of 46% reproductive success) while the additional seabird/tower collisions reduced adult survival by a rate of 0.92% per year. These mortality rates were held constant (i.e., kept the same) when projected over the 50-year project term.

Based on the findings of the Environmental Baseline with PMRF Activities model, which added the adverse effects of the proposed action on the Newell's shearwater to the Environmental Baseline estimates, light attraction fallout and seabird collision fatalities likely to be caused by PMRF lighting and communication towers increased the annual decline of the Newell's shearwater Environmental Baseline condition from -10.3% to -11.0% (a decrease in the growth rate from a λ of 0.897 to 0.890).

The Environmental Baseline with PMRF Activities model also calculated the total (accumulated) take of Newell's shearwaters that is likely to occur over a 50-year period of implementing the action. The accumulated adverse effect of PMRF activities over a 50-year period of

implementing the action is likely to result in the loss of 450 adults and 63 egg/chicks caused by PMRF communication towers and the loss of 63 fledglings due to PMRF lighting. The number of Newell's shearwaters taken per year is anticipated to decrease each year, because as years pass in the implementation of the proposed action, the Newell's shearwater population in the action area is anticipated to decline by 11% and the proportion of individuals affected by the action in each respective age class (fledgling, sub-adults, and adults) of the action area population remains the same. For example, the number of adult seabird collision fatalities (50 individuals in the first year, see Effects of the Action, section *iii,a*) decrease by 11% per year with the action area population (i.e., fatalities continue to equal 0.92% of the action area adult population). The estimated number of indirect mortalities (7 chicks or eggs in the first year) due to the loss of these breeding adults also continues to decrease by 11% per year with the action area population. In addition, the number of fledgling seabird mortalities due to fallout (7 in the first year) decreases with the action area population. Thus, the proposed action results in less mortality per year as years pass in its implementation due to the decreasing population trend of the population in the action area.

v. *Summary of the Total Take of Newell's Shearwater due to Proposed Action*

The total anticipated take of Newell's shearwaters as a result of PMRF lighting and communication towers over the 50 year term of the action, is shown below and in Table 4.

Over the 50 year project term, up to an average of seven (7) fledgling Newell's shearwaters per year and a total maximum of 63 fledgling Newell's shearwaters are likely to be killed or injured as a result of attraction and fallout from lighting associated with the proposed action (*See Effects of the Action*, section *ii*, pg. 41 & section *iv*, pg. 45).

In addition, over the 50 year term, up to an average of fifty (50) adult Newell's shearwaters per year and a total maximum of 450 adult Newell's shearwaters are likely to be killed or injured due to collision with communication towers associated with the proposed action (*See Effects of the Action*, section *iii, a*, pg. 44 & section *iv*, pg. 45).

Finally, over the 50 year term, up to seven (7) Newell's shearwater eggs/chicks per year and a total maximum of 63 eggs/chicks are likely to be killed as a result of a parent colliding with a communication tower as a result of the proposed action (*See Effects of the Action*, section *iii,a*, pg. 44 & section *iv*, pg. 45).

Table 4. Annual estimate of take and total (accumulated) take of Newell's shearwater that is likely to occur over the 50-year period of the proposed action. The 50-year take estimate denoted by the asterisk (*) are calculated from results of the Environmental Baseline with PMRF Activities model which indicates the number of Newell's shearwater taken per year is anticipated to decrease at the same rate of decline as the population in the action area.

		Annual	50-year*
PMRF lighting	Fledglings	7	63
PMRF Communication Towers	adults & sub-adults	50	450
	eggs/chicks	7	63

vi. *Beneficial Effects of Conservation Measures*

The implementation of lighting practices to minimize seabird attraction by the Navy at PMRF will likely reduce the attraction of listed seabirds, but does not completely eliminate the threat as discussed above (See Effects of the Action, section *ii*, pg. 42). In order to offset the total anticipated take over the project duration as described in the previous section, the Navy and NNSA will provide funding to support management activities for predator and ungulate removal at an existing Newell's shearwater colony on Kauai where current management does not exist or is insufficient to adequately enhance the reproductive success of the Newell's shearwater. The Navy and NNSA will direct funds to the Hawaiian Seabird Conservation Account, developed by the NFWF and administered by the Service for the management of Newell's seabird breeding colonies on Kauai. The Navy's contributions are anticipated to support, annually, management for 30 breeding pairs in 2018 and build to 50 breeding pairs by 2022, and then continue annually in years after 2022 at the same level unless the Navy and Service reinitiate consultation and this conservation measure is no longer deemed necessary.

a) Population Modeling of Benefits from Colony Management

The Service used the following approach to calculate the benefit of the proposed funding of colony management for purposes of off-setting the accumulated total losses of Newell's shearwaters equal to 63 fledglings injured or killed, 450 adults injured or killed, and 63 eggs/chicks killed (i.e., the maximum take) due to the proposed action over the 50 year action.

In order to determine the increase in fledgling production from implementing predator management at nesting colonies for the purposes of this analysis, the Service relied on deterministic modeling (the "Predator Management" model, Appendix 2), building on methodologies in the Environmental Baseline with PMRF Activities model above (See Effects of the Action, section *iv*). The Service determined that the deterministic model used in this analysis is the appropriate tool to clearly illustrate (1) the Navy's impacts to the Newell's shearwater population within the action area and (2) the beneficial effect of predator management to offset these impacts as a result of Navy funding contributions to NFWF.

In the Environmental Baseline with PMRF Activities model, we added threats that decreased demographic parameters to define the current condition in the action area and Kauai population, respectively. In the Predator Management model, we added predation to one meta-population in the action area then added predator control which removed a proportion of the decrease due to predation in the parameters.

The Predator Management model was developed to estimate the beneficial effect of PMRF's proposed predator management at breeding sites on the population in the action area (Appendix 2). We expressed the effect of management as a change in the number of fledglings produced by the breeding pairs that would be directly affected by the management. We considered management that decreased predation by removing predators, including feral cats, feral pigs, rats, and barn-owls. We expressed the efficacy of the management by decreasing predation of individuals and nests proportionally (considering that management would be 70-90% effective in reducing predation) such that 80% management efficacy meant that out of 20 burrows with

chicks or eggs depredated in the absence of management, predator removal would reduce the number of depredated burrows to 4 (20 percent of 20 burrows)(Appendix 2).

The proposed conservation measure will provide funding to protect a nesting area with the capacity to support at least 50 breeding pairs. Based on experience in the field, protecting such an area with sufficient predator management will likely result in a gradual increase in the number of pairs and requisite funding to support further expanding the predator management as the colony grows in size. The Service anticipates the predator management as a result of the Navy's contributions to NFWF is likely to achieve a targeted increase in shearwater reproductive success (and resulting fledgling production) at established or new breeding areas that are protected and managed. Predator control at 80% effectiveness for 50 breeding pairs over 50 years would provide a reproductive benefit of 1,476 fledglings to the Kauai population (Appendix 2). Although it is anticipated that the population at the nesting area receiving management will not reach 50 breeding pairs until the year 2022, the continuing growth of the colony beyond 50 pairs (in years 2023 to 2068) will likely provide additional benefits in excess of these modeled estimates. The Service anticipates this management will likely offset the losses due to PMRF activities and the additional decline of the shearwater population occurring in the action area caused by the additional seabird fallout due to light attraction and additional seabird/tower collision mortalities likely due to PMRF activities over the 50-year term of the proposed action.

Non-native predators are significantly impacting Newell's shearwater populations in the action area as described in the Environmental Baseline section in this biological opinion. The predator management funded by Navy contributions will reduce predation in a nesting colony(ies) addressing a major threat to the continued existence of the Newell's shearwaters breeding in that colony(ies).

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, local or private actions that are reasonably certain to occur within the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Future state, local, or private actions that are reasonably certain to occur in the action area are listed below.

- KIUC submitted a permit renewal request to the Service for its STHCP and ITP, prior to its expiration in May of 2016, to cover the period until the Service renders a decision on their Long-term HCP, which is currently under development. In the interim, the Service estimates that 1,800 Newell's shearwater mortalities are occurring per year as a direct result of power line strikes under the KIUC STHCP and ITP, using the rounded average of 2014 and 2015 strikes from scenarios IV, VB, and VIA selected in the USFWS Newell's Shearwater Landscape Strategy Appendix 2 (2017b, p. 123). Based on coordination with KIUC in February 2018, the Service anticipates receiving a revised

draft Long-term HCP by the end of 2018 that will propose minimization and mitigation measures to address these take impacts.

- State and local governmental entities together with other private entities are expected to apply for a State incidental take license and a Federal incidental take permit in 2018, to address ongoing and future take of Newell's shearwaters within the action area caused by the use of artificial nighttime lighting. The state-sponsored Kauai Seabird HCP is anticipated to seek authorization for an approximate annual *lethal* take of up to 30 shearwaters and *non-lethal* take of 45 shearwaters. This state-sponsored HCP is being developed to address a stressor responsible for an aspect of the environmental baseline conditions for Newell's shearwaters within the action area.

CONCLUSION

After reviewing the current status, the Environmental Baseline, the Effects of the Action, and the Cumulative Effects, it is the Service's Biological Opinion that the proposed action discussed herein is not likely to jeopardize the continued existence of the Newell's shearwater. As stated in the Effects section above, the adverse effects of the proposed action over the 50 year term of the action are likely to result in anticipated take in the form of injury or death for up to 63 Newell's shearwater fledglings as a result of attraction and fallout from lighting, 450 Newell's shearwater adults due to collision with communication towers as well as the death for up to 63 eggs/chicks as a result of a parent colliding with a communication tower. The beneficial effects of the seabird mitigation will offset the anticipated loss of the fledglings, adults, and eggs/chicks as well as any additional decline of the population in the action area. Overall, taken all these effects together, there will not be a significant change in the reproduction, numbers, or distribution of the Newell's shearwater that will reduce appreciably the likelihood of both the survival and recovery of these species in the wild.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including, breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Navy and NNSA in order for the exemption in section 7(o)(2) to apply. In order to monitor the impact of incidental take, the Navy and NNSA must report the progress of the action and its impact on the listed species to the Service as specified in this incidental take statement and reporting requirements below [50 CFR 402.14(i)(3)].

Amount or Extent of Take Anticipated

Based on the analysis presented in this biological opinion, the Service anticipates the following incidental take may occur for as long as PMRF infrastructure, operations, and maintenance are active and in place.

Newell's Shearwater

Over the 50 year project term, up to an average of seven (7) fledgling Newell's shearwaters per year and a total maximum of sixty-three (63) fledgling Newell's shearwaters are likely to be taken in the form of injury or death due to attraction and fallout from lighting associated with the project.

Over the 50 year project term, up to an average of fifty (50) adult Newell's shearwaters per year and a total maximum of four hundred fifty (450) adult Newell's shearwaters are likely to be taken in the form of injury or death due to collisions with communication towers associated with the project.

Over the 50 year project term, up to seven (7) Newell's shearwater chicks or eggs per year and a total maximum of sixty-three (63) Newell's shearwater chicks or eggs are likely to be taken in the form of injury or mortality as a result of its parent colliding with a communication tower.

The Migratory Bird Treaty Act (MBTA) of 1918 as amended (16 USC 703-712) prohibits the purposeful take of migratory birds without a permit. However, incidental take of birds is no longer considered a violation of MBTA (DOI M-Opinion 37050, <https://www.doi.gov/sites/doi.gov/files/uploads/m-37050.pdf>); thus, incidental take statements under ESA no longer convey incidental take authority under MBTA to species covered by both acts.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the effect of take on Newell's shearwater:

- (1) The Navy and NNSA will minimize the potential for death or injury of Newell's shearwater due to lighting at PMRF.
- (2) The Navy and NNSA will minimize the potential for death or injury of Newell's shearwater due to collisions with PMRF communication towers.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Navy and NNSA must comply with the following terms and conditions, which implement the reasonable and prudent measures, described above and specified reporting requirements. These terms and conditions are nondiscretionary.

1. Minimize impacts of PMRF lighting on the survival and reproduction of Newell's shearwater.
 - 1.1. The Navy will schedule non-time sensitive night operations outside the peak of the fledging season to the extent practicable.
 - 1.2. Navy will schedule operations planned to occur during peak fledging season to avoid dark moon phases to the extent practicable.
 - 1.3. The Navy will train personnel about listed seabird fallout and methods for searching for downed birds, and conduct searches for downed listed seabirds at all facilities with lighting.
 - 1.4. The Service will be notified by telephone and email within 24 hours upon the discovery of an injured or dead Newell's shearwater at PMRF. This includes notification for Newell's shearwaters turned into the SOS aid station by Navy personnel or members of the public. The Navy and NNSA will provide the Service a written notification, summarizing the event, within 30 days. The Navy and NNSA will also follow the protocols to report downed wildlife in Appendix 3, Attachments 1 and 3, when any carcass of a listed species is found injured or dead.
 - 1.5. Access to any of the PMRF sites will be provided by the Navy and NNSA to the Service with 24 hour notification so that they may independently monitor for seabirds and retrieve reported downed seabird carcasses.
 - 1.6. The Navy and NNSA will submit annual reports detailing the implementation of the above Terms and Conditions used to minimize impacts of the action. The first report will be submitted by January 30th, one and half months after the end of the first seabird season following the issuance of this biological opinion and continue annually throughout the life of the project. Annual reports will summarize survey and monitoring results, and levels of take of Newell's shearwater. Because the amount of incidental take anticipated for Newell's shearwater are expressed in terms of the average number of individuals that may be taken, the following formula will be used to calculate average take for these species, whereby "b_p" is the take of the species since date of the biological opinion issuance, "p" is the take assessment period expressed as the total number of years since date of the biological opinion issuance, and "R_p" is the average take of the species per year over the take assessment period:

$$R_p = \frac{b_p}{p}$$

- 1.7. Should take of listed species occur and the carcass be recovered, the Service may request that the carcass be shipped to Honolulu for necropsy and species verification. Otherwise, the depository designated to receive specimens of the listed species that

are found is the B.P. Bishop Museum, 1525 Bernice Street, Honolulu, Hawaii, 96817 (telephone: 808/847-3511). If the B.P. Bishop Museum does not wish to accession the specimens, contact the Service's Division of Law Enforcement in Honolulu, Hawaii (telephone: 808/861-8525; fax: 808/861-8515) for instructions on disposition.

2. Minimize impacts of communication towers on the survival and reproduction of Newell's shearwater.
 - 2.1. The Navy will assess what measures can be implemented at Kokee communication tower 764 and implement effective measures to the maximum extent feasible.
 - 2.2. The Navy and NNSA will monitor incidental take as described in Appendix 3 for monitoring communication towers. In addition to the ground based carcass searches as described in Appendix 3, the Navy will monitor using other methodologies as approved by the Service and report the number of seabird collisions with communication towers at Kokee Site C.
 - 2.3. The Service will be notified by telephone and email within 24 hours upon the discovery of an injured or dead Newell's shearwater at PMRF. This includes notification for Newell's shearwaters turned into the SOS aid station by Navy personnel or members of the public. The Navy and NNSA will provide the Service a written notification, summarizing the event, within 30 days. The Navy and NNSA will also follow the protocols to report downed wildlife in Appendix 3, Attachments 1 and 3, when any carcass of a listed species is found injured or dead.
 - 2.4. Access to any of the PMRF sites will be provided by the Navy and NNSA to the Service with 24 hour notification to allow independent monitoring for seabirds and to retrieve reported downed seabird carcasses.
 - 2.5. The Navy and NNSA will submit annual reports detailing the implementation of the above Terms and Conditions used to minimize impacts of the action. The first report will be submitted by January 30th, one and half months after the end of the first seabird season following the issuance of this biological opinion and continue annually throughout the life of the project. Annual reports will summarize survey and monitoring results, and levels of take of Newell's shearwater. Because the amount of incidental take anticipated for Newell's shearwater are expressed in terms of the average number of individuals that may be taken, the following formula will be used to calculate average take for these species, whereby "b_p" is the take of the species since date of the biological opinion issuance, "p" is the take assessment period expressed as the total number of years since date of the biological opinion issuance, and "R_p" is the average take of the species per year over the take assessment period:

$$R_p = \frac{b_p}{p}$$

- 2.6. Should take of listed species occur and the carcass be recovered, the Service may request that the carcass be shipped to Honolulu for necropsy and species verification. Otherwise, the depository designated to receive specimens of the listed species that are found is the B.P. Bishop Museum, 1525 Bernice Street, Honolulu, Hawaii, 96817 (telephone: 808/847-3511). If the B.P. Bishop Museum does not wish to accession

the specimens, contact the Service's Division of Law Enforcement in Honolulu, Hawaii (telephone: 808/861-8525; fax: 808/861-8515) for instructions on disposition.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs all Federal agencies to use their authority to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. The term "conservation recommendations" has been defined as suggestions from the Service regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information. The recommendations provided here relate only to the proposed action and do not necessarily represent complete fulfillment of the agency's 7(a)(1) responsibility for the species.

The Service recommends that the Navy and NNSA undertake the following conservation recommendations:

- Assist with island- and State-wide efforts to assess and minimize the effects of communications towers, power transmission lines, lighting, and other threats to Newell's shearwaters posed by infrastructure.

REINITIATION NOTICE

This concludes formal section 7 consultation on this action. As required in 50 CFR § 402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species in a manner or to an extent not considered in this biological opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by this action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

We appreciate your efforts to conserve protected species. If you have any questions concerning this biological opinion, please contact Mary Abrams of the USFWS Pacific Islands Fish and Wildlife Office at (808) 792-9400.

Sincerely,

Mary M
Abrams

Digitally signed by
Mary M Abrams
Date: 2018.08.20
08:35:54 -10'00'

Mary Abrams
Field Supervisor

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APPENDIX 1. Estimated average fatality rates of Newell's shearwater for communication towers at the PMRF Kokee Site, Kauai, based on radar data collected in summer of 2015.

Movement Rates		Tower 764	Tower 763	Notes / References
A	Movement rate during peak hours (average targets/hour)	386.70	386.70	KESRP 2015
B	Total movement rate during peak hours (targets/6.5 hours)	2,513.55	2,513.55	(A x 6); 6.5 peak hours of movement
C	Daily movement rate (targets/day)	2,840.31	2,840.31	(B x 1.13); 1 (6.5 peak hours) + 0.13 (mean proportion of birds moving during off-peak hours of night)
D	Flock size (Mean birds/target)	1.02	1.02	
E	Daily movement rate (birds/day)	2,897.12	2,897.12	(C x D)
F	Mortality domain (days/year)	231.00	231.00	Breeding phenology adults present week 14-46 (33 weeks x 7 days)
G	Annual movement rate (birds/year)	669,234.20	669,234.20	(E x F)
Tower Characteristics				
H	Height of tower exposed above tree line (m)	30.53	30.53	Tree height is approximately 3-5m. Exposed tower is height of tower minus tree height
I	Tower width at base (m)	9.14	9.14	Estimate of tower width at base is 30 feet
J	Exposed area of tower above tree line (m ²)	279.15	279.15	(I x H)
K	Height of highest guy wire exposed above tree line (m)	30.53	0.00	Guy wires anchored at top of Tower 764
L	Guy wire distance from pole exposed above tree line (m)	45.79	0.00	Estimate of maximum distance
M	Area occupied by guy wires (m ²) both sides	1,398.03	0.00	Area to the left and right of tower in profile (A = ((1/2)b x h) x 2)
Horizontal Interaction Probability				
N	Maximum cross-sectional of exposed area of tower (m ²)	1,677.18	279.15	(J + M)
O	Cross-sectional sampling area of radar above tree line and below tower height (m ²)	91,584.0	91,584.0	(3,000m x H)
P	Probability of NESH intersecting tower	0.018313	0.003048	(N/O)
Vertical Interaction Probability				
Q	Proportion of birds flying above treeline and below overall tower height (~33.5m)	0.350	0.350	Travers et al. 2014, p.41, ~ % of birds flying below 35m at powerlines with similar exposure height to Kokee comm.towers
Exposure Rate				
R	Annual exposure rate	4,289.49	713.94	(G x P x Q)
Annual Fatality Probability				
S	90% Avoidance (R x 0.10)	428.95	71.39	
T	95% Avoidance (R x 0.05)	214.47	35.70	
U	99% Avoidance (R x 0.01)	42.89	7.14	

APPENDIX 2.

Newell's Shearwater Population Modeling to Inform the Biological Opinion for the Pacific Missile Range Facilities Base-wide Infrastructure, Operations, and Maintenance Activities.

APPENDIX 3.

Carcass search protocol provided by USFWS to be used for monitoring for nocturnal seabird fallout at communication towers at PMRF.

1.0 STANDARDIZED CARCASS SEARCHES

Carcass searches will be conducted to estimate the number of avian fatalities attributable to the broadcast towers. An estimate of the total number of carcasses will be made by adjusting for removal bias (affected by scavenging) and searcher efficiency bias (affected by detection) (see Sections 2.0 and 3.0). The methods, timing, and duration of the carcass searches are described below.

1.1 Methods

Personnel trained in proper search techniques (“the searchers”) will conduct carcass searches at the broadcast tower location pursuant to timing specified by the carcass scavenging trials, but no less than two times per week. Boundaries of square plots will be delineated along each broadcast tower. A strip transect design is appropriate for this study, providing almost 100 percent coverage of the search area. Each search plot will be split into four quadrants, with each searched sequentially. This facilitates the searchers ability to stay on transect lines and maximize searching efficiency (Gritski pers. comm. 2006).

Important factors considering in developing this monitoring plan include tower dimensions, target species size, and vegetation structure. Because most carcass searches to date have been associated with wind power projects, we use standards developed for that industry. When carcass searches are conducted for wind turbines, plot size typically extends outward from the base of a wind turbine a minimum distance equal to the turbine height.

The subject towers are variable in height. If the results from the initial carcass surveys show that the plot size is too large or small, the area will be adjusted accordingly pending approval by the Service. Geographic Positioning System (GPS) locations of the search plot corners will be included in initial data collection. Transects will be set at approximately 6 meters (19.7 feet) apart, depending on the habitat type, and the searcher will walk along each transect at a rate of 45-60 m per minute searching both sides out to 3 m (10 feet) for downed birds and bats. Search area and speed may be adjusted by habitat type, after evaluation of the first searcher efficiency trial, if needed. The applicant may request approval from the Service to revise the search protocol. Since equipment cabinets and other structures associated with the towers will obstruct transects, the areas with equipment will be searched such that those areas have 100% coverage.

If a carcass of a listed species is found, searchers will follow the Downed Wildlife Protocol (**Attachment 1**), and carcasses will be left in place and moved only if directed by the Service. If directed to move the carcasses, searchers will deliver carcasses to Service Law Enforcement who will send them to a forensics lab for future reference and necropsy.

All carcasses found during the standardized carcass searches will be recorded and identified by a unique number. A copy of the data sheet for each carcass will be kept with the carcass at all times. For each carcass found, searchers will record species, sex and age when possible, date and time collected, location, condition and any comments that may indicate cause of death

(**Attachment 2**). Searchers will record the condition of each carcass found, using the following condition categories:

- Intact – a carcass that is completely intact, is not badly decomposed and shows no sign of being fed upon by a predator or scavenger
- Scavenged – an entire carcass that shows signs of being fed upon by a predator or scavenger, or portions of a carcass in one location (e.g., wings, skeletal remains, legs, pieces of skin, etc.)
- Feather Spot – 10 or more feathers at one location indicating predation or scavenging or 2 or more primary feathers

Searchers will photograph each carcass as found and establish GPS points, with point accuracy provided. A detailed map of the search area will then be created showing the location of the broadcast towers and associated facilities, the study area, and any carcasses located.

The searchers may discover carcasses incidental to formal carcass searches (e.g., predation or while driving within the project area). For each incidentally discovered carcass, the searcher will identify, photograph, and record data for the carcass as would be done for carcasses found during formal scheduled searches.

Any injured native birds found on the facility site will be carefully captured by a trained project biologist or technician and transported to a local wildlife rehabilitator. All project staff and consultants will be trained on how to handle any downed wildlife or carcasses found anywhere within the project area. Furthermore, an Avian Injury/Mortality Form (**Attachment 3**) will be completed for any injured or killed animal found.

1.2 Important Considerations

Important factors to consider in developing the monitoring plan include target species size and the type of vegetative cover being surveyed. The Hawaiian petrel and Hawaiian goose are relatively large birds. Downed individuals should be detectable compared to smaller bird species and most bats.

2.0 CARCASS SCAVENGING TRIALS

“Carcass scavenging or removal” is the disappearance of a carcass from the search area due to scavenging. This may serve as a potential source of bias associated with fatality rate estimation. Scavengers may preclude detection of carcasses or make it problematic to identify remains and determine cause of death. Thus, seasonal differences in scavenging rates (i.e., changes in scavenger population density) and possible differences in the size of animal being scavenged are typically taken into account when estimating fatality. Additionally, the timing of fatality searches must be conducted at a frequency that minimizes loss due to scavenging.

The objective of the carcass scavenging trials is to document the length of time avian carcasses remain in the search area and subsequently determine the frequency of carcass searches within the search plots. Carcass scavenging trials will be conducted during each season in the vicinity of the search plots. Carcass scavenging rates will be used to adjust carcass surveys for removal bias. Removal rates will be determined for each season.

Carcasses used in the trials may include representatives of the seabirds if legally available and permitted by the Service and DOFAW. Navy will coordinate with the Service to follow appropriate protocols in using carcasses during carcass scavenging trials. Carcasses of legally obtained wedge-tailed shearwaters, commercially available adult game birds, or cryptically colored chickens will be used to simulate seabirds.

To avoid confusion with broadcast tower-related fatalities, planted carcasses will not be placed in fatality monitoring search plots. Planted carcasses will be placed in the vicinity of the broadcast towers but not so near as to attract scavengers to the search plots. The planted carcasses will be located randomly within the carcass scavenging trial plots.

Carcasses will be placed in a variety of postures to simulate a range of natural conditions. For example, birds will be: 1) placed in an exposed posture (e.g., thrown over the shoulder), 2) hidden to simulate a crippled bird (e.g., placed beneath a shrub or tuft of grass) and, 3) partially hidden. Trial carcasses will be marked discreetly for recognition by searchers and other personnel. Trial carcasses will be left at the location until the end of the carcass scavenging trial.

Carcasses will be checked as follows, although actual intervals may vary. Carcasses will be checked for a period of 28 days to determine removal rates; however, total number of searcher days will be adjusted according to observed scavenging rates. Carcasses will be checked approximately every day for the first 7 days, and then on day 10, day 14, day 21, and day 28. This schedule may vary depending on the initial removal rate observed, weather, and coordination with the other survey work. At the end of the 28-day period, any remaining trial carcasses and scattered feathers will be removed. Each trial will use as many bird carcasses as are available; the target is 10-20 carcasses.

3.0 SEARCHER EFFICIENCY TRIALS

The objective of searcher efficiency trials is to estimate the percentage of bird fatalities that searchers are able to find. Searcher efficiency will be estimated by habitat type and season. Estimates of searcher efficiency will be used to adjust carcass counts for detection bias. Searcher efficiency trials will be conducted on the fatality monitoring search plots in all habitat types.

Searcher efficiency trials will be conducted in each season as defined above, during the period in which the fatality monitoring occurs. Trials will be spread throughout the year to incorporate the effects of environmental variables such as weather and scavenger populations. Key elements of these trials include:

- At least three trials will be conducted in each season.
- Each trial will use a variable number of carcasses so that the searcher will not know the total number of trial carcasses being used in any trial.
- For each trial, birds will be used according to their availability.
- Wedge-tailed shearwater will be the primary species used for searcher efficiency trials.
- Personnel conducting searches will not know in advance when trials are conducted; nor will they know the location of the trial carcasses.

- Carcasses will be placed in a variety of postures to simulate a range of conditions. For example, birds will be: 1) placed in an exposed posture (thrown over the shoulder), 2) hidden to simulate a crippled bird and 3) partially hidden.
- Each non-domestic carcass will be discreetly marked and located with GPS at the planted site so that it can be identified as an efficiency trial carcass after it is found.
- The number and location of the efficiency trial carcasses found during the carcass search will be recorded.

If new searchers are brought into the search team, additional detection trials will be conducted to ensure that detection rates incorporate searcher differences.

4.0 SAMPLING INTENSITY AND DURATION

Search efforts will begin in mid-October and end in mid-December. Each tower will be checked twice per week, with no greater than three days between surveys. This will be very useful in increasing the efficiency of the study since scavenging rate detections will determine the appropriate search frequency. If scavenging is high, search frequency needs to be high (see Arnett 2005).

However, based on Service recommendations, carcass searches will be conducted approximately two times per week or no longer than 3 days apart during the initial scavenging trial. Once data from the initial scavenging trial has been evaluated, the frequency of carcass searches will be adjusted accordingly for effectiveness and efficiency for the remainder of the fall 2008 survey season, as approved by the Service. Additional surveys may be conducted after climatic conditions/events, such as storm events, fog, or moonless nights, as these events could increase the likelihood of collisions with broadcast towers.

Changed circumstances such as hurricanes, major storms, fire, and other such events may affect the timing of the surveys. If the broadcast towers are not accessible as a result of storm events or road conditions, and/or staff safety is questionable, the surveys will continue as soon as is safely possible. The Navy will coordinate with the Service on such changed circumstances as soon as possible.

5.0 ANALYTICAL METHODS FOR FATALITY ESTIMATES

Estimates of avian fatalities during the life of the broadcast towers are based on the following:

- (1) The number of carcasses located during standardized searches for which the cause of death is attributed to the broadcast towers; carcasses found within survey plots are assumed to be the result of the broadcast tower unless other obvious indicators exist.
- (2) Carcass scavenging rates expressed as the estimated average time a carcass is expected to remain in the study area and be available for detection by the searchers during the entire survey period.
- (3) Searcher efficiency expressed as the proportion of planted carcasses found by searchers.

The following sections describe how the avian fatalities will be quantified.

5.1 Fatality calculations

The estimate of total fatalities is based on the number of fatalities found within the survey plots, confirmed to be attributed to the broadcast towers, and adjusted for the probability that the observer found the carcass and the time that the carcasses remained to be found (i.e., was not scavenged). Calculations are based on Young *et al.* (2003) and are presented below.

5.1.1 Number of carcasses

The average number of carcasses per search period is calculated using:

$$\bar{c} = \frac{\sum_{i=1}^k c_i}{k}$$

where c_i is the number of carcasses found at broadcast tower i , and k is the number of broadcast towers searched.

Total number of carcasses found is calculated by:

$$C = k * \bar{c}$$

5.1.2 Searcher Efficiency

Searcher efficiency (p) was calculated as the proportion of the carcasses found by observers divided by the total number of carcasses available to find.

$$p = \frac{p(1-p)}{n}$$

5.1.3 Scavenging rate

The average number of days that a carcass remained on site is calculated using:

$$\bar{t} = \frac{\sum_{i=1}^k t_i}{k}$$

where t_i is the number of days each carcass remained on the study area and k is the number of carcasses evaluated.

5.1.4 Mortality estimate

The estimated total number of fatalities is calculated by

$$m = \frac{N * I * C}{k * \bar{t} * p}$$

where N is the total number of broadcast towers, I is the time between searches (days), C is that total number of carcasses during the study period, k is the number of broadcast towers searched, \bar{t} is the mean length of time a carcass remained on the plot, and p is the searcher efficiency.

6.0 RESULTS

Fatality rates will be calculated on the project as a whole. Each season's percent searcher efficiency will be applied to the observed direct take (carcasses found, if any, during searches) to quantify adjusted take (direct and unobserved direct take combined). Variance will not be calculated pursuant to Service recommendation.

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Attachment 1
Downed Wildlife Protocol

DOWNED WILDLIFE PROTOCOL *

Downed birds (any seabirds, and or Hawaiian short-eared owl) considered here may be dead or injured at discovery. All need immediate attention by the discoverer.

A ***prioritized*** Contact List of Service and Division of Forestry and Wildlife (DOFAW) Staff follows, prioritized from first to last to contact. It is essential for you to actually speak with a person and not to rely on voicemail as “a contact”; however you may leave a message and then contact the next person in the listing.

DEAD BIRD:

- Leave in place, the Service or DOFAW will do site and circumstantial assessment, make photographs, and measurements before securing and removing bird.
- Contact Service about find; Call list for Service staff, in order for calling:
 1. Adam Griesemer 808-285-8261 or 808-822-2175
 2. Law Enforcement 808-861-8525

INJURED BIRD:

Equipment necessary to have available for response:

- Pet carriers (medium) – 2 available at minimum
- Cardboard small animal (rat/rabbit/hamster) carriers – 2 minimum
- Pieces of artificial turf/outdoor carpeting to place on floors of pet carriers
- Non-tippable shallow dog water-bowls for water; water
- Gloves
- Tent stakes (6)

Procedure

1. Gently pick up and place bird into carrier equipped with turf/carpet. Place only 1 bird in a carrier.
2. Mark exact spot of find(s) with tent stake(s).
3. Place the bird in the SOS aid station at PMRF, or transport to Kauai Humane Society if the bird was picked up after the SOS aid station was checked for the day.
4. DO NOT feed birds, provide water in bowl.
5. Notify the Service within 24 hours by telephone, using call list above, and by email - adam_griesemer@fws.gov.

Attachment 2
Avian Fatality Survey Form

Biological Opinion 197

Attachment 3

Avian Injury / Mortality Form

Report Date:

Species (common name):

Date Found:

Time Found:

Age:

Bands:

Found by:

Documented by:

GPS Coordinates:

Location Found (including closest structure & distance to structure):

Condition of Specimen (include a description of general condition, as well as any visible injuries):

Probable Cause of Injury or Mortality and Supportive Evidence (attach photos and map, next page):

Action Taken (include notifications, reporting dates and times):

Additional Comments:



Appendix 2:

Newell's Shearwater Population Modeling to Inform the Biological Opinion for the Pacific Missile Range Facilities Base-wide Infrastructure, Operations, and Maintenance Activities.

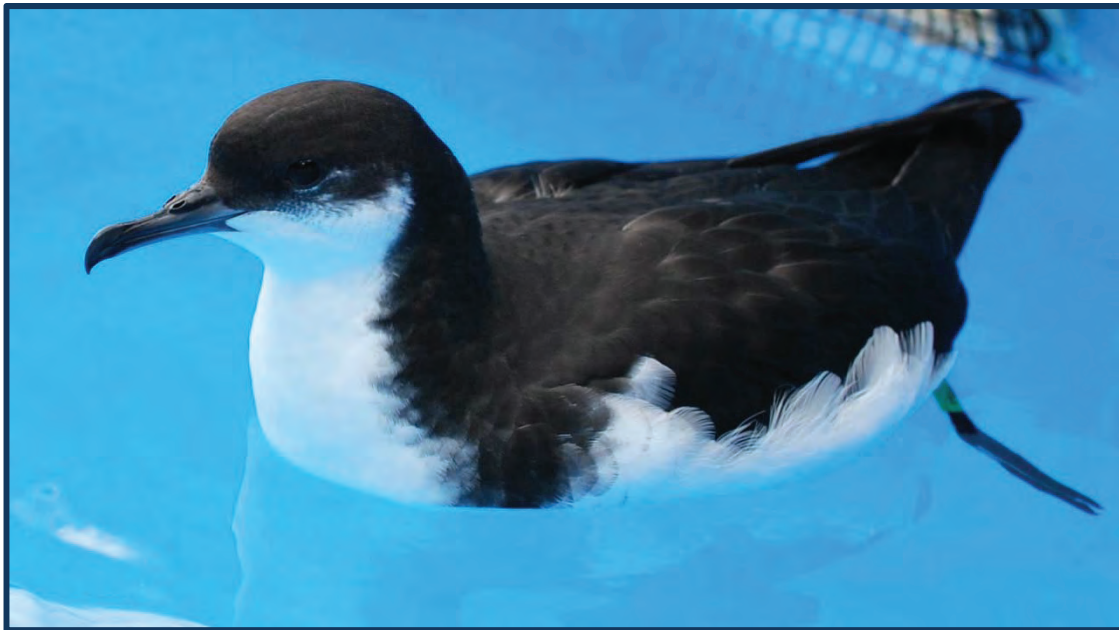


Photo Credit: Newell's shearwater, Tracy Anderson, Save Our Shearwaters Program.

Prepared By:

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1.0 INTRODUCTION

The primary purpose of this modeling assessment was to estimate the effects on the Newell's shearwater population likely to be caused by the Pacific Missile Range Facility (PMRF) Base-wide Infrastructure, Operations, and Maintenance Activities over the 50-year term of the biological opinion, absent the predation management actions proposed by the U.S. Department of the Navy (Navy). This modeling assessment differs from the stochastic and geographic assessments developed by the Service (USFWS 2017a) which inform Newell's shearwater strategic habitat conservation on the island of Kauai. This assessment is not meant to comprehensively analyze the variability of all major threats to Newell's shearwater and their potential range of effects on the species population viability as in USFWS (2017a), rather it assesses only the impacts of fallout and tower collision mortalities likely to be caused by PMRF activities on the Newell's shearwater population in the consultation action area. The action area spans the western region of Kauai (as described in the biological opinion), therefore this assessment focuses on a meta-population of shearwaters breeding within the Kauai (island-wide) population. Although this assessment uses a deterministic modeling approach, the stochastic and geographic analyses in USFWS (2017a) informed selection of inputs (demographic parameters) to model the current condition of the Newell's shearwater population in the action area and the Kauai population.

A secondary purpose of this assessment was to estimate the beneficial effects of predator management in nesting colonies specific to PMRF's proposed predation management actions. The effects of different predators on nesting colonies were partitioned based on approaches used in the Service's mitigation efficacy calculator (USFWS 2017a). The assessment was further defined to a meta-population (a sub-set of pairs breeding in colonies within the action area population) for the purposes of scaling management to the number of breeding pairs that will be supported by predator management funded by the Navy.

The objectives of this modeling assessment were the following: 1) estimate the additional decline associated with seabird fallout and seabird tower collisions likely to be caused by PMRF activities on the Newell's shearwater population occurring in the action area; 2) calculate the total (accumulated) take in terms of additional seabird fallout and additional seabird tower collisions likely to be caused by PMRF activities over 50-years; and 3) determine the increase in fledgling production from implementing predator management at nesting colonies as discussed in the biological opinion.

2.0 METHODS

The Service relied on deterministic demographic modeling to calculate Newell's shearwater population assessment metrics for growth rate, population loss, and endpoints (e.g., timing to population extinction). Deterministic population modeling was performed in PopTools v3.2 (Hood 2011) using stage-based Lefkovitch matrices. The stage-based matrices were based on survival (juvenile, sub-adult, and adult), fecundity, and an age of first breeding of six years old (Ainley *et al.* 2001), as illustrated in Figure 1.

$$N_t \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & F_a \\ S_0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & S_1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & S_2 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & S_3 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & S_4 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & S_5 & S_a \end{bmatrix}$$

Figure 1. Population matrix of stage-based model. N_t is the stage-specific population size at time t , S is the age specific survival at ages 0, 1, 2, 3, 4, 5 and adult (6+), and F is fecundity (proportion of females in population, breeding probability, and reproductive success).

2.1 Modeling Scenarios

The first modeling scenario was developed for the purposes of comparing model projections of population decline to trends in breeding activity garnered from ornithological radar monitoring data (i.e., to check if the projection of the baseline for the Kauai population makes biological sense).¹ This served as a method to corroborate our selection of demographic parameters and our characterization of threats to the Kauai population and action area population (See section 2.3). A model of the current condition of Kauai Newell's shearwater population was developed for this scenario.

The second modeling scenario was developed to project the additional decline likely to be caused by impacts from PMRF lighting and communication towers over the 50-year term of the proposed action on the Newell's shearwater population occurring in the action area due to the effects of (a) additional seabird fallout due to light attraction and (b) additional seabird/tower collision mortalities. In order to estimate this decline, we first developed a model to assess the current condition of the population in the action area (the Environmental Baseline), then added the impacts of the additional seabird fallout and tower collisions to the current condition. Thus, two models of population projections were considered in this second scenario, including "Environmental Baseline" and "Environmental Baseline with PMRF Activities."

The third modeling scenario was developed to estimate the beneficial effect of PMRF's proposed predator management at breeding sites on the population in the action area. We expressed the effect of management as a change in the number of fledglings produced by the breeding pairs that would be directly affected by the management. We considered management that decreased predation by removing predators, including feral cats (*Felis catus*), pigs (*Sus scrofa*), rats (*Rattus spp.*), and barn-owls (*Tyto alba*). We expressed the efficacy of the management by decreasing predation of individuals and nests proportionally (considering that management would be 70-90% effective in reducing predation) such that 80% management efficacy meant that out of 20 burrows with chicks or eggs depredated in the absence of management, predator removal would reduce the number of depredated burrows to 4 (20 percent of 20 burrows). One meta-population

¹ Radar has been used to monitor the summer movement patterns of Newell's shearwaters in coastal areas of known seabird flyways in May through mid-July, during the incubation and early chick-rearing stage, which provides a conservative index of breeding activity.

at breeding sites in the action area equal to 50 breeding pairs was considered for this scenario as discussed in the biological opinion. We produced one management model for this scenario:

- (i) "Predator Control" decreasing predation by feral cats, pigs, and rats (70-90% efficacy) for 50 breeding pairs.

Although predator management was ongoing in 2017 at two Newell's shearwater breeding sites under management of the Kauai Island Utility Cooperative (KIUC), no long-term mitigation or minimization measures have been approved by the Service for inclusion in a long term HCP and associated Incidental Take Permit (ITP). Therefore, all of the scenarios and management models considered in this assessment could not and did not assume ongoing or long-term colony management by KIUC HCP.

2.2 Modeling Approach

To model the above the scenarios, we adjusted demographic parameters of a Growth model²; the growth of the population in the absence of predation by non-native predators, fallout, power line, and tower collisions (i.e., threats). In Scenario 1 and Scenario 2, we added threats that decreased demographic parameters to define the current condition in the Kauai population and the action area population, respectively. In Scenario 3, we added predation management to one meta-population in the action area as discussed in the biological opinion (one meta-population equal to 50 breeding pairs) which removed a proportion of the decrease in the parameters due to predation.

We determined that adjustments from a growth model, rather than a stable population model, are appropriate for this assessment, based on lambdas (λ) (i.e., model output) produced using monitoring data from the Upper Limahuli nesting colony. The data suggests the potential for Newell's shearwater population to achieve a high breeding probability and reproductive success as a result of intensive predator control and ungulate exclusion at breeding sites.³ Although breeding sites within Upper Limahuli are not free of terrestrial predators and constant removal of predators is required to maintain high reproductive performance, the high breeding probability and reproductive success rates combined with best estimates of survivorship (Section 2.4.4 Annual Survivorship) produced a growth rate of at least 1.016.

2.3 Data Quality

We compiled the best available data to develop inputs to demographic parameters for our modeling scenarios including the population size, age at first breeding, survivorship of adults, sub-adults, and juveniles, reproductive success, and breeding probability.⁴ Table 1 summarizes the studies and data used that provided direct measures of demographic information. Significant resources for this information on Newell's shearwater and analogous species were found in Ainley *et al.* (2001), Griesemer and Holmes (2011), and USFWS (2017a).

² A growth model has an output, lambda (λ), greater than one (1).

³ The Kauai Endangered Seabird Recovery Project provided the Service summarized empirical data in 2014 to assist the Service with information to update Newell's shearwater demography and parameters in Service population modeling (KESRP unpublished data 2014).

⁴ A general description of Newell's shearwater demographic information is included in the main text of the Biological Opinion, Status of the Newell's Shearwater, section *iv*.

Model development of the current condition of the Kauai Newell's shearwater population and the action area population (Environmental Baseline) required estimating the effects of major threats on the population, including collisions with power lines, light attraction/fallout, and predation.⁵ To develop models for additional fallout and tower collisions due to PMRF activities, we relied on data used for our analysis of these effects in the biological opinion. The beneficial effects on colony productivity from predator management were also investigated in the modeling. The monitoring data that we relied on to model these threats and colony management are summarized in Table 1.

⁵ A general description of threats to the Newell's shearwater population is included in the main text of the Biological Opinion, Status of the Newell's Shearwater, section v.

Table 1. Data Quality for Newell's shearwater Modeling Inputs

Measure	Direct		Indirect
	Recent (≥ 2010)	Historic (< 2010)	Estimated from Analogous Species
Basic Life History			
Adult Survival			Griesemer and Holmes 2011, USFWS 2017a
Juvenile/Sub-adult Survival			Ainley <i>et al.</i> 2001
Reproductive Success		Kalaheo colony 81-85, 93-94	
Breeding Probability		Kalaheo colony 81-85, 93-94	
Age of first breeding			Ainley <i>et al.</i> 2001
Population Size	NOAA surveys 98-11	At-sea studies 80-94	
Threat Rates			
Power line Collision	KIUC UMP studies 14-15	EPRI studies 93-94	
Fallout	SOS Database 10-15	SOS Database 79-10, EPRI studies 93-94	
Predation	Hono o Na Pali 11-13 Predation Mortalities	Kalaheo colony 81-85, 93-94	
PMRF Fallout	SOS Database 14-15, PMRF Monitoring 14-15	SOS Database 07-10	
PMRF Comm. Tower Collision	PMRF tower surveys 10, 15		
Colony Management			
Adult Survival			Griesemer and Holmes 2011, USFWS 2017a
Juvenile/Sub-adult Survival			Griesemer and Holmes 2011, USFWS 2017a
Reproductive Success	Hono o Na Pali 13-15, Upper Limahuli 11-15		
Breeding Probability	Hono o Na Pali 13-15, Upper Limahuli 11-15		

2.4 Demographic Parameters

2.4.1 Population Size and Age of First Breeding

The most recent assessment of population size, based on survey data collected by the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA-NMFS) Southwest and Pacific Islands Fisheries Science Centers from 1998 to 2011, estimated the total Newell's shearwater population at 27,011 (95% CI = 18,254-37,125) including juveniles and sub-adults (Joyce 2013). Previous assessments of population size estimated the total Newell's shearwater population at 84,000 (95% CI = 57,000-115,000) including juveniles and sub-adults, based on at-sea surveys conducted in the central and eastern tropical Pacific between 1980 and 1994 (Spear *et al.* 1995). Estimates indicate a significant percent of the global population resides on Kauai (Ainley *et al.* 1997). For the purposes of our modeling, we adjusted Joyce's (2013)

estimate for the population breeding on other islands (10% in Griesemer and Holmes 2011) producing an estimated Kauai Newell's shearwater population of 24,310 individuals (USFWS 2017a, p. 113).

Our models used an age of first breeding of 6 years of age, consistent with other Newell's shearwater modeling efforts (Ainley *et al.* 2001; Griesemer and Holmes 2011; and USFWS 2017a). Ainley *et al.* (2001) reported this breeding age, based on the timing of recoveries of banded Newell's shearwater of known age and the average of empirical data from the closely related Manx shearwater (*Puffinus puffinus*) (Brooke 1990). The percentage of the population that is breeding age (6 years of age or older) is estimated at 0.637 (Ainley *et al.* 2001, p.115), equaling a Kauai Newell's shearwater adult population of 15,485 individuals.

The initial population size in the action area was projected using a methodology similar to those employed in USFWS (2017b), based on statistical analyses of Newell's shearwater calling data from auditory surveys conducted by the Kauai Endangered Seabird Recovery Project (KESRP). The populations in all occupied nesting areas of Kauai were partitioned from the current Newell's shearwater population estimate (Joyce 2013). The subset of the meta-population within the action area provided an estimate of the initial population size (8,508 individuals). Of these individuals, 5,420 (63.7%) are assumed to be adults (Ainley *et al.* 2001).

2.4.2 Breeding Probability

Ainley *et al.* (2001) estimated breeding probability between 0.60 and 0.50 based on monitoring data from the Kalaheo nesting colony on the island of Kauai (Ainley *et al.* 2001, p. 118). This breeding probability is markedly lower than the breeding probability (0.82) of other Procellariidae species (Griesemer and Holmes 2011), likely the result of high mate loss due to predation (Ainley *et al.* 2001), the presence of predators at unprotected burrows reducing breeding attempts, or other threats affecting individual fitness. Adults that lose a mate cannot obtain a new one quickly and have been observed not to breed the following season.

Between 2011 and 2015 at breeding sites in Upper Limahuli, where the largest set of burrows are known, the percentage of active burrows (i.e., confirmed breeding) ranged from 0.76 to 0.87 (Raine and McFarland 2013, Raine and McFarland 2014, Raine and Banfield 2015a, Raine *et al.* 2016a).⁶ During this period, the number of burrows monitored by KESRP in Upper Limahuli increased from 15 (2011) up to 82 (2015). An average of 92 percent of burrows was active in 2012 and 2013 out of a subset of 31 burrows known to have previously hosted breeding pairs (KESRP unpublished data, 2014). Ongoing predator management at Upper Limahuli likely influenced a reproductive performance consistently higher than previously measured at Kalaheo.

Based on the information above, we used a breeding probability of 0.90 for our Growth model (Table 2). The 90% breeding probability is consistent with analogous species for which long-term measures of breeding probability are available: 86-90% (n=15 years) in Cory's shearwater (*Calonectris diomedea*) (Mougin *et al.* 1997) and 86% (n>40 years) in short-tailed shearwaters (*Puffinus tenuirostris*) (Bradley *et al.* 2000). Adjustments to breeding probability to account for

⁶ KESRP confirms breeding status through presence of (1) adult during day in June or July, (2) an egg or eggshell fragments, or (3) chick.

negative effects of predation and beneficial effects of predator management are described in corresponding sections.

2.4.3 Reproductive Success

Using data collected in a five-year monitoring study (1981-1985) of the Kalaheo nesting colony, Ainley *et al.* (2001) estimated an annual reproductive success of 0.66 fledglings per breeding pair. In the years of the study, predation primarily consisted of adults and sub-adults rather than chicks. Over a recent five year period (2011-2015), the reproductive success of Newell's shearwater pairs ranged between 0.68 and 0.88 within Upper Limahuli (Raine *et al.* 2016a, p. 16), where breeding pairs received intensive predator control to reduce chick mortalities. In comparison, the Manx shearwater, a closely related species with an extensive range and a stable global population, has a reproductive success of 0.70 (Brooke 1990, Ainley *et al.* 2001). Brooke (1990) measured the 0.70 success rate at Skolkhom Island colony where non-native predators have not occurred at nest sites.

The Service used 70% in our Growth model (Table 2) to represent mean, long-term reproductive success in predator free conditions, consistent with Griesemer and Holmes (2011) and USFWS (2017a). This is based on the mean reproductive success and long-term studies of other Procellariidae species (n=44 studies); Griesemer and Holmes (2011) considered that 0.70 reproductive success represents an upper end of Newell's shearwater mean, long-term reproduction. In the USFWS (2017a) assessment of variance in Newell's shearwater reproductive success, 0.70 was approximately the upper quartile boundary of the boxplot representing mean reproductive success without predation. Adjustments to reproductive success to account for negative effects of predation and fallout and the beneficial effects of predator management are described in corresponding sections.

2.4.4 Annual Survivorship

Annual survivorship of adult Newell's shearwater has not been directly measured in field studies (Ainley *et al.* 2001, USFWS 2017a). Adult survivorship of Procellariidae species is related to body mass, where adults with a greater body mass exhibit a higher likelihood of survival, all else being equal (Croxall and Gaston 1988, p. 1184). Based on this allometric relationship and linear regression of the log of adult body size to survivorship data from closely related Procellariidae species, previous modeling studies estimated Newell's shearwater adult survivorship at 0.905 (Ainley *et al.* 2001, p. 116) to 0.920 (Griesemer and Holmes 2011, p. 20). An updated linear regression assessment incorporating additional field-derived adult survivorship data from other Procellariidae species estimated Newell's shearwater adult survivorship at 0.920 (USFWS 2017a). We used an adult survivorship of 0.920 for our Growth model (Table 2) consistent with the Service's updated assessment (USFWS 2017a) and Griesemer and Holmes (2011).

Based on long-term survivorship data from the Manx shearwater, we estimated the likelihood of a Newell's shearwater fledgling surviving to adulthood (0.333) (Brooke 1990). We followed methods of Ainley *et al.* 2001, to develop age specific survivorships, consistent with other studies (Griesemer and Holmes 2011, USFWS 2017a). For our Growth model (Table 2) we used age specific survivorships of 0.654 (age 0-1), 0.78 (age 1-2), 0.89 (age 2-3), and 0.905 (ages 3-4, 4-5, and 5-6). Adjustments to the adult and sub-adult survivorship for the effects of predation,

power line collisions, communication tower collisions, and predator management are described in corresponding sections.

Table 2. Adjustments from growth modeling for all Newell's shearwater model scenarios.

		Breeding Probability	Reproductive Success	Survivorship (age)				
				0 to 1	1 to 2	2 to 3	3 to 4	4 to 5
Growth Model		0.9000	0.7000	0.6540	0.7800	0.8900	0.9050	0.9050
Predation		-0.3000	-0.2000			-0.0242	-0.0242	-0.0242
Power Line Collision	Low					-0.1570	-0.1570	-0.1570
	Medium					-0.2174	-0.2174	-0.2174
	High					-0.2778	-0.2778	-0.2778
Fallout	Low		-0.0358					
	Medium		-0.0460					
	High		-0.0562					
PMRF Fallout	Action Area Pop.		-0.0044					
PMRF Comm. Tower Collision	Action Area Pop.							
Predation with cats, rats, pigs & barn-owls controlled	70% Effectiveness	-0.0900	-0.0600			-0.0073	-0.0073	-0.0073
	80% Effectiveness	-0.0600	-0.0400			-0.0048	-0.0048	-0.0048
	90% Effectiveness	-0.0300	-0.0200			-0.0024	-0.0024	-0.0024

2.4.5 Power Line Collision

For purposes of this assessment, we relied on modeled estimates in USFWS (2017a) which extrapolate the amount of Newell's shearwater collisions with power lines documented by the KIUC Underline Monitoring Program (UMP) to the entire power line system, encompassing power lines and infrastructure in the central, eastern, northern, southern, and western portions of the island of Kauai.

In the Kauai Population model, we used the island-wide collision estimate of 1,800 Newell's shearwater mortalities per year, the rounded averages of selected scenarios for the 2014 and 2015 projections (USFWS 2017(a), p.123). This data set was used to scale collision levels such that the minimum, average, and maximum values represented low collision mortality (1,300), medium collision mortality (1,800), and high collision mortality (2,300) in that order. We separated the strike estimates into age classes using an adult to sub-adult ratio (80:20) of Newell's shearwater carcasses collected under power lines during standardized searches (Ainley *et al.* 2001), consistent with previous assessment methods (USFWS 2017a; Griesemer and Holmes 2011). The adult mortalities at low, medium, and high collision levels (260, 360, and 460) equaled 1.68%, 2.32%, and 2.97%, respectively, of the total Kauai adult population of 15,485. The sub-adult mortalities for the collision levels (1,040; 1,440; and 1,840) equaled 15.70% (low), 21.74% (medium), and 27.78% (high) of the total Kauai sub-adult population of 6,624 [24,310 minus adults (15,485) and 2,200 one-year olds at sea (0.09% of Kauai population; Ainley *et al.* 2001)]. We reduced the adult and sub-adult survivorship according to these percentages to account for power line collision in the Kauai population (Table 2). These estimates are substantially greater than previously modeled estimates in Ainley *et al.* (2001), based on 1993-1994 Electric Power Research Institute studies.

The Service's modeled estimates of the annual number of collisions per line segment were used to characterize power line threats to the Newell's shearwater in the consultation action area for the Environmental Baseline model. Figure 2 illustrates the annual number of collisions, including both Newell's shearwater and Hawaiian petrel (*Pterodroma sandwichensis*) projected across transmission power line segments, based on power line exposure heights, least cost path flyways, and modeled UMP data (USFWS 2017a). The relative likelihood of two of the seabird species on the island of Kauai affected by power lines is 0.81 Newell's shearwater and 0.19 Hawaiian petrel (USFWS 2017a). Under the scenarios selected in the USFWS Newell's Shearwater Landscape Strategy Appendix 2 (2017a, p. 123) estimate of 1,800 mortalities (scenarios IV, VB, VIA), approximately 15% of Newell's shearwaters that strike power lines die as a result of the collision. According to the distribution of collisions across power lines depicted in Figure 2, less than five strikes per year per line segment are anticipated in the action area; however, low to moderate levels of strike are anticipated to occur at specific line segments in the Waimea and Kekaha. On the basis of the estimated number of strikes per segment in the action area (Figure 2), that 81% of strikes are Newell's shearwaters, and that 15% of those strikes result in mortality, the Service applied the low rates of collision to the action area population in the Environmental Baseline model. We reduced survivorship of adults in the action area by 1.68% and sub-adults by 15.7%.

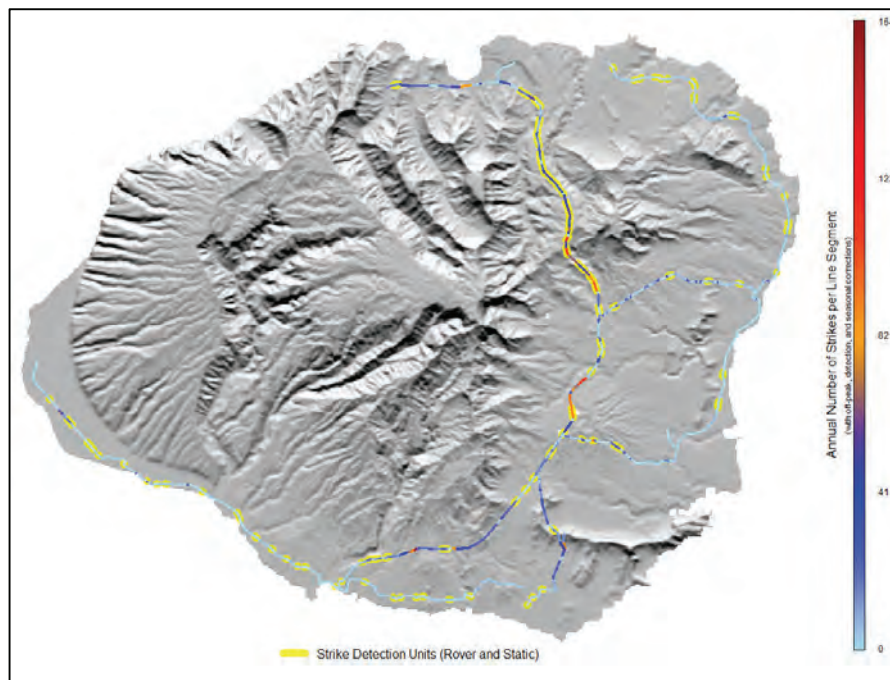


Figure 2. Map of projected annual power line collisions of Newell's shearwater and Hawaiian petrel per power line segment from USFWS (2017a). Strike detection units, shown in yellow, represent locations of song meter units in 2015.

2.4.6 Predation

We developed current estimates of predation at breeding sites using recent data collected in 2011-2015 by the KESRP at the Hono o Na Pali nesting colonies. The Service estimated adult and chick predation (differential predation) using estimates of mortalities for an unmanaged colony, based on observations during seabird colony monitoring in 2011 to 2013 (KESRP unpublished data 2014).⁷ We estimated that approximately 29 chicks and 17 adults are predated by cats, rats, pigs, and barn-owls in an unmanaged colony with a meta-population of 400 breeding adults (Table 3). Assuming that this meta-population, predator-free, would produce 125 chicks (0.90 breeding probability and 0.70 reproductive success), the 29 chicks represent 20% of the total chicks produced. We reduced reproductive success for predation by 0.20 in our Kauai Population model and Environmental Baseline model (Table 2), consistent with moderate rates of chick predation estimated in Griesemer and Holmes (2011). To account for the predation of adults, we reduced adult survivorship by 4.25% (17 out of every 400 adults) in these models (Table 2). This adult mortality rate suggests that the extent of adult Newell's shearwater predated by cats, pigs, and barn-owls is substantially higher than observed at the Kalaheo colony (which was 1%) (Ainley *et al.* 2001) or considered in threat models by Griesemer and Holmes (2011).

Although differential predation estimates were derived from data collected in the 2011 to 2013 breeding seasons, the predation of adult and nestling shearwaters has continued to occur at the Hono o Na Pali colony in 2014 and 2015. At least eleven Newell's shearwaters from over 20

⁷ USFWS (2017a) used the same predation data to develop demographic variables for Leslie matrices, referred to as KESRP Defined Predation, and transformed variables to proportional estimates for 100 breeding pairs.

shearwater burrows monitored by KESRP were predated by cats, consisting of eight adults and three nestling shearwaters (Raine *et al.* 2016b, 2016c, 2016d). At one burrow in 2015, a cat was documented on camera killing an adult Newell's shearwater and its nestling over two consecutive nights (Raine *et al.* 2016c). In 2014, at nesting colonies within Hono o Na Pali, rats predated 11% of burrows (n=14 of 125) where breeding of Newell's shearwater or Hawaiian petrel was confirmed (Raine and Banfield 2015b, 2015c, 2015d). These predation events provide further evidence of moderate to high levels of predation of adults and chicks in unmanaged seabird colonies.

Table 3. Estimated number of Newell's shearwaters predated by cats, pigs, rats, and barn-owls in a colony not receiving predator management, assuming a meta-population of 400 breeding pairs.

Predator		
	Adults	Chicks
Cat	8	8
Pig	8	8
Barn-owl	1	0.5
Rat	0	12
Total	17	28.5

On the basis of the adult mortality data from Hono o Na Pali nesting colony and the breeding probability reported in Ainley *et al.* (2001), we used a breeding probability of 0.60 for the Kauai Population model and Environmental Baseline model, reducing by 0.30 to account for mate loss due to predation, the presence of predators decreasing breeding attempts, and other factors affecting individual fitness (Table 2).

We also estimated reductions in survivorship of sub-adults which are susceptible to predation when returning to nesting colonies to prospect and form pair bonds (Warham 1996). We considered a stable-age distribution (Ainley *et al.* 2001; USFWS 2017a, p. 121) to estimate an additional 36.3% of the adults predated are sub-adults (2 to 5 years old), and reduced sub-adult survivorship by 2.42% in our Kauai Population model and Environmental Baseline model (Table 2). In an unmanaged colony with 400 breeding adults (above) this corresponded to an additional 228 sub-adults at risk of predation by cats, rats, pigs, and barn-owls. Based on this sub-adult mortality, we estimated 22 out of the 228 sub-adults are predated, totaling the 2.42% across each age (2-3, 3-4, 4-5, and 5-6 years old).

2.4.7 Fallout

Our estimates of lighting impacts to the Kauai Newell's shearwater population and action area population are based on Save Our Shearwaters (SOS) program recoveries of Newell's shearwaters that have been disoriented by lighting and grounded (referred to as "fallout"). Fallout was modeled as a reduction in breeding success at low, medium, and high levels, relying on the methodologies followed in other deterministic Newell's shearwater modeling studies (Griesemer and Holmes 2011, Ainley *et al.* 2001). We estimated the proportional decrease in the chick production of the population, assuming predation also impacted production (Griesemer and Holmes 2011). Recent results of satellite tagging studies of fledglings released by the SOS

program were considered in selecting an appropriate fallout level for the Kauai population model.

The five year average fallout (2011-2015) was 142 Newell's shearwater fledglings, based on the number of fledglings recovered by the SOS program.⁸ We used a 50% discovery rate to estimate the percentage of the total birds found and recovered by the SOS program (Ainley *et al.* 2001). The 17th, 50th, and 83rd percentiles of the range of fallout recorded in 2011 to 2015 (142-284 fledglings) represented low, medium, and high fallout mortalities. The proportional decrease in the total chick production (lowered for predation) of the Kauai population equaled 3.6%, 4.6%, and 5.6% using an average fallout of 166 (low), 214 (medium), and 261 fledglings (high) (Table 2).

Research was conducted in 2014 and 2016 to compare the survival of SOS-released shearwater fledglings to the survival of shearwater fledglings that naturally leave out to sea from montane breeding colonies. Although earlier years of the program did not always include bird banding prior to release, since 1979 a total of 24 Newell's shearwaters previously banded and released through the SOS program as fledglings have been recovered or re-sighted as adults (T. Anderson, personal communication, July 27, 2016). The SOS low re-sight numbers prompted the pilot studies conducted by KESRP in coordination with the U.S. Geological Survey, Western Ecological Research Center. The primary focus of the 2014 pilot study was to evaluate attachment technique and tagging technology. Results of the 2016 study indicated that the same percentage of birds (83.3%, n=12) survived beyond 14-days after release regardless of whether they naturally fledged to sea from Upper Limahuli or were SOS-retrieved fledgling birds. Fourteen days is expected to be the maximum time period in which a hatch-year bird would need to learn how to feed itself or succumb to starvation (Mougin *et al.* 2000), and it is the time period in which we would expect the hatch-year bird to succumb to any unknown injuries from being grounded, if those injuries were present (Raine *et al.* 2017a, p. 15). All SOS-released and naturally fledged hatch-year birds (n=12), successfully traveled to foraging grounds at-sea and exhibited normal movement patterns as indicated from tagging data (Raine *et al.* 2017a, p. 9). The SOS-released fledglings chosen for the 2016 tagging study were individuals that were submitted to SOS and deemed healthy (e.g., good release weight, plumage, body condition, and lack of physical injuries) and suitable for immediate release (within 0-1 days); therefore, the 2016 tagging study did not evaluate SOS-rehabilitation efficacy.

In 2016, 100 Newell's shearwater fledglings were handled by the SOS program, including 93 fledglings released and seven that were dead on arrival, died in care, or were euthanized (2016 DOFAW). Of the 100 fledglings handled by the SOS program, 63 (63%) were released to sea the same day or next day (DOFAW 2016). Another 30 fledglings were rehabilitated with time in care equal to or exceeding two days, then released to sea. Based on the above and the results of the 2016 pilot study, we estimate that at least 63 of the 2016 SOS-released birds are likely to survive at the same rate as fledglings that naturally fledged to sea (65.4%, Section 2.4.4 Annual Survivorship). The 63% SOS-release survival would lower the maximum mortality considered in our models from 261 to 172 (89 of the 142 fledglings (5 year average) survive). Thus, in our Kauai population model, we selected low fallout mortality (166 fledglings) and decreased

⁸ The 5 year average excludes Newell's shearwater downed and recovered at PMRF facilities which were considered as additional threats in this assessment.

reproductive success by 3.6%; consistent with SOS-release survival resulting from tagging studies.

In the Environmental Baseline model, we estimated reductions to breeding success based on the amount of fallout fledglings recovered by SOS in the action area, including Port Allen, Hanapepe, and Waimea aid stations. The Newell's shearwaters recovered at these aid stations in 2012 through 2015 equaled up to 27% of the total recovered by SOS.⁹ Given the percentages of fallout in the action area and information on SOS-release survival above, we selected the low rate, and decreased breeding success of the population in the action area by 3.6%.

2.4.8 PMRF Fallout and Communication Tower Collisions

To adjust demographic parameters for PMRF activities, we relied on our analysis (included in the Effects of the Action section of the biological opinion) of the average annual fallout at PMRF sites and fatalities at PMRF towers located at Kokee Site C. We used data on the number of Newell's shearwater downed at PMRF sites and recovered by SOS in 2014-2015 to model impacts from fallout which is anticipated to be reflective of lighting conditions over the 50-year term of the biological opinion. As part of the Service's collision risk assessment for PMRF communication towers, we evaluated direct measures of mortalities at PMRF communication towers (Kleidosty Pacific 2011; Kleidosty Pacific 2016) and developed a collision model to estimate Newell's shearwater fatalities from PMRF towers located at Kokee Site C. The collision model (Appendix 1 of the biological opinion) is based on a template modified from Sanzenbacher and Cooper (2013), incorporating updated seabird movement rates in the action area and tower characteristics.

We calculated the anticipated proportional decrease in the chick production associated with Newell's shearwater fallout due to lighting at PMRF facilities to further adjust reproductive success for PMRF fallout in the Environmental Baseline with PMRF Activities model. The average annual fallout of seven Newell's shearwater fledglings at PMRF sites further decreased reproductive success by 0.44% in the action area population (Table 2).

We used the medium fatality estimate of 50 adult Newell's shearwater per year to further adjust adult survivorship for collisions with PMRF communication towers. We reduced adult survivorship by 0.918% to account for the additional impact on the adult population in the action area (50 out of 5,420 adults) in the Environmental Baseline with PMRF Activities model (Table 2).

The Service estimated the number of Newell's shearwater chicks or eggs that are likely to be killed per year as a result of its parent colliding with a PMRF communication tower, based on the annual number of adult collisions (0.918% of adults in action area) and the reproductive rates of the action area population in the Environmental Baseline model (breeding probability of 60% and reproductive success of 46.4%).

2.4.9 Predator Management

⁹ Beginning in 2012, the specific number of Newell's shearwaters recovered from each aid station was summarized in SOS reports (KHS 2013, 2014, 2015, 2016); thus, the amount of fallout at Port Allen, Hanapepe, and Waimea aid stations in previous years was omitted from current condition section for purposes of reporting consistency.

We adjusted the reduction for predation in demographic parameters in our Predator Control model (Table 2). The predation effect on demographic parameters was decreased by 70%, 80%, or 90% in the Predator Control model. The Service considered 80% efficacy achievable in nesting habitat (providing sufficient funding), based on Newell's shearwater reproduction measured in Upper Limahuli nesting colony which suggests a very high efficacy in decreasing the number of active burrows predated by feral cats, pigs, rats, and barn-owls (Raine and Banfield 2015a, Raine *et al.* 2016a). Predator management that achieves 80% effectiveness (from the removal of feral cats, pigs, rats, and barn-owls) increased breeding probability to 84%, reproductive success to 66%, adult survival to 91.2%, and fledgling to adult survival to 32.9%.

3.0 RESULTS

3.1 Environmental Baseline and Kauai Population Models

The lambdas (growth rate) for all threat combinations considered in the development of the Environmental Baseline model and the Kauai population model are shown in Table 4. In the absence of predation, power line, and fallout threats, the demographic parameters of the growth model produced a lambda of 1.016. Predation produced a decline of 7.4% per year ($\lambda = 1.016 - 0.942$). Power line mortality produced declines of 5.2% (low), 7.0% (medium), and 8.8% (high) per year. Fallout produced declines of 0.4%, 0.5%, and 0.6% per year at low, medium, and high levels, respectively.

The Environmental Baseline model with predation, *low* power line collision, and *low* fallout resulted in an annual decline in the action area population of -10.3% (λ of 0.897). The Kauai Population model with predation, *medium* power line collision, and *low* fallout resulted in a population decline of -11.7% per year (λ of 0.883). This decline in the Newell's shearwater Kauai population is comparable to the mean annual rates of decline indicated by ornithological radar data for the island of Kauai (-12.5%) over the 20-year period 1993-2013.¹⁰ This rate of decline is also within the range of annual declines reported in stochastic Newell's shearwater population models which incorporated variability in mortality and climate change (USFWS 2017a, p 159).

Table 4. Growth rates for Newell's shearwater without predation (none) and with predation (unmanaged colony) under none, low, medium, and high levels of fallout and power line mortality.

		Power Line Collisions			
		<i>None</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>
Predation <i>None</i>	Fallout <i>None</i>	1.016	0.964	0.946	0.928
	<i>Low</i>	1.013	0.962	0.944	0.927
	<i>Medium</i>	1.012	0.961	0.943	0.926
	<i>High</i>	1.011	0.961	0.943	0.926

¹⁰ The overall mean for shearwaters across all 13 radar sites on the island of Kauai surveyed in 1993 was 524 ± 207 targets/h and in 2013 was 34 ± 9 targets/h, representing a mean decrease of 94% between the two periods ($t = 2.37$, $P = 0.03$; Raine *et al.* 2017b). All of the 13 sites showed a large decrease in movement rates over the entire period, with movement rates at 12 (92%) out of 13 sites showing statistically significant declines (Raine *et al.* 2017b). Based on the radar data (Raine *et al.* 2017b) as a proxy for the breeding population, the Newell's shearwater population on the island of Kauai declined, annually, at a mean rate of 12.5 percent over the 20-year period.

Predation	<i>Unmanaged Colony</i>	Fallout	<i>None</i>	0.942	0.900	0.885	0.870
			<i>Low</i>	0.939	0.897	0.883	0.869
			<i>Medium</i>	0.938	0.897	0.882	0.869
			<i>High</i>	0.937	0.896	0.882	0.868

3.2 PMRF Activities added to Environmental Baseline

The accumulated effect of PMRF activities over a 50-year period of implementing the action is likely to result in the loss of 450 adults and 63 egg/chicks caused by PMRF communication towers and the loss of 63 fledglings due to PMRF lighting (Table 5). The number of Newell's shearwaters taken per year is anticipated to decrease each year, because as years pass in the implementation of the proposed action, the Newell's shearwater population in the action area is anticipated to decline by 11% (Environmental Baseline) and the proportion of individuals affected by the action in each respective age class (fledgling, sub-adults, and adults) of the action area population remains the same.

The fallout and seabird collision mortalities likely to be caused by PMRF lighting and communication towers increased the annual decline of the Newell's shearwater Environmental Baseline condition from -10.3% to -11.0% (a decrease in the growth rate from a λ of 0.897 to 0.890) (Table 6, Figure 3). By year 10 of implementation of the proposed action, the decrease in the baseline population in the action area likely to be caused by PMRF facilities was estimated to be 236 individuals [3,208 (action area population) – 2,971 (PMRF effects added to action area population)].

Table 5. Annual estimate of take and total (accumulated) take of Newell's shearwater that is likely to occur over the 50-year period of the proposed action.

		Annual	50-year
PMRF Lighting (Fallout)	fledglings	7	63
	adults & sub-adults	50	450
PMRF Communication Towers	eggs/chicks	7	63

Table 6. Lambdas and projected annual decline of (1) the action area population, including effects of predation, low fallout, low power line (Environmental Baseline), and (2) PMRF fallout and tower collision mortalities added to the action area population.

	Growth rate (λ)	Projected Annual Decline
Environmental Baseline (action area population)	0.897	-10.3%
Environmental Baseline with PMRF Fallout + Tower Collision	0.890	-11.0%

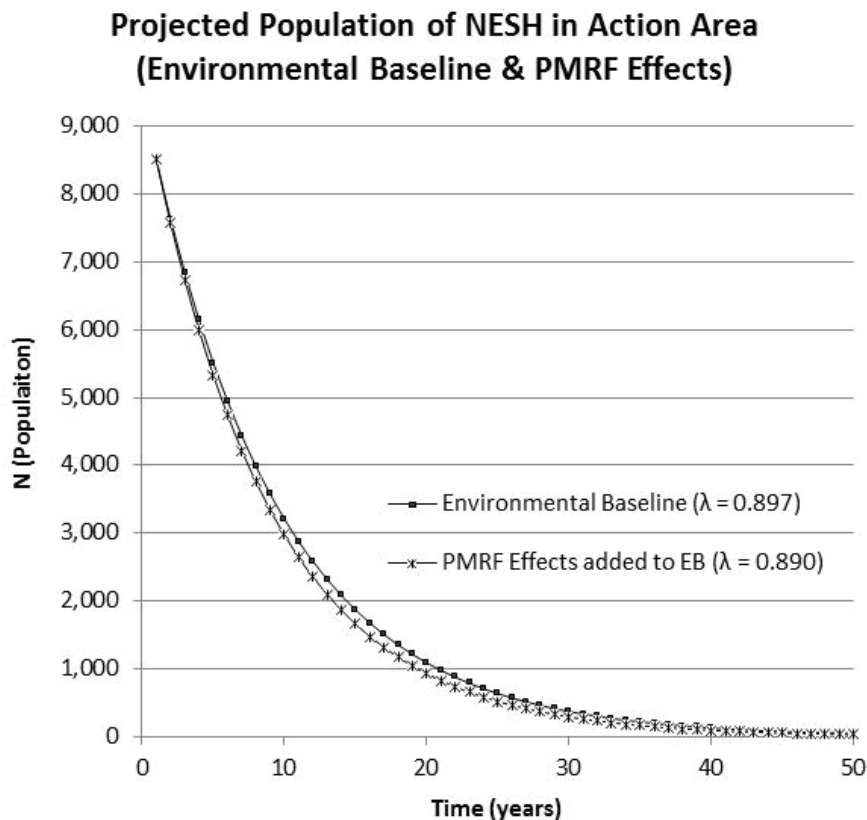


Figure 3. Newell's shearwater population in action area, including (a) growth rate associated with population in action area (Environmental Baseline, line-dots), and (b) growth rate for PMRF fallout and tower collisions added to the environmental baseline (line-crosses).

3.3 Predator Management

Decreasing predation by feral cats, pigs, rats, and barn-owls at 70%, 80%, and 90% efficacies resulted in lambdas of 0.995 (70% effectiveness), 1.002 (80% effectiveness), and 1.009 (90% effectiveness), respectively. Predator control at 80% effectiveness for 50 breeding pairs over 50 years (the term of the biological opinion) provided a reproductive benefit of 1,476 fledglings to the Kauai population (Figure 4).

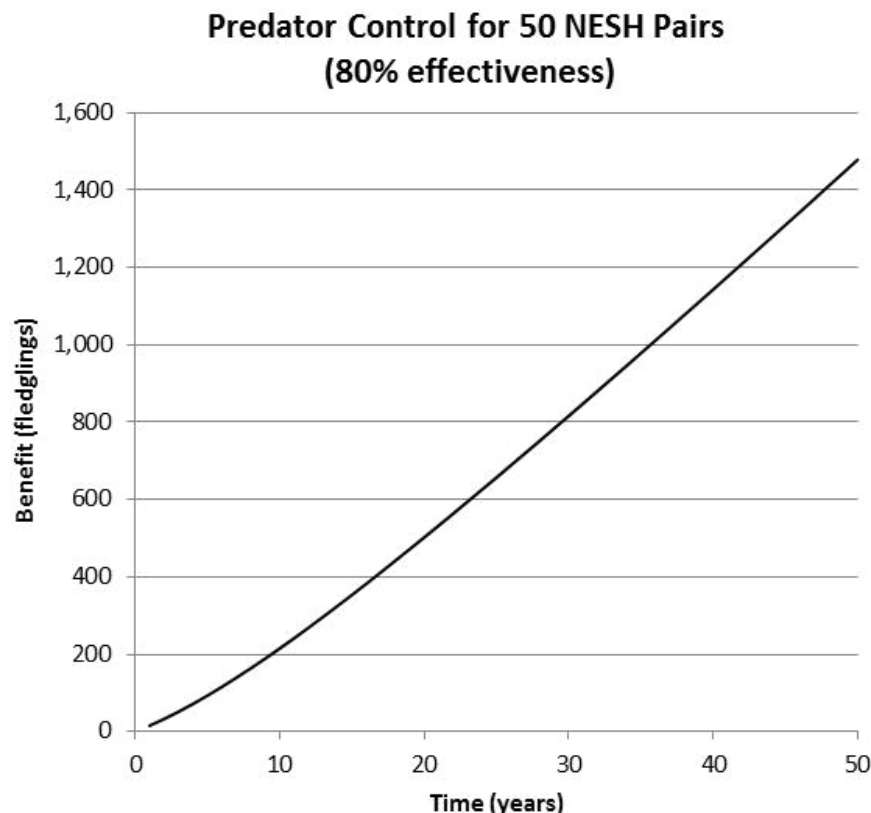


Figure 4. Projected fledgling benefit including control of cat, rat, pig, and barn-owl predation with 80% effectiveness for 50 Newell's shearwater breeding pairs.

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Appendix B

Accidents and Hazards

Appendix B-1 - Credited Controls

Appendix B-2 - Evaluated Accidents and Hazards

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Appendix B-1 - Credited Controls

Control	Description	Category
Access Control	KTF has limited access to authorized personnel only	Engineered
Approved Facility	KTF is approved for explosives assembly and for launching rockets	Engineered
Approved Packaging	Packaging is appropriate for hazardous materials	Engineered
Lightning Protection	Approved Facilities and Assembly Buildings are equipped with lightning protection	Engineered
Grounding and Bonding	The KTF Assembly Buildings and Launch Pads are grounded and bonded. Ordnance Operations require all electrical equipment above 110V to have a GFCI	Engineered
Ground Straps	A robust ESD Control Program is in place that ensures grounded wrist straps are used to mitigate any ESD potential	Engineered
Digital Multimeter	Certified AMPTEC multimeter or Fluke multimeter is approved for electrical testing of explosive devices	Engineered
FTS	Flight Termination System serves as an “initial condition” to help prevent a catastrophic event. Note: The FTS is managed by PMRF	Engineered
Safe Plug	Safe Plug is used to inhibit the fireset and is also used to prevent inadvertent powering up during arming	Engineered
Shorting and Shunting	Shorting wand allows for safe shorting of equipment	Engineered

Control	Description	Category
Proof Testing of Lifting Hardware	Fixtures are proof tested to ensure capability of lifting devices	Engineered
Approved Electrical Equipment	Equipment is NRTL Rated	Engineered
Surge Suppression	To prevent the possibility of electrical discharge to the missile on the launch pad from lightning induced voltages, surge suppression devices have been integrated into each Ground Support Equipment (GSE)	Engineered
Railing	Hand Rails are also present on the MST	Engineered
Key Control of Fireset	Keys are controlled by a designated personnel	Engineered
PGRADS	Potential Gradient is monitored at the site. Work on explosive devices is suspended when +/- 2000V/m has been reached	Engineered
Custom Below the Hook Lifting Device	Custom Lifting Devices are certified lifting devices	Engineered
Crane Certification	Crane is certified to perform the work within capacity	Engineered
Engineered and Critical Lift Plans	Critical Lift Plans are performed in accordance with Corporate Policy using Engineered Analysis	Engineered
Spark Arrestors	Spark Arrestors are installed on all transport and escort vehicles or vehicles must observe a minimum 100' separation distance from ordnance	Engineered
DOT Design	Compressed Gas Cylinders are designed to DOT Specifications (hydrazine, nitrogen, etc.)	Engineered
CGA Fittings and Valves	Fittings and Valves are designed to Compressed Gas Association Standards	Engineered
GSE	Ground Support Equipment is certified and rated	Engineered
Emergency Off (EMO)	EMO allows for one button shutoff of all power	Engineered
Zero Energy Checks	Zero Energy Checks are performed at the site	Administrative
Speed Limits	Speed Limits for transportation between assembly buildings limits the potential for vehicular accidents	Administrative
Exclusion Zone	Exclusion zones are established at the site	Administrative
Cardinal Rule	The Cardinal Rule of Explosives is practiced at KTF	Administrative
SSO	KTF Test Director (TD) functions as the Site Safety Officer (SSO) during assembly and launch activities. The SSO designates trained personnel to act as Safety Officers (SO) and observe all hazardous activities.	Administrative
Access Control	Access is limited to authorized personnel	Administrative
Road Blocks	Road blocks will be set up during ordnance transport between the two assembly buildings.	Administrative
RF Avoidance	Portable / Mobile Communication radios are not allowed in the KTF Launch Field. Only exception is Low-Power RF Radios with power level <30mW.	Administrative
RF Calculations	RF Calculation has determined minimum safe distance from active antennas is 18 inches corresponding to a power level of 4mw/sq.cm	Administrative

Control	Description	Category
Technical Work Documents	<u>Operating Procedure (OP)</u> SP472378 Hazardous Operations at Kauai Test Facility OP provide an overview of the operation, identifies roles and responsibilities, hazard identification and controls, training, and emergency guidelines.	Administrative
	<u>Emergency Guidelines</u> Emergency guidelines are provided in the Kauai Test Facility Operating Procedures, KTF Operating Procedures. PMRF provides a Missile Accident Emergency Team (MAET) for all launches at KTF	
	<u>Pre-Job Briefing</u> Pre-Job Briefings and Plan of the Day discuss hazards and controls, emergency guidelines and specific roles and responsibilities	
	<u>Safety Case</u> The safety case presents the arguments and evidence that the operation may be safely conducted. Safety Case identifies the Unacceptable Consequences and reliability of the system.	
	<u>Dry Runs and Drills</u> Dry runs are performed on all OPs and are modified in the field. No-fire, Misfire and Hang-fire Drills are conducted to ensure operational readiness	
	<u>Training and Qualifications</u> XPL160-161 and Refresher ELC200 for Electrical Workers LTO210 Lockout / Tagout FPP105 Fall Prevention and Protection Awareness FPP110 Fall Prevention and Protection Competent Person PRS150 Pressure Safety Orientation RGH100 Crane Rigging and Hoisting, Explosives Certifications (eg. JCTR) ENV112 Hazardous Waste Generator Training KTF Site Training ESD Training OJT	
MAET	Missile Accident Emergency Team at PMRF provides emergency response in the event of a missile mishap. On call for all Launches	Administrative
PMRF Fire Protection Program	Emergency Response is coordinated by PMRF Fire Department, Site Test Director and KTF	Administrative
PMRF Transportation	PMRF personnel are trained and qualified to transport hazardous materials	Administrative
Approved Suppliers	Hydrazine is delivered to KTF by an approved supplier	Administrative
KTF EOC	Emergency Operations Center serves as the interface between the PMRF Commander and all subordinate facilities and tenants	Administrative
Explosive Safety Program (Safety)	The explosives safety program provides programmatic and technical support to assist employees on the safe handling of explosives. (See	Administrative

Control	Description	Category
Management Program – SMP)	<i>Organization 4122, Safety Engineering and MN471011, Explosives Safety Manual)</i>	
Electrical Safety Program (Safety Management Program – SMP)	This program provides guidance for working with/on electrical equipment and ensures the proper use the Energized Decision Tool. The Electrical SMP also provides guidance for qualifying an Electrical Worker. <i>(See Organization 4122, Safety Engineering, and MN471004, Electrical Safety Manual.)</i>	Administrative
Pressure Safety Program (Safety Management Program – SMP)	Safety Engineering provides the safety programs and technical support to assist employees to perform work on pressure systems in a safe manner. <i>(See Organization 4122, Safety Engineering and MN471000, Pressure Safety Manual.)</i>	Administrative
Safety Engineering (Safety Management Program – SMP)	Safety Engineering provides the safety programs and technical support to assist employees to perform work all systems in a safe manner. <i>(See Organization 4122, Safety Engineering)</i>	Administrative
PPE	Hearing Protection, Safety Glasses with Side Shields, Cotton Clothing, Hard Hat, Steel Toed Boots, ESD Protection as required	PPE

Appendix B-2 - Evaluated Accidents and Hazards

PHS Q #	Hazard / Energy Source	Present (Y/N)	Description of Hazard	Location	Carried Forward (Y/N)
1	RGD	N	<ul style="list-style-type: none"> • 		
2	Radioactive Materials	Y	<ul style="list-style-type: none"> • <4% Mag/Thorium Skin (STARS / POLARIS) 	KTF	No, Magnesium/Thorium is considered part of the skin and is not accessible. SIH Hazards with Low Risk are covered under Corporate Safety Management Programs
3	Explosives	Y	<ul style="list-style-type: none"> • Rocket Motors – 1.1 and 1.3C • Propellant (up to 35,000 lbs. of 1.1 or up to 100,000 lbs. of 1.3) • MDF • FLSC • Detonators • Ignitors • Initiators • Pressure Cartridges • Bottle Stabbers and Cutters 	KTF	YES, Presents potential for Unacceptable Consequence
4	Lasers (Regulated)	N	<ul style="list-style-type: none"> • 		

PHS Q #	Hazard / Energy Source	Present (Y/N)	Description of Hazard	Location	Carried Forward (Y/N)
5	Chemicals	Y	<ul style="list-style-type: none"> Hydrazine – up to 100 lbs. Paints (Marine Grade Epoxy) RTV Flammable and Combustibles for bench top applications (Solvents, Epoxies, Adhesives, Cleaning Solutions) Fuel (Gasoline and Diesel) – up to 10,000 gal Asphyxiants - Nitrogen (up to 485 ft³) 	KTF	<p>YES, Hydrazine has potential to cause an unacceptable consequence.</p> <p>No, SIH Hazards are covered under Corporate Safety Management Programs and the Center 5400 Checklist Analysis</p>
6	Electrical	Y	<ul style="list-style-type: none"> 208V/3 Phase Sources (Launcher) 320 kW Diesel Generators 	KTF	<p>No, SIH Hazards are covered under Corporate Safety Management Programs and the Center 5400 Checklist Analysis</p>
7	Mechanical	Y	<ul style="list-style-type: none"> Overhead Crane – Critical Lifts Forklift Ladders Power Tools Heavy Equipment 	KTF	<p>YES, Presents potential for Unacceptable Consequence</p>
8	Nonionizing Radiation	Y	<ul style="list-style-type: none"> 2 Way Radios Cellular Phones UV from Torch Cutting, Welding 	KTF	<p>No, SIH Hazards are covered under Corporate Safety Management Programs and the Center 5400 Checklist Analysis</p>

PHS Q #	Hazard / Energy Source	Present (Y/N)	Description of Hazard	Location	Carried Forward (Y/N)
9	Thermal	Y	<ul style="list-style-type: none"> Thermal Hazards Thermal Stressors 	KTF	No, SIH Hazards are covered under Corporate Safety Management Programs and the Center 5400 Checklist Analysis
10	Pressure	Y	<ul style="list-style-type: none"> ACS Cart (up to 3600 psi on Vehicle) Missile Hydraulics (On Vehicle) Gas Cart (up to 10,000 psi) (On Vehicle) Payload (On Vehicle) 	KTF	YES, Presents potential for unacceptable consequence Note: Vehicle hazards are analyzed under a separate FMA
11	Noise	Y	<ul style="list-style-type: none"> Noise associated with Explosive Work Noise associated with filling pressure vessels 	KTF	No, SIH Hazards are covered under Corporate Safety Management Programs and the Center 5400 Checklist Analysis
12	Miscellaneous (List)	Y	<ul style="list-style-type: none"> Elevated Work Surfaces (man lift, ladders, scissor lifts, etc.) Ergonomic stressors Construction like activities Venomous Animals (Hornets) Airborne Objects 	KTF	YES, Falls from Height and Airborne Objects present potential for Unacceptable Consequence Airborne Objects are covered under the specific project Flight Safety Analysis

PHS Q #	Hazard / Energy Source	Present (Y/N)	Description of Hazard	Location	Carried Forward (Y/N)
13	Outside of Manufactures Recommendations	N	<ul style="list-style-type: none"> 		
14	Noncommercial Equipment	Y	<ul style="list-style-type: none"> Rocket Motors Rail Launchers Rocket Stages, etc. 	KTF	YES, Presents potential for Unacceptable Consequence
15	Environmental	Y	<ul style="list-style-type: none"> Air Emissions Gas and Diesel Fuel Combustion Equipment Hazardous Waste (Solvent Wipes, Motor Oil) Protected species 	KTF	No, SIH Hazards are covered under Corporate Safety Management Programs, KTF NEPA and the Center 5400 Checklist Analysis
16	Movement of Hazardous Material	Y	<ul style="list-style-type: none"> Movement of Explosives, Chemicals and RGDs by Commercially Certified PMRF Personnel Movement of paints, solvents, lubricants, etc. 	KTF	No, This activity is performed by PMRF Personnel
17	Fire Protection Concerns	Y	<ul style="list-style-type: none"> Wildfire Associated with Rocket Launch 	KTF	YES, Presents potential for Unacceptable Consequence
18	Biological	N	<ul style="list-style-type: none"> 		
19	Confined Spaces	Y	<ul style="list-style-type: none"> Launchers are considered non-permitted confined spaces Antenna Masts are also considered non-permitted confined spaces Septic Tanks – Permitted Confined Space 	KTF	No, These SIH Hazards are managed by the onsite Contractor Wolverine. SNL Personnel do not engage in these activities

PHS Q #	Hazard / Energy Source	Present (Y/N)	Description of Hazard	Location	Carried Forward (Y/N)
20	Beryllium	N	•		
21	Offsite Locations	Y	• KTF	KTF	See above List of Hazards that carry forward for additional analysis
22	Roving	Y	• KTF	KTF	See above List of Hazards that carry forward for additional analysis
23	Emergency Response	N	•		
24	Off-Hours Activities	Y	<ul style="list-style-type: none"> • Work may occur outside of normal working hours • Extended Work Hours 	KTF	No, SIH Hazards are covered under Corporate Safety Management Programs and the Center 5400 Checklist Analysis
25	Other Hazards	Y	<ul style="list-style-type: none"> • Operations at KTF may include use of: Mixed Amine Fuel (MAF), 2 containers @ 75 lbs. each; Inhibited Red Fuming Nitric Acid (IRFNA), 2 containers @ 220 lbs. each 	KTF RMSA	YES, Presents potential for Unacceptable Consequence

Table 3.1 —HE Consequence Guidelines

Abbreviation	Consequence Level	Worker Impact	Environmental Impact	Mission Impact
H	High (Unacceptable)	Death, Life Threatening – Permanent total disability requiring hospitalization	Irreversible significant, reportable, environmental impact; Permit NOV with fines & required facility shutdown	Monetary loss equal to or exceeding \$1M Loss of mission requiring restart.
M	Moderate (Unacceptable)	Near Life Threatening – Permanent partial disability, injuries or occupational illness that results in hospitalization	Reversible significant reportable environmental impact; Permit NOV with fines	Monetary loss equal to or exceeding \$100K, but less than \$1M Delay of mission requiring restart. Uncontrolled Wildland Fire
L	Low (Undesirable)	Less than Life Threatening – injury or occupational illness that may require medical treatment beyond first aid	Reversible moderate reportable environmental impact; permit NOV without fines	Monetary loss equal to or exceeding \$10K, but less than \$100K Delay of mission, not requiring restart.
N	Negligible (Undesirable)	Minor Injury – injury or occupational illness that may require first aid	Minimal non-reportable environmental impact; no permit NOV	Monetary loss less than \$10K No mission impact.

Table 3.2—Hazard Evaluation

Event ID	Location	Activity	Hazard	Event Description / What-If Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
Fielding and Launch (Event ID – F&L) – This activity includes.... Ready storage, Crate Inspection, Unpacking, Cork Installation, Missile Assembly, Transportation of Motors, Equipment and Materials, Rigging, Umbilical's, Installation of Tarp, Upload, Pad Operations, Arming / Disarming, Launch, Hang-Fire / Mis-Fire. Note: Scenarios involving Reaction and Physical Environment were discussed by the FMA Team and deemed Not-Credible								
F&L-00	KTF	Ready Storage	Toxic and Corrosive Materials (Hydrazine, IRFNA)	Container in Storage is damaged and leaking	H – Worker Death	<ul style="list-style-type: none"> • DOT Approved Sealed Containers • Secondary Containment • Tertiary Containment • Locked Gate • Positive Air Flow • Audible Alarms 	<ul style="list-style-type: none"> • OP • Access Control • Visual Inspection • Pre-Job Briefing • Two-Person Rule • IH Exposure Assessment • Trained Staff • SDS • Emergency Response • Certified Transport • First Aid • First Aid Training • AED / CPR • Water for Neutralization • PPE per IH Assessment 	
F&L-01	KTF MAB, Assembly Buildings (AB) or Launch Pad	Thermal Protection Touch Up	Toxic Material in RTV	Workers performing touch up exposed to Toxic Vapors	L – Minor Injury	<ul style="list-style-type: none"> • Pedestal Fan 	<ul style="list-style-type: none"> • OP • Pre-Job Briefing • Two-Person Rule • IH Exposure Assessment • Well Ventilated Area (Roll-up Doors Open) • PPE (Butyl rubber gloves, Safety Glasses) • Hand Scrubbing and Wet Method 	

Event ID	Location	Activity	Hazard	Event Description / What-If Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
F&L-02	KTF	Material Handling	Pinch and Crush	During transport of materials between building, contents shift exposing workers when opening crates	H – Severe Injury	<ul style="list-style-type: none"> Approved Packaging Secured Tie-downs 	<ul style="list-style-type: none"> Exclusion Zone Access Control Inspections Safety Spotter OP Speed Limit Pre-Job Briefing Two-Person Rule Material Handling Training Emergency Response First Aid First Aid Training AED / CPR Authorized Handlers Supervised Activity 	
F&L-03	KTF MAB, Assembly Buildings (AB) or Launch Pad	Missile / Ordnance Assembly	Electro-Explosive Energy	Unintended detonation while performing assembly operations	H – Worker Death	<ul style="list-style-type: none"> Approved Facility Building Ground PG Monitoring Lightning Protection and Monitoring Approved Electrical Equipment Ground Straps Wrist Strap Tester Shorting / Shunting 	<ul style="list-style-type: none"> Exclusion Zone Access Control Building Inspection Humidity Monitoring Posting and Signage OP Pre-Job Briefing Two-Person Rule Cardinal Rule (3M) Explosives Certifications (eg. JCTR) First Aid First Aid Training AED / CPR Emergency Response KTF Safety Officer PPE (Cotton Clothing) 	

Event ID	Location	Activity	Hazard	Event Description / What-if Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
F&L-04	KTF MAB, AB's, Launch Pad	Missile / Ordnance Assembly	Rocket Motors (1.1 or 1.3 propellant)	What if the motors are influenced by Heat or Flame	H – Worker Death H – Mission Delay	<ul style="list-style-type: none"> Approved Facility Lightning Protection and Monitoring PG Monitoring Fire Extinguisher? Fire Suppression? CCTV Environmentally Controlled Trailers (FIG) (if available) 	<ul style="list-style-type: none"> Exclusion Zone Access Control Propellant Leak Check KTF Safety Officer OP Pre-Job Briefing Two-Person Rule Cardinal Rule (3M) Explosives Certifications (eg. JCTR) First Aid First Aid Training AED / CPR PMRF Fire Protection Emergency Response 	
F&L-05	KTF MAB, AB's, Launch Pad	Missile / Ordnance Assembly	Rocket Motors (1.1 or 1.3 propellant)	Equipment Failure: What if the motors are subjected to Shock (dropped or handled roughly)	H – Damage to Equipment / Mission End	<ul style="list-style-type: none"> Rated Below the Hook Lifting Device Crane Certification Approved Containers Proof Tested Lift Critical Lift CCTV Mechanical hardware engineered for motor fixturing 	<ul style="list-style-type: none"> Exclusion Zone Access Control Propellant Leak Check KTF Safety Officer OP Pre-Job Briefing Two-Person Rule Cardinal Rule (3M) Explosives Certifications (eg. JCTR) Crane Inspection Critical Lift Plan Rigging and Hoisting Training CONOPS 	

Event ID	Location	Activity	Hazard	Event Description / What-If Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
F&L-06	KTF MAB, Assembly Buildings (AB), Launch Pad	Missile / Ordnance Assembly	Rocket Motors (1.1 and 1.3 propellant)	What if the motors are affected by Electrical (ESD, RF, Power Supply, etc.)	H – Worker Death H - Damage to Building and end to Mission	<ul style="list-style-type: none"> Approved Facility Approved Electrical Equipment PG Monitoring Lightning Protection and Monitoring Certified Facility Grounding Shorting / Shunting Wrist strap tester 	<ul style="list-style-type: none"> All energy is powered off Authorized Users Exclusion Zone OP Pre-Job Briefing Two-Person Rule Cardinal Rule (3M) Explosives Certifications (eg. JCTR) Zero Energy Check ESD Assessment Emergency Response First Aid First Aid Training AED / CPR PPE (Cotton / Blend Clothing, wrist straps, etc.) 	
F&L-07	KTF AB, MAB	Missile Assembly - Installation of Pressure Cartridges	Pressure Cartridges or electro-explosive devices (EED) (Static Sensitive)	What if the pressure cartridges or electro-explosive devices (EED) are affected by Electrical (ESD, RF, Power Supply, etc.)	L – Mission Delay to replace cartridge	<ul style="list-style-type: none"> Approved Facility Lightning Protection and Monitoring Certified Facility Grounding Wrist Strap Tester Wrist Straps Shorting / Shunting Resistive Current Limiting/Shunting Circuits 	<ul style="list-style-type: none"> All energy is powered off Authorized Users Exclusion Zone RF Avoidance OP Pre-Job Briefing Two-Person Rule Cardinal Rule (3M) Explosives Certifications (eg. JCTR) ESD Assessment Zero Energy Check 	

Event ID	Location	Activity	Hazard	Event Description / What-If Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
F&L-08	KTF AB, MAB	Missile Assembly – Installation of Pressure Cartridges	Pressure Cartridges or EEDs (Static Sensitive)	What if the pressure cartridges or EEDs are affected by a change in Physical Environment (humidity, weather, PG, Lightning, etc.,)	L – Mission Delay to replace cartridge	<ul style="list-style-type: none"> Approved Facility Lightning Protection and Monitoring PG Monitoring Certified Facility Grounding Wrist Strap Tester Wrist Straps Shorting / Shunting 	<ul style="list-style-type: none"> Authorized Users Access Control Weather Monitoring Exclusion Zone RF Avoidance OP Pre-Job Briefing Two-Person Rule Cardinal Rule (3M) Explosives Certifications (eg. JCTR) Lightning Data Image 	
F&L-09	KTF AB, MAB	Missile Assembly – Installation of Dets	Detonators (Static Sensitive)	What if the detonator goes off unintentionally because of Electrical (ESD, RF, Power Supply, etc.,) influence	M – Severe Injury H – Damage to Equipment. End of Mission	<ul style="list-style-type: none"> Approved Facility Approved Tools PG Monitoring Certified Facility Grounding Wrist Strap Tester Wrist Straps Shorting / Shunting 	<ul style="list-style-type: none"> All energy is powered off RF Exclusion / Low Power RF Avoidance Authorized Users Access Control Exclusion Zone KTF Safety Officer Emergency Response First Aid First Aid Training AED / CPR OP Pre-Job Briefing Two-Person Rule Cardinal Rule (3M) Explosives Certifications (eg. JCTR) ESD Assessment PPE (Safety Glasses, Cotton Clothing) 	

Event ID	Location	Activity	Hazard	Event Description / What-If Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
F&L-10	KTF AB, MAB	Missile Assembly – Installation of Dets	Detonators (Static Sensitive)	What if the detonator is affected (Fires) by a change in Physical Environment (humidity, weather, PG, Lightning, etc.)	M – Severe Injury H – End of Mission due to Damage to Equipment.	<ul style="list-style-type: none"> Approved Facility Lightning Protection and Monitoring PG Monitoring Certified Facility Grounding Shorting / Shunting Wrist strap tester 	<ul style="list-style-type: none"> Authorized Users Exclusion Zone KTF Safety Officer OP Pre-Job Briefing Two-Person Rule Cardinal Rule (3M) Emergency Response First Aid First Aid Training AED / CPR Explosives Certifications (eg. JCTR)Lightning Data Image Weather Monitoring PPE (Safety Glasses, cotton clothing, wrist straps, etc.) 	
F&L-11	KTF AB, MAB	Missile Assembly – Installation of MDF, Initiators	Explosives (1.1D, 1.4S)	MDF or Initiator fires unintentionally	H – End of Mission due to Extensive Damage to Equipment	<ul style="list-style-type: none"> Approved Facility Approve Container Approved Tools Shorting / Shunting 	<ul style="list-style-type: none"> Authorized Users Exclusion Zone Quantity Limits OP Pre-Job Briefing Supervised Activity Emergency Response Two-Person Rule Cardinal Rule (3M) Explosives Certifications (eg. JCTR) 	

Event ID	Location	Activity	Hazard	Event Description / What-If Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
F&L-12	KTF AB, MAB	Assembly of HE Payload	Explosives	Unintentional firing or detonation due to shock, impact, friction, ESD, RF, Reaction, Heat,	H – Worker Death	<ul style="list-style-type: none"> • Approved Facility • Approved Assembly Area • Rated Equipment • Proof Testing • Lightning Protection and Monitoring • PG Monitoring • Certified Facility • Grounding • Shorting / Shunting • Safe Plug (inhibit) • Wrist Straps 	<ul style="list-style-type: none"> • Authorized Users • Exclusion Zone • Quantity Limits • ESD Assessment • Critical Lift Plan • Qualified Personnel • Equipment Inspections • RGH Training • KTF Safety Officer • OP • Pre-Job Briefing • Two-Person Rule • Cardinal Rule (3M) • Emergency Response • First Aid • First Aid Training • AED / CPR • Explosives Certifications (eg. JCTR) Lightning • Data Image • Weather Monitoring • PPE (Safety Glasses, Cotton Clothing) 	

Event ID	Location	Activity	Hazard	Event Description / What-If Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
F&L-13	KTF AB, MAB, Launch Pads	Missile Assembly - Attach Attach Next Stage to existing stages and interstage motor component s and the Missile Front End and Lifting hardware	Pinch / Crush Hazards	Worker suffers injury while performing stage stackup	M – Severe Injury	<ul style="list-style-type: none"> Rated Equipment Approved Tools Certified Crane Load Testing 	<ul style="list-style-type: none"> Authorized Users Exclusion Zone Equipment Inspections Rigging / Hoisting Training Crane Training/Certification KTF Safety Officer Spotter / Tagline OP Pre-Job Briefing Two-Person Rule Supervised Activity Emergency Response First Aid First Aid Training AED / CPR PPE (Hard Hat, Safety Boots) 	
F&L-14	KTF AB, MAB	Missile Assembly - ACS Installation and Leak Test	Pressure	Mechanical failure with workers present	L – Minor Injury	<ul style="list-style-type: none"> DOT design Cylinder Relief Valve Ductile Materials CGA Approved Fittings Whip Protector 	<ul style="list-style-type: none"> PSDP MAWP Authorized Users Exclusion Zone OP Pre-job briefing Supervised Activity Pressure Safety Training Emergency Response First Aid First Aid Training AED / CPR PPE (Hard Hat, Safety Glasses) 	

Event ID	Location	Activity	Hazard	Event Description / What-If Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
F&L-15	KTF or PMRF to KTF Pad	Transport Missile to Launch pad	Vehicular Accident (Severe Impact or Shock)	While transporting missile to launch pad driver has accident or swerves off road	M – Mission Delay with Damage to Equipment	<ul style="list-style-type: none"> Widened Gate 	<ul style="list-style-type: none"> CDL Certified Drivers Exclusion Zone Access Control Speed Limits Inspected Bridges Spotters Supervised Activity Two-Person Rule 	
F&L-16	Launch Pad	Pad Processing. Upload (or Download) Missile to/from Rail or Vertical Stool	Mechanical Pinch / Crush	Workers not paying attention, body part gets caught while uploading (or downloading)	M – Severe Injury	<ul style="list-style-type: none"> Emergency Off Button Audible Alarms Pre-engineered Lift CCTV Rated, Certified, Inspected Equipment Transporter Erector (TE) – Manual Pump Override 	<ul style="list-style-type: none"> Exclusion Zone Access Control Authorized Personnel OP Procedure Pathfinders Pre-Job Briefing Two-Person Rule Crane Inspection Critical Lift Plan Crane Training/Certification PPE KTF Safety Officer Emergency Response First Aid First Aid Training AED / CPR PPE (Hard Hats, Safety Boots) 	

Event ID	Location	Activity	Hazard	Event Description / What-If Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
F&L-17	Launch Pad	Pad Processing. Upload / Download Missile to/from Rail or Vertical Stool	Mechanical Pinch / Crush	Hydraulic failure on erector or air log trailer with workers in proximity	H – Worker Death	<ul style="list-style-type: none"> Shielding CGA Rated Fittings Emergency Off Audible Alarms Pre-engineered Lift Load Test CCTV Rated, Certified, Inspected Equipment TE – Manual Pump Override 	<ul style="list-style-type: none"> Exclusion Zone Authorized Personnel OP Pre-Job Briefing Guard Two-Person Rule Crane Inspection Crane Training/Certification Procedure Pathfinders KTF Safety Officer Pre-Use Inspection Annual Certifications Emergency Response First Aid First Aid Training AED / CPR PPE 	
F&L-18	Launch Pad	Install GSE	Fall Hazard	Worker falls from height at MST	M – Severe Injury	<ul style="list-style-type: none"> Guard Rails 	<ul style="list-style-type: none"> Exclusion Zone Authorized Personnel OP Pre-Job Briefing KTF Safety Officer Supervised Activity Emergency Response First Aid First Aid Training AED / CPR Weather Monitoring (Wind) 	

Event ID	Location	Activity	Hazard	Event Description / What-If Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
F&L-19	Launch Pad	Pressurize ACS	High Pressure (5000 psi)	Mechanical failure with high pressure leak	L – Minor Injury N - Mission Minimal Impact	<ul style="list-style-type: none"> CGA Design DOT Design Cylinder Rated Piping 	<ul style="list-style-type: none"> Exclusion Zone Authorized Personnel OP Pre-Job Briefing Two-Person Rule Pressure Safety Training KTF Safety Officer PSDP MAWP Equipment Inspections Emergency Response First Aid First Aid Training AED / CPR PPE (Safety Glasses) 	
F&L-20	MST	Pressurize ACS	Asphyxiation (N2)	Mechanical failure with breach in N2 Line	N – Mission Minimal Impact M – Worker Injury	<ul style="list-style-type: none"> CGA Design DOT Design Cylinder Rated Piping 	<ul style="list-style-type: none"> Exclusion Zone OP Pre-Job Briefing Two-Person Rule KTF Safety Officer PSDP MAWP Equipment Inspections 	

Event ID	Location	Activity	Hazard	Event Description / What-If Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
F&L-21	Launch Pad	Initial Power Up	Ordnance	Power up and power down.	H – Mission End with Destruction of vehicle	<ul style="list-style-type: none"> Lightning protection and Monitoring PGRADS Certified Facility Grounding On Boarding Safeties Booster fire inhibits CCTV GSE Power and Remote Control 	<ul style="list-style-type: none"> Exclusion Zone Access Control OP CONOPS Key Control KTF Safety Officer Two-Person Rule Cardinal Rule (3M) Explosives Certifications (eg. JCTR) Emergency Response PMRF Fire Protection Pre-Job Briefing Quantity Limits 	
F&L-22	Launch Pad	EMI RF Compatibility Tests	RF / Ordnance	Vehicle Functional Testing	H – Worker Death	<ul style="list-style-type: none"> Shielding Safe by Design Bleed Resistors ESD Control Program Arm/Safe Relay 	<ul style="list-style-type: none"> Exclusion Zone OP CONOPS Quantity Limits Pre-Job Briefing Two-Person Rule Cardinal Rule (3M) Explosives Certifications (eg. JCTR)Cables and Components are Certified KTF Safety Officer First Aid First Aid Training AED / CPR GSE is Tested and Validated for Flight Hardware Power / Logic Tests 	

Event ID	Location	Activity	Hazard	Event Description / What-If Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
F&L-23	Launch Pad	Ordnance Interconnect	Ordnance	Removing safe plug and hooking up fireset.	H – Worker Death	<ul style="list-style-type: none"> • SAFE Status of Fireset • GSE • Pad Power Interlocks • CCTV • Test Plugs control • GSE Power and Remote Control • Certified Ord. Meter • Remove Test RF Equipment (FTS) 	<ul style="list-style-type: none"> • Exclusion Zone • Access Control • OP • CONOPS • No Voltage Checks • KTF Safety Officer • Emergency Response • First Aid • First Aid Training • AED / CPR • Pre-Job Briefing • Cardinal Rule (3M) • Explosives Certifications (eg. JCTR) • RF Silence • PPE (Safety Glasses) 	

Event ID	Location	Activity	Hazard	Event Description / What-If Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
<p>Launch (Event ID - LCH) – Launch activities include successful firing and post-launch activities to wrap up activities on the pad. Personnel are removed from the launch area and beyond an established exclusion zone during firing and launch. No exposure is anticipated. Following a successful launch, the safety officer will revisit the pad to provide an "all clear." Public Notifications (NOTAMS, NOTMARS) are given Kauai Test Facility controlled by the Range to modify for keep out zones. If an anomaly occurs precautions have been taken to prevent exposure (i.e. personnel in LOB, safety analysis, Emergency Response Standby). During an abort operation, the activities would be reversed and controls to disarm (under the "Arming" section) would be implemented.</p> <p>Note 1: If the launch fails catastrophically, only the onsite EOD team would respond. No Sandia personnel would be exposed.</p> <p>Note 2: For each Rocket Launch, a separate Flight Safety Analysis is developed that covers the entirety of hazards and controls associated with vehicle failure / deviation during flight. Therefore, those scenarios will not be covered here.</p>								

Event ID	Location	Activity	Hazard	Event Description / What-If Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
Post Test (Event ID - Post) – Post-test activities involve removing all umbilical's (forward, interstage), disconnecting GSE and rolling up cables and equipment. Post-Test also includes Pad Cleanup Hazards include: Elevated Work, Pinch and Crush Hazards,								
Post-01	Launch Pad	Removing Cables	Elevated Work	Worker falls from height while removing cables, umbilical's	M - Severe Worker Injury	<ul style="list-style-type: none"> Guard Rails 	<ul style="list-style-type: none"> Exclusion Zone Authorized Personnel OP Pre-Job Briefing Supervised Activity Ladder Safety Training KTF Safety Officer Emergency Response First Aid First Aid Training AED / CPR PPE (Hard Hats, Safety Glasses) 	
Post-02	Launch Pad	Pad Cleanup	Pinch and Crush	Workers in way while equipment is being lowered	M - Severe Worker Injury	<ul style="list-style-type: none"> Certified, Rated and Inspected Equipment 	<ul style="list-style-type: none"> Exclusion Zone Authorized Personnel OP Spotter Pre-Job Briefing Supervised Activity Ladder Safety Training KTF Safety Officer Emergency Response First Aid First Aid Training AED / CPR PPE (Hard Hats, Safety Glasses) 	

Event ID	Location	Activity	Hazard	Event Description / What-If Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
<p>Misfire / No-Fire and Hang-Fire (Event ID – MIS) – All three scenarios represent anomalies that can potentially impact operations with unacceptable consequences.</p> <p>No-Fire – A no-fire is where the launch system fails to Fire</p> <p>Hangfire – Is the partial or complete failure of the launch system to operate as intended due to faulty firing mechanism or faulty element in the propelling charge explosive train. Energy was sent without lighting</p> <p>Misfire – (Did not Fire) A misfire is an unexpected delay between the triggering mechanism and the ignition of the propellant. A misfire is an event that is “known”</p>								
MIS-01	Launch Pad	Rocket Launch	Explosives	Rocket Misfires	H – Worker Death H – Mission Delay / End	<ul style="list-style-type: none"> Dual Redundant System Safe / Arm Device Monitoring Flight Termination System Vehicle Launch Systems Booster Fire Control PMRF OC on Missile Condition PMRF OC Request Approval to Disarm Polls for Go / No-Go Lock on Rail Launches Range Interlocks (Opened) Turned Off 	<ul style="list-style-type: none"> Missile Accident Emergency Team Emergency Response First Aid First Aid Training AED / CPR Interim Response Team Interim Safety Board PMRF Ground Safety Officer KTF Safety Officer Launch Vehicle Team Rocket Mishap Plan Countdown Procedure Practice Counts Off Nominal Drills Misfire Drills Scrub Checklist 30 Minute Wait Period Radio Silence 	

Event ID	Location	Activity	Hazard	Event Description / What-If Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
MIS-02	Launch Pad	Rocket Launch	Explosives	Rocket Hang-Fire	H – Mission Delay or End	<ul style="list-style-type: none"> Dual Redundant System FS fire ADD Monitoring Flight Termination System Ground Launch Computer Flight Computer Countdown Control Scripts Autopilot Guidance & Control Booster Fire Control Navigation Control LC-Status RCO on Missile Condition LC-Request Approval to Disarm from Range Safety Polls for Go / No-Go Remove Arm Plugs Lock on Rail Launches Range Interlocks or Launch Keys (Opened) Turned Off 	<ul style="list-style-type: none"> Missile Accident Emergency Team Emergency Operations Center Interim Response Team Interim Safety Board KTF Safety Officer PMRF Ground Safety Officer Launch Vehicle Team Rocket Mishap Plan Countdown Procedure Practice Counts Off Nominal Drills 30 minute wait period Range policy PMRF Hang Fire Drills 	

Event ID	Location	Activity	Hazard	Event Description / What-if Question	Consequence (Worst Case)	Engineered Controls	Administrative Controls	Actions
MIS-03	Launch Pad	Rocket Launch	Explosives	Rocket No-Fire	H – Mission Delay / End	<ul style="list-style-type: none"> Dual Redundant System Safe / Arm Device Monitoring Flight Termination System Vehicle Launch Systems Booster Fire Control PMRF OC on Missile Condition PMRF OC Request Approval to Disarm Polls for Go / No-Go Lock on Rail Launches Range Interlocks (Opened) Turned Off Remove Arm Plugs 	<ul style="list-style-type: none"> Missile Accident Emergency Team Emergency Operations Center Interim Response Team Interim Safety Board PMRF Ground Safety Officer Launch Vehicle Team Rocket Mishap Plan Countdown Procedure Practice Counts Off Nominal Drills 30 minute wait period Range policy PMRF No-Fire Drills 	